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SKILL SUBSTITUTION, EXPECTATIONS, AND THE BUSINESS CYCLE*

Andreas Leibing[†]

February 3, 2026

Abstract

This paper studies how labor market conditions around high school graduation affect postsecondary skill investments. Using administrative data on more than six million German graduates from 1995–2018, and exploiting deviations from secular state-specific trends, I document procyclical college enrollment. Cyclical increases in unemployment reduce enrollment at traditional universities and shift graduates toward vocational colleges and apprenticeships. These effects translate into educational attainment. Using large-scale survey data, I identify changes in expected returns to different degrees as the main mechanism. During recessions, graduates expect lower returns to an academic degree, while expected returns to a vocational degree are stable.

Keywords: college enrollment, expectations, business cycles, apprenticeships

JEL Codes: D84, E24, E32, I23, I24, I26

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I. INTRODUCTION

Skills are a key driver of economic growth (e.g., [Hanushek and Woessmann, 2008](#)), and the type of skills acquired is crucial for individual earnings trajectories. While general skills offer higher long-term returns and greater adaptability, specific skills provide immediate labor market advantages but may become obsolete more quickly (e.g., [Hanushek et al., 2017](#), [Deming and Noray, 2020](#)). Economic shocks can affect human capital investments by shifting expected returns and the value of outside options (e.g., [Becker, 1962](#)). But how do they affect the choice between general and specific skills? While countercyclical college-going is a stylized fact in economics, less is known about how economic conditions shape the skill content of educational choices – particularly the tradeoff between general and specific skills.¹

Germany’s education system provides an ideal case to study how individuals substitute between general and specific skill investments. Traditional universities emphasize general skills, while other colleges, such as universities of applied sciences, blend general and vocational training. Apprenticeships, the typical outside option, focus on specific skills. Unlike the U.S., Germany’s centrally funded higher education system and regulated labor market resemble those of many OECD countries. Both aspects may affect not only the cyclicity of outside options but also how economic shocks influence the expected returns to different skill investments.²

This article exploits deviations from secular state-specific trends in the unemployment rate around high school graduation to study how economic conditions affect postsecondary skill investments. Using administrative microdata on German higher education, I construct a panel at the commuting zone level on the share of more than six million high school graduates who enroll in and graduate from different institutions between 1995 and 2018. To distinguish between expected returns and outside options as mechanisms, I supplement my analysis with administrative data on the apprenticeship system, large-scale survey data on the expected returns to college, and a decomposition of business-cycle fluctuations into their national and local components.

I find that economic shocks reduce overall college enrollment, particularly at traditional universities. A 1 percentage point (pp) deviation of the state unemployment rate (UR) from its long-term quadratic trend in the senior high school year reduces first-time college enrollment by 2.10 pp. Enrollment effects are concentrated at traditional universities and result in a long-term reduction in educational attainment at these institutions (-1.04 pp). In contrast, attainment at more vocationally oriented colleges

¹ I distinguish between general and specific skills (i.e., firm- or occupation-specific) and abstract from the distinction between basic and applied skills (see [Sanders and Taber, 2012](#), [Woessmann, 2025](#), for respective overviews).

² See [Section II](#) for more relevant institutional details and [Section VIII](#) for external validity.

increases by 0.40 pp. Survey data on expectations and decompositions of the state UR show that these effects are mainly driven by national shocks that reduce the expected returns to an academic degree. However, especially low-performing young men expect returns to a vocational degree to be stable and even to increase during downturns. While state-specific shocks have no effect on students' expectations, both national and state-specific shocks have opposing effects on outside options. Capacity and credit constraints play a negligible role.³

This paper makes three main contributions. First, it contrasts the conventional wisdom of countercyclical college-going in predominantly Anglo-Saxon contexts (see [Graves and Kuehn, 2022](#), for a survey). I find that college enrollment is procyclical. Focusing on the German context further allows me to contribute to the literature by examining different enrollment options that entail substantially different skill content. While in the U.S., especially community colleges serve as "safe port in a storm" ([Betts and McFarland, 1995](#)), my findings suggest that rather than enrolling in college, more graduates choose apprenticeships as a highly regulated outside option that focuses on specific skills. Higher state-level unemployment rates affect traditional universities that emphasize general skills. Enrollment at universities of applied sciences, which are a hybrid, serves as a middle ground and is less affected.⁴

Second, this paper contributes to a better understanding of how economic conditions shape human capital investment by distinguishing between national shocks and shocks at the (sub-) state level. Traditionally, the literature on graduating in a recession has focused on more macroeconomic shocks to study different outcomes.⁵ Recently, the literature focuses more on local labor markets ([Clark, 2011](#), [Sievertsen, 2016](#), [Deneault, 2025](#), e.g.), or sector and occupation-specific shocks, ([Charles et al., 2018](#), [Han and Winters, 2020](#), [Acton, 2021](#), [Weinstein, 2022](#), [Bütikofer et al., 2025](#)). I synthesize the two strands of the literature by showing that local unemployment shocks affect outside options, while macro shocks affect both outside options and expectations. Conditioning on year fixed effects may change signs by closing the expectations channel.

³ The evidence on credit constraints is mixed. [Hazarika \(2002\)](#) and [Christian \(2007\)](#) suggest that enrollment is more procyclical for low-income households. However, [Cameron and Taber \(2004\)](#) and [Hilger \(2016\)](#) find that most individuals with enrollment intentions are not liquidity constrained; [Bulman and Hoxby \(2015\)](#) detect only small effects of tax credits on college-going. [Bulman et al. \(2021\)](#) find that only large lottery wins have a small positive impact. However, [Lovenheim \(2011\)](#), [Pan and Ost \(2014\)](#) and [Manoli and Turner \(2018\)](#) find significant effects of increases in housing wealth, parental layoff, and tax refunds on enrollment, respectively. For Germany, [Goehausen and Thomsen \(2024\)](#) finds negative effects of housing costs on enrollment and student mobility.

⁴ Related work has mostly focused on the effects of economic shocks on on-the-job training ([Fukao and Otaki, 1993](#), [Méndez and Sepúlveda, 2012](#)), and the demand for skills ([Hershbein and Kahn, 2018](#), [Blair and Deming, 2020](#)), rather than investment decisions.

⁵ For high school graduation, these include college enrollment (e.g., [Betts and McFarland, 1995](#), [Dellas and Koubi, 2003](#), [Dellas and Sakellaris, 2003](#), [Johnson, 2013](#), [Alessandrini, 2018](#), [Long, 2014](#)), major choice ([Ersoy, 2020](#), [Blom et al., 2021](#)), later cognitive skills ([Hampf et al., 2020](#), [Arellano-Bover, 2022](#)), and earnings ([Bičáková et al., 2021, 2023](#)).

Lastly, this paper contributes to the literature on belief formation and its interplay with the business cycle (e.g., [Beaudry and Portier, 2006](#), [Blanchard et al., 2013](#), [Enke and Zimmermann, 2019](#), [Nowzohour and Stracca, 2020](#)). Based on large-scale survey data on the expected value of different degrees, I show that aggregate UR increases are substantially more salient than local conditions and reduce the expected value of an academic degree. At the same time, the expected value of a vocational degree is stable over the business cycle. For low-achieving male graduates without college-educated parents, recessions even increase the expected value of a vocational degree. This belief is at odds with empirical evidence showing that college graduates, especially those in majors with more general skill sets, workers with more general skills, and graduates from selective institutions are less vulnerable to recessions (see [Hoynes et al., 2012](#), [Altonji et al., 2016](#), [Eggenberger et al., 2022](#), [Weinstein, 2025](#), respectively). The literature on expectations in education has not yet explicitly studied the influence of the business cycle (see [Giustinelli, 2023](#), for an overview).

In the following, [Section II](#) discusses the institutional context. [Section III](#) presents a simple conceptual framework of skill investment. [Section IV](#) outlines the data and the empirical model. [Section V](#) presents evidence on college enrollment and attainment, as well as apprenticeships. [Section VI](#) decomposes the main effects into macroeconomic and more disaggregated components. [Section VII](#) studies expectations and other potential mechanisms. [Section VIII](#) discusses external validity. [Section IX](#) concludes.

II. INSTITUTIONAL BACKGROUND

I focus on high school graduates who obtained the highest leaving qualification (*allgemeine Hochschulreife*, aka *Abitur*). Typically, this takes 12–13 years of schooling. These graduates represent the largest subgroup, with about 75 percent of all high school graduates (including, e.g., *Fachgebundene Hochschulreife*, aka *Fachabitur*) and 40 percent of the population aged 18–19. Graduates with *Abitur* have the full choice set: They can enroll at any institution, in any degree, and, sometimes, depending on their GPA, in any major. In the main analysis, I abstract from the specific institutional type and major and distinguish between three options that vary in their underlying skill content:

1. **University:** Traditional universities in Germany are publicly financed, offer a wide range of academic programs, and are known for providing a comprehensive and theoretical education. University degrees are typically full-time and emphasize the acquisition of general skills. Internships are allowed but usually not mandatory. There is, hence, greater emphasis on general skills.
2. **Other colleges:** All other colleges, such as universities of applied sciences (*Fachhochschule*), typically offer a more practice-oriented education. They focus on en-

gineering, business, design, media, and technology programs. Their curriculum often includes internships. They can be privately financed and typically offer bachelor's degrees through dual study programs, in which students spend much of their studies in paid on-the-job training. Depending on the degree type chosen (dual or full-time), the focus on specific skills is stronger.

3. **Apprenticeship:** High school graduates who enter the labor market typically start an apprenticeship at a firm. Apprenticeships combine on-the-job training at the firm with theoretical education at a vocational school (*Berufsschule*). These vocational training programs cover various occupations, e.g., traditional crafts, technical fields, and healthcare. By design, apprenticeships are highly firm- and occupation-specific, as is their skill content.

Higher education has low direct costs, as there are no general tuition fees in Germany.⁶ A means-tested federal aid program (*BAFöG*) supports around 25 percent of full-time students. However, only 28 percent of formally eligible students (i.e., those under 30) receive any *BAFöG*, either because they failed the means test, or because they did not apply (Fidan and Manger, 2022). Similarly, only five percent of students take on a private loan. Of the average monthly income of students under 21, 66 percent is parental allowances, 13 percent is own earnings, twelve percent stems from federal aid *BAFöG*, and nine percent is from other sources (Middendorff et al., 2017). I discuss credit constraints as a mechanism in [Section VII.B](#).

The largest reform in the European Higher Education sector was arguably the Bologna Process, which began in 1999 (Crosier and Parveva, 2013). In Germany, the main change, alongside the introduction of the European Credit Transfer and Accumulation System (ECTS), was the transition from a single-tier to a two-tier degree system. Adoption accelerated in the mid-2000s: by 2008, bachelor's programs had become the dominant entry route, with the sharpest compositional shift around 2005 (see [Figure A.1](#)). Relative to the *Diplom* and *Magister* degrees, the median time-to-degree for the first cycle was reduced from 6 to 4 years (Bietenbeck et al., 2023), while apprenticeships typically take around 2.5 years. A further institutional change was the disappearance of the "Diplom (FH)" suffix for universities of applied sciences with the BA/MA harmonization, which reduced visible credential segmentation between institution types and facilitated "stacking" across pathways (e.g., combining apprenticeship and BA) within a similar overall time window. These shifts plausibly altered substitution patterns across educational options and the horizon over which students map current macroeconomic conditions to expected returns. Consistent with this, the mid-2000s mark a structural change in both levels and slopes of the enrollment series (see [Section IV.B](#)). I therefore

⁶ Between 2007 and 2014, some states introduced minor tuition fees (500 EUR per semester) with little effect on overall attainment (Bietenbeck et al., 2023). Private institutions can still charge tuition fees.

model state-specific trends with a 2005 break in the main specification (Section IV.C) and report effects before and after the Bologna process.

III. CONCEPTUAL FRAMEWORK

I extend a Roy-type model from Charles et al. (2018) to incorporate the effect of UR shocks at different levels of aggregation, as well as parental income, and derive testable comparative statics at two different enrollment margins. Consider high school students i with academic ability $\theta_i \in [0, 1]$ that maximize lifetime payoff by choosing between three postsecondary options: enrolling at a traditional university (college type $c = A$, general skills), enrolling at other colleges (college type $c = B$, skill mix), or starting an apprenticeship ($c = 0$, specific skills), before working until retirement L .

Students finance their studies via parental income ω_i .⁷ As college type B allows one to allocate more time to work besides studying (e.g., via dual studies), its average monetary net costs are lower ($F_A > F_B$). At college, potential students also face psychic costs of learning κ_c . The curriculum at college type A focuses on general skills and is thus more challenging ($\kappa_A > \kappa_B$), depending on students' academic ability. The expected college premium at the current period t for type- c college graduates equals $\pi_t^c = Y_t^c - Y_t^0 \geq 0$, where Y_t^c and Y_t^0 denote earnings of college and non-college educated workers, respectively. The lifetime payoff for student i at period t from attending a type- c college thus equals:

$$R_i^c(\theta_i, w_i) = \sum_{k=1}^{L-t} E_t[\pi_{t+k}^c] - Y_t^0 - (F_c - \omega_i) - \kappa_c(1 - \theta_i). \quad (1)$$

When the payoff of the outside option, apprenticeships, R_i^0 , is normalized to zero and under the assumption that changes in unemployment rates do not affect F_c and $\kappa_{c'}$, changes in the state s unemployment rate dUR_{st} around graduation affect the expected returns to college enrollment via the following channels:

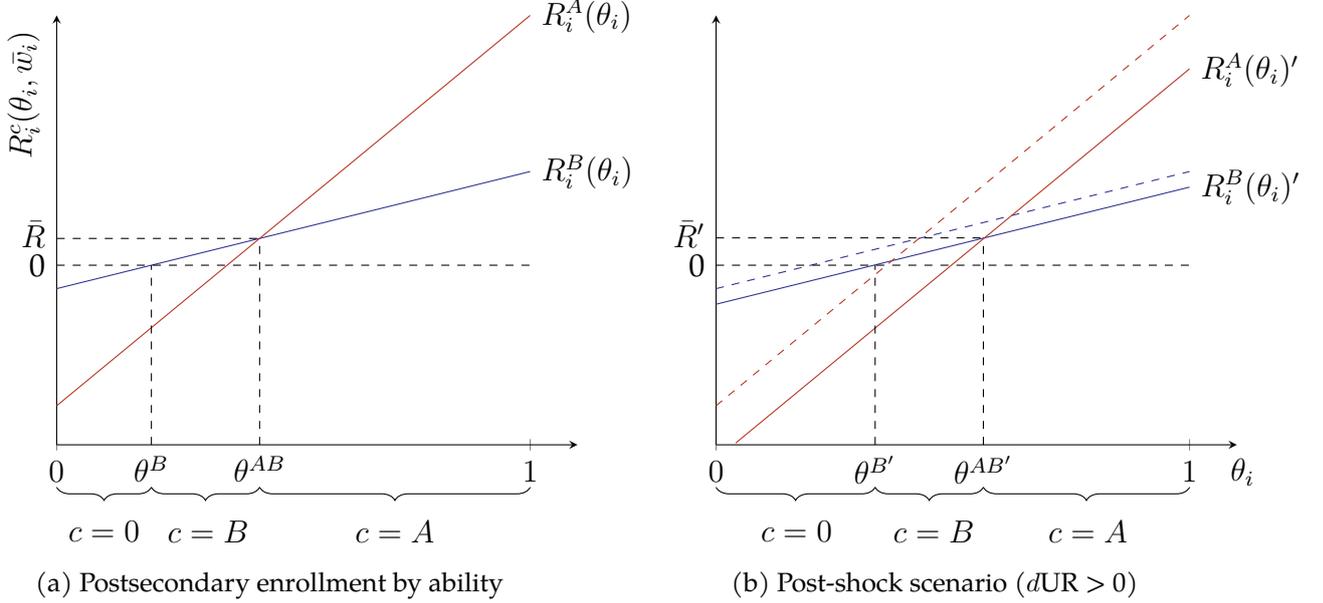
$$\frac{dR_i^c(\theta_i, w_i)}{dUR_{st}} = \underbrace{\frac{d \sum_{k=1}^{L-t} E_t[\pi_{t+k}^c]}{dUR_{st}}}_{(i)} - \underbrace{\frac{dY_t^0}{dUR_{st}}}_{(ii)} + \underbrace{\frac{dw_i}{dUR_{st}}}_{(iii)}. \quad (2)$$

Figure I Panel (a) shows the equilibrium sorting where students with ability up to threshold θ^B choose an apprenticeship, students with ability between θ^B and θ^{AB} enroll at college type B, and all students with $\theta_i > \theta^{AB}$ enroll at college type A. Panel (b) shows a possible scenario where a state-level unemployment shock reduces overall college enrollment ($\theta^{B'} > \theta^B$) while keeping constant the share of high school graduates

⁷ Parental transfers constitute 66 percent of the average monthly income of a first-year student in Germany, and loan-aversion is high (Middendorff et al., 2017).

enrolling at vocationally oriented colleges ($\theta^{AB'} - \theta^{B'} = \theta^{AB} - \theta^B$ and $\bar{R} = \bar{R}'$). A necessary condition for this is that the negative effect on expected returns to college type A exceeds the negative effect on expected returns to college type B.

Figure I: A Roy model of skill investment



Notes: Panel (a) shows the lifetime payoff of traditional universities (college type $c = A$) and vocational universities (college type $c = B$) by ability, normalizing the lifetime payoff of apprenticeships ($c = 0$) to zero. Segments on the x-axis indicate enrollment shares. Panel (b) shows a new equilibrium in a scenario where the negative effect of an economic shock at high school graduation on expected returns is stronger for college type A and outweighs the effect on outside options for college type A and B. Source: Own representation based on Charles et al. (2018).

The effect of changes in labor demand depends on how changes in the state UR affect (i) the expected average returns to college type c , (ii) outside options, and (iii) parental income. Conceptually, each change in the unemployment rate $UR_{s(r)t}$ in state $s(r)$ of commuting zone r at time t can be into a national and a state-specific component:

$$dUR_{s(r)t} = dUR_t^{\text{nat}} + dUR_{s(r)t}^{\Delta}, \quad (3)$$

where UR_t^{nat} is the national unemployment rate (common across states) and $UR_{s(r)t}^{\Delta}$ is the deviation of the state unemployment rate from the national rate.⁸ Empirically, it remains an open question which level of variation dominates for each separate channel.

Section V.A estimates the overall effects of state-level labor market conditions on college enrollment across institutions. Section V.B estimates effects on eventual attainment. Section V.C studies the apprenticeship market as outside options. Section VI compares enrollment effects when using different levels of variation in labor demand. As mechanisms, Section VII.A estimates the effect of the state-level UR on expectations, and Section VII.B studies the role of household income for enrollment.

⁸ Note that the state-specific deviation could also be represented as a weighted average across commuting zones r in state s . Section VI decomposes the state UR into a national component and the state-specific deviation, and uses more granular variation on the CZ-level.

IV. DATA AND IDENTIFICATION

IV.A Main Data Sources

The *Studierendenstatistik* (student register), provided by the Federal Statistical Office, covers the universe of students enrolled in higher education in Germany (RDC, 2019b). Each observation represents one individual enrollment spell and contains information on the institution, degree, field of study, final grade, entry qualification, gender, age, county, and year of high school graduation. Due to strict data protection, it does not contain individual identifiers. County-level data on the number of high school graduates, population, and economic indicators stems from the *Regionaldatenbank*; county-level unemployment rates from the Federal Employment Agency (BA). I link student register data on the number of first-year students who graduated from high school in a given county and year to the county-level data described above.

To account for the relevance of local labor markets (e.g., Amior and Manning, 2018, Hershbein and Stuart, 2024) and the high share of commuting across county borders in Germany (Krebs and Pflüger, 2023), I aggregate all counties to the so-called *Raumordnungsregionen* level. These regions are groups of counties that reflect a larger commuting zone (CZ). Throughout the analysis, I use the current 96 CZ delineations from the Federal Office for Building and Regional Planning (BBR). My final sample spans the years 1995 to 2018 and includes 6,296,662 high school graduates.⁹

As main outcome variables, I use the share of high school graduates with *Abitur*, from commuting zone r and graduation cohort t , enrolling in different colleges c within one year after high school graduation.¹⁰ I focus on individuals i in the student register (*Enrolled*) with *Abitur* and use the number of high school graduates from the CZ with *Abitur* as the denominator. Until 2011, male high school graduates had to fulfill one year of civil service. Hence, I consider enrollment up to one year after graduation.

IV.B Descriptive Evidence

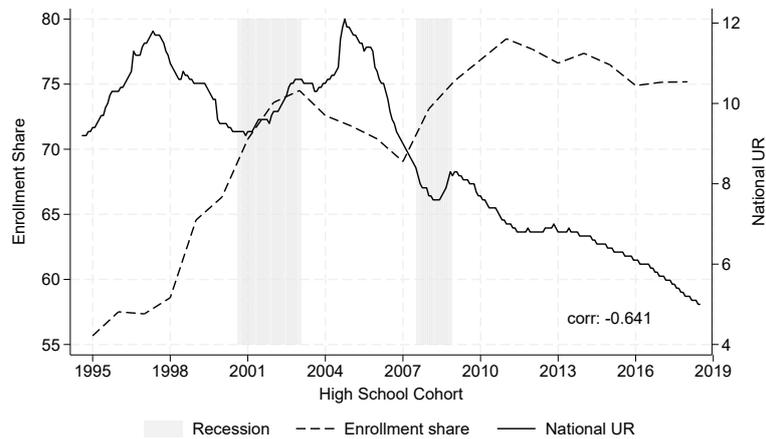
Panel A of Figure II plots the national unemployment rate and the aggregate share of high school graduates enrolling at any college. After the German reunification in 1990, the unemployment rate rose continuously until the late 1990s. A short recovery period was interrupted by the dot-com crash in 2000, after which unemployment reached a

⁹ Of the potential 2,304 CZ \times cohort cells, I have to exclude five cells from the state of Hesse (no data on high school graduates in 2007), two cells for the years 1996 and 1997 in the commuting zone of Osnabrück, and four cells from each state Mecklenburg-Western Pomerania and Saxony-Anhalt in the years 2001 and 2000 each (no high school graduates due to an increase in the mandatory years of schooling), which totals 2,289 cells. Descriptive statistics in Table A.1.

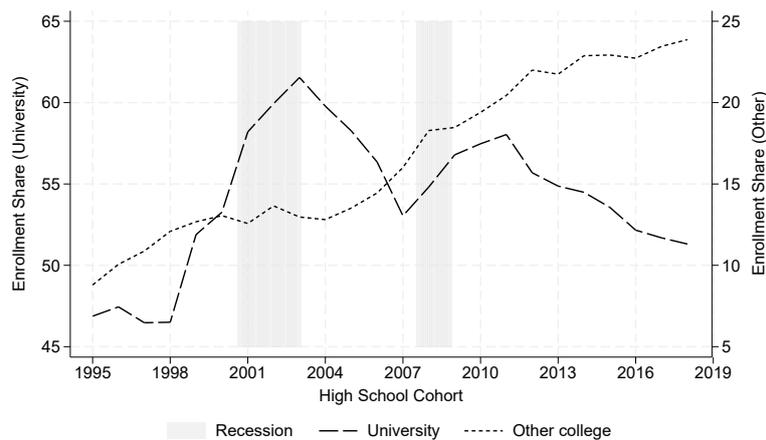
¹⁰ Each enrollment share is defined by: $E_{rt} = \sum_{\tau=t}^{t+1} \sum_{i \in r, t} \text{Enrolled}_i^{y=\tau} / \sum_{i \in r, t} \text{Graduates}_i$, where y indicates the year of first-time enrollment.

peak at around 12% in 2005, making Germany “the sick man of Europe” (Dustmann et al., 2014). After the implementation of the last wave of the Hartz reforms in that year, the unemployment rate fell rapidly until the COVID-19 pandemic, which is excluded from the sample, with only a minor setback during the financial crisis.

Figure II: Time Series of Enrollment and Unemployment
 (a) Panel A: Overall College Enrollment and National UR



(b) Panel B: Enrollment by College Type



Notes: Share of high school graduates with *Abitur* enrolling at different college types (yearly), national unemployment rate (monthly), and recession periods (grey, following Breuer et al. (2022)).

Source: Student register, Federal Employment Agency, *Regionaldatenbank*, German Council of Economic Experts, years 1995–2018.

During the same 24-year period, enrollment rates rose from around 55 percent in 1995 to almost 80 percent in 2011, after which they slowly decreased. The previous rise in enrollment rates was interrupted during the mid-2000s, coinciding with the Bologna process and the introduction of general tuition fees in 2007 in seven German states.¹¹ Overall, there is a strong procyclical relationship ($\rho = -0.641$) between unemployment and college enrollment. This negative correlation is driven by the period before 2010. Since 2011, unemployment and college enrollment have fallen simultaneously.

Splitting enrollment rates by college type in Panel B suggests that these educational

¹¹ While tuition fees had negative enrollment effects (Bietenbeck et al., 2023), existing evidence on enrollment effects of the Bologna Process is inconclusive (see Kroher et al., 2021, for a literature review).

reforms during the mid-2000s also triggered distinct trends at traditional universities and all other colleges. While enrollment at traditional universities has been decreasing on average since 2003, enrollment rates at other colleges have surged. In two separate growth periods, from 1995 to 2003, and 2004 to 2018, enrollment at colleges other than traditional universities rose from below 10 to around 24 percent. Structural break tests in [Table A.2](#) confirm that unemployment and enrollment rates experience structural breaks during the mid-2000s. The year 2005, which lies amidst the Bologna Process and where the last wave of the Hartz Reforms was introduced, is a potential structural break for all these variables.

Time series of unemployment rates across states ([Figure A.3](#)) and on enrollment rates across commuting zones ([Figure A.4](#)) show that the structural breaks are particularly pronounced in East Germany. Except for 2005, in West Germany, state-level unemployment fell more or less constantly between 1995 and 2018, with overall levels below 10 percent. In East Germany, however, they rose to a peak in 2005 before they fell sharply afterwards, converging to West German levels. Conversely, enrollment rates in West Germany increased in the 1990s and have fluctuated around 75 percent since 2001. Except for the mid-2000s, enrollment rates in East Germany have been increasing from below 50 percent and have converged to West German levels.

IV.C Identification

Against this background, the main challenges for identification are secular, state-specific trends in unemployment and enrollment rates, as well as structural breaks in these variables. To estimate the causal effect of labor market conditions on postsecondary education choices, I exploit state-specific business-cycle variation and account for a structural break in 2005. Explicitly, I regress enrollment rates E of each high school graduation cohort t from commuting zone r on the unemployment rate UR_{st} in the corresponding state $s(r)$ for each college type c :

$$E_{rt}^c = \beta UR_{s(r)t} + \alpha_{s(r)} + g_{s(r)}(t) + \gamma' Z_{s(r)t} + \varepsilon_{rt}, \quad (4)$$

where $\alpha_{s(r)}$ are state fixed effects, and:

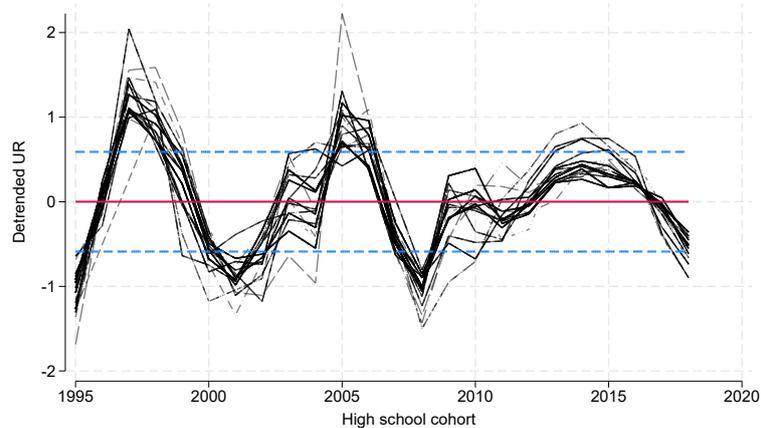
$$g_s(t) = \theta_{1s} \tau_t + \theta_{2s} \tau_t^2 + \theta_{3s} \mathbf{1}\{t \geq 2005\} \tau_t + \theta_{4s} \mathbf{1}\{t \geq 2005\} \tau_t^2, \quad (5)$$

is a function that controls for quadratic time trends within each state $s(r)$, that are allowed to change slope after the year 2005, and $\tau_t = t - 2005$ gives the number of years relative to 2005. As a result, the empirical analysis relies on cyclical deviations from state-specific quadratic time trends (see [Figure III](#)). To obtain β coefficients equivalent to those of a regression on the individual level, I weight each cell by the number of high school graduates. I allow for two-way clustering by state and cohort to adjust standard

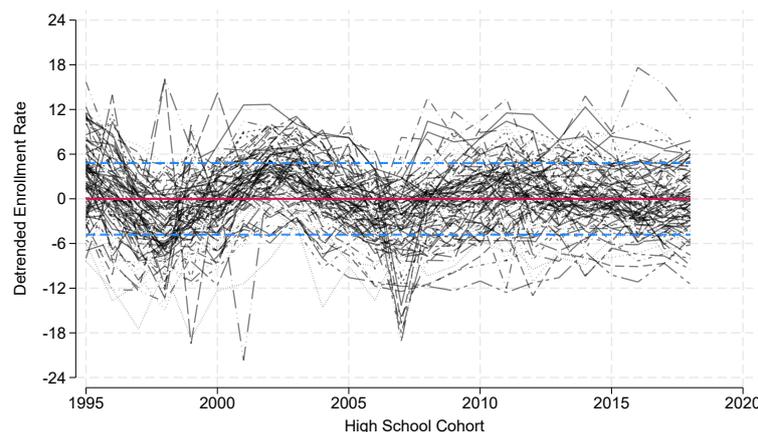
errors for common shocks across cohorts and correlation within states (Cameron et al., 2011). To better understand the dynamics at play, I focus on the state UR at graduation in year t and in the senior year preceding graduation, $t - 1$, in the main analysis.

Figure III: Business cycle variation across states and commuting zones

Panel A: Detrended state UR



Panel B: Detrended CZ-level enrollment (any college)



Notes: This figure plots for each year the residual state UR (in Panel A) and CZ-level college enrollment rate (Panel B) after controlling for state fixed effects and state-specific quadratic time trends, allowing for a trend break in 2005. Zero mean in red and standard deviations in blue.

Source: Student register, Federal Employment Agency (BA).

In my main specification, I deliberately do not control for year fixed effects, as these would net out the macroeconomic component described in Section III. Figure A.5 and Figure A.6 show that year FEs absorb a large share of the identifying variation in unemployment and enrollment rates, respectively. Instead, I am interested in how both national and state-specific conditions affect investment choices. To this end, Section VII decomposes the state UR into year-specific and state-year-specific components and alternatively uses finer-grained variation in CZ-level unemployment rates.

To improve precision in the light of year-specific policy shocks, Z contains state-specific education reforms that affected college enrollment. These include the introduction and abolition of tuition fees (see, e.g., Bietenbeck et al., 2023) across years and states, as well as inflated high school graduation cohorts (“double-cohorts”) resulting

from reducing statutory years spent in high school (see [Marcus and Zambre, 2019](#), for this so-called *G8 reform*). “Empty cohorts” without high school graduates are not included in my sample (see [Section IV.A](#)). Both double-cohorts and empty cohorts may otherwise affect enrollment rates and simultaneously act as supply shocks on the apprenticeship market ([Mühlemann et al., 2022](#), [Dorner et al., 2024](#)).

ii. Identifying assumptions. Under the conditional independence assumption, i.e., $E(\varepsilon_{rt} \mid \text{UR}_{s(r)t}, \alpha_{s(r)}, g_{s(r)}(t)) = 0$, my estimates reflect the causal effect of a one percentage point deviation from the state-specific UR trend on CZ-level enrollment shares E_{rt} in the corresponding year. Explicitly, I assume that, conditional on state fixed effects, quadratic time trends, and educational reforms, the unemployment rate at graduation is exogenous to other changes in the relative returns to certain institutional choices or cohort characteristics. As variation in unemployment likely reflects changes in state-level labor demand, reverse causality seems implausible. However, all unobserved within-year across-state shocks that affect both enrollment rates and unemployment may cause omitted variable bias.

A first omitted variable suspect is technology shocks. For example, high-skill augmenting technology shocks may simultaneously increase the expected return to general skill investments and affect unemployment rates. Yet, larger technology shocks often take time to be adopted and cause reallocations in the labor market (see, e.g., [Comin and Hobijn, 2010](#)). In turn, adoption speed varies geographically and depends on economic conditions ([Hershbein and Kahn, 2018](#)). As a result, a larger share of technology-induced changes in unemployment may be captured by state-specific trends. Most importantly, however, the effects of technology shocks on the labor market are typically ambiguous ex-ante.¹² Hence, it is unlikely that technology shocks immediately affect average college-going.¹³ Overall, while I cannot rule out that single technology shocks may affect enrollment choices in specific periods, a systematic bias due to unobserved technology shocks is unlikely.

A second main suspect are firm’s expectations. If firms were to lower their economic expectations, e.g., due to political uncertainty, then they may hire fewer workers and apprentices ([Bloom, 2009](#), [Mühlemann et al., 2020](#)), and the unemployment rate would increase. As a result, high school graduates with *Abitur* may fail to find an apprenticeship and enroll at college instead. If this were the case, my finding of procyclical college enrollment would be attenuated and may represent a lower bound. Importantly, however, such expectation-driven changes in firms’ hiring and training behavior are arguably part of the fluctuations in labor demand that my analysis intends to capture.

¹² Take artificial intelligence as an example, where the exact impact on labor markets is complex and hard to predict (see, e.g., [Frank et al., 2019](#), [Acemoglu, 2024](#)).

¹³ On an intensive margin, however, specific technology shocks may locally affect field of study choice (see, e.g., [Acton, 2021](#), [Weinstein, 2022](#)).

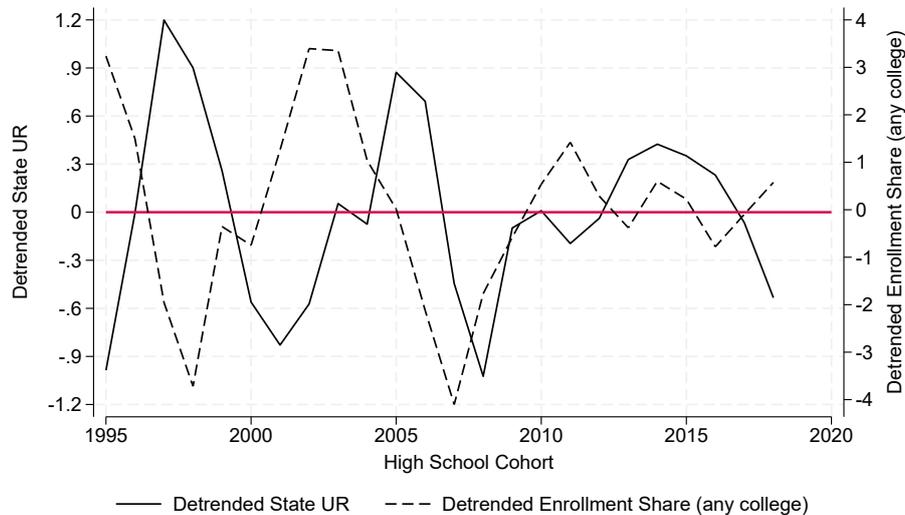
Negative firm expectation shocks would only generate omitted variable bias if they reduce apprenticeship availability relative to other local labor-market opportunities at a given unemployment rate. Consequently, [Section V.C](#) studies the cyclical nature of the apprenticeship market.

V. EFFECTS OF BUSINESS CYCLE VARIATION

V.A College Enrollment

i. Main results. [Figure IV](#) shows aggregated values of the detrended state UR and college enrollment rate for each year. Overall, there is a clear procyclical pattern: unemployment is negatively correlated with overall enrollment. Increases in the unemployment rate precede decreases in the enrollment rate with a lag of around 1-2 years. This pattern is particularly visible until the financial crisis and the end of the Bologna Process around 2008. Consistent with the parallel and relatively smooth decreases in both unemployment and overall college enrollment after 2010, the corresponding years exhibit relatively little variation, but a procyclical relationship persists.¹⁴

Figure IV: Aggregated business cycle variation in enrollment and unemployment



Notes: This figure plots for each year the aggregated residual unemployment rate (solid line) and average college enrollment rate (dashed line) from [Figure III](#).
Source: Student register, Federal Employment Agency (BA).

[Table I](#) presents corresponding estimation results from [Equation \(4\)](#) on the impact of cyclical fluctuations in the state UR on skill investment across higher education institutions. Panel A focuses on economic conditions in the year of graduation. To account

¹⁴The following analyses present average results for the complete sample and for pre- and post-2008 periods, i.e., before and after the completion of the Bologna process. This also allows comparison of enrollment results with expectations and with the apprenticeship market, for which data are available from 2008 onwards.

for the visibly lagged pattern, Panel B uses the state UR in the senior year preceding graduation. Overall, increases in the state UR in the graduation year are associated with lower enrollment rates at both traditional universities and other colleges. However, the results are not statistically significant in either the overall sample or in the periods before and after the Bologna Process (i.e., the year 2008).

However, as suggested by [Figure IV](#), business cycle fluctuations in the senior year of high school have a sizeable and significant effect on enrollment rates. A 1 pp deviation of the state UR from its long-term quadratic trend one year before graduation decreases later college enrollment by 2.10 pp. The effects are almost entirely attributable to enrollment at traditional universities (-2.05 pp). This means that a one-standard-deviation increase in the state UR (+0.6 pp) decreases university enrollment by approximately a quarter of a standard deviation (-1.23 pp). For enrollment at other colleges, the effect is close to zero and statistically insignificant. All effects follow the same pattern before and after 2008, and are not statistically different across periods.

Table I: Enrollment effects across institutions

	Overall		University		Other college	
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Panel A: State-level UR (graduation year)</i>						
State UR (t)	-1.000 (0.593)		-0.886 (0.662)		-0.114 (0.124)	
... × pre 2008		-0.940 (0.689)		-0.860 (0.715)		-0.075 (0.096)
... × post 2008		-0.833 (0.976)		-0.812 (0.965)		-0.007 (0.128)
p-value (β_{Δ})		[0.811]		[0.916]		[0.299]
<i>Panel B: State-level UR (senior year)</i>						
State UR (t-1)	-2.102*** (0.378)		-2.047*** (0.373)		-0.055 (0.063)	
... × pre 2008		-2.243*** (0.416)		-2.249*** (0.363)		0.052 (0.095)
... × post 2008		-2.416*** (0.556)		-2.498*** (0.475)		0.142 (0.159)
p-value (β_{Δ})		[0.466]		[0.294]		[0.195]
Outcome mean	71.2	71.2	54.2	54.2	17.0	17.0
No. CZ-cohort cells	2,289	2,289	2,289	2,289	2,289	2,289
No. high school graduates	6,296,662	6,296,662	6,296,662	6,296,662	6,296,662	6,296,662

Notes: This table presents estimates from [Equation \(4\)](#) for the share of high school graduates with *Abitur* enrolling in different college types, spanning high school cohorts 1995–2018. The pre- (post-) Bologna variables are dummy variables indicating the period before (after) 2008. P-values in brackets for effect differences across periods. Policy controls include tuition fee introductions and abolitions, as well as double cohorts. Each cell is weighted by the number of high school graduates with *Abitur*. Standard errors in parentheses allow for two-way clustering at the state and cohort level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Source: Student register, Federal Employment Agency, *Regionaldatenbank*.

These results contrast with the conventional wisdom of countercyclical college-going and are consistent with the scenario described in [Figure I](#), where negative effects on expected returns are larger for traditional universities and fewer graduates choose apprenticeship paths. Consequently, effects on the apprenticeship market are presented in [Section V.C](#). Effects on expectations are presented in [Section VII.A](#). As the current

exercise suggests a lagged relationship between enrollment and unemployment, and because expectation data is available for graduates in the senior year, and not in the graduation year, the remainder of this paper will focus on the state UR in the senior year ($t-1$). [Section VI](#) decomposes business cycle effects into national, state-specific, and CZ-specific components.

ii. Robustness. Overall, the results are robust to alternative business cycle measures and parametric choices. [Table A.4](#) shows that effects remain negative and significant when using different lags ($t-2$) or averages in the unemployment rate during high school as the main regressor. When using the state UR in the year following high school graduation, the effects are positive but largely insignificant. While this could simply reflect serial correlation in unemployment, it may also reflect the outside options channel, assuming that expectations are primarily affected during high school. The results are robust to alternative trend (see [Table A.5](#)).

[Table A.6](#) shows that the results on overall enrollment and university enrollment remain negative and mostly significant when using linear trends in combination with the 2005 trend break, or state-specific quadratic trend, without a trend break. Dropping the trend break also leads to a sizeable negative effect on enrollment at other colleges. [Figure A.2](#) shows that a global quadratic trend “interprets” the slowdown and consequent, presumably Bologna-induced, acceleration in enrollment at universities of applied sciences as a negative deviation from an overall trend. The concurrent 2005 peak in unemployment accounts for the negative effect.

Lastly, lagged negative effects of labor market conditions on college enrollment may reflect compositional changes of high school graduates. For example, [Gaini et al. \(2013\)](#) suggests that in times of higher unemployment, secondary schooling may act “as a shelter” (also see [Petrongolo and San Segundo, 2002](#)). If, during recessions, low-performing students choose to remain in school and graduate, college enrollment rates in these inflated cohorts may be lower. Using log cohort sizes by gender, [Table A.7](#) shows that adverse labor market conditions two to three years before graduation increase the number of students completing the academic track, consistent with a shelter or continuation effect. Importantly, however, this response occurs before the enrollment decision studied in this paper. Reassuring, enrollment effects are largest for shocks in $t-1$. Also, cyclical UR shocks in the senior year do not significantly affect high school cohort sizes.

iii. Heterogeneity. As the student register contains no information on socioeconomic background, I use the German Socio-economic Panel (SOEP v39) to estimate effects across students with and without college-educated parents (high vs. low SES) and across gender. The SOEP data contain information on the first post-secondary enrollment spell of 1,851 high school graduates between 1995 and 2018 and information on

the state of graduation. In contrast to the student register, it also allows for direct estimation of business cycle effects on the probability of starting an apprenticeship.

Table A.3 summarizes the main results for different enrollment choices (any college, vocational training, university, other college, and neither or missing) in each panel and for the whole sample, as well as splits by gender and SES in each column. Overall, the main results follow a pattern similar to that observed in the administrative data. The overall enrollment effect is -3.4 pp and appears larger at traditional universities (Panel D) than at vocational colleges (Panel E). However, these effects are not statistically significant, and the baseline probability of college enrollment (61 percent) is considerably lower than in the student register.

Panel B shows that vocational training is positively and significantly affected by higher unemployment rates (+2.9 pp). The effect is largest and statistically significant among female high school graduates (+4.3 pp). A simple explanation for this is that a higher share of women obtain the *Abitur*. Men are more likely to begin an apprenticeship after obtaining an intermediate secondary school degree and to forgo high school. Hence, the remaining men might be preselected and have stronger study intentions. In line with this, the adverse enrollment effects at traditional universities are also stronger for women.¹⁵ Splitting by SES, the enrollment effects on overall college enrollment seem to be stronger and are statistically significant for low SES graduates, which seems intuitive. **Section VII.A** presents results for expectations as the main mechanism across gender, SES, and along the GPA distribution of graduates.

V.B College Attainment

Given the possibility to enroll in later years, to switch degrees, college, and major, and the low completion rates of university degrees in Germany (between 60 percent and 70 percent, see [Bietenbeck et al., 2023](#)), any enrollment effects do not necessarily translate to changes in educational attainment and associated skills. This section repeats the previous analysis, treating the share of high school graduates with *Abitur* who obtain any given postsecondary degree by 2018 as the outcome, using data from the final exams register ([RDC, 2019a](#)) for long-run effects on attainment.

Table II Panel A shows a higher state UR at graduation also has a positive long-run effect on attainment, even though it does not significantly affect enrollment in the short run. A 1 pp increase in the state UR at graduation increases attainment from other colleges. One potential explanation consistent with procyclical enrollment is that some high school graduates who choose to enter an apprenticeship during a recession sub-

¹⁵ Gendered business cycle effects align with [Leibing et al. \(2023\)](#), who document stronger associations between the expected returns to college and actual enrollment for female high school graduates, and [Bietenbeck et al. \(2023\)](#), who find larger effects of tuition fees on female college attainment in Germany.

Table II: Attainment effects across institutions

	Overall		University		Other college	
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Panel A: State-level UR (graduation year)</i>						
State UR (t)	0.348 (0.426)		-0.267 (0.397)		0.615*** (0.169)	
... × pre 2008		0.234 (0.401)		-0.323 (0.366)		0.557*** (0.158)
... × post 2008		-0.085 (0.551)		-0.480 (0.457)		0.379** (0.167)
p-value (β_{Δ})		[0.262]		[0.512]		[0.181]
<i>Panel B: State-level UR (senior year)</i>						
State UR (t-1)	-0.640 (0.374)		-1.039*** (0.231)		0.399** (0.184)	
... × pre 2008		-0.999** (0.413)		-1.309*** (0.251)		0.332* (0.179)
... × post 2008		-1.473** (0.526)		-1.667*** (0.328)		0.210 (0.245)
p-value (β_{Δ})		[0.051]		[0.019]		[0.294]
Policy controls	yes	yes	yes	yes	yes	yes
Outcome mean	59.9	59.9	40.0	40.0	19.9	19.9
No. CZ-cohort cells	2,097	2,097	2,097	2,097	2,097	2,097
No. high school graduates	5,727,918	5,727,918	5,727,918	5,727,918	5,727,918	5,727,918

Notes: This table presents estimates from Equation (4) for the share of high school graduates with *Abitur* graduating from different college types, spanning high school cohorts 1995–2016. Policy controls include tuition fee introductions and abolitions, as well as double cohorts. Each cell is weighted by the number of high school graduates with *Abitur*. Standard errors in parentheses allow for two-way clustering at the state and cohort level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Source: Exam register, Federal Employment Agency, *Regionaldatenbank*.

sequently enroll at a university of applied sciences after the economy has recovered.¹⁶

Panel B shows that enrollment effects translate to changes in later postsecondary attainment. Although the effect on overall attainment is insignificant, a 1 pp higher state-level unemployment rate in the senior high school year decreases attainment at traditional universities by 1.04 pp. For attainment, effects are also statistically significant for other colleges that focus on more specific skills. Here, attainment increases by approximately 0.40 pp. Given attainment shares of 40 percent for traditional universities and around 20 percent for other colleges, these effects seem relatively modest and amount to two and three percent, respectively. For attainment, effects also experience a structural break after the Bologna process was completed. After 2008, they are significantly larger for traditional universities (1.67 pp vs. 1.31 pp), consistent with the considerably shorter expected median study duration for a Bachelor's degree (4 years) compared with the *Diploma* and *Magister* (6 years).

¹⁶ Dahm and Peter (2023) show that the share of college graduates with previous vocational education declined from 39 percent in 1997 to 19 percent in 2017, and that other colleges, such as universities of applied sciences, are particularly popular among former apprentices.

For German high school graduates, the outside option to college enrollment is to invest in specific skills through an apprenticeship. I use administrative state-level data from the *Berufsbildungsstatistik* (1995–2018) on the universe of new apprenticeship contracts by school degree provided by the Federal Institute for Vocational Education and Training (BIBB). To better understand the role of relevant labor market conditions, I complement this with CZ-level data from the *Ausbildungsmarktstatistik* of the Federal Employment Agency (BA) on apprenticeship applicants and apprenticeship positions reported to the BA between 2008 and 2018.

Table III presents three sets of estimates: Panel A focuses on new apprentices and applicants with a high school degree, Panel B on total new apprenticeship contracts, applicants, and positions, and Panel C on the share of apprentices and applicants with a high school degree. Panel A shows a large and positive effect of state-level unemployment on the number of new apprentices with a high school diploma. A 1 pp increase in the state UR in $t-1$ is associated with a 5.1 percent increase in new apprentices with a high school degree. However, the results are not statistically significant for years after 2008. Consistent with this, a 1 pp increase in the state UR increases the number of applicants with *Abitur* by around 6.4-7.3 percent. This aligns with the main findings on college enrollment, suggesting that a significant share of high school graduates make skill-specific investments rather than enroll in college.¹⁷

Panel B presents results for the total number of new apprentices, regardless of qualification. Depending on the sample period, a 1 pp increase in the state UR increases the number of new contracts by 2.3-2.5. For the years 2008 to 2018, BA data indicate that higher URs also increase the share of applicants with any degree by approximately 2.2-4.1 percent, depending on the level of analysis. Simultaneously, economic shocks do not significantly increase the number of registered new positions. My results again contrast with most international evidence, which indicates that the number of new apprentices is mildly procyclical (see, e.g., Lüthi and Wolter (2020) for Switzerland and Brunello (2009) for a review). For Germany, however, Baldi et al. (2014) find no significant effect of the business cycle on apprenticeship contracts between 1999 and 2012.¹⁸ The next section studies the separate effects of national and state-specific unemployment rate on the apprenticeship market.

Lastly, Panel C presents results for the share of new apprentices and applicants with

¹⁷ As I do not explicitly observe the year of high school graduation of new apprentices, I focus on the year and state/CZ of the contract signing instead. As a result, the effects may include, but are not limited to, recent high school graduates. Effect sizes and baseline shares are thus not directly comparable to the effects on college enrollment studied earlier.

¹⁸ Note that the BA data only contains positions and applications posted at the employment agency. A higher number of posted positions or applicants may signal greater labor market frictions rather than higher supply or demand.

Table III: Effects on the apprenticeship market

	Contracts		Applicants		Positions
	(1)	(2)	(3)	(4)	(5)
<i>Panel A: ln(high school)</i>					
State UR (t-1)	0.051** (0.021) [6,915]	0.018 (0.015) [8,245]	0.073*** (0.020) [8,237]	0.064** (0.019) [1,373]	
<i>Panel B: ln(total)</i>					
State UR (t-1)	0.023** (0.009) [35,442]	0.025** (0.010) [33,566]	0.041** (0.018) [34,253]	0.022 (0.017) [5,709]	0.021 (0.015) [5,570]
<i>Panel C: Share high school</i>					
State UR (t-1)	0.358 (0.268) [20.5]	-0.069 (0.321) [25.2]	0.779* (0.357) [23.3]	0.795*** (0.202) [21.9]	
No. Cells	384	176	176	1,056	1,056
Level of analysis	State	State	State	CZ	CZ
Time frame	1995-2018	2008-2018	2008-2018	2008-2018	2008-2018
Data source	BIBB	BIBB	BA	BA	BA

Notes: This table presents estimates from different regressions mirroring Equation (4), on the state level and CZ level, on new apprenticeship contracts, applicants, and positions. Panel A shows effects on the number (in logs) of high school graduates starting or applying for an apprenticeship. Panel B shows effects on the total number (in logs) of new apprenticeship contracts, applicants, and positions reported. Panel C shows effects on the share of high school graduates among new apprenticeship contracts and applicants. Outcome means in levels in brackets. Standard errors in parentheses allow for clustering at the state and year level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Source: Federal Institute for Vocational Education and Training (BIBB), Federal Employment Agency (BA).

a high school degree. In the post-Bologna years (2008-2018), the larger relative increase in high school graduates leads to a higher share of such graduates among applicants. A 1 pp increase in the state-level UR increases the share of high school graduates by around 0.78 pp from a baseline of around 22 percent. This may come at the expense of school leavers with lower academic qualifications, who must now compete with high school leavers. However, I find no significant effects on apprenticeship contracts, and the data do not permit direct testing of such displacement effects.

VI. DECOMPOSING VARIATION IN UNEMPLOYMENT

Broadly, the literature distinguishes between two main mechanisms of how economic conditions affect enrollment decisions: outside options and expected returns. Under imperfect mobility, more localized economic measures should determine graduates' outside options. Yet, it remains an open question which type of information students actually use to form economic expectations. To study the distinct effect of national vs. state-level conditions as conceptualized in Equation (3), I calculate state-specific shocks as $UR_{st}^{\Delta} = UR_{st}^{\text{state}} - UR_t^{\text{national}}$. Equation (6) uses the national UR and state-specific residuals instead of the state UR:

$$E_{rt}^c = \beta_1 UR_t^{\text{national}} + \beta_2 UR_{s(r)t}^{\Delta} + \alpha_{s(r)} + g_{s(r)}(t) + \gamma' Z_{s(r)t} + \varepsilon_{rt}. \quad (6)$$

In this specification, β_1 represents the part of the main effect that can be explained by conditions, and β_2 represents that part of the effect that can be explained by state-specific residual shocks net of national conditions.

Table IV: Decomposed effects on college enrollment

	Overall		University		Other college	
	(1)	(2)	(3)	(4)	(5)	(6)
National UR (t-1)	-2.364*** (0.433)		-2.369*** (0.449)		0.006 (0.072)	
... × pre 2008		-2.606*** (0.436)		-2.711*** (0.398)		0.176 (0.134)
... × post 2008		-2.937*** (0.539)		-3.187*** (0.449)		0.335 (0.240)
p-value ($\beta_{1\Delta}$)		[0.104]		[0.020]		[0.169]
UR $^{\Delta}$ (t-1)	-0.432 (0.736)		0.011 (0.545)		-0.444* (0.235)	
... × pre 2008		-0.396 (0.736)		0.067 (0.531)		-0.500** (0.196)
... × post 2008		-0.265 (0.794)		0.310 (0.575)		-0.598** (0.234)
p-value ($\beta_{2\Delta}$)		[0.653]		[0.225]		[0.555]
Outcome mean	71.2	71.2	54.2	54.2	17.0	17.0
No. CZ-cohort cells	2,289	2,289	2,289	2,289	2,289	2,289
No. high school graduates	6,296,662	6,296,662	6,296,662	6,296,662	6,296,662	6,296,662

Notes: This table presents estimates from Equation (4) for the share of high school graduates with *Abitur* enrolling in different college types, spanning high school cohorts 1995–2018. Policy controls include tuition fee introductions and abolitions, as well as double cohorts. Each CZ is weighted by the number of high school graduates with *Abitur*. Standard errors in parentheses allow for two-way clustering at the state and cohort level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Source: Student register, Federal Employment Agency, *Regionaldatenbank*.

Table IV shows that the main effect of the state UR is explained by its national component. A 1 pp deviation of the national UR from its trend decreases overall enrollment rates by 2.36 pp. This effect is entirely driven by enrollment at traditional universities, while the effect for other colleges is zero across all samples. For university enrollment, the negative effect is significantly larger since 2008, consistent with the explanation that, following the Bologna Process, other colleges have become a more popular alternative to traditional universities (see Figure IIb).

Conditional on the national UR, a 1 pp higher state-specific residual $UR_{s(r)t}^{\Delta}$ has no significant effect on university enrollment, but significantly decreases enrollment at other colleges by 0.5-0.6 pp, depending on the time frame. One plausible explanation is that the marginal university student is more mobile and responds to changes in national conditions. In contrast, the marginal student at other colleges would be less mobile and respond more to state-specific conditions. To study effects driven by local labor market conditions, Table A.8 repeats the main estimation but uses more granular, cyclical variation in the CZ-level UR in Panel A and within-CZ across-time variation net of cohort fixed in Panel B. Consistent with the expectations channel, Panel A shows that a 1 pp cyclical increase in CZ-level UR reduces overall enrollment by 1 pp. In this

case, the effects are also negative and significant for other colleges. However, the results are overall smaller and noisier, suggesting that macroeconomic conditions tend to be more salient than local ones. To clarify the mechanisms of how local vs. macroeconomic shocks affect enrollment, I decompose their effects on apprenticeships, before I estimate effects on expectations in [Section VII.A](#).

[Table V](#) repeats the decomposition analysis for the apprenticeship market. For overall contracts, there seems to be a clear difference in the effects of national and state-specific labor market conditions. While, consistent with [Table III](#), national conditions positively affect the number of new contracts with high school graduates especially, higher state-specific unemployment reduces both the number of total new contracts and to a larger extent the number of contracts with high school graduates. The effects are less pronounced after 2008 and differently affect the number of registered applicants. Here, both national and state-specific unemployment increases are associated with a higher number of applicants in the following years. For the total number of registered position, there is again no significant effect.

Table V: Decomposed effects on the apprenticeship market

	Contracts		Applicants		Positions
	(1)	(2)	(3)	(4)	(5)
<i>Panel A: ln(high school)</i>					
National UR (t-1)	0.084*** (0.028)	0.042** (0.019)	0.069** (0.029)	0.063** (0.024)	
UR Δ (t-1)	-0.085*** (0.029) [6,915]	-0.022 (0.013) [8,245]	0.080*** (0.025) [8,237]	0.067** (0.025) [1,373]	
<i>Panel B: ln(total)</i>					
National UR (t-1)	0.033** (0.012)	0.029* (0.014)	0.036* (0.018)	0.012 (0.014)	0.021 (0.021)
UR Δ (t-1)	-0.017** (0.008) [35,442]	0.018 (0.013) [33,566]	0.049* (0.025) [34,253]	0.046* (0.024) [5,709]	0.020 (0.024) [5,570]
<i>Panel C: Share high school</i>					
National UR (t-1)	0.653* (0.336)	0.377 (0.507)	0.865 (0.575)	1.109*** (0.337)	
UR Δ (t-1)	-0.857*** (0.288) [20.5]	-0.820** (0.298) [25.2]	0.634 (0.561) [23.3]	0.090 (0.360) [21.9]	
No. Cells	384	176	176	1,056	1,056
Level of analysis	State	State	State	CZ	CZ
Time frame	1995-2018	2008-2018	2008-2018	2008-2018	2008-2018
Data source	BIBB	BIBB	BA	BA	BA

Notes: This table presents estimates based on [Equation \(6\)](#), on the state and CZ level, on new apprenticeship contracts, applicants, and positions. Panel A shows effects on the number (in logs) of high school graduates starting or applying for an apprenticeship. Panel B shows effects on the total number (in logs) of new apprenticeship contracts, applicants, and positions reported. Panel C shows effects on the share of high school graduates among new apprenticeship contracts and applicants. Outcome means in levels in brackets. Standard errors in parentheses allow for clustering at the state and year level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Source: Federal Institute for Vocational Education and Training (BIBB), Federal Employment Agency (BA).

Negative effects on overall contracts and positive effects on applicants registering

at the BA may very well reflect increased frictions on the apprenticeship market. A zero effect on posted positions may still be consistent with this, e.g., when the true demand for apprentices is lower, but more of the remaining positions are posted due to frictions. Procyclical effects of state-level labor demand on the apprenticeship market align with the international evidence (e.g., Lüthi and Wolter (2020) and Brunello (2009) as discussed above). Together with the decomposition results on college enrollment, these effects suggest that national labor demand shocks cause students at the margin between enrollment at a traditional university and other colleges to enroll at other college, while more localized shocks operate at the margin of college going.

VII. MECHANISMS

VII.A Expectations

i. Data. The Roy model described in Section III presents changes in the expected risk and return to general and more specific human capital as the main mechanism of how economic shocks affect postsecondary education choices. To measure the expected returns to college and apprenticeship degrees as representing general and more specific human capital, respectively, I rely on the *Panel Study of School Leavers with a Higher Education Entrance Qualification* (Daniel et al., 2017) of the German Centre for Higher Education Research and Science Studies (DZHW). The data cover more than 100,000 high school students scheduled to graduate in 2008, 2012, 2015, and 2018 in a given state. Students are surveyed in the calendar year before and half a year after high school graduation on their expected returns to (i) a college degree and (ii) an apprenticeship.¹⁹ To mirror my main analysis and to avoid selective attrition, I focus on expectations as measured in the calendar year before graduation and estimate the following model on the repeated cross-section of high school students scheduled to graduate in year t :

$$Y_{ist} = \beta UR_{s,t-1} + \psi' X_i + \phi' (UR_{s,t-1} \cdot X_i) + \alpha_s + h_s(t) + \gamma' Z_{st} + \varepsilon_{ist}, \quad (7)$$

where Y_{ist}^e is the standardized value of either type of expectation e (college, vocational education, and relative return) for student i in state s , α_s are state fixed effects, $UR_{s,t-1}$ is

¹⁹ Students are asked (i): “In general, how do you value the job perspectives for graduates with a college degree?” and (ii) “In general, how do you value the job perspectives for graduates with a vocational degree, without a college degree?”, on a five-point Likert scale, with the option to state “do not know.” From these measures, I compute (iii) a proxy for the implicitly expected relative general value of academic vs. vocational education, i.e., the standardized difference between the two. I refer to this measure as “relative return,” even though it does not resemble the returns to college in a stricter sense. The raw measure ranges from -4 (negative returns to college) to 4 (very high returns to college), with a mean of 0.52. I consider students who are uncertain about either option to have a weak preference for the other. If a student values the return on a college degree as good (4) and is uncertain about apprenticeships, the difference would be equal to 1.

the state UR, Z_{st} are policy controls and, X_i is a vector of individual-level controls (GPA, GPA squared, gender, and SES) and all their two-way and three-way interactions. To learn about heterogeneity, some versions additionally interact the state UR with the full set of interacted controls. In contrast to the main analysis, $h_s(t) = \theta_{1s}t + \theta_{2s}t^2$ are simple state-specific quadratic trends without a trend break, as the sample starts in 2008. Standard errors are two-way clustered by state and cohort.

Table VI: State UR effects on implicitly expected returns to college

	Vocational		Academic		Relative Returns	
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Panel A: State-level UR</i>						
State UR (t-1)	0.015 (0.017)	0.021 (0.017)	-0.101** (0.027)	-0.115** (0.031)	-0.084* (0.028)	-0.099** (0.030)
Female	-0.009 (0.028)	0.017 (0.073)	0.161 (0.120)	0.005 (0.215)	0.123 (0.086)	-0.010 (0.118)
Low SES	0.079*** (0.006)	0.105 (0.051)	-0.060** (0.016)	-0.057 (0.040)	-0.104*** (0.009)	-0.123* (0.042)
GPA	-0.009 (0.019)	0.033 (0.016)	0.084*** (0.009)	0.084* (0.032)	0.068** (0.019)	0.035 (0.026)
GPA ²	-0.013** (0.003)	-0.020 (0.015)	-0.002 (0.005)	0.009 (0.020)	0.009* (0.003)	0.022 (0.016)
<i>Panel B: Decomposed UR</i>						
National UR (t-1)	0.036 (0.048)	0.033 (0.049)	-0.151** (0.035)	-0.247** (0.049)	-0.136* (0.053)	-0.203** (0.059)
UR ^Δ (t-1)	-0.022 (0.070)	-0.033 (0.054)	-0.013 (0.042)	-0.017 (0.042)	0.007 (0.073)	-0.001 (0.074)
No. students	103,249		103,249		103,249	
State FE	Yes	Yes	Yes	Yes	Yes	Yes
State-specific trends	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Interactions	No	Yes	No	Yes	No	Yes

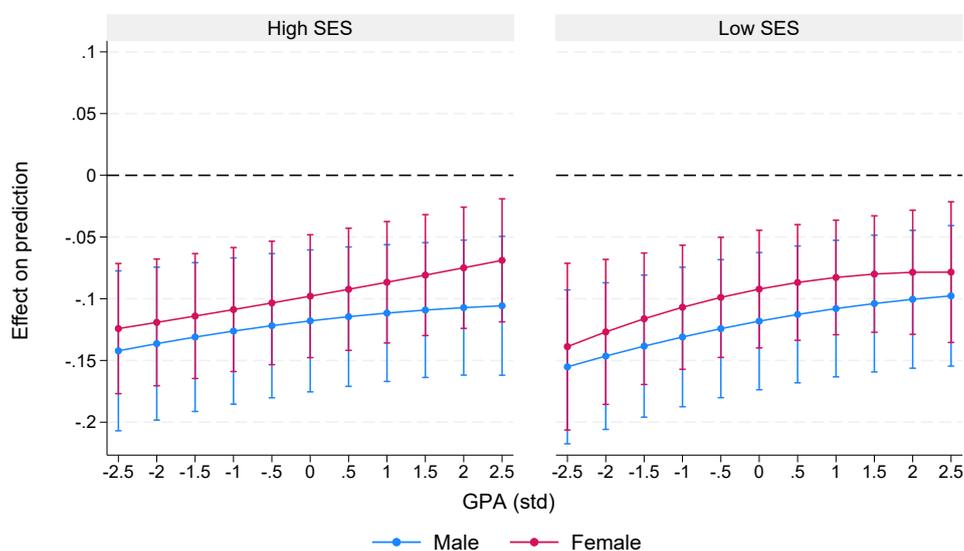
Notes: This table presents estimates from Equation (7) for the effect of the state-level unemployment rate (Panel A) and its components (Panel B) on the standardized value of the expected returns to a vocational degree (apprenticeship), to an academic degree (college), and the implicitly expected relative returns to college, one year before high school graduation. Controls include gender, SES, and the current high school GPA (standardized), as well as its squared value and are reported in Panel A only. Interactions are presented in Figure V. Standard errors in parentheses allow for clustering at the state and cohort level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. *Source:* Federal Employment Agency (BA), and DZHW, years 2008, 2012, 2015, and 2018.

ii. Main results. Table VI presents the effect of the state UR one year before high school graduation on the expected value of a vocational degree, the expected value of an academic degree, and the implicitly expected relative returns to college. Panel A column 1 shows that a 1 pp increase in the state UR has no significant effect on the expected value of a vocational degree. Adding interaction terms, if anything, increases the already positive point estimate, suggesting that most students perceive vocational education as relatively stable over the business cycle. Conversely, the same state UR shock decreases the expected value of an academic degree by around 0.1 SD. As a result, the implicitly expected general returns to college are significantly procyclical and thus likely explain the procyclical pattern in college enrollment. Given that students were asked about college in general, the negative effect for traditional universities is likely

to be even larger, which may explain the relatively smaller enrollment effect for other colleges.

To examine how students form expectations, Panel B repeats the analysis as in [Section VI](#) and includes both the national UR and state-specific deviations. While the effect of state-specific fluctuations is small and insignificant throughout, the effect of the national unemployment rate again follows the same pattern as in Panel A. Conditional on covariates and interactions, a 1 pp increase in the national UR decreases the expected value of a college degree by a quarter of a standard deviation. It decreases the implicitly expected relative returns by 0.2 SD.

Figure V: Marginal state UR effects on implicitly expected returns to college by covariates



Notes: This figure plots the marginal effect of a positive 1 pp deviation of the state UR from its trend one year before high school graduation on the implicitly expected relative return to a college degree. Estimates are based on the fully interacted model presented in [Table VI](#).

Source: Federal Employment Agency (BA), and DZHW, years 2007, 2011, 2014, and 2017.

iii. Heterogeneity. [Figure V](#) plots marginal effects of a state-level labor market shock along the GPA distribution, separately by gender and SES. The effects tend to be greater among male students and among students from low-SES backgrounds (i.e., those without college-educated parents), who also have lower baseline expected returns (see [Table A.1](#)). The effects are decreasing in GPA, suggesting that high-performing students are either better informed about the cyclical nature of vocational outside options or more confident about their labor market outcomes, irrespective of the business cycle. [Figure A.7](#) repeats this exercise separately for the expected value of a college degree and of a vocational degree. Strikingly, low-performing low-SES students even expect a significantly higher return to a vocational degree in the labor market when unemployment is high. This could again imply that they are either less informed about the cyclicity of general vs. specific skills, or are primarily concerned about finding a job after (postsecondary) graduation at all. If this is true, they may place greater value on

the smooth school-to-work transition typically associated with apprenticeships (see, e.g., [Hanushek et al., 2017](#)) or have a higher time preference.²⁰

VII.B Alternative Mechanisms

i. Credit constraints. One alternative mechanism to expectations suggested in the conceptual framework is credit constraints. If downturns reduce parental income, the main financial resource of students in Germany (see [Section II](#)), then credit-constrained students may forgo college. However, using SOEP data, I show that credit constraints play a negligible role. [Table VII](#) Panel A shows that a 1,000 EUR increase in net household income is statistically significantly associated with a 2.9 pp increase in the probability of attending college. Yet, given the mean net household income (about 3,678 EUR; (sd=1,804)), this is a very small estimate.²¹ Thus, Panel B shows that a one percent increase in income is associated with an increase in the probability of attending college of 0.096 percentage points. The effects on vocational training are reversed (-0.070 pp), and the effects on institutional choice are insignificant.

Table VII: Household income and postsecondary education

	Tertiary (1)	Vocational training (2)	Neither or missing (3)	By college type	
				University (4)	Other (5)
<i>Panel A: Net income at graduation</i>					
w_t (in 1,000 EUR)	0.029** (0.010)	-0.019* (0.010)	-0.009* (0.005)	0.019 (0.020)	0.002 (0.012)
<i>Panel B: $\ln(\text{Income})$</i>					
$\ln(w_t)$	0.096*** (0.027)	-0.070** (0.031)	-0.027** (0.010)	0.062 (0.054)	0.014 (0.033)
<i>Panel C: Immediate change</i>					
$\ln(w_t) - \ln(w_{t-1})$	0.046 (0.072)	-0.023 (0.081)	-0.024 (0.056)	0.126 (0.123)	-0.094 (0.091)
<i>Panel D: Deviation from trend</i>					
$\ln(w_t) - \ln(\hat{w}_t)$	0.041 (0.071)	-0.043 (0.086)	0.002 (0.044)	0.028 (0.087)	0.016 (0.043)
Outcome mean	0.61	0.31	0.08	0.55	0.10
No. graduates	1,090	1,090	1,090	957	957

Notes: This table presents estimates from a linear probability model with state fixed effects, as well as state-specific trends including a 2005-trend break and policy, gender, and SES controls for high school graduates with any high school degree, spanning graduation years 1995–2018 in a repeated cross-section. Standard errors in parentheses allow for clustering at the state and year level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Source: SOEP v39, Federal Employment Agency (BA).

After conditioning on gender and SES, there can still be unobserved shocks on the

²⁰ In line with this, [Table A.9](#) shows that economic preferences significantly moderate enrollment for low-SES students. The results are similar but not statistically significant for high-SES students.

²¹ Online Appendix [Table A.10](#) shows effects of the state UR increases on different income measures. A 1 pp increase in the state UR at graduation reduces household income by 3.8 percent (140 EUR).

household level that affect income and the decision to enroll in college. Hence, the estimates do not have a causal interpretation. However, as potential confounding factors, such as health shocks, similarly affect college enrollment and income, the effects are more likely to be downward-biased. Panels C and D use within-household, across-time changes and deviations from each household's predicted income trend before the graduation year as income measures to account for potential shocks around graduation. A 1 pp higher change in income relative to the pre-graduation year is associated with an insignificant 0.046 pp increase in the probability of attending college (Panel C). Similarly, a 1 pp higher deviation in income from the pre-graduation linear prediction has no significant effect on enrollment.

ii. Capacity constraints. Another alternative mechanism for procyclical enrollment is supply-side adjustment, for example, a reduction in the maximum number of students a university would admit to a given program. For the U.S. (Deming and Walters, 2017) show that a 10 percent increase in spending increases enrollment by 3 percent. In Germany, traditional universities are financed through state budgets and multi-year framework agreements that use upper-bound projections of student numbers (Eurydice, 2025). Around 90 percent of university funding comes from public sources, with roughly three-quarters provided by the states and the remainder by the federal government through joint programs such as the Higher Education Pact (*Hochschulpakt*) and its successor, the Contract for the Future of Higher Education and Teaching (*Zukunftsvertrag Studium und Lehre stärken*) (GWK, 2022, HRK, 2025). It is explicitly aimed at maintaining need-based study capacity, and provides dynamically increasing federal co-financing, largely independent of short-run state-level unemployment shocks.

Consistent with this institutional background, there is only a small and statistically insignificant correlation between the state UR and the log total annual spending across college types in the current year (see Table A.11) However, since the expenditure data do not separate teaching from research, the estimates in Table A.11 only have limited information value for any cyclical adjustment on the teaching margin. Overall, this suggests that federal funding arrangements largely stabilize aggregate capacity, and that supply-side restrictions play a secondary role at best. This is consistent with Marcus and Zambre (2019), who find no effects of large double cohort shocks (see Section IV.C) on the number of study programs using any GPA-based admission cutoffs, as a proxy for capacity constraints.

VIII. DISCUSSION

What explains the opposing enrollment patterns between Germany and the U.S.? And how representative is the German case? First and foremost, Germany's apprenticeship system poses a fundamentally different outside option for high school graduates.

While apprenticeships are certainly not acyclical per se, they are relatively less cyclical than direct labor market entry in the U.S. (see, e.g., [Wolter and Ryan, 2011](#), for an overview). Moreover, wages in an increasing number of apprenticeships are bound to collective agreements, and marginal high school graduates who choose an apprenticeship in a recession would often compete with school graduates from lower tracks for remaining positions. Lastly, apprenticeship training in regions with high unemployment is subsidized by the federal and state governments (see, e.g., [OECD, 2025](#), for an overview). As a result, Germany may be comparable to other countries with an established dual education system, such as Switzerland, Austria, and Denmark.²²

[Figure A.8](#) shows that Germany may also be representative of several countries with centrally funded higher education and less cyclical labor markets. One example along these two dimensions is Spain. For Spain, the time series presented in [Albert \(2000\)](#) shows a procyclical pattern for university enrollment. Her regression analysis, however, relies on within-year variation in unemployment across regions and yields a positive effect of unemployment on enrollment. My decomposition helps reconcile this tension: macroeconomic unemployment fluctuations are the main driver of belief changes in my data, whereas more local deviations primarily shift outside options and need not generate the same cyclicalities as aggregate shocks.²³

Another difference between Germany and the U.S. is that enrollment effects may occur at a different margin. In the U.S., effects are concentrated at two-year and weaker at four-year colleges (see e.g., [Charles et al., 2018](#)). Individuals who would have otherwise started or continued employment now enroll for more short-term degrees or retrain to wait out the recession. However, the German higher education system does not offer comparable associate degrees. Instead, more vocational institutions offer formally equivalent bachelor's degrees. Thus, college enrollment in Germany is generally a longer-term commitment, and retraining at college is less common. The de facto study duration of a bachelor's degree in Germany is about four years, but it used to be about six years before the stepwise Bologna reform in the early 2000s ([Bietenbeck et al., 2023](#)). However, retraining alone is unlikely to explain the different results. Like this study, work from the U.S. mostly focuses on first-time enrollment at college-going age (e.g., [Lovenheim, 2011](#), [Charles et al., 2018](#)) and papers that consider retraining generally have similar conclusions (e.g., [Betts and McFarland, 1995](#)).

²² Evidence from Scandinavian countries finds countercyclical enrollment (for Sweden and Denmark, see [Fredriksson, 1997](#), [Sievertsen, 2016](#), respectively).

²³ Different levels of variation in unemployment may also reconcile conflicting findings on an intensive margin. For the U.S., [Blom et al. \(2021\)](#) use detrended state UR and find that recessions reduce enrollment in education majors. In contrast, [Deneault \(2025\)](#) finds the opposite when using CZ-level UR variation conditional on CZ and cohort fixed effects.

IX. CONCLUSION

This paper examines how labor market conditions at high school graduation affect postsecondary skill investments, distinguishing between general academic education and more specific vocational pathways. Using administrative microdata on the universe of students in German higher education, as well as administrative data on the apprenticeship market, I find that higher unemployment at graduation can cause students to shift toward vocationally oriented colleges and apprenticeships.

I embed my analysis in a simple Roy model where students weigh general and specific skill investments based on their expected returns. My empirical analysis shows that high school graduates respond mainly to macroeconomic, rather than local labor market conditions, consistent with the role of salient macroeconomic conditions in shaping expectations. Survey data on subjective expectations shows that for the average student, downturns reduce the expected value of an academic degree, while low-performing male students even expect greater returns to a vocational degree in a recession. I find that capacity and credit constraints only play a negligible role.

My findings contrast with conventional wisdom on countercyclical college-going and demonstrate that downturns can cause a shift to investments in more specific skill investments. The results highlight that students' adjustment to business cycle conditions depends critically on the available outside options. In systems with established vocational pathways, recessions can shift students toward investments in specific skills, while overall college enrollment declines. Countries that wish to adopt elements of the German apprenticeship system should be aware of how these changes affect the responsiveness of human capital investments to economic shocks. Ultimately, my findings highlight the need to clearly distinguish between the effects of macroeconomic and local conditions on human capital investment.

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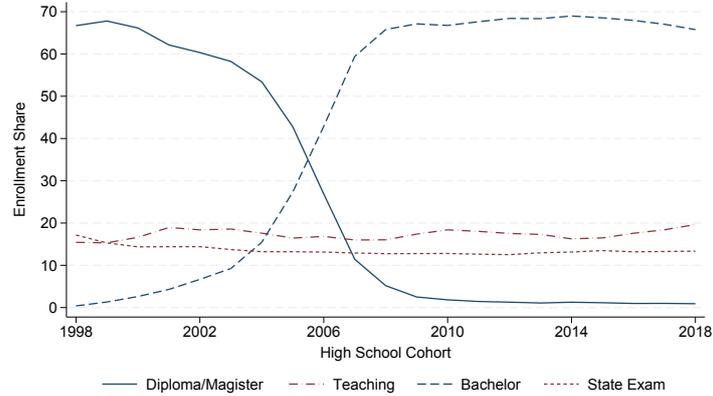
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APPENDIX

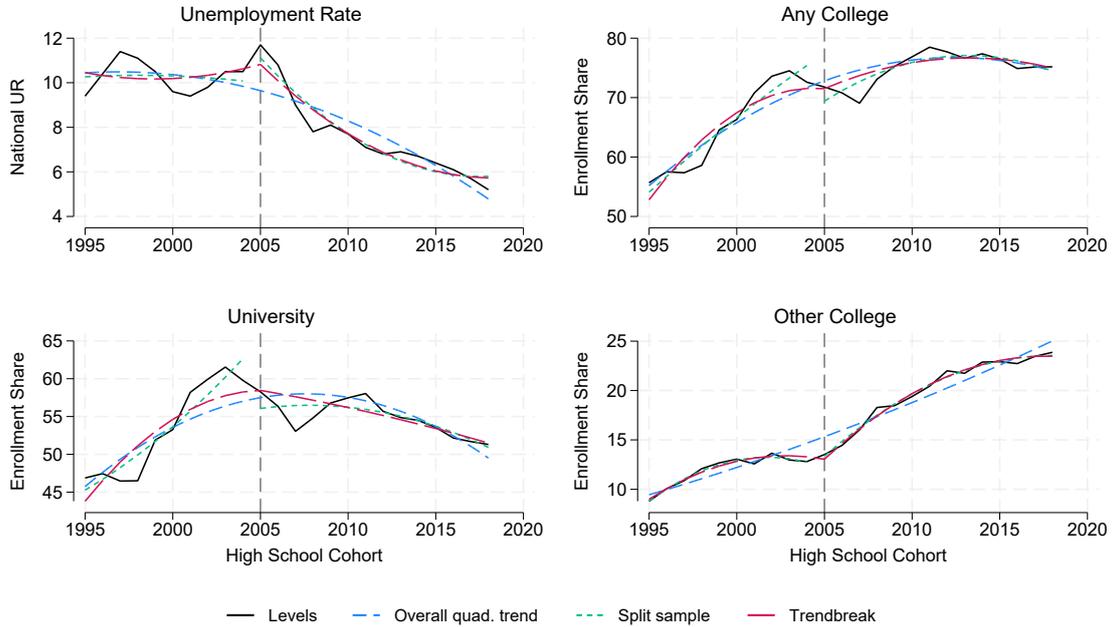
Additional Figures and Tables

Figure A.1: Bologna Reform and degree choice of first-year students



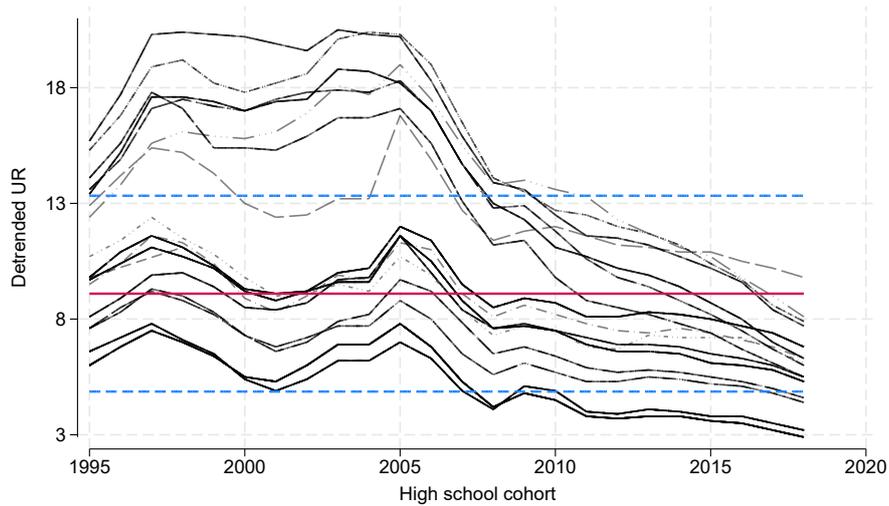
Notes: Share of first-year university students enrolling across degree types.
Source: Federal Statistical Office (Student Register).

Figure A.2: Quadratic fits for enrollment and unemployment

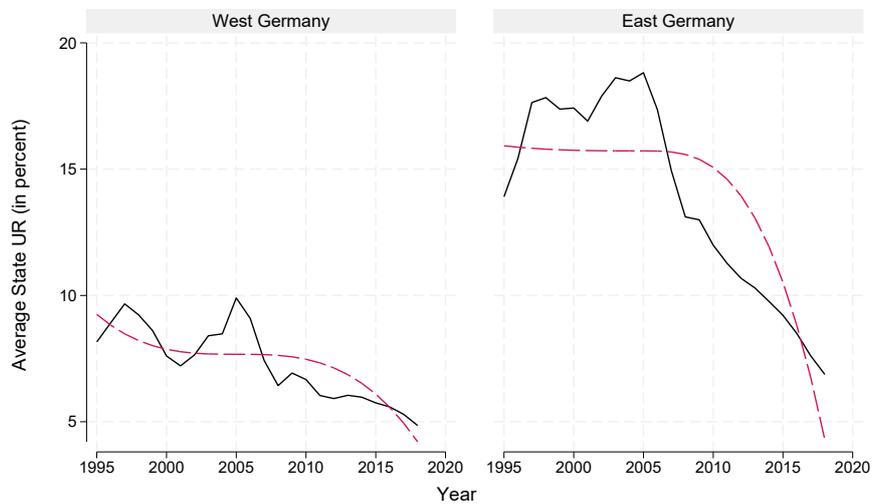


Notes: This table shows time series for each of the four variables: (i) national unemployment rate, average share of high school graduates going to (ii) any college, (iii) university, and (iv) other college. For each variable, the graph also shows fitted values from different quadratic trends: Using the whole sample 1995 to 2018 (blue dashed line), allowing for a slope and a level shift in 2005 (green dotted line), and allowing for only a slope shift in 2005 (red dashed line) as in Equation (5).
Source: Student register, Federal Employment Agency (BA).

Figure A.3: Unemployment rates over time
 Panel A: By state

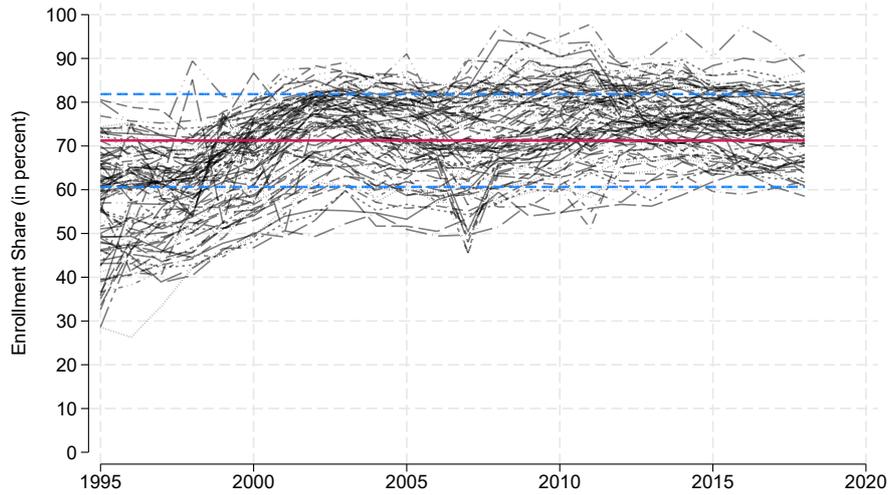


Panel B: Separately for West and East Germany

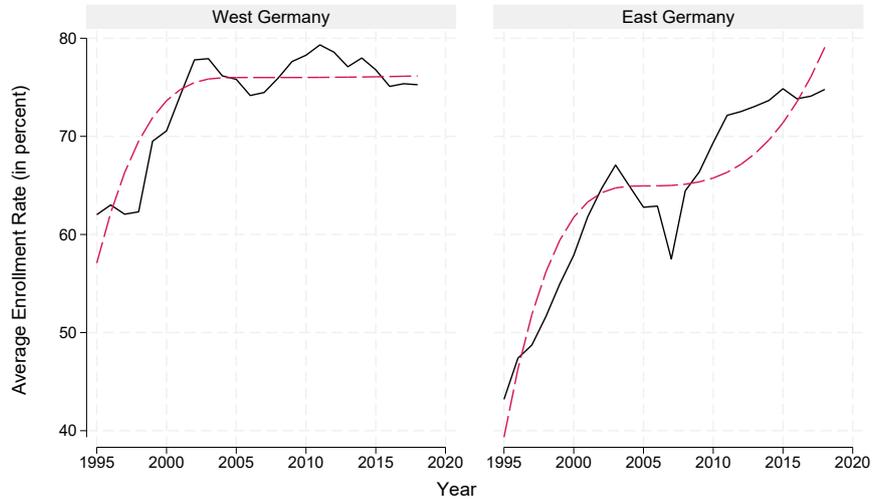


Notes: Panel A plots the unemployment rate for each state over time, as well as the average state UR (in red) and the standard deviation (in blue). Panel B plots the average state UR of West German states and East German states (including Berlin) for each year, as well as the respective quadratic trend (in red), allowing for a trend break in 2005.
 Source: Federal Employment Agency, years 1995–2018.

Figure A.4: Overall college enrollment over time
 Panel A: By commuting zone



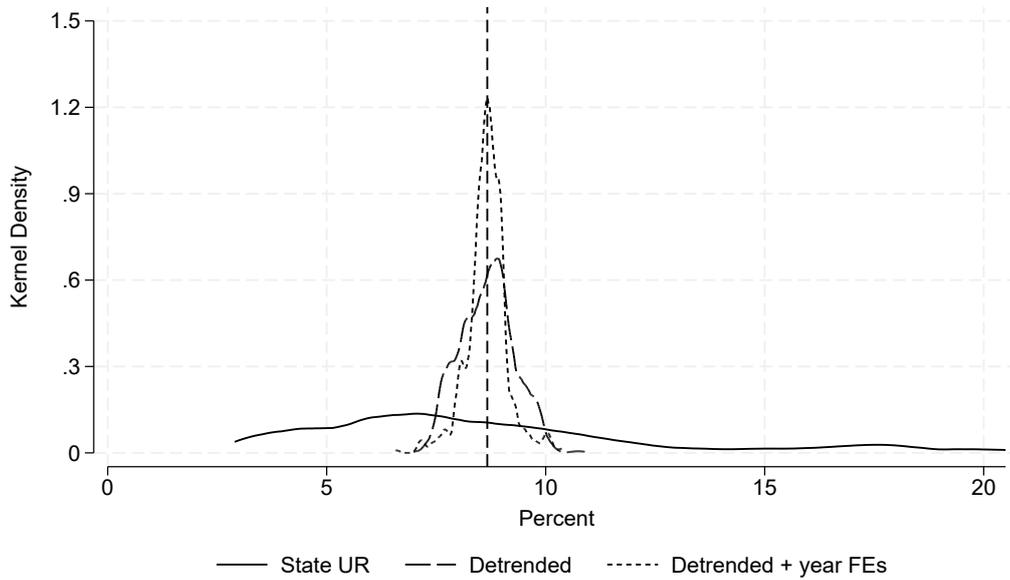
Panel B: Separately for West and East Germany



Notes: Panel A plots the overall enrollment rate of high school graduates with *Abitur* for each state over time, as well as the average enrollment rate (in red) and the standard deviation (in blue). Panel B plots the average enrollment rate for West German states and East German states (including Berlin) for each year, as well as the respective quadratic trend (in red), allowing for a trend break in 2005.

Source: Student register, *Regionaldatenbank*, years 1995–2018.

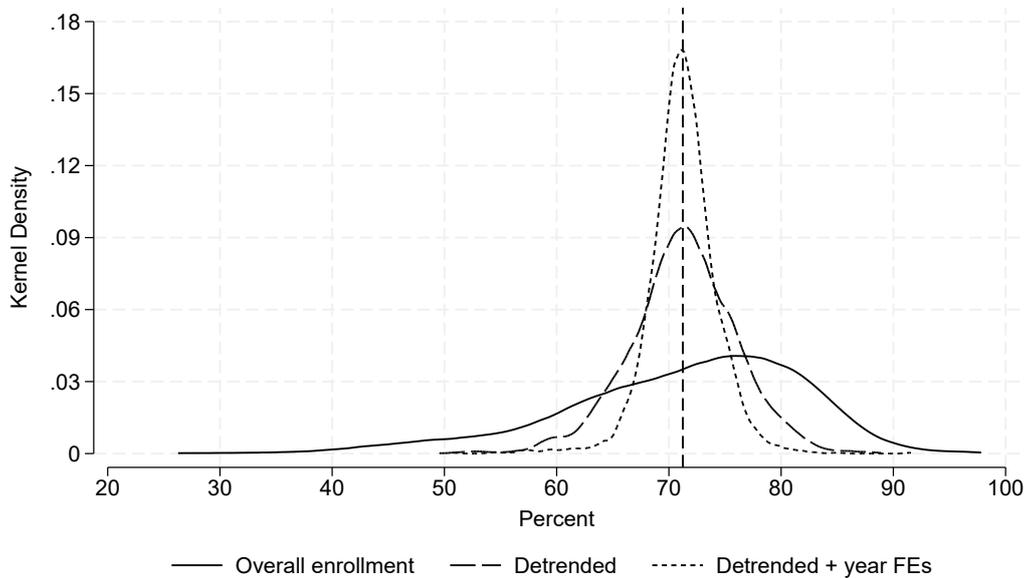
Figure A.5: Distributions of state-level UR



Notes: This figure shows the distribution of the state UR in levels across cells (solid line) and the distribution of residuals after controlling for state fixed effects and state-specific quadratic trends (dashed line), as in the main analysis, and residuals from a regression that additionally controls for year fixed effects (dotted line). The mean unemployment rate is added to the residuals for illustration purposes.

Source: Federal Employment Agency, years 1995–2018.

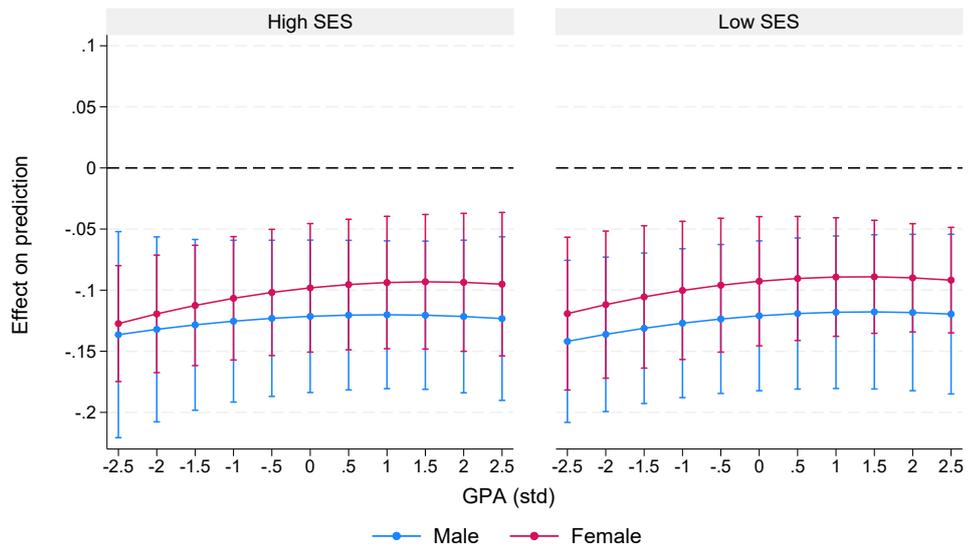
Figure A.6: Distributions of college enrollment share



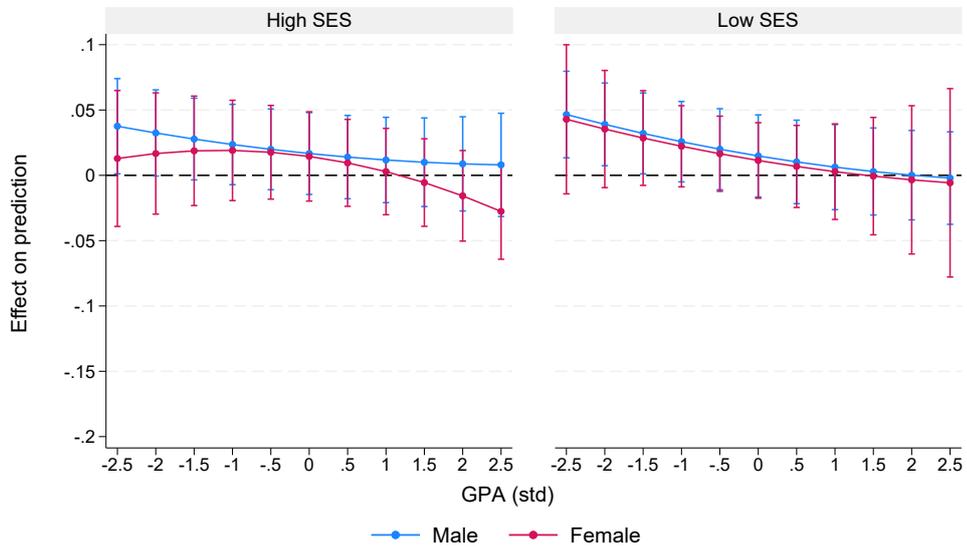
Notes: This figure shows the distribution of enrollment rates of high school graduates with *Abitur* across regions and years (solid line) and the distribution of residuals after controlling for state fixed effects and state-specific quadratic trends (dashed line), as in the main analysis, and residuals from a regression that additionally controls for year fixed effects (dotted line). The mean enrollment rate is added to the residuals for illustration purposes.

Source: Federal Employment Agency, years 1995–2018.

Figure A.7: Marginal state UR effects on expectations by covariates (separate degrees)
 Panel A: Expected value of a college degree

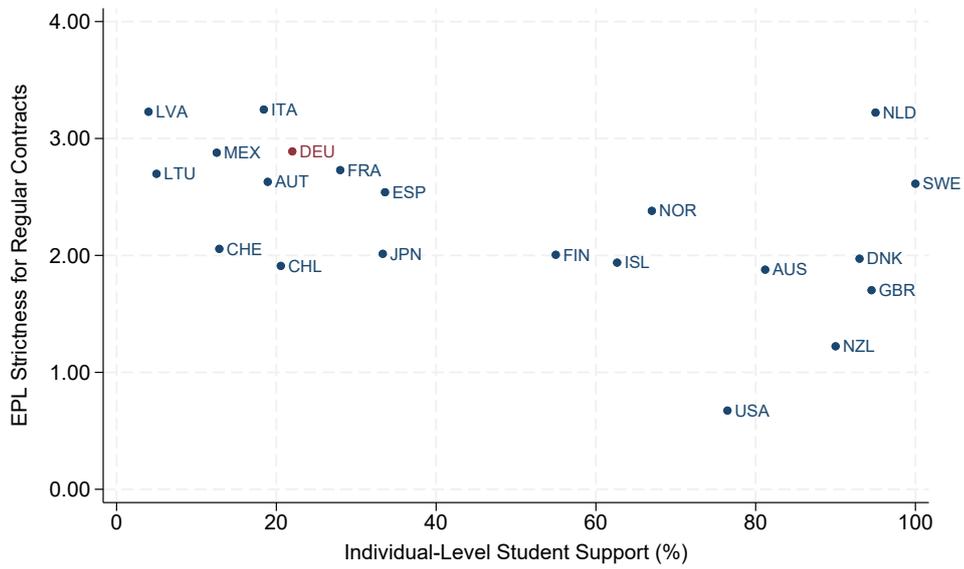


Panel B: Expected value of a vocational degree



Notes: This figure plots the marginal effect of a positive 1 pp deviation of the state UR from its trend one year before high school graduation on the standardized explicitly expected general value of a college degree in (Panel A) and a vocational degree (Panel B). Estimates are based on the fully interacted model presented in Table VI.
 Source: Federal Employment Agency (BA), and DZHW, years 2008, 2012, 2015, and 2018.

Figure A.8: Labor market and higher education institutions in the OECD



Notes: Share of college students benefiting from student loans or grants and the summary indicator for individual and collective dismissal of regular workers (1998-2018 average) as a proxy for labor market cyclicality.

Source: OECD Employment Protection Legislation Database (2020), OECD Education at a Glance (2011, 2022)

Table A.1: Summary statistics

	Mean	SD	min	max	N
Students (1995–2018, regions)					
High School Graduates (<i>Abitur</i>)	4,461	3,453	357	19,182	2,289
Enrollment Share (Any College)	71.36	10.38	26.27	97.82	2,289
Enrollment Share (Traditional University)	54.25	9.15	16.68	78.78	2,289
Enrollment Share (Other College)	17.11	6.07	3.51	41.30	2,289
Detrended Enrollment Rate (Any College)	0.01	4.53	-21.69	17.64	2,289
Detrended Enrollment Rate (Traditional University)	0.35	4.92	-20.01	18.57	2,289
Detrended Enrollment Rate (Other College)	-0.33	2.93	-12.00	11.75	2,289
Unemployment (1995–2018, regions)					
Detrended State UR	0.00	0.61	-1.69	2.22	2,289
State UR	9.00	4.12	2.90	20.50	2,289
National UR	8.75	1.95	5.20	11.70	2,289
CZ-level UR	8.77	4.34	1.95	23.98	2,003
SOEP v39 (1995–2018, individuals)					
Female	0.56	0.50	0.00	1.00	1,851
Low SES	0.69	0.46	0.00	1.00	1,851
Any college	0.61	0.49	0.00	1.00	1,851
Vocational training	0.28	0.45	0.00	1.00	1,851
University	0.57	0.50	0.00	1.00	1,567
Other college	0.10	0.30	0.00	1.00	1,567
Household Income (EUR)	3,678	1,804	614	10,000	1,447
DZHW (2008–2018, individuals)					
Female	0.49	0.50	0.00	1.00	103,249
Low SES	0.48	0.50	0.00	1.00	103,249
GPA	2.42	0.59	0.70	6.00	103,249
Expected Returns	0.52	1.05	-4.00	4.00	103,249
Academic Expectations	3.90	0.75	1.00	5.00	103,249
Vocational Expectations	3.38	0.81	1.00	5.00	103,249

Notes: This table shows summary statistics for the main data sources used in the analysis. GPA: In the German grading system, the best grade is effectively a 0.7, and the worst is a 6.0. In the empirical analysis, I multiply the current GPA by -1 to ease interpretation (higher = better). In this table, “above median GPA” also means better GPA.

Source: Student register, Federal Employment Agency, SOEP v39, DZHW, *Regionaldatenbank*.

Table A.2: Structural break estimation and tests

	Estimated break		H_0 : No Break H_1 : Break in 2005	
	Year (1)	95% CI (2)	F-statistic (3)	p-value (4)
<i>Panel A: Quadratic trend (levels)</i>				
State UR	2006	[2005, 2007]	152.57	0.00
Any college	2003	[2002, 2004]	28.53	0.00
University	2003	[2002, 2004]	62.06	0.00
Other college	2006	[2005, 2007]	140.35	0.00
<i>Panel B: State UR coefficients</i>				
Any college	2006	[2005, 2007]	102.96	0.00
University	2006	[2005, 2007]	158.08	0.00
Other college	2007	[2002, 2012]	10.73	0.00

Notes: Panel A reports estimated break dates and tests for a structural break at 2005. Panel B uses detrended series (state FE and state-specific quadratic trends with a trend break at 2005) and estimates a break in the UR-enrollment relationship. All estimates and tests based on $N=2,289$ cells and implemented via `xtbreak` for `paneldata`, based on [Ditzen et al. \(2025a,b\)](#). * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Source: Student register, Federal Employment Agency, *Regionaldatenbank*.

Table A.3: Enrollment effects in the Socio-economic Panel

	By gender			By SES	
	Main (1)	Female (2)	Male (3)	High (4)	Low (5)
<i>Panel A: Any college</i>					
State UR (t-1)	-0.034 (0.021)	-0.038 (0.026)	-0.041 (0.026)	-0.025 (0.054)	-0.044* (0.023)
Outcome mean	0.61	0.59	0.64	0.74	0.56
No. graduates	1,851	1,035	816	571	1,280
<i>Panel B: Vocational training</i>					
State UR (t-1)	0.029** (0.013)	0.043* (0.022)	0.025 (0.022)	0.045 (0.033)	0.026 (0.020)
Outcome mean	0.28	0.31	0.25	0.15	0.34
No. graduates	1,851	1,035	816	571	1,280
<i>Panel C: Neither or missing</i>					
State UR (t-1)	0.005 (0.013)	-0.005 (0.010)	0.016 (0.021)	-0.020 (0.021)	0.018 (0.013)
Outcome mean	0.10	0.10	0.11	0.11	0.10
No. graduates	1,851	1,035	816	571	1,280
<i>Panel D: University</i>					
State UR (t-1)	-0.024 (0.021)	-0.049* (0.026)	-0.003 (0.035)	-0.029 (0.037)	-0.031 (0.026)
Outcome mean	0.57	0.54	0.60	0.73	0.50
No. graduates	1,567	883	684	461	1,106
<i>Panel E: Other college</i>					
State UR (t-1)	-0.006 (0.010)	0.006 (0.012)	-0.027 (0.025)	-0.017 (0.014)	-0.003 (0.011)
Outcome mean	0.10	0.09	0.11	0.09	0.10
No. graduates	1,567	883	684	461	1,106

Notes: This table presents estimates from a linear probability model with state fixed effects, as well as state-specific trends including a 2005-trend break and policy controls, for high school graduates with any high school degree, spanning graduation years 1995–2018 in a repeated cross-section. Panels A-C focus on all high school graduates. Panels D-E focus on high school graduates for whom enrollment information by institution is available. Standard errors in parentheses allow for clustering at the state and cohort level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Source: SOEP v39, Federal Employment Agency (BA).

Table A.4: Robustness towards different leads, lags, and moving averages

	Overall	University	Other college
	(1)	(2)	(3)
<i>Panel A: Two years to graduation</i>			
State UR (t-2)	-1.601*** (0.262)	-1.739*** (0.218)	0.138 (0.154)
<i>Panel B: 2-year moving average</i>			
State UR (t, t-1)	-2.287*** (0.458)	-2.168*** (0.530)	-0.119 (0.099)
<i>Panel C: 3-year moving average</i>			
State UR (t, t-1, t-2)	-3.354*** (0.442)	-3.378*** (0.413)	0.024 (0.154)
<i>Panel D: One year after graduation</i>			
State UR (t+1)	1.004 (0.643)	1.083* (0.600)	-0.080 (0.097)
Outcome mean	71.2	54.2	17.0
No. region-cohort cells	2,289	2,289	2,289
No. high school graduates	6,296,662	6,296,662	6,296,662

Notes: This table presents estimates from Equation (4) for the share of high school graduates with *Abitur* enrolling in different college types, spanning high school cohorts 1995–2018, but using different UR measures in each Panel. Panel A uses the state UR two years before high school graduation, Panel B uses the two-year moving average in the respective graduation and senior year, Panel C additionally averages over the second year before graduation, and Panel D uses the lead UR one year after high school graduation. Standard errors in parentheses allow for two-way clustering at the state and cohort level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Source: Student register, Federal Employment Agency, *Regionaldatenbank*.

Table A.5: Robustness towards alternative trend breaks

	Overall		University		Other college	
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Panel A: trend break in 2004</i>						
State UR (t-1)	-2.120*** (0.365)		-2.010*** (0.383)		-0.110 (0.089)	
... × pre 2008		-2.262*** (0.414)		-2.236*** (0.379)		0.009 (0.106)
... × post 2008		-2.416*** (0.560)		-2.480*** (0.490)		0.111 (0.168)
p-value (β_Δ)		[0.511]		[0.271]		[0.141]
<i>Panel B: trend break in 2006</i>						
State UR (t-1)	-2.102*** (0.378)		-2.047*** (0.373)		-0.055 (0.063)	
... × pre 2008		-2.243*** (0.416)		-2.249*** (0.363)		0.052 (0.095)
... × post 2008		-2.416*** (0.556)		-2.498*** (0.475)		0.142 (0.159)
p-value (β_Δ)		[0.466]		[0.294]		[0.195]
Outcome mean	71.2	71.2	54.2	54.2	17.0	17.0
No. region-cohort cells	2,289	2,289	2,289	2,289	2,289	2,289
No. high school graduates	6,296,662	6,296,662	6,296,662	6,296,662	6,296,662	6,296,662

Notes: This table presents estimates from Equation (4) for the share of high school graduates with *Abitur* enrolling in different college types, spanning high school cohorts 1995–2018, but using different trend breaks in $g_s(t)$. Panel A uses a trend break in 2004, and Panel B in 2006. Standard errors in parentheses allow for two-way clustering at the state and cohort level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Source: Student register, Federal Employment Agency, *Regionaldatenbank*.

Table A.6: Robustness towards different trends

	Overall		University		Other college	
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Panel A: Linear trends, trend break in 2005</i>						
State UR (t-1)	-1.473** (0.542)		-1.310** (0.503)		-0.163 (0.184)	
... × pre 2008		-1.605** (0.624)		-1.734*** (0.491)		0.128 (0.179)
... × post 2008		-1.698** (0.764)		-2.033*** (0.599)		0.338 (0.218)
p-value (β_{Δ})		[0.669]		[0.110]		[0.007]
<i>Panel B: Quadratic trends, no trend break</i>						
State UR (t-1)	-1.100** (0.466)		-0.706 (0.488)		-0.394** (0.172)	
... × pre 2008		-1.799*** (0.487)		-1.739*** (0.417)		-0.053 (0.188)
... × post 2008		-2.216*** (0.619)		-2.355*** (0.524)		0.149 (0.253)
p-value (β_{Δ})		[0.050]		[0.004]		[0.034]
Outcome mean	71.2	71.2	54.2	54.2	17.0	17.0
No. region-cohort cells	2,289	2,289	2,289	2,289	2,289	2,289
No. high school graduates	6,296,662	6,296,662	6,296,662	6,296,662	6,296,662	6,296,662

Notes: This table presents estimates from Equation (4) for the share of high school graduates with *Abitur* enrolling in different college types, spanning high school cohorts 1995–2018, but using different trend fits $g_s(t)$. Panel A employs a trend break in 2005 but linear trends on both sides. Panel B uses quadratic trends but includes no trend break. Standard errors in parentheses allow for two-way clustering at the state and cohort level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Source: Student register, Federal Employment Agency, *Regionaldatenbank*.

Table A.7: Upstream effects on the number of high school graduates

	log(total graduates)		log(male graduates)		log(female graduates)	
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Panel A: Graduation year assuming G9</i>						
State UR (t-3)	0.027** (0.012)		0.029** (0.013)		0.029** (0.013)	
... × pre 2008		0.032** (0.014)		0.029* (0.014)		0.022 (0.021)
... × post 2008		0.028** (0.012)		0.029** (0.013)		0.018 (0.019)
p-value (β_{Δ})		0.522		0.993		0.580
Outcome mean (in levels)	2,769	2,769	1,194	1,194	1,539	1,539
No. region-cohort cells	2,193	2,193	2,193	2,193	2,193	2,193
<i>Panel B: Graduation year assuming G8</i>						
State UR (t-2)	0.026** (0.009)		0.027*** (0.009)		0.026** (0.010)	
... × pre 2008		0.026** (0.010)		0.026** (0.010)		0.024* (0.013)
... × post 2008		0.029** (0.011)		0.032** (0.011)		0.026* (0.015)
p-value (β_{Δ})		0.549		0.156		0.532
Outcome mean (in levels)	2,751	2,751	11,85	1,185	1,528	1,528
No. region-cohort cells	2,289	2,289	2,289	2,289	2,289	2,289
<i>Panel C: Senior year</i>						
State UR (t-1)	0.012 (0.008)		0.012 (0.008)		0.009 (0.009)	
... × pre 2008		0.016* (0.009)		0.019** (0.007)		0.010 (0.012)
... × post 2008		0.022 (0.014)		0.030** (0.011)		0.014 (0.020)
p-value (β_{Δ})		0.514		0.214		0.699
Outcome mean (in levels)	2,751	2,751	11,85	1,185	1,528	1,528
No. region-cohort cells	2,289	2,289	2,289	2,289	2,289	2,289
<i>Panel D: Graduation year</i>						
State UR (t)	-0.010 (0.009)		-0.009 (0.011)		-0.014 (0.009)	
... × pre 2008		-0.009 (0.009)		-0.005 (0.010)		-0.018* (0.010)
... × post 2008		-0.008 (0.016)		0.001 (0.018)		-0.022 (0.014)
p-value (β_{Δ})		0.904		0.562		0.732
Outcome mean (in levels)	2,751	2,751	11,85	1,185	1,528	1,528
No. region-cohort cells	2,289	2,289	2,289	2,289	2,289	2,289

Notes: This table presents estimates from equation (4) for the number of high school graduates with *Abitur* by gender as outcome, spanning high school cohorts 1996–2018 in Panel A and 1995–2018 in Panels B-D. Policy controls include tuition fee introductions and abolitions, as well as double cohorts. “G9” assumes three years of upper-secondary education. In comparison “G8” assumes two years of upper-secondary education (see Marcus and Zambre, 2019, on enrollment effects the so-called “G8 reform.”) Standard errors in parentheses allow for two-way clustering at the state and cohort level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Source: Student register, Federal Employment Agency, *Regionaldatenbank*.

Table A.8: Enrollment effects of within-CZ variation across institutions

	Overall		University		Other college	
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Panel A: Without year FEs</i>						
CZ-level UR (t-1)	-1.031** (0.444)		-0.734 (0.481)		-0.297** (0.138)	
... × pre 2008		-1.021* (0.531)		-0.789 (0.486)		-0.144* (0.074)
... × post 2008		-1.015 (0.702)		-0.822 (0.633)		-0.088 (0.105)
p-value (β_{Δ})		[0.982]		[0.897]		[0.396]
<i>Panel B: Including year FEs</i>						
CZ-level UR (t-1)	0.111 (0.413)		0.214 (0.334)		-0.103 (0.199)	
... × pre 2008		0.111 (0.397)		0.211 (0.323)		-0.146 (0.167)
... × post 2008		0.101 (0.526)		0.335 (0.381)		-0.257 (0.193)
p-value (β_{Δ})		[0.967]		[0.415]		[0.466]
Outcome mean	73.7	73.7	55.4	55.4	18.3	18.3
No. CZ-cohort cells	1,907	1,907	1,907	1,907	1,907	1,907
No. high school graduates	5,366,608	5,366,608	5,366,608	5,366,608	5,366,608	5,366,608

Notes: This table presents estimates from Equation (4), but using CZ-level unemployment rates, for the share of high school graduates with *Abitur* enrolling in different college types, spanning high school cohorts 1999–2018. Policy controls include tuition fee introductions and abolitions, as well as double cohorts. Panel B additionally includes cohort fixed effects. Each cell is weighted by the number of high school graduates with *Abitur*. Standard errors in parentheses allow for two-way clustering at the state and cohort level in Panel A and at the state level in Panel B. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Source: Student register, Federal Employment Agency, *Regionaldatenbank*.

Table A.9: Enrollment effects and economic preferences by SES

	University		Other college		Apprenticeship	
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Panel A: All graduates (N = 1,029)</i>						
State UR (t-1)	-0.048** (0.021)	-0.051** (0.022)	0.011 (0.016)	0.013 (0.016)	0.036* (0.019)	0.038* (0.020)
... × Patience		0.008** (0.003)		-0.002 (0.002)		-0.006* (0.003)
... × Risk-taking		-0.010** (0.004)		0.005 (0.003)		0.004* (0.002)
Outcome mean		[0.58]		[0.10]		[0.32]
<i>Panel B: Low SES (N = 710)</i>						
State UR (t-1)	-0.047* (0.023)	-0.052* (0.024)	0.020 (0.019)	0.021 (0.020)	0.027 (0.024)	0.031 (0.025)
... × Patience		0.009** (0.004)		-0.001 (0.002)		-0.008* (0.004)
... × Risk-taking		-0.009** (0.004)		0.005 (0.003)		0.005 (0.004)
Outcome mean		[0.50]		[0.10]		[0.39]
<i>Panel C: High SES (N = 317)</i>						
State UR (t-1)	-0.029 (0.045)	-0.038 (0.052)	-0.028** (0.011)	-0.020 (0.015)	0.057 (0.041)	0.058 (0.043)
... × Patience		0.008 (0.008)		-0.003 (0.003)		-0.005 (0.006)
... × Risk-taking		-0.006 (0.010)		0.006 (0.005)		-0.000 (0.006)
Outcome mean		[0.76]		[0.08]		[0.16]

Notes: This table presents estimates from a linear probability model on the individual level with state fixed effects, and state-specific trends, including a 2005-trend break, for the enrollment probability of high school graduates with *Abitur* to enroll at university, other college, or to start an apprenticeship. Graduation years 1995–2018. All specifications control for economic preferences and gender. Standard errors in parentheses allow for clustering at the state and cohort level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. *Source:* SOEP v39, Federal Employment Agency (BA).

Table A.10: State UR and household income (w_t)

	w_t	$\ln(w_t)$	$\ln(w_t) - \ln(w_{t-1})$	$\ln(w_t) - \ln(\hat{w}_t)$
	(1)	(2)	(3)	(4)
<i>Panel A. All graduates</i>				
State UR (t-1)	-0.038 (0.068)	-0.005 (0.022)	-0.001 (0.007)	-0.011 (0.015)
Outcome mean	3.68	8.09	0.02	-0.04
No. graduates	1,447	1,447	1,369	1,107
<i>Panel B. High SES</i>				
State UR (t-1)	0.222* (0.113)	0.079** (0.032)	0.004 (0.027)	0.013 (0.039)
Outcome mean	4.59	8.32	-0.00	-0.04
No. graduates	447	447	416	317
<i>Panel C. Low SES</i>				
State UR (t-1)	-0.114 (0.067)	-0.034 (0.023)	-0.004 (0.007)	-0.011 (0.020)
Outcome mean	3.27	7.99	0.03	-0.05
No. graduates	1,000	1,000	953	790

Notes: This table presents estimates from a model with state fixed effects, as well as state-specific trends including a 2005-trend break and policy controls for the effects of the state UR on household income (w_t , in 1,000 EUR) and alternative (change) measures for high school graduates with any high school degree, spanning graduation years 1995–2018 in a repeated cross-section. Standard errors in parentheses allow for clustering at the state and year level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. *Source:* SOEP v39, Federal Employment Agency (BA).

Table A.11: Spending effects across institutions

	Overall	University	Other college
	(1)	(2)	(3)
<i>Panel A: Current unemployment</i>			
State UR (t)	-0.002 (0.013)	-0.003 (0.013)	0.002 (0.014)
<i>Panel B: Lagged unemployment</i>			
State UR (t-1)	-0.012 (0.011)	-0.012 (0.013)	-0.008 (0.011)
Outcome mean (in levels)	6,928	5,223	1,705
No. state-year cells	208	208	208

Notes: This table presents estimates from two sets of regressions of the total real annual spending of universities per state (in Million EUR) on the state UR, years 2006–2018. All specifications include controls for tuition fee introductions and abolitions, as well as double cohorts. All values are deflated to reflect 2020 real values. The analysis excludes spending of university hospitals for two main reasons. First, university hospitals rely on different funding schemes than their associated universities. Second, state-examination degrees in medicine are always oversubscribed and study places allocated via a central clearinghouse (*Stiftung für Hochschulzulassung (SfH)*, until 2010: *Zentralstelle für die Vergabe von Studienplätzen (ZVS)*). Standard errors in parentheses allow for two-way clustering at the state and year level in Panel A and at the state level in Panel B. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. *Source:* Finance statistics of institutions of higher education, *Regionaldatenbank*.