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Results at a glance

We investigate the cyclicality of skill accumulation in Europe, using data from the European Labour Force Survey (ELFS) for 2005-18. Pooling data across all EU-27 countries, and across employed and not employed workers, we estimate that adult learning – which comprises both formal education and training – is acyclical and that training is mildly countercyclical. We show that there is substantial heterogeneity in the cyclicality of adult learning and training both across European countries and by employment status.

Executive summary

This report investigates the cyclicality of skill accumulation in Europe. We use data from the ELFS for 2005-18 and consider both adult learning (which comprises both formal education and training) and training. Pooling data across all EU-27 countries, as well as across employed and not employed workers, we estimate that adult learning is acyclical and training is mildly countercyclical.

Considering that firm-sponsored training is mostly undertaken by employed workers and that firms are likely to encourage training during recessions, these average effects may hide heterogeneities by employment status. We estimate the response of adult learning and training to the business cycle separately for employed and not employed workers. We find that training is countercyclical for the employed and acyclical for the not employed, and that adult learning (which includes training) is acyclical for the former group and procyclical for the latter. Countercyclical training of the employed is consistent with the view of recessions as times of reorganisation. Procyclical learning for the not employed can be explained instead by the presence of credit constraints preventing the investment in formal education when the economy is in dire straits.

We also document the substantial heterogeneity in the cyclicality of adult learning and training across European countries. Although it is difficult to classify this heterogeneity across well-defined areas, procyclical adult learning seems to be more frequent in the countries of Eastern Europe, where financing constraints affecting firms and workers are more likely to appear.

We associate the cyclical behaviour of skills across countries with country-specific variables that characterise the existing differences in product and labour market institutions, as well as in labour policies. We show that in countries where training is countercyclical there is a higher public training expenditure (that can support investment in a downturn), higher union density and employment protection (that restrain the lay-off of redundant workers and therefore increase the incentive to train during recessions), a lower share of financially

constrained firms (that may not be able to afford training during downswings), higher R&D expenditure and lower product market regulation (that push firms to innovate and compete more intensively, also by training more when the opportunity arises, and opportunity costs are lower).

What are the implications of countercyclical training for the European economy? The available evidence suggests that labour productivity typically increases in economic expansions and declines in economic downturns. If training positively affects labour productivity, countercyclical training can contribute to attenuating the procyclical behaviour of productivity. The estimates in this paper suggest that the 4.5% average decline in European GDP per capita observed in the 2009 recession has increased training participation by only 0.17 percentage points and, via this route, labour productivity by 0.003%. This tiny effect, however, conceals the substantial heterogeneity in the sensitivity of training to the business cycle across European countries. When we consider country-specific estimates, the effects on productivity are larger in Portugal (0.04%), Sweden (0.03%) and France (0.03%).

Aperçu des résultats

Nous étudions la cyclicité de l'accumulation de compétences en Europe en utilisant les données issues de l'enquête européenne sur les forces de travail (2005-2018). Il ressort de la collecte de données sur les travailleurs salariés et au chômage dans l'Union des Vingt-sept que l'apprentissage des adultes — qui inclut à la fois l'enseignement formel et la formation — est acyclique et que la formation est légèrement anticyclique. Nous mettons en évidence la grande hétérogénéité de la cyclicité de l'enseignement et de la formation des adultes, aussi bien entre les pays européens qu'en fonction du statut professionnel.

Résumé

Le présent rapport étudie la cyclicité de l'accumulation de compétences en Europe. Nous utilisons les données obtenues dans le cadre de l'enquête européenne sur les forces de travail (2005-2018) et étudions tant l'apprentissage (qui inclut à la fois l'enseignement formel et la formation) que la formation des adultes. Il ressort de la collecte de données sur les travailleurs salariés et au chômage dans l'Union des Vingt-sept que l'apprentissage des adultes est acyclique et que la formation est légèrement anticyclique.

Étant donné que les formations commanditées par les entreprises sont généralement suivies par des travailleurs salariés et que les entreprises sont susceptibles d'encourager la formation en période de récession, ces effets de moyenne pourraient cacher certaines hétérogénéités en fonction du statut professionnel. Nous considérons la contribution de l'apprentissage et de la formation des adultes au cycle économique séparément pour les travailleurs salariés et au chômage. Nous constatons que la formation est anticyclique pour les salariés et acyclique pour les travailleurs au chômage et que l'apprentissage des adultes (qui inclut la formation) est acyclique pour les salariés et procyclique pour les travailleurs au chômage. Le fait que la formation soit anticyclique pour les salariés va de pair avec l'idée que les périodes de récession sont des moments de réorganisation. Le fait que l'apprentissage soit procyclique pour les travailleurs au chômage s'explique plutôt par la présence de contraintes financières, qui empêchent d'investir dans l'enseignement formel lorsque l'économie est en difficulté.

Nous mettons également en évidence la grande hétérogénéité de la cyclicité de l'enseignement et de la formation des adultes dans les pays européens. Bien qu'il soit difficile de classer cette hétérogénéité selon des zones bien définies, l'apprentissage des adultes semble plus fréquemment procyclique dans les pays de l'Europe de l'Est, où les difficultés financières touchant les entreprises et les travailleurs sont plus susceptibles d'apparaître.

Nous associons le comportement cyclique des compétences à travers les pays à des variables nationales spécifiques qui caractérisent les différences existantes dans les institutions des marchés des produits et du travail ainsi que dans les politiques de travail. Nous faisons valoir que les pays où la formation est anticyclique présentent des dépenses publiques en formation plus élevées (qui peuvent soutenir l'investissement en cas de ralentissement), une densité syndicale et une protection de l'emploi plus importantes (qui empêchent le licenciement de travailleurs et incitent par conséquent à la formation en période de récession), une proportion plus faible d'entreprises en difficulté financière (qui peuvent ne pas avoir les moyens de proposer des formations pendant les périodes de ralentissement des activités), des dépenses plus élevées en recherche et développement et une réglementation du marché des produits moins stricte (qui poussent les entreprises à innover et à se faire davantage concurrence, également par le biais de formations lorsque des opportunités se présentent et les coûts d'opportunité sont plus faibles).

Quelles sont les conséquences d'une formation anticyclique pour l'économie européenne ? Les données disponibles suggèrent que la productivité augmente généralement en période d'expansion et diminue en période de ralentissement économique. Si la formation a un effet positif sur la productivité, la formation anticyclique peut contribuer à atténuer le comportement procyclique de la productivité. Selon les estimations reprises dans le présent article, la baisse moyenne de 4,5 % du PIB européen par habitant observée lors de la récession de 2009 n'a augmenté la participation à des formations que de 0,17 point de pourcentage et, par la même, la productivité de 0,003 %. Ce minuscule effet masque toutefois l'hétérogénéité substantielle de la sensibilité de la formation au cycle économique dans les pays de l'Union européenne. Lorsque nous examinons les estimations par pays, les effets sur la productivité sont plus élevés au Portugal (0,04 %), en Suède (0,03 %) et en France (0,03 %).

Die Ergebnisse im Überblick

Wir untersuchen anhand von Daten der europäischen Arbeitskräfteerhebung (ELFS) für den Zeitraum 2005–2018 die Zyklik der Kompetenzakkumulation in Europa. Die

Auswertung von Daten aus allen 27 Mitgliedstaaten und sowohl von aktiven Beschäftigten als auch von inaktiven Personen/Nichterwerbstätigen hat ergeben, dass Erwachsenenbildung – die die formale allgemeine und berufliche Bildung gleichermaßen umfasst – azyklisch und Weiterbildung leicht antizyklisch geprägt ist. Wir konnten zeigen, das bezüglich der Zyklik von Erwachsenenbildung und Weiterbildung sowohl zwischen den europäischen Ländern als auch nach Beschäftigungsstatus große Unterschiede bestehen.

Zusammenfassung

Dieser Bericht widmet sich der Frage der Zyklik der Kompetenzakkumulation in Europa. Wir haben anhand von ELFS-Daten für die Jahre 2005-2018 sowohl die Erwachsenenbildung (formale allgemeine und berufliche Bildung gleichermaßen) als auch den Bereich der Weiterbildung untersucht. Die Auswertung von Daten aus allen 27 Mitgliedstaaten und von aktiven Beschäftigten und inaktiven Personen/Arbeitslosen hat ergeben, dass Erwachsenenbildung azyklisch und Weiterbildung leicht antizyklisch geprägt ist.

Da unternehmensfinanzierte Weiterbildung meist von aktiven Beschäftigten in Anspruch genommen wird und die Unternehmen in Zeiten der Rezession eher die Weiterbildung fördern, könnten entsprechende Durchschnittswerte bestehende Unterschiede nach Beschäftigungsstatus kaschieren. Wir untersuchten die Reaktion der Bereiche Erwachsenenbildung und Weiterbildung auf den Konjunkturzyklus getrennt für aktive Beschäftigte und inaktive Personen/Nichterwerbstätige. Dabei hat sich gezeigt, dass Weiterbildung für Beschäftigte in Arbeitsverhältnissen antizyklisch und für inaktive Personen/Nichterwerbstätige azyklisch ist, und Erwachsenenbildung (die berufliche Bildung einschließt) für die erste Gruppe azyklisch und für die zweite prozyklisch ist. Der antizyklische Charakter der Weiterbildung von aktiven Beschäftigten deckt sich mit der Einschätzung, dass Rezessionsperioden für die Reorganisation genutzt werden. Der prozyklische Charakter der Erwachsenenbildung von Erwerbslosen kann hingegen durch Kreditbeschränkungen erklärt werden, die Investitionen in formale Bildung in wirtschaftlich schwierigen Zeiten verhindern.

Wir stellen auch eine erhebliche Heterogenität bezüglich der Zyklik der Erwachsenenbildung in den europäischen Ländern fest. Es ist zwar schwierig diese Heterogenität geografisch genau einzuordnen, die Erwachsenenbildung scheint aber in den osteuropäischen Ländern, wo finanzielle Engpässe von Unternehmen und Arbeitnehmer*innen wahrscheinlicher sind, häufiger prozyklisch geprägt zu sein.

Wir führen das zyklische Verhalten von Kompetenzen in verschiedenen Ländern auf länderspezifische Faktoren zurück, die die bei den Produkt- und Arbeitsmarkteinrichtungen

sowie in der Arbeitspolitik bestehenden Unterschiede widerspiegeln. Die Untersuchungen haben ergeben, dass Weiterbildung in Ländern mit höheren Ausgaben der öffentlichen Hand für Weiterbildung (die in einer Abschwungphase Investitionen unterstützen können), höherem gewerkschaftlichen Organisationsgrad und besserem Kündigungsschutz (was Entlassungen erschwert und daher den Anreiz für Weiterbildung in Zeiten der Rezession erhöht), einem geringeren Anteil an Unternehmen mit finanziellen Engpässen (die sich während einer Wirtschaftsflaute möglicherweise keine Weiterbildung leisten können), mit höheren FuE-Ausgaben und einer weniger stark ausgeprägten Produktmarktregulierung (die die Unternehmen zu Innovationen und intensiverem Wettbewerb anspornen, auch durch verstärkte Weiterbildung, wenn sich die Gelegenheit bietet und die Opportunitätskosten niedriger sind) prozyklisch geprägt ist.

Was sind die Auswirkungen antizyklisch geprägter Weiterbildung auf die europäische Wirtschaft? Die verfügbaren Daten deuten darauf hin, dass die Arbeitsproduktivität in Zeiten des wirtschaftlichen Aufschwungs typischerweise steigt und in Phasen der Rezession hingegen sinkt. Wenn Weiterbildung sich positiv auf die Arbeitsproduktivität auswirkt, kann antizyklisch betriebene Weiterbildung dazu beitragen, das prozyklische Verhalten der Produktivität abzuschwächen. Die Schätzungen in diesem Papier legen nahe, dass der in der Rezession von 2009 beobachtete durchschnittliche Rückgang des europäischen Pro-Kopf-BIP um 4,5 % mit einer Erhöhung der Weiterbildungsbeteiligung um 0,17 Prozentpunkte und einem dementsprechenden Anstieg der Arbeitsproduktivität um 0,003 % einherging. Dieser minimale Wert verdeckt jedoch die erhebliche Heterogenität in der Sensitivität der Weiterbildung gegenüber dem Konjunkturzyklus in den europäischen Ländern. Bei Betrachtung länderspezifischer Schätzungen fallen die Auswirkungen auf die Produktivität in Portugal (0,04 %), Schweden (0,03 %) und Frankreich (0,03 %) größer aus.

1. Introduction

The 2020 pandemic is having a dramatic impact on GDP per capita, triggering a yearly decline that is expected to be larger than the one experienced in 2009 (about –7.5% in the EU-27 countries). What is the effect of this drastic economic slowdown on training participation? The answer to this question depends on whether training is pro- or countercyclical. If training is countercyclical, an economic downturn triggers additional training. When training affects labour productivity, the reduction in the latter, which is typical of recessions, is attenuated. Procyclical training, however, aggravates the decline of labour productivity.

In this analytical report, we address this question by looking at the relationship between training, adult learning and the business cycle in the EU-27 member states. We start with a review of what the economic literature has to say. We then introduce our data, which cover the quarters from 2005Q1 to 2018Q4, and the empirical model. We present our results both for training (or non-formal learning) and for adult learning, which includes the former as well as formal education.[1]

To preview our results, we find that, when we pool all countries together, adult learning is not sensitive to the business cycle and training is mildly countercyclical. By implication, formal education – or the difference between adult learning and training – is mildly procyclical.

We argue that these average results may hide differences by employment status, for instance because the employed and the not employed behave differently when economic conditions vary. We therefore estimate a model that explicitly allows for differences across these two groups,[2] controlling for the fact that selection into employment is non-random, and find that: a) training is countercyclical for the employed; and b) adult learning is procyclical for the not employed.

Countercyclical training is consistent with the view that firms use recessions as times to reorganise production and equip their labour force with the required skills. Procyclical adult

[1] In the European Labour Force Survey (ELFS), adult learning is defined as education or training received during the previous four weeks. Training is defined instead as attendance of any courses, seminars, conferences, or private lessons or instructions outside the regular education system (hereafter mentioned as taught learning activities) within the last four weeks.

[2] The characteristics of both groups also change with the business cycle, for instance because the young and unskilled are more likely to lose their jobs in a recession.

learning for the not employed is instead consistent with the view that liquidity constraints prevent the latter from investing in a downturn, and this underlines the importance of countercyclical public policies that help the unemployed and inactive to update their skills by participating in adult learning.

Results based on pooled data could hide country differences. When we estimate the relationship between adult learning or training and the business cycle separately by country, we uncover substantial heterogeneity within Europe (EU-27). The impact of the business cycle on adult learning and training is negative in Denmark, Estonia, Spain, Portugal, Greece, Sweden, France, Malta, Luxemburg and the Netherlands, and positive in Bulgaria, Cyprus, Finland, Italy, Poland, Latvia, Lithuania, Ireland, Hungary and Slovenia. In Germany and Slovakia, the business cycle has a positive effect only on training and on adult learning respectively. In Croatia and Romania, it negatively affects adult learning and training. In Austria, Belgium and the Czech Republic, neither adult learning nor training are sensitive to business cycle fluctuations.

We associate this heterogeneity with country differences in structural economic indicators and labour market institutions. We find that countries with countercyclical training have: a) higher public expenditure in training, trade union density, employment protection, R&D expenditure on GDP, and employment rate; and b) lower product market regulation, a smaller share of financially constrained firms and a smaller share of households making ends meet with great difficulty.

The report is organised as follows: Section 1 reviews the economic literature and Section 2 introduces the data. The empirical approach is discussed in Section 3 and the results are shown in Section 4. We first discuss aggregate estimates, which pool the employed and the not employed across all countries; next, we distinguish between effects on the employed and the not employed. Finally, we look at country-specific effects. The Conclusions discuss the implications of our findings for the relationship between the business cycle and productivity.

2. Investment in skills and the business cycle: a review of the literature

In this section, we review the literature that has investigated the effects of business cycle fluctuations on the investment in skills, which consists of two main components: a) formal education; and b) training (non-formal education), both employer-provided and chosen by individuals.

2.1 Education and the business cycle

The key trade-off affecting the decision to invest in education is between the opportunity cost of going to school, which declines in a downturn, and the ability to pay, which is typically lower in a recession. In the absence of borrowing constraints, human capital accumulation should be countercyclical. However, when credit markets are imperfect and individuals or firms are liquidity constrained, investment in adult learning can become procyclical.[3]

Dellas and Sakellaris (2003) examine the patterns of college enrolment in the US and show that it is countercyclical, suggesting that the negative effect of a downturn on the opportunity cost of schooling prevails on liquidity constraints.[4] Similar evidence is presented by King and Sweetman (2002). Evidence for the UK (Clark, 2011) and Ireland (Flannery and O'Donoghue, 2009) also suggests a countercyclical pattern in post-secondary enrolment. Enrolment in higher education appears to be positively associated with unemployment in Sweden, as shown by Fredriksson (1997). Sievertsen (2016) reports that the local unemployment rate has positive effects on post-secondary schooling enrolment in Denmark, both in the short and the long run.

An important reason why young individuals tend to stay on or enrol in school during a downturn is that entering the labour market in a recession can have persistent effects on employment prospects and earnings. Oreopoulos, von Watcher and Heisz (2008), for instance, show that the initial earnings loss is substantial and does not fade until 8 to 10 years after graduation.

2.2 Training and the business cycle

Training benefits firms and workers by impacting on productivity, profits and wages (see for instance Bassanini et al., 2007). It produces the required skills in-house, and therefore

[3] We are assuming that going to school in a recession rather than in a boom does not affect the expected returns from additional schooling.

[4] In North America, post-secondary education has been a safe haven during economic storms over the last 50 years. Aggregate unemployment stimulated post-secondary enrolment (e.g. Méndez & Sepúlveda, 2012) and increased aggregate time spent studying (Aguiar, Hurst, & Karabarbounis, 2013). Enrolment in community colleges has been more responsive to the unemployment rate than university enrolment, possibly due to colleges' open admission policies (Dellas & Sakellaris, 2003). Overall, post-secondary education acted as a buffer and played the role of an automatic stabilizer (Alessandrini, 2018).

saves firms the recruitment costs needed to locate, select and hire these skills (Stevens, 1994). Training costs consist of the salaries paid to workers undergoing training, net of their contribution to output during training. Additional costs include the pay of trainers, or their foregone production when these are senior workers who need to take time off production to train.

Both benefits and costs are affected by the business cycle. Consider the training episodes initiated by firms. A business downswing reduces productivity as output shrinks faster than employment. Since foregone production associated with training also declines, recessions are times for reorganisation and for the production of organisational capital (Hall, 1991). One facet of reorganisation is training; firms typically hoard temporarily idle employees in a downswing and train them in the expectation that their productivity will be higher when the economy picks up again.

Reorganisation produces countercyclical training. Two other effects, however, push in the opposite direction. First, since unemployment rises in a downswing, the cost of recruiting skilled labour declines, which might induce some firms to hire the required skills rather than train unskilled workers. Second, in a business downswing profits decline and firms (especially those that are financially constrained) may be forced to cut or delay some expenses, including training. Because of these contrasting effects, it is difficult to establish a priori whether firm–provided training is countercyclical or procyclical.

Next, consider the training episodes initiated by individuals. During recessions individuals typically redirect their activities away from production and towards leisure, home production and the production of human capital. By doing so, they take advantage of the lower foregone costs of production. If training requires resources, however, this shift into training activities could be hampered by the presence of liquidity constraints, which are typically stronger during a recession. As in the case of firm–provided training, it cannot be established a priori whether this type of training is procyclical or countercyclical.

There is a small empirical literature discussing the relationship between training and the business cycle, with mixed results. Sepúlveda (2004) develops a real business-cycle model with employment adjustment costs, labour hoarding and countercyclical training activities. In a downturn, the foregone production cost of training declines, labour is retained because of the presence of adjustment costs and training occurs, much in the spirit of Hall's model of organisational capital.

Sepúlveda uses data from the 1979 US National Longitudinal Survey of Youth (NLSY) to construct a panel of individuals aged 14 to 22, which he follows until 1998. He focuses on the incidence and intensity of off-the-job and on-the-job training, measured in hours and

net of apprenticeships, and reports that they are weakly countercyclical, lead the cycle and are highly volatile, with a standard deviation of more than 10 times that of output.

Majmudar (2007) also uses NLSY data for 1979 to 1988 but finds that the probability of receiving company training decreases when the local unemployment rate increases, which points to procyclical training. This negative association, however, is only statistically significant for workers who have joined the firm since the last wave. Majmudar motivates his results as the outcome of two countervailing effects, with the latter dominating the former. On the one hand, labour market opportunities for trained workers are fewer in a downturn, which reduces their bargaining power with the firm and increases the employer's incentive to train. On the other hand, there are many alternatives to training in a slack labour market, which induce firms to hire rather than train.

Bassanini and Brunello (2008) study the relationship between product market regulation and workplace training, using data for 15 European countries and 8 years, drawn from the ELFS. They find that their measure of training incidence – the proportion of employed individuals who received training in the four weeks before the reference week – is negatively correlated with their measure of the business cycle, the logarithm of worked hours filtered from trend using the Hodrick–Prescott filter,[5] in line with Sepúlveda's findings for the US.

Felstead and Green (1996) report instead that training was procyclical in Britain during the 1970s, 1980s, and 1990s. Felstead et al. (2012) examine the impact of the 2008–09 recession on training activity in the UK. Using data from the National Employer Skills Survey 2009, they show that cuts in training expenditures were not as severe as feared. Although a minority of employers did cut expenditure and coverage as a result of the recession, most reported no significant change, and some had even increased their commitment. Training expenditure in real terms fell by only 5% between 2007 and 2009.

In his review of the literature focusing on apprenticeships, Brunello (2009) concludes that the ratio of apprentices to employees tends to be (mildly) procyclical and to decline during a recession, with the notable exception of the Great Depression, when it rose (at least in England). Recent evidence from Switzerland confirms this assessment (Luthi and Wolter, 2020). When broader measures of training are considered, which exclude apprentices, the weight of the evidence is in favour of countercyclical training incidence.

[5] The Hodrick–Prescott filter or decomposition is a procedure that decomposes a time series into its trend and business cycle components.

Using German data on apprenticeships from 2007 to 2019 and information on business cycle expectations up to June 2020, Muehlemann et al. (2020) estimate that the coronavirus-related decrease in firms' expectations about the business cycle is associated with a predicted 8% decrease in firm demand for apprentices and a 6% decrease in the number of new apprenticeship positions in Germany, compared with 2019.

Méndez and Sepúlveda (2012) argue that, in the US, while aggregate schooling exhibits a countercyclical pattern, the case for countercyclical training is weak at the *aggregate* level. However, when training episodes are decomposed into independent categories, they highlight two key distinctions: a) between firm-financed training, which tends to be strongly procyclical, and training financed by the individual, which tends to be countercyclical (see also Alessandrini et al., 2015); and b) between employed and unemployed individuals. Training seems much more procyclical for the former than for the latter.

Di Pietro et al. (2020) examine the impact of the business cycle on participation in adult learning in the EU-27, using aggregate country-level data for 2005–19 drawn from the quarterly ELFS. They find that the share of individuals involved in adult learning (both formal and informal) tends to correlate positively with the employment rate, and that the procyclicality of adult learning is more pronounced in Eastern and Western countries than in the rest of Europe.

3. The data

We investigate the relationship between adult learning, training and the business cycle using the ELFS. The ELFS is a household survey which contains information on: a) training, defined as attendance within the last four weeks at courses, seminars, conferences, or private lessons or instructions outside the regular education system; and b) adult learning, which combines training and regular education.

We recognise that household surveys are not the ideal source of data to investigate the effects of the business cycle on employer-provided training, about which firms are likely to have better information than employees. Barron et al. (1997) use data from a matched employer–employee survey dataset to see to what extent employer and employee responses are consistent. They find that the correlation between worker and employer measures is less than 0.5 and that employers report 25% more hours of training on average than workers do.

There are only two surveys that measure employer-provided training by asking firms. Eurostat's Continuous Vocational Training Survey (CVTS) is an employer survey that collects annual information on the training activities of European firms. However, only

three waves of data have been collected so far (in 2005, 2010 and 2015). As a result, there is too little within-country variation in the cyclical indicator for us to retrieve meaningful estimates of cyclical effects. Similar considerations apply to the European Investment Bank Investment Survey (EIBIS), which has been collecting information on training investment by firms since 2015. Again, the period 2015–19 is too short for us to retrieve reliable estimates of the impact of the business cycle on employer-provided training.

Although ELFS data is available from the 1980s, we use only quarterly data from 2005 up to 2018. This is to account for the substantial change in the survey in the late 1990s and early 2000s following the transition from the spring version (only one quarter per year) to a continuous quarterly survey, with the reference week spread uniformly across the year. This transition occurred in 2003 in France, 2004 in Italy and 2005 in Germany. Since we are interested in adult education, we consider only individuals aged 25-64 years and exclude from the sample those who are still in full-time education. Our final estimation sample spans 14 years and 27 countries and counts over 43 million observations.

Descriptive statistics for our final sample are reported in Table 1. Overall, 9.3% of individuals report participation in formal or non-formal adult learning, while 6.6% report participation in training during the four weeks before the interview. Participation in both adult learning and training is much higher for the employed (10.2% and 7.9%) than for the not employed (7.1% and 3.4%). As reported in Figures 1 and 2, there is substantial heterogeneity by country, with Eastern European countries showing very low participation (0-3%) and Nordic countries a much higher one (in some countries above 25%). The average age of individuals in our sample is close to 45 years, 49% of individuals are males, 25% have a tertiary education degree and 70% are employed.

4. Our empirical approach

4.1 The Hodrick–Prescott decomposition

We measure the business cycle using quarterly country-level data for the log of real GDP per capita and the employment/population ratio (source: Eurostat). Quarterly macroeconomic data can be typically decomposed into: a) a trend component; b) a cyclical component; c) seasonal effects; and d) residual noise. For both the real GDP per capita and the employment rate, the trend is the outcome of medium- to long-term economic growth and of technical progress, and the cycle consists of short- to medium-term deviations from the trend.

We decompose the evolution of the two macroeconomic indicators into a trend and a cyclical component - separately for each country - using the Hodrick–Prescott filter (see Hodrick and Prescott, 1997). Following Ravn and Uhlig (2002) we set the smoothing parameter for quarterly data to 1600. We illustrate our procedure with the trend-cycle decomposition of the quarterly series of the logarithm of real GDP per capita in Austria. Figure 3 reports the scatterplot of the raw data (dots) and the estimated trend obtained using the Hodrick–Prescott filter (the continuous line).

It is tempting to obtain the cyclical component of real GDP simply as the difference between each dot and the line. However, Figure 3 shows that these differences have a clear seasonal component. To avoid this problem, we apply the filter not to the raw data but to the residuals of a regression of each macroeconomic indicator on quarter dummies – separately by country. Figure 4 illustrates the results of the trend-cycle decomposition on seasonally adjusted log real GDP per capita for Austria, with the dots showing the adjusted data, and the line-reporting trend GDP. The 2009 global recession is now clearly visible, as well as the economic expansions preceding and following it.

Participation in adult learning and training also includes a stark seasonal component – see Figures 5 and 6 for Austria – as its level drops by about 50% during the summer quarter of each year. Therefore, we adjust participation for seasonality as discussed above.

4.2 The empirical specification

We investigate the relationship between adult learning and training and the business cycle using individual data and estimating the following regression model:

$$\mathrm{T}_{\mathrm{ict}} = \sum_c \alpha_c D_c + \beta_1 \mathrm{CYCLE}_{\mathrm{ct}} + \sum_c \beta_{2c} D_c \, TREND_{\mathrm{ct}} + \gamma X_{ict} + u_{ict} \qquad (1)$$

In Equation (1), $\mathrm{T}_{\mathrm{ict}}$ is a binary variable that takes value one if individual *i* in country *c* participated in adult learning or training in time period *t*, and zero otherwise;[6] $\mathrm{D_c}$ is a vector of country dummies, $\mathrm{CYCLE}_{\mathrm{ct}}$ and $TREND_{\mathrm{ct}}$ are the business cycle and trend indicators described in sub-section 3.1; X_{ict} is a set of individual-level controls that include age, gender and whether the individual has a tertiary education degree or not; and u_{ict} is the error term. We cluster the standard error by country and time period.

This baseline specification allows for trend effects that are country-specific but constrains the business cycle effect to be homogeneous across countries. We also estimate more flexible specifications that allow the key coefficient β_1 to vary by country. In addition, while

[6] We eliminate seasonality from $\mathrm{T}_{\mathrm{ict}}$ as described in Section 3.1.

our baseline specification does not control for year dummies, we will show in a robustness test that their inclusion does not change our estimated effects.

The parameter of interest β_1 in Equation (1) includes both the direct effect of CYCLE on adult learning and training and the indirect effect operating via changes in the probability of employment. Since skill investment is more frequent among the employed and the employment probability increases in economic expansions and decreases in economic downturns, failure to control for the indirect effect may lead either to underestimating the countercyclical behaviour of adult learning or to concluding that this behaviour is procyclical. We address this issue by also estimating an augmented version of (1)

$$\mathrm{T}_{\mathrm{ict}} = \sum_c \alpha_c D_c + \beta_1 \mathrm{CYCLE}_{\mathrm{ct}} + \sum_c \beta_{2c} D_c \, TREND_{\mathrm{ct}} + \beta_3 E_{ict} + \gamma X_{ict} + u_{ict} \qquad (2)$$

where E is employment status, a binary variable equal to 1 if the individual is employed and to zero otherwise.

Considering that E_{ict} is also responsive to the business cycle, the overall marginal effect of the business cycle on training is given by

$$\frac{\partial T}{\partial CYCLE} = \beta_1 + \beta_3 \times \frac{\partial E}{\partial CYCLE}$$

where $\beta_3 \times \frac{\partial E}{\partial CYCLE}$ is likely to be positive and captures two facts: a) the incidence of training is higher among the employed (β_3 is positive); and b) the probability of employment increases over the cycle ($\frac{\partial E}{\partial CYCLE} > 0$). While Equation (1) focuses on the overall marginal effect $\frac{\partial T}{\partial CYCLE}$, Equation (2) allows us to separate the direct (β_1) from the indirect effect working through employment changes.

4.3 Adult learning and training of the employed and the not employed

When the sensitivity of training T to the business cycle varies by labour market status – as shown for instance by Méndez and Sepúlveda (2012) for the US labour market – our model needs to be adjusted to account for this heterogeneity. In this case, the relationship between T and the business cycle indicator CYCLE becomes

$$\mathrm{T}_{\mathrm{ict}} = \phi \mathrm{W}_{ict} + \theta_1 \mathrm{CYCLE}_{\mathrm{ct}} \, \mathrm{x} \, E_{ict} + \theta_2 \mathrm{CYCLE}_{\mathrm{ct}} \times (1 - E_{ict}) + \theta_3 E_{ict} + u_{ict} \qquad (3)$$

where the vector W_{ict} includes the individual covariates in X_{ict}, the country-specific trends and the constant term. Letting $\delta = \theta_1 - \theta_2$, the marginal effect of the business cycle on average T is

$$\frac{\partial T}{\partial CYCLE} = \theta_2 + \delta E + (\theta_3 + \delta CYCLE) \times \frac{\partial E}{\partial CYCLE}$$

We investigate the differential response of training and adult learning to the business cycle for the employed and not employed (i.e. parameters θ_1 and θ_2) by estimating Equation (1) separately for each group.

Since individuals do not randomly select into employment or non-employment in response to the business cycle, we control for this selection process when estimating Equation (2) and Equation (3) by explicitly modelling individual employment as a function of the business cycle and trend indicators, individual characteristics (age, gender, education), and country-specific demand shocks that shift employment without directly affecting training. The technical details are relegated to the Appendix.

5. Empirical results

5.1 The effects of the business cycle on participation in adult learning

We report in Table 2 for the pooled sample of EU-27 countries the estimates of the effect of the cyclical component of log real GDP per capita on individual participation in adult learning and training. The table has four columns: the first two columns report the OLS (ordinary least squares) estimates of specification (1), and the last two columns show the IV estimates of specification (2), where employment status is instrumented using the demand shock Z discussed in the Appendix. For both activities, we find small and not statistically significant effects. Using the results in columns (1) and (2), we estimate that a 1% decrease in real GDP per capita causes adult learning and training to increase by 0.030 and 0.037 percentage points respectively, which correspond to 0.3% and 0.56% with respect to the mean sample values. These estimated effects are smaller in absolute value than those reported in columns (3) and (4), but the difference is negligible.

We verify whether our results are sensitive to the inclusion of year dummies, which control for aggregate shocks hitting all European countries in a given year, or for the effects of (potentially endogenous) policies implemented jointly across all European countries. As shown in Table 3, results do not change with respect to our baseline – and more parsimonious – specification.[7]

We also replace log GDP per capita – trend and cycle – with the trend and cyclical component of the employment rate. Our results in Table 4 are broadly comparable to those in Table 2, with the notable exception that the countercyclical effect on training is now

[7] Since it does not require to control for aggregate year effects, our baseline specification also has the advantage that it can be replicated separately for each country. We report results of this analysis in Section 4.2.

precisely estimated. The estimated effects, however, remain small; we find that a 1 percentage point decrease in the cyclical component of the employment rate boosts participation in training by 0.2 percentage points (or 3% of the mean value, equal to 6.6 percentage points).

Our results are in line with Méndez and Sepúlveda (2012), who find weak evidence for the US that training at the *aggregate* level is countercyclical. They are instead in contrast with the ones produced by Di Pietro et al. (2020), who use the same data but find that training is procyclical. Differences in empirical methods explain this discrepancy. While we decompose log real GDP per capita and the employment rate in a trend and a cyclical component, and study the effects of the latter, they use the raw employment rate. As a result, their estimates combine the effects of the trend and the cycle component.

To illustrate, we have replicated the estimates by Di Pietro et al. (2020) in our final data, and regressed training on the employment rate (trend+cycle), individual controls, country dummies and year dummies. Results are reported in Appendix Table 9. We find that the effect of the employment rate on learning is positive and statistically significant at the 5% level of confidence, in line with the findings by Di Pietro et al. (2020). However, when we distinguish between the cyclical and trend component of the employment rate – as done in Table 4 – the effect of the former on learning is negative and statistically not significant, while the country-specific effects of the latter (not reported to save space) are in all but three cases positive and statistically significant. These results suggest that the coefficient estimated by Di Pietro et al. (2020) picks up the effects of employment trends on training.

5.2 The cyclicality of adult learning and training for the employed and the unemployed

As shown for the US by Méndez and Sepúlveda (2012), the cyclicality of skill investment may depend on the employment status of individuals. We investigate whether the employed and the not employed (unemployed or inactive) respond differently to the business cycle by estimating the switching regression model introduced in the Appendix. The results are reported in Table 5.

Column (1) shows the estimated coefficients of the probit equation for selection into employment, using data for both the employed and the not employed. As expected, employment is procyclical: the estimated coefficient is equal to 0.668 (standard error: 0.077), implying that a 1% increase in the cyclical indicator raises the probability of employment by 0.002. In addition, the demand shock Z, which we use as an instrument for employment status, positively affects the probability of employment (coefficient: 0.026; standard error: 0.004).

We control for the fact that employment status is not randomly allocated across individuals using a control function approach, and we augment the regressions for both adult learning and training of the employed and the not employed with the Inverse Mills Ratio (IMR), computed using the estimates reported in column (1) of Table 5. As discussed in the Appendix, the IMR is the conditional mean of the error term u_{ict} in (1) – which we assume to be normally distributed – when individuals are employed or unemployed. By adding this ratio, we restore the necessary condition that the conditional mean of the error term in (1) is zero.

Technically, identification is achieved not only by functional form but also by including in the employment equation the demand shock Z, which has a positive and statistically significant effect on employment. This shock is computed as the product of EU-27 sectoral employment changes by the pre-sample (1995 for most countries) share of employment in each country and sector. Conditional on country-specific GDP or employment trends, it is unlikely that overall EU employment changes affect directly country-specific adult learning. Therefore, the exclusion restriction relies on assumption that the pre-sample shares are uncorrelated with u_{ict} in (1). Since these shares are computed about 10 years before the start of our sample, we consider this assumption plausible.

The estimates of the effect of the business cycle on adult learning are reported in columns (2a) of Table 5 for the employed and (2b) for the not employed. While participation in adult learning by the employed does not vary significantly with the business cycle, it is clearly procyclical for the not employed. For this group, we estimate that a 1% increase in cyclical GDP increases adult learning by 0.34 percentage points (or by 4.79% of the mean value of adult learning, equal to 7.1 percentage points). Assuming that in 2020 GDP per capita will fall by 7.5% in the EU-27 area, this effect translates in a substantial 35.2% (2.5/7.1) decline in the participation of the not employed.

The estimated effects for training are reported in column (3a) for the employed and column (3b) for the not employed and show that training is countercyclical for the employed and acyclical for the not employed. We estimate that a 7.5% reduction in cyclical GDP – as expected in 2020 – will increase training participation in the former group by 7.1% (0.075/7.9 x 7.5).[8] Considering that training is mostly paid for or organised by firms (see

[8] The statistically significant coefficients attracted by the Inverse Mills Ratio suggest that controlling for selection into employment is important. Failure to do so produces different but misleading effects: for adult learning we obtain that the coefficient associated with log GDP cycle is -0.029 for the

Bassanini et al., 2007), this result suggests that firms take advantage of periods of low demand to upgrade the skills of their workforce.

Since adult learning includes both formal education and training, our results for the not employed suggest that the procyclical effect is driven by education, and may reflect the presence of credit constraints, which reduce the ability of individuals to access further education during recessions.

5.3 The effects of the business cycle on hours of training

Tables 2 and 5 report the effects of the business cycle on individual participation in adult learning and training. In this sub-section, we consider instead the effects on average hours of training during the previous four weeks. We assign zero hours to individuals who report that they have not participated in training during the same period.

Results for the full sample and for the sub-samples of employed and not employed individuals are reported in Table 6. We find that the effect of the business cycle on training hours is negative but not statistically significant both in the full sample (-0.578, standard error: 0.389) and in the sub-sample of the employed (-0.326, standard error: 0.325). This effect is estimated instead to be positive and statistically significant for the not employed (1.722, standard error: 0.742). Therefore, although training for the not employed does not vary in a significant way with the business cycle along the extensive margin (participation), the intensity of this type of learning increases in an expansion and declines in a recession. In particular, we estimate that a 1% decline in GDP per capita reduces hours of training by 1.47% with respect to the sample mean (0.0172/1.170). Applying this to the current recession, our results indicate that a 7.5 contraction in GDP per capita is likely to be associated with an 11% reduction in the training intensity of the not employed.

5.4 Summary of results based on EU-27 countries

Table 7 presents a summary of our results based on the pooled sample of 27 EU (European Union) countries. We find that – for the full sample – participation in adult learning does not vary in general with the business cycle but is procyclical for the not employed. We also find that training is countercyclical for the employed (when measured as participation) and procyclical for the not employed (when measured as learning hours). These results indicate

employed and -0.003 for the not employed; for non-formal adult learning we estimate instead -0.040 for the employed and -0.035 for the not employed.

that a substantial downturn in Europe is likely to be accompanied by a decline in participation in adult learning by the not employed and by an increase in the participation by the employed.

A reduction in GDP per capita typically reduces average hours worked. How many of these hours will be employed in training? To answer this question, we define hours worked per week by individual *i* as

$$\mathrm{H_{ict}} = \mathrm{h_{ict}} \times \mathrm{E}_{ict} \tag{4}$$

where h are average hours if employed. A reduction in the business cycle indicator CYCLE affects hours H as follows

$$\frac{\partial H}{\partial CYCLE} = \frac{\partial h}{\partial CYCLE} \times E + h \times \frac{\partial E}{\partial CYCLE} \tag{5}$$

The first component on the right-hand side of (5) is the change of hours worked by the employed and the second component is the change in employment status.

We estimate that a 1% reduction in the cyclical indicator CYCLE reduces employees' hours worked in the previous week by the small amount of 0.047, or 0.1% (0.047/34.87). We also estimate that the marginal effect of the cyclical indicator on the probability of employment is 0.002. Since average E in the sample is 0.703 and average hours worked by the employed are 34.87, we obtain that $\frac{\partial H}{\partial CYCLE}$ =0.103, or 0.42% (0.103/(34.87*0.703)).

Although employees' average hours worked decline during an economic downswing, their average hours spent in training (in the past four weeks) do not vary in a statistically significant way. However, those losing their jobs in a downswing reduce both their participation in and their hours of adult learning. We conclude that there is no evidence in our data that in a downturn, individuals substitute hours of work with hours of training.

Although our estimates of the effects of the business cycle on training are broadly in line with those by Méndez and Sepúlveda (2012) for the US, when we do not distinguish between the employed and the not employed, they differ when we consider the employed and the not employed separately. In particular, while these authors find that training is procyclical for the employed, we find that it is countercyclical.

5.5 Country-by-country effects

The negative but statistically insignificant average effect of cyclical GDP on adult learning in the EU-27 may hide heterogeneous effects across European countries, which are characterised by different labour market institutions and policies. We therefore re-estimate

by country both the baseline specification (1) and the specification that separates the employed from the not employed. The results are reported in Table 10 in the Appendix.

They reveal the presence of substantial heterogeneity, both in the sign and in the magnitude of estimated effects. To illustrate, the effect of a 1% change in cyclical real GDP per capita on participation in adult learning varies between -0.333 percentage points in Sweden to +0.207 percentage points in Slovenia. But the effects on participation in training vary between -0.482 percentage points in Portugal to +0.107 percentage points in Slovenia.

We classify countries in three groups, according to the cyclicality of skill accumulation.

1. Countercyclical: the effect of the business cycle on adult learning/training is negative and statistically different from zero at the 5% level.
2. Procyclical: the effect of the business cycle on adult learning/training is positive and statistically different from zero at the 5% level.
3. Acyclical: the effect of the business cycle on adult learning/training is imprecisely estimated and not statistically different from zero.

We use maps to report our findings visually, separately for adult learning (Figure 7) and for training (Figure 8). Figure 7 shows that adult learning, on the one hand, is countercyclical in Spain, Portugal, France, the Netherlands, Denmark, Sweden, Croatia, Estonia, Malta, Greece and Luxemburg; procyclical in Italy, Ireland, Finland, Poland, Slovenia, Slovakia, Latvia, Lithuania, Hungary, Bulgaria and Cyprus; and acyclical in Belgium, Germany, Austria, Romania and the Czech Republic. Figure 8 shows that training, on the other hand, is countercyclical in Spain, Portugal, France, the Netherlands, Denmark, Sweden, Estonia, Malta, Greece, Romania and Luxemburg; procyclical in Italy, Ireland, Poland, Slovakia, Latvia, Lithuania, Hungary, Bulgaria, Germany and Cyprus; and acyclical in Belgium, Austria, Finland, Slovenia, Croatia and the Czech Republic.

This heterogeneity cuts across the classical classification of European countries into Northern, Southern, Western and Eastern/Central regions, suggesting that separate estimates by region are unlikely to be informative. To illustrate, the group with countercyclical training includes Spain (Southern), France (Western), Sweden (Northern) and Romania (Eastern).

Why is the cyclicality of adult learning so heterogeneous across countries? We address this question by looking at the relationship between countercyclical or procyclical behaviour and country-specific labour market institutions.[9] We consider the following indicators:

- public training expenditure to GDP ratio (source: OECD; reference year: 2004)
- trade union density (source: OECD; reference year: 2007)
- an index of the strength of employment protection legislation (source: OECD; reference year: 2004)
- percentage of firms reporting financial constraints (source: EIBIS; reference year: 2015-18)
- R&D expenditure to GDP ratio (source: Eurostat; reference year: 2015)
- an index of the strength of product market regulation (source: OECD; reference year: 2018)
- employment rate (source: ELFS; reference year: 2004)
- share of households reporting that they make ends meet with great difficulty (source: EU-SILC (European Union statistics on income and living conditions); reference year: 2007).

Since the classifications of countries based on the cyclicality of adult learning and training are very similar, we only consider training and report our results in Table 8. Column (1) of Table 8 shows that training is countercyclical in the countries where public expenditure in training is higher. This expenditure, which includes subsidies to individuals and firms, can be particularly supportive of training during recessions.

Columns (2) and (3) show that both trade union density and employment protection are higher in countries where training is countercyclical. In these countries, the dismissal of employees during recessions is either costlier or more complicated, which favours training of redundant labour as an alternative and viable option. Training is also countercyclical in countries with a lower share of firms reporting that they are financially constrained. Since these constraints are likely to bind more during hard economic times, a lower share of financially constrained firms may facilitate training during recessions.

The fact that countercyclical training is more likely in countries with both higher public training expenditure and a lower share of financially constrained firms may be surprising, as in principle there would be more need for public support for training in countries with a larger share of financially constrained firms. This finding may be due to heterogeneity

[9] We leave acyclical countries out of the sample for this exercise as we lack the statistical power to classify them univocally.

within the group of countries with countercyclical training – some may provide large public support to training, and have a large share of financially constrained firms, while in others public support may be lower and the share of financially constrained firms may be lower. Alternatively, in countries with more public support for training, the institutions available for firms to ensure their liquidity may be more developed as well.

Columns (5) and (6) show that training is countercyclical in countries where average R&D expenditure is higher and product market regulation is lower, suggesting that firms that innovate more and are under stronger competitive pressure are more likely to take advantage of recessions to update the skills of their workers.

Finally, training is countercyclical in countries with a higher employment rate (column 7) and a lower share of households reporting making ends meet with great difficulty (column 8) that we take as an indicator of households' financial constraints.

6. Conclusions

This report has investigated the cyclicality of skill accumulation in Europe. We have used data from the ELFS for 2005–18 and considered both formal and non-formal adult education (or training). Pooling data across all EU-27 countries, and across employed and not employed workers, we have estimated that adult learning is acyclical and training is mildly countercyclical.

Considering that firm-sponsored training is mostly undertaken by employed workers and that firms are likely to encourage training during recessions, these average effects may hide heterogeneities by employment status. As a result, we have estimated the response of adult learning and training to the business cycle separately for employed and not employed workers. We have found that training is countercyclical for the employed and procyclical for the not employed, and that adult learning (which includes training) is acyclical for the former group and procyclical for the latter. Countercyclical training of the employed is consistent with the view of recessions as times of reorganisation. Procyclical learning for the not employed can be explained instead, with the presence of credit constraints preventing the investment in formal and non-formal education when the economy is in dire straits.

We have also documented substantial heterogeneity in the cyclicality of adult learning and training across European countries. Although it is difficult to classify this heterogeneity across well-defined areas, procyclical adult learning seems to be more frequent in the

countries of Eastern Europe, where financing constraints affecting firms and workers are more likely to appear.

We have associated the cyclical behaviour of skills across countries with country-specific variables that characterise the existing differences in product and labour market institutions, as well as in labour policies. We have shown that in countries where training is countercyclical there is a higher public training expenditure (which can support investment in a downturn), higher union density and employment protection (which restrain the lay-off of redundant workers and therefore increase the incentive to train during recessions), a lower share of financially constrained firms (that may not be able to afford training during downswings), higher R&D expenditure and lower product market regulation (that push firms to innovate and compete more intensively, and by training more when the opportunity arises and opportunity costs are lower).

What are the implications of countercyclical training for the European economy? The available evidence suggests that labour productivity typically increases in economic expansions and declines in economic downturns.[10] If training positively affects labour productivity, countercyclical skill accumulation can contribute to attenuating the procyclical behaviour of productivity.

Recent empirical evidence on the effects of training on productivity includes Konings and Vanormelingen (2015), Martins (2020), and Brunello et al. (2021). The latter study estimates the effect of training investment on productivity for the 27 EU countries, using data from the EIBIS survey and from the Orbis (Bureau van Dijk) database, and finds that a 10% increase in training investment per employee raises firm productivity by 0.2%.

Assuming that the effect of training participation and training investment on productivity are the same, and ignoring the heterogeneous response of training across different European countries, this and the other estimates in this paper imply that the 4.5% average decline in European GDP per capita observed in the 2009 recession have increased training participation by only 0.17 percentage points (0.037 x 4.5) and labour productivity by 0.003% (0.17 x 0.2 /10). This tiny effect, however, conceals the substantial heterogeneity in the sensitivity of training to the business cycle across European countries. When we

[10] The correlation of labour productivity with GDP between 1970 and 2016 has been as high as 0.69 in France, 0.70 in Germany and 0.82 in Italy (see Burda, 2018). On the contrary, Gali et al., 2010, have shown that the procyclical behaviour of labour productivity in the US has virtually disappeared since 1984.

consider the country-specific estimates reported in Appendix Table 10, the effects on productivity are larger in Portugal (0.04%), Sweden (0.03%) and France (0.03%).

The implementation of policies fostering training provision entails both direct (paying trainers, organising and managing the programme) as well as indirect (foregone working hours) costs, and the decision to implement or not countercyclical training policies, depends on whether the benefits outweigh the costs. Our results suggest that this decision should be country specific and rely on whether these costs are lower than the heterogeneous returns to adult learning discussed above.

Appendix

Country-specific demand shocks

We estimate Equation (2) using an instrumental variable approach to control for the endogenous selection of workers into employment over the business cycle. Our instrument is a variable that we assume affects employment without directly affecting training (the exclusion restriction). This variable, Z_{ct}, captures country-specific demand shocks. Following the shift-share logic developed by Autor et al. (2013), Z_{ct} is defined as follows

$$Z_{ct} = \sum_k \frac{E_{ck,t-\tau}}{E_{k,t-\tau}} * \left[\frac{E_{kt}}{E_{k,t-1}} - 1\right] \quad \text{(A1)}$$

Or as the weighted average of EU-27 employment growth by industry *k*, where the weights $\frac{E_{ck,t-\tau}}{E_{k,t-\tau}}$ are the ratios of industry k workers in country c to the EU-27 number of industry k workers in period t-τ, and $\left[\frac{E_{kt}}{E_{k,t-1}} - 1\right]$ is the percentage change in EU-27 employment in industry k between period t and period t-1. By combining predetermined employment shares by industry and country with aggregate industry-level employment changes in the whole EU-27, this exclusion restriction captures the changes in the employment rate that are not purely explained by country- and industry-specific labour supply shocks.

A switching regression model for training of the employed and the not employed

The sensitivity of training and adult learning may vary with employment status, and we take this into account by estimating the following model

$$T_{ict} = \sum_c \gamma_{0c}^e D_c + \gamma_1^e CYCLE_{ct} + \sum_c \gamma_{2c}^e D_c\, TREND_{ct} + \gamma_3^e X_{ict} + \gamma_4^e \lambda_{ict} + \varepsilon_{ict}^{e} \text{ if } E_{ict} = 1 \quad \text{(A2)}$$

$$T_{ict} = \sum_c \gamma_{0c}^u D_c + \gamma_1^u CYCLE_{ct} + \sum_c \gamma_{2c}^u D_c\, TREND_{ct} + \gamma_3^u X_{ict} + \gamma_4^u \lambda_{ict} + \varepsilon_{ict}^{u} \text{ if } E_{ict} = 0 \quad \text{(A3)}$$

$$E_{ict} = \sum_c \delta_{0c} D_c + \delta_1 CYCLE_{ct} + \sum_c \delta_{2c} D_c\, TREND_{ct} + \delta_3 X_{ict} + \phi Z_{ict} + \omega_{ict} \quad \text{(A4)}$$

where i is for the individual, the superscripts *e* and *u* are for employment and non-employment (unemployment plus inactivity) and T is a binary variable equal to 1 if the individual participated in a learning activity and 0 otherwise.

The first two equations describe the relationship between learning and the cycle for the employed and the non-employed. The third equation describes how the probability of employment E varies with the business cycle. Assuming that the error term ω is normally distributed, we estimate (A4) using a probit specification. We then compute the IMR λ,

that we use as a control function for the endogeneity of selection into employment or non-employment in Equations (A2) and (A3) respectively (see Wooldridge, 2002).[11]

Equations (A2)–(A4) constitute a switching regression model, which can, in principle, be identified by functional form alone. As it is customary, however, we also include in Equation (A4) Z_{ct}, our measure of country-specific labour demand shocks introduced in the previous paragraph. As in the case of Equation (2), we assume that Z_{ct} affects employment without directly affecting training.

[11] We de-seasonalise the IMR within country, as described in Section 3.1, before plugging it in the regression.

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Figures and Tables

Figure 1. Adult learning participation rate by country

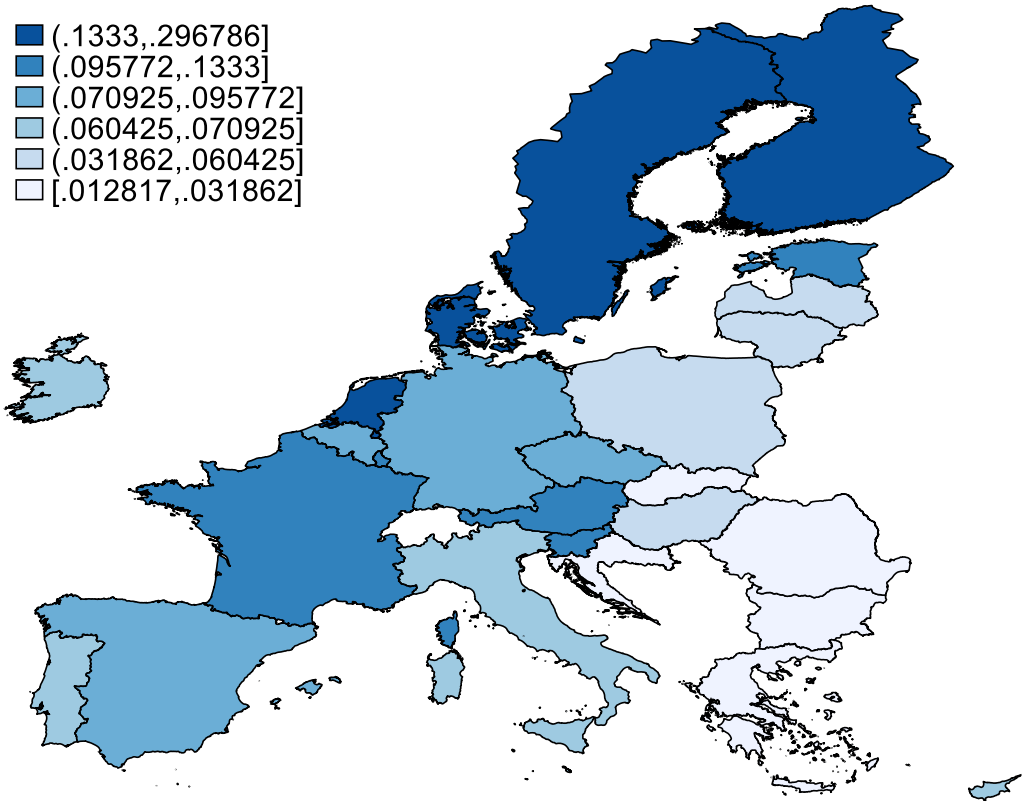


Figure 2. Non-formal training participation rate by country

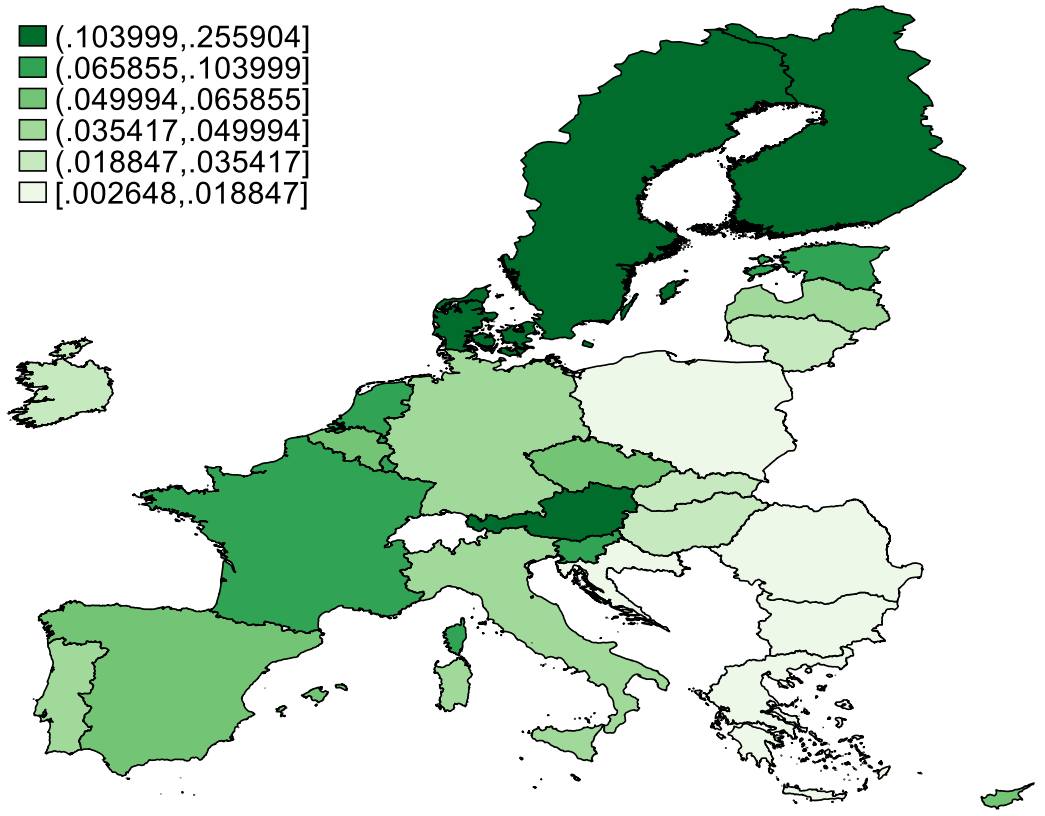


Figure 3. Trend-cycle decomposition of log GDP per capita – Austria

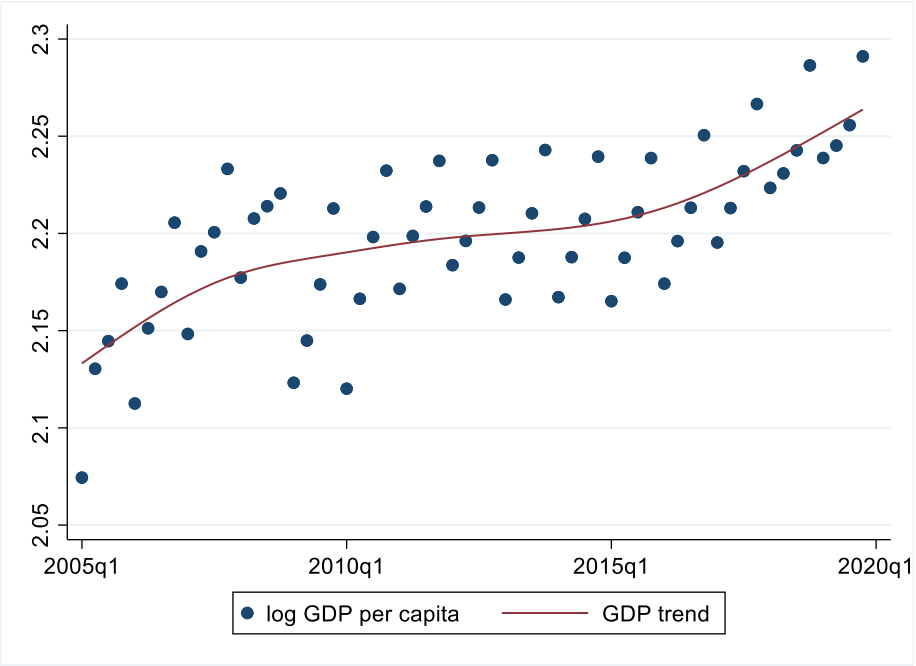


Figure 4. Trend-cycle decomposition of seasonally adjusted log real GDP per capita – Austria

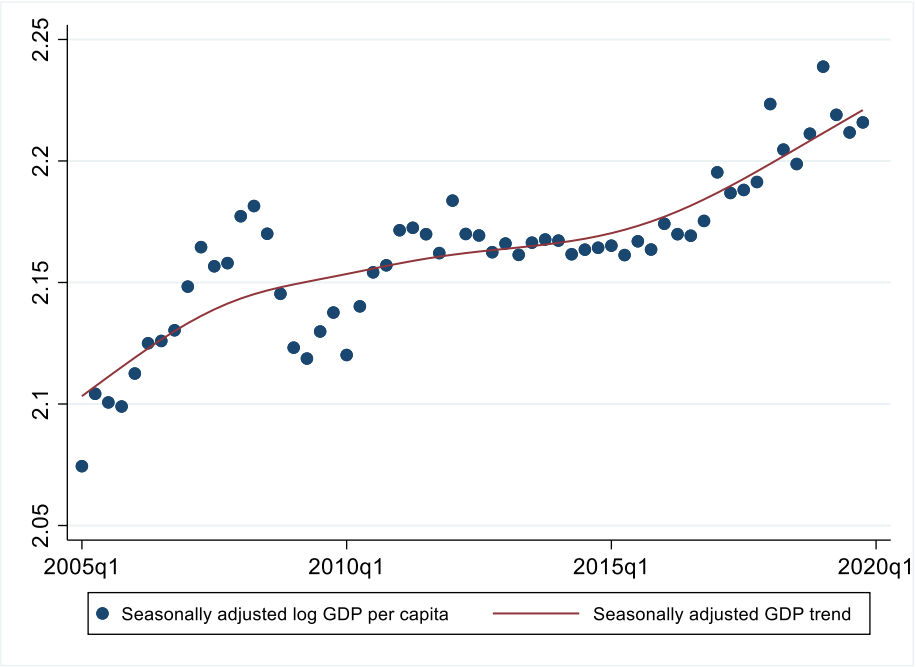


Figure 5. Adult learning participation rate – Austria

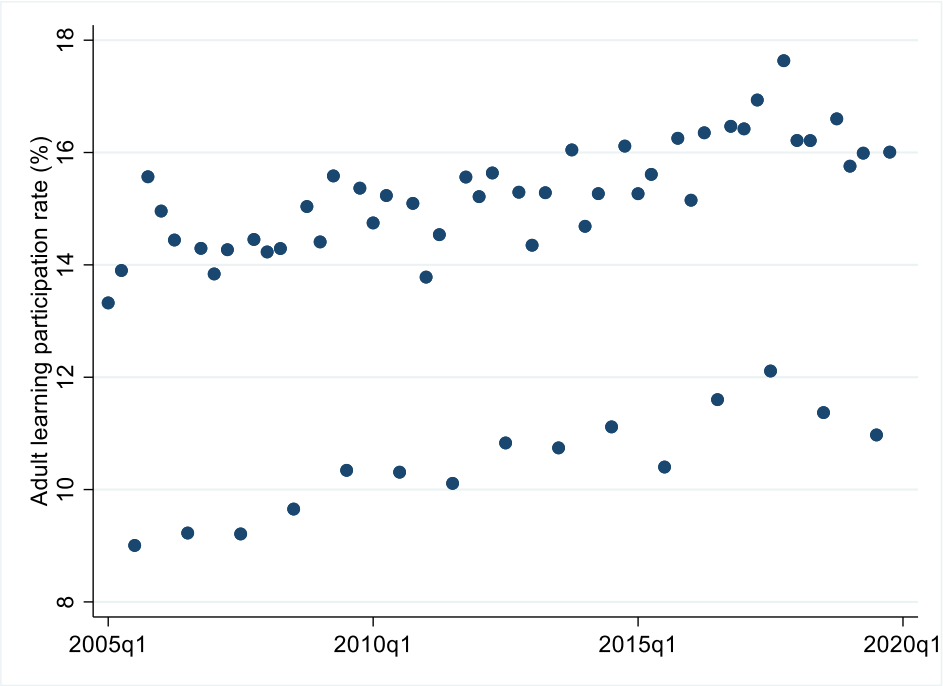


Figure 6. Training participation rate – Austria

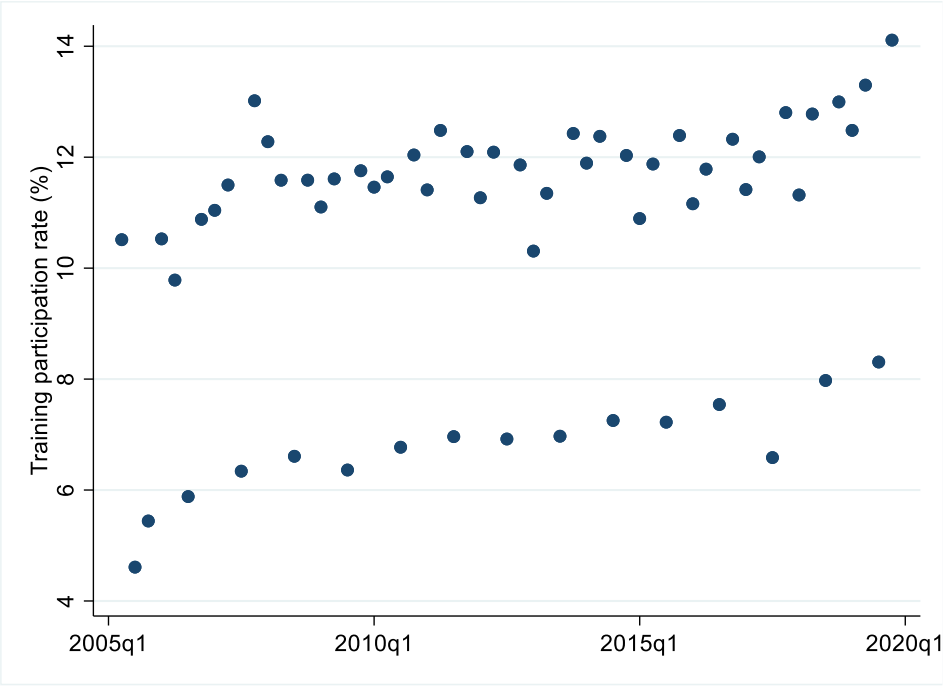
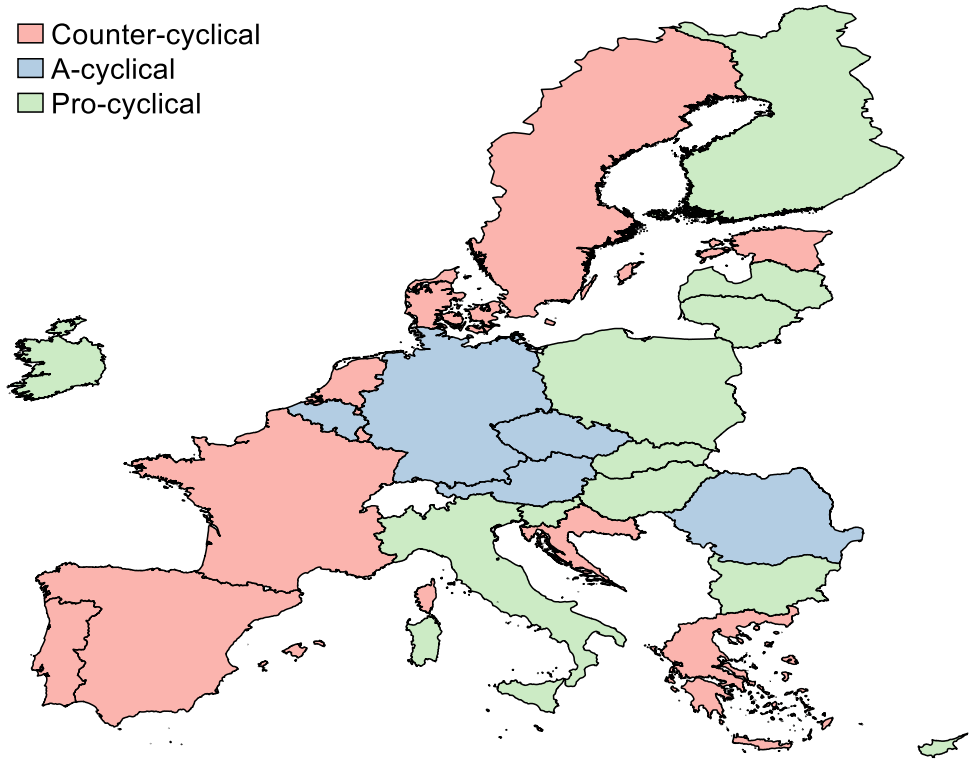
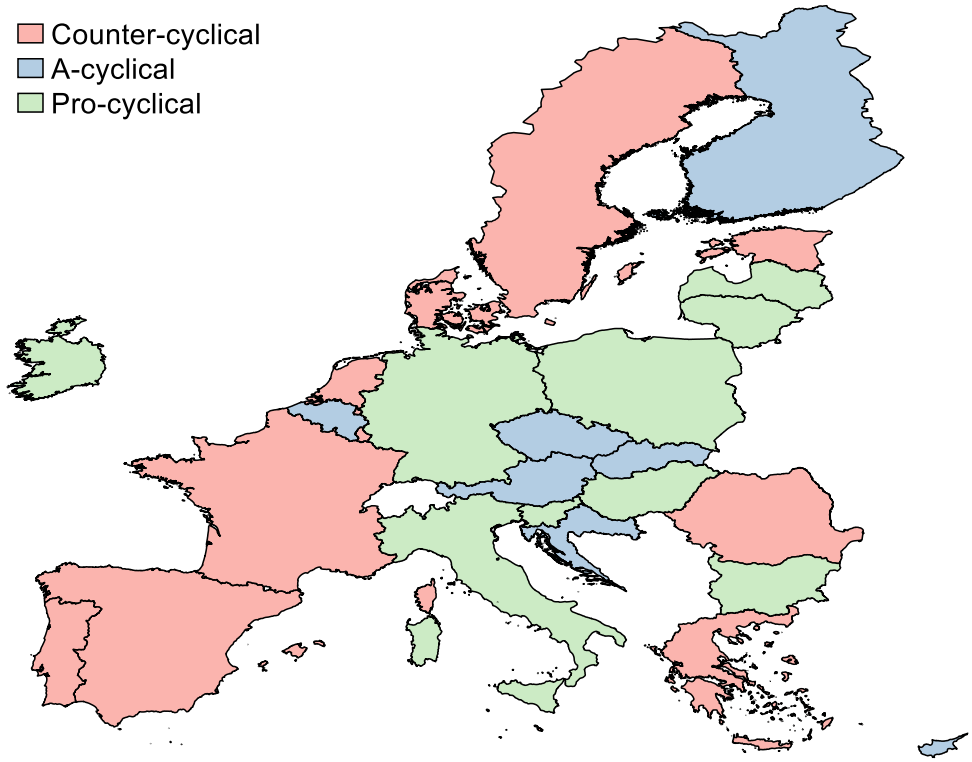


Figure 7. European countries by cyclicality of adult learning



Note: the figure is obtained by estimating Equation (1) country by country, and by classifying countries as countercyclical if the effect of the business cycle on adult learning is negative and statistically different from zero, acyclical if it is not statistically different form zero, and procyclical if it is positive and statistically different from zero. Country-by-country estimates are reported in Appendix Table 10.

Figure 8. European countries by cyclicality of training



Note: the figure is obtained by estimating Equation (1) country by country, by classifying countries as countercyclical if the effect of the business cycle on training is negative and statistically different from zero, acyclical if it is not statistically different form zero, and procyclical if it is positive and statistically different from zero. Country-by-country estimates are reported in Appendix Table 10.

Table 1. Descriptive statistics

	Observations	Mean	Standard . deviation.
Participated in adult learning	43,173,984	0.093	0.291
Participated in training	43,173,984	0.066	0.248
Participated in adult learning - employed	30,372,367	0.102	0.303
Participated in training – employed	30,372,367	0.079	0.271
Participated in adult learning – not employed	12,801,617	0.071	0.257
Participated in training – not employed	12,801,617	0.034	0.181
Hours of training	43,160,876	1.113	9.205
Hours of training - employed	30,365,920	1.090	7.664
Hours of training – not employed	12,794,956	1.170	12.100
Age	43,173,984	45.38	11.07
Male	43,173,984	0.486	0.500
Has a tertiary education degree or higher	43,173,984	0.249	0.432
Employed	43,173,984	0.703	0.457
Weekly hours worked	43,173,984	34.87	21.26
Log(GDP) – cyclical component	1,620	0	0.026
Log(GDP) - trend	1,620	1.561	0.697
Employment rate – cyclical component	1,620	0	0.994
Employment rate - trend	1,620	64.30	5.983

Table 2. The effects of the business cycle on participation in adult learning and training, baseline specification

	(1)	(2)	(3)	(4)
Dependent variable	Adult learning	Training	Adult learning	Training
log (GDP) cycle	-0.030	-0.037	-0.031	-0.049
	(0.026)	(0.026)	(0.049)	(0.047)
Employed			0.006	0.059
			(0.204)	(0.196)
Observations	43,173,984	43,173,984	43,173,984	43,173,984

Notes: the table reports the effects of the business cycle on participation in adult learning. The dependent variable is listed in the heading of each column. Columns (1) and (2) are based on OLS estimates and columns (3) and (4) on IV estimates. Each regression also includes age, gender, a dummy for tertiary education, country effects and country-specific GDP trends. The specification adopted is the one reported in Equation (1). Standard errors clustered by country and time period are reported in parenthesis. *, p<0.1; **, p<0.05; ***, p<0.01.

Table 3. The effects of the business cycle on participation in adult learning and training, with year dummies

	(1)	(2)
Dependent variable	Adult learning	Training
log (GDP) cycle	-0.034	-0.039
	(0.031)	(0.032)
Observations	43,173,984	43,173,984

Notes: the table reports the effects of the business cycle on participation in adult learning. The dependent variable is listed in the heading of each column. Each regression also includes age, gender, a dummy for tertiary education, year effects, country effects and country-specific GDP trends. The specification adopted is the one reported in Equation (1). Standard errors clustered by country and time period are reported in parenthesis. *, p<0.1; **, p<0.05; ***, p<0.01.

Table 4. The effects of the business cycle on participation in adult learning and training, using the cyclical component of the employment rate instead of log(GDP)

	(1)	(2)
Dependent variable	Adult learning	Training
Employment rate – cycle	-0.001	-0.002**
	(<0.001)	(<0.001)
Observations	43,173,984	43,173,984

Notes: the table reports the effects of the business cycle on participation in adult learning. The dependent variable is listed in the heading of each column. Each regression also includes age, gender, a dummy for tertiary education, country effects and country-specific GDP trends. The specification adopted is the one reported in Equation (1). Standard errors clustered by country and time period are reported in parenthesis. *, p<0.1; **, p<0.05; ***, p<0.01.

Table 5. The effects of the business cycle on employment, adult learning and training, by employment status

	(1)	(2a)	(2b)	(3a)	(3b)
Dependent variable	Employed	Adult learning	Adult learning	Training	Training
Sample	All	Employed	Not Employed	Employed	Not Employed
log (GDP) cycle	0.668***	-0.010	0.342***	-0.075**	-0.016
	(0.077)	(0.031)	(0.019)	(0.030)	(0.018)
Demand shock - Z_{ct}	0.026***				
	(0.004)				
Inverse Mills Ratio (IMR) - λ		0.060***	0.915***	-0.111***	0.051***
		(0.013)	(0.017)	(0.010)	(0.005)
Observations	43,173,984	30,372,267	12,801,617	30,372,267	12,801,617
Estimation method	Probit	OLS	OLS	OLS	OLS

Notes: the table reports the effects of the business cycle on employment and participation in adult learning and training. The dependent variable is listed in the heading of each column. Effects for the full sample in column (1), for the employed in columns (2a) and (3a) are for the not employed in columns (2b) and (3b). Each regression also includes age, gender, a dummy for tertiary education, country effects and country-specific GDP trends. The specification adopted is the one in Equations (A1) – (A3). Standard errors clustered by country and time period are reported in parenthesis. *, p<0.1; **, p<0.05; ***, p<0.01.

Table 6. The effects of the business cycle on average number of hours of non-formal adult learning in the past four weeks, by employment status

	(1)	(2)	(3)
Dependent variable	Training	Training	Training
Sample	All	Employed	Not Employed
log (GDP) cycle	-0.578	-0.326	1.722**
	(0.389)	(0.325)	(0.742)
Observations	43,160,876	30,365,920	12,794,956

Notes: the table reports the effects of the business cycle on participation in adult learning. The dependent variable is listed in the heading of each column. Each regression also includes age, gender, a dummy for tertiary education, country effects and country-specific GDP trends. The specification adopted is the one reported in Equation (1). Standard errors clustered by country and time period are reported in parenthesis. *, p<0.1; **, p<0.05; ***, p<0.01.

Table 7. Summary of results

	(1) Adult learning	(2) Training
Participation – all	No effect	Countercyclical
Hours – all		No effect
Participation – employed	No effect	Countercyclical
Hours – employed		No effect
Participation – not employed	Procyclical	No effect
Hours – not employed		Procyclical

Note: 'no effect' means that the estimated effect is not statistically different from zero.

Table 8. Macroeconomic outlet, by groups of countries defined on the basis of cyclicality of adult learning

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Macroeconomic variable	Public expenditure in training	Trade union density	Employment protection index	Share of firms reporting financial constraints	R&D expenditure	Product market regulation index	Employment rate	Share of households making ends meet with great difficulty
Cyclicality of training								
Countercyclical	0.192	0.306	2.916	0.070	1.450	1.334	0.643	0.075
Procyclical	0.128	0.266	2.510	0.089	0.980	1.441	0.614	0.129

Notes: countries grouped on the basis of cyclicality of trainings, as in Figure 8. Economic indicators and their sources are described in the text.

Table 9. The effects of the employment rate (trend+cycle) on training participation

	(1)
Dependent variable	Adult learning
Employment rate	-0.0005***
(trend+cycle)	(0.0002)
Observations	43,173,984

Notes: the table reports the effects of the business cycle on participation in adult learning. The dependent variable is listed in the heading of each column. Each OLS regression also includes age, gender, a dummy for tertiary education, country effects and country-specific GDP trends. The specification adopted is the one reported in Equation (1). Standard errors clustered by country and time period are reported in parenthesis. *, p<0.1; **, p<0.05; ***, p<0.01.

Table 10. The effects of the business cycle on adult learning and training participation, by country

	(1) Adult learning - all	(2) Training - all	(3) Adult learning - employed	(4) Training - employed	(5) Adult learning – not employed	(6) Training – not employed
Austria	-0.016	0.009	0.016	0.009	0.971***	0.137***
Belgium	-0.007	0.015	0.051	0.003	0.499***	0.039
Bulgaria	0.019***	0.011***	0.099***	0.032***	0.479***	0.027***
Cyprus	0.064***	0.007	0.089***	-0.027	0.715***	0.096***
Czechia	-0.002	0.008	0.072***	-0.022***	1.157***	-0.013
Germany	-0.002	0.015**	-0.090**	-0.106***	0.396***	-0.056
Denmark	-0.235***	-0.085***	-0.021	-0.109***	0.453***	-0.081***
Estonia	-0.065***	-0.058***	0.025***	-0.070***	0.644***	0.091***
Spain	-0.035***	-0.048***	0.031	-0.086***	0.513***	0.052
Finland	0.105***	0.009	-0.404***	-0.434***	0.235***	-0.105***
France	-0.320***	-0.307***	-0.078***	-0.131***	0.405***	-0.023**
Greece	-0.085***	-0.099***	0.068***	0.023**	0.528***	0.024**
Croatia	-0.026**	0.010	0.170***	0.082***	0.647***	0.025***
Hungary	0.092***	0.053***	0.083***	0.037***	0.415***	-0.012**
Ireland	0.032***	0.057***	0.076***	-0.002	0.836***	0.039***
Italy	0.033***	0.031***	0.016	-0.006	0.235***	0.017*
Lithuania	0.022***	0.024***	-0.153***	-0.178***	-0.170***	-0.204***
Luxemburg	-0.141***	-0.170***	0.046***	-0.009	0.104***	-0.091***
Latvia	0.057***	0.041***	-0.297***	-0.453***	0.784***	0.109***
Malta	-0.183***	-0.252***	-0.091***	-0.209***	0.629***	-0.183***
Netherlands	-0.125***	-0.154***	0.168***	0.100***	0.409***	-0.014**
Poland	0.063***	0.059***	-0.295***	-0.602***	-0.482***	-0.312***
Portugal	-0.278***	-0.482***	0.024***	-0.019***	0.461***	0.009***
Romania	0.001	-0.015***	-0.252***	-0.294***	0.147***	-0.055*

Sweden	-0.333***	-0.350***	0.223***	0.009	0.463***	-0.004
Slovenia	0.207***	0.107***	0.035***	-0.026***	0.559***	-0.034***
Slovakia	0.020***	-0.003	0.016	0.009	0.971***	-0.137***

Note: standard errors are not reported to save space. *, p<0.1; **, p<0.05; ***, p<0.01.

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