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Wage scarring among unlucky European cohorts

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Abstract: This paper examines how starting one's career in a weak labour market affects future labour market outcomes using data from 13 European countries. Income losses, so called scarring effects, are found to be solely levied on college graduates. For every percentage point increase in the national unemployment rate at graduation, college graduates incur wage penalties of 2% one year later. These penalties are over 1% for the next eight years but are zero by year ten. During the Great Recession, college graduates in countries who experienced harsh sovereign debt crises were particularly affected. In Portugal, Italy, Ireland, Greece and Spain new graduates with a college education faced wage losses of between 12 and 23% in each of the first ten years of their career.

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The early part of a worker's career is an important determinant of future financial success. Wage growth is at its highest (Murphy and Welch 1990) and job-switching is frequently used to increase wages (Topel and Ward 1992) . Recent evidence from Lagakos, Moll, Porzio, Qian, & Schoellman (2018) also points to the substantial variation in lifecycle wage growth across countries. Wage growth profiles are predominantly concave in developed countries but have a flatter, linear profile in developing countries. Notably, German workers see wages grow by over 100% over the first twenty years of their careers. Workers in the United States, United Kingdom and Canada experience more modest growth of 75% in the same period. In both cases however, most of this wage growth occurs in the first decade of a worker's career. While the first decade of experience is clearly important, part of this impact can be traced as far back as the first job a worker attains. Devereux (2002) highlights the state-dependence of wages in the United States labour market; for two identical workers beginning their careers at different wage levels, half of this wage differential is still present five years later. Given the importance of early career wage growth, how does a young worker commencing their career in the depths of an economic downturn fare?

At first glance, it seems the issue may be trivially borne by a small group of unlucky cohorts relative to the size of the labour market, and in aggregate the social costs will be minimal. This is not the case however. While the possible negative wage effects are indeed levied at the worker level, there are also implications for the health of the economy in other respects. Stuart (2019) shows that the 1980-1982 recession in the United States led to 1-3 million less college graduates and a reduction in earned income between $64 and $145 billion. Clearly, wage penalties borne by individuals can materially impact public finances and the skill levels of the future workforce. An appreciation of this subject is important for policy makers as there may be tools at their disposal which can mitigate these longer run implications.

In this paper I examine how an increase in the national unemployment at the outset of young workers' careers impact their labour market outcomes over the first decade of their career. Numerous authors have examined this topic internationally[1]. I examine the subject from a European perspective. I examined how earnings, wages and hour worked for employees in

[1] See Oreopolus et al. (2012) in the case of Canadian college educated workers. Schwandt & von Wachter (2019), Speer (2016), Khan (2010), Altonji et al.(2016) and Oyer (2006, 2008) have examined how recessions affect various types of young workers in the United States.

European countries are affected by variation in initial labour market conditions. I look at workers who finished their education between 1987 and 2014 using survey micro data from 13 countries.

The evidence on wage scarring across European countries is very varied. Wage scarring estimates are generally found to be negative, but the duration and types of workers affected vary across countries. In some settings, more educated workers suffer the largest losses (Cockx & Ghirelli, 2016) while others have found that negative penalties are mainly levied on the less skilled workers (Haaland (2018); Fernandez-Kranz & Rodriguez-Planas (2018); Umkehrer (2019)). Despite numerous studies of individual countries, little is known about wage scarring processes in the largest labour market in Europe- the common labour market of European Union member countries.

I contribute to this literature by estimating scarring models at the common European labour market level using a sample of long-standing member countries. As the common labour market is large, an appreciation of how new workers are affected by recessions is an important feature to understand. I find income losses, in wages and earnings, are exclusively levied on college graduates. For every 1 percentage point increase in the national unemployment rate at graduation, college graduate incur wage penalties of 2% one year later. These penalties are over 1% for the next eight years but are zero by year ten. Earnings losses tend to be larger than wage losses in the first two years after graduation, as hours worked decrease slightly. Consistent with estimates from the US and Canada, both earning and wage losses tend to dissipate after a decade.

I offer one particularly novel contribution. I simulate the heterogenous effects of the Great Recession upon young workers in countries who experienced a harsh sovereign debt crisis (Portugal, Ireland, Italy, Portugal and Spain) and the non-crisis countries in my sample. The results are striking. New college graduates in non-crisis countries experience negative wage penalties for ten years, these are close to 3% in each year. However, new college educated workers in crisis countries fare much worse. They incur wage losses of over 20% one year after graduation. This decreases below 15% by year six but these losses are around 20% seven to ten years after graduation. These estimates show that the Great Recession had a particularly large, negative effects for college graduates in crisis countries, where unemployment rates increased noticeably during the financial crisis.

Literature Review

A large literature has sought to isolate the causal effect of early career unemployment upon future wage outcomes. One of the earliest examinations of the topic came from Ellwood (1982). Using a panel of young American men, he found that early career unemployment lent itself to reductions in future wages but did not change the probability of future employment. Another early piece, by Franz et al. (2000), found that Germans failing in apprenticeship training schemes incurred persistent income losses thereafter. In Denmark, Rosholm (1997) found that young males entering the weak Danish labour market of the 1980s had a higher risk of becoming marginalised if they did not acquire work experience shortly after school completion.

This early literature examining recessions and youth labour markets transitions showed the negative effects induced by a lacklustre start. From an econometric stance, the methods were dogged by endogeneity grievances. For instance, it's unclear whether the types of young people who fell into unemployment differed on some unobservable (e.g. motivation etc.) from those who found employment. If they are, estimates will be biased. Neumark (2002) addressed these concerns and was the first author to use the unemployment rate in the early part of a worker's career as an instrumental variable for job security upon graduation. More recent wage scarring research has adopted this reduced form approach, often implicitly, and have estimated how variation in the national/local unemployment rates affect outcomes of young workers during the early part of their career.

The onset of the financial crisis of 2008 gave researchers increased impetus to examine the role of macroeconomic conditions on future career outcomes. Most of the research in this field has revolved around labour markets in North America. Schwandt & von Wachter (2019) examine a broad range of workers in the United States who began their careers between 1976 and 2015 by pooling waves of the Annual Economic Supplement to the Current Population Survey, the American Community Survey and Decennial Census. The authors examine whether scarring estimates from starting one's career in a weak labour market vary by race, gender and educational attainment. They find an average worker incurs losses in the region of 60% of a year of earnings over the course of a decade if starting their career in a typical US recession. Men and women experience similar losses while non-whites and the least educated workers incur the largest losses.

While providing general estimates for an "average worker" in an economy is of interest, many authors have focused solely on college graduates for methodological reasons. College graduates are more likely to immediately search for work upon graduation and are less likely to have substantial compositional changes over the business cycle (Oreopolus et al., 2012). This thinking means that identified wage scarring effects are more likely to be true, causal effects rather than correlations biased by unobserved confounders in cohort quality. Using a matched employer-employee dataset Oreopolus et al., (2012) found that Canadian college graduates starting in a recession suffer wage losses of 9% initially, with the effect diminishing over a ten-year period. The predicted quality of the graduate also played a role in determining the duration of the effect. Graduates whom had a high predicted wage based on degree type and institution quality incurred smaller and less persistent losses. This finding ties with Altonji et al., (2016) who found that higher earning majors are less likely to suffer high wage penalties and are more likely to find work in high paying occupations. Oyer (2006, 2008) conducted two studies examining the outcomes of specialised college graduates in the form of PhD economists and MBAs respectively. Weak market conditions upon graduation negatively affected lifetime earnings for MBA graduates and reduced placement prestige for new PhD economists.

Taken collectively, the North American literature gives evidence that wage scarring effects are sizable and typically last a decade. Across skill groups there are varying conclusions however. Speer (2016) concluded that low skilled labour incurs large initial losses, but these are not evident after the first year of experience, whilst college graduates are faced with persistent losses. In contrast, Schwandt & von Wachter (2019) found that least educated workers incur the largest and most persistent income losses.

While there is some variability in findings in North America, the recent European literature has been very varied. In the United Kingdom, Cribb, Hood & Joyce (2017) find that recessions result in wage losses for up to a decade. However, losses are much less persistent when family income is examined. If we assume income sharing occurs this indicates that living with a spouse or in the home of birth has an income protection effect. Other authors have sought to differentiate losses based on educational attainment. Haaland (2018) and Fernandez-Kranz & Rodriguez-Planas (2018) find that lowest skilled workers suffer the largest and most persistent wage losses[2]. Cockx

[2] These authors examine Norway and Spain respectively.

& Ghirelli (2016) find opposing results. In Flanders, minimum wage laws offer wage protection to less educated men in a recession. As a result, more educated men are more adversely affected by recessions at the point of labour market entry. In the German setting, Stevens (2008) found no evidence of persistent wage penalties from starting one's career in the depths of a recession. However, Umkehrer (2019) finds that low ability German apprentices tend to be more negatively affected in recessions than their more skilled counterparts - a similar within skill group narrative as found in Oreopolus et al., (2012) and Altonji et al., (2016). While most studies indicate wage penalties are felt for close to a decade, Gaini, Leduc & Vicard (2012) find that these effects were very transitory in the French labour market, lasting just three years.

When analysing the European literature, it's unclear what portion of the variation in results across countries is driven by variation in: 1) data sources/quality 2) empirical techniques and 3) true population effects. More precisely, it's difficult to say, unequivocally, that reported differences are entirely due to true population effects as the econometric specifications and data used vary across studies. While there appears to be substantial variation across countries, little is known about how recessions affect workers in the *common European labour market*. My analysis uses harmonised cross-country data sets to estimate wage scarring effects for new workers in the European labour market for 13 member countries. I make no onerous sample selection assumptions and examine workers irrespective of their educational attainment or gender. This flexibility is important as it allows for a more accurate representation of how a recession affects the average worker while also allows for an exploration of possible heterogenous effects.

Data and Empirical Strategy

Data Sources

I use two nationally representative pan-European surveys in my analysis. The first of these is the European Community Household Panel Survey (ECHPS) from 1995-2001. The ECHPS is a longitudinal survey which ran from 1994-2001 before being replaced by, the second data set I use, the Survey of Income and Living Conditions (SILC) in 2004. SILC is a cross-sectional survey conducted annually. It also has a longitudinal component, with a portion of households surveyed in a given year resampled for between one and three more years. I use SILC waves from 2004-2017 and I examine 13 sample countries who participated in both ECHPS and SILC,

namely: Denmark, Finland, Austria, Portugal, Spain, Greece, Belgium, the Netherlands, the United Kingdom, France, Ireland, Italy and Germany. These are all long-standing members of the European Union. All these countries were members of the European Union by 1995, the first year of data I use to estimate wage scars.

All ECHPS waves provide income data on a current basis, namely, the last weekly wage received. SILC income data is reported on an annual basis[3]. I make these comparable by dividing the SILC income by 52 and using this as a measure of weekly earnings. I divide these weekly earnings measures by hours worked per week to derive hourly wages. My sample is made up of individuals aged 16 to 35 who completed their education between 1987 and 2014. I restrict my sample to natives, defined as people born in the country of observation. This is important as I do not wish for varying skill levels of migrants across countries to influence my scarring estimates. I adjust all nominal earnings and wages to be in constant 2017 US purchasing power parity dollars. The country level PPP conversion factors come from OECD (2019a) and I then convert these into constant dollars by inflating each wage series by US CPI growth to 2017.

I look solely at employee income in estimating scarring effects. This is a common feature of the literature. As most young workers will work as employees, it is the most relevant channel in which scarring will present. Both surveys also have rich information on educational attainment[4], the year in which the highest educational qualification was attained[5] and nationality.

I use a harmonised measurement of unemployment rates derived by the OECD (2019b). This approach means that variation in initial labour market conditions, my identifying variation, is consistently measured across countries and within countries over time. In Table 1 show the variation in unemployment rates across countries for cohorts who began their careers between 1987 and 2014. Spain (5.2%), Greece (6.6%) and Ireland (4.7%) have the most volatile labour markets, with high standard deviations in national unemployment rates over the period.

[[Table 1 near here]]

[3] In the last calendar year for all countries except Ireland, where earnings in the past 12 months are reported.
[4] Educational attainment in both surveys is defined in line with the International Standard Classification of Education system. This means that educational attainment is consistently defined across surveys and across countries.
[5] I used this year to approximate year of graduation.

Econometric Model

I follow the recent literature, Oreopolus et al., (2012) and Schwandt & von Wachter (2019) and estimate a cell-based model which aggregates labour market outcomes at the country (c), graduation cohort[6] (g), educational attainment (d), potential experience (e) and year (t) level. This approach also allows me to work on a level close to my identifying variation- national unemployment rates at the cohort level. I estimate a baseline model identical to that used by Schwandt & von Wachter (2019). Schwandt & von Wachter exploited cohort-state level variation in unemployment rates to assess scarring in the United States. With this approach I treat countries in my sample as they treat states, and I derive scarring estimates at the European level, where they derive them at the national level. The baseline model regresses a cell level average of outcome Y onto a series of fixed effects: country (c), year (t), potential experience[7] (e), cohort (g) and educational attainment[8] (d). For outcomes I examine the log of hourly wage (wages), log of weekly wage (earnings) and log hours worked for all employees in my sample. My sample is made up of close to 250,000 employees before collapsing to the cell level.

$$\bar{Y}_{c,t,g,e,d} = a + B_c + \partial_t + \gamma_e + \delta_g + \rho_d + \sum_{e=1}^{e=10} \beta_{e,s} \left(UR_{c,g}\ X\ Pot.Exp_e\right) \tag{1}$$

A common theme in this empirical literature is an acknowledgement that fixed effects in cohort, year and potential experience are collinear[9]. I opt to drop one cohort (those graduating in 2014) and estimate experience and year effects. I am treating cohort effects as a "nuisance parameter", as does most of the wage scarring literature[10]. In a static setting, fluctuations in cohort size can lead to decreased wages due to an increased supply of labour. In this setting, early career wages are decreasing in cohort size. I model these cohort effects at the European labour market level using fixed effects. This assumes cohort size at the European level is the relevant channel, rather

[6] For ease, I use cohort to imply graduation cohort for the remainder of the text.
[7] Potential experience is used as actual experience or years worked will be endogenous to initial labour market conditions. I used the terms "time since graduation" and "potential experience" interchangeably as they are equivalent.
[8] A dummy variable for college graduate or non-college educated workers.
[9] Potential experience is defined as: (year of observation) – (cohort graduation year). Clearly potential experience is a linear function of year and cohort effects. For this reason, fixed effects in all three cannot be identified.
[10] Rothstein (2019) is an exception. He explicitly models cohort effects in order to decompose transitory scarring effects and permanent cohort effects in employment rates of Great Recession cohorts.

than national fluctuations in cohort sizes. While flexibility modelling cohort sizes at the national level would also be desirable, I am limited in my ability to do so. I identify scarring effects by exploiting variation in national unemployment rates across cohorts. A series of country-level fixed effects in cohort size would swallow all this identifying variation.

The scarring parameters are identified in $\beta_{e,s}$. Scarring effects are identified as an interaction between fixed effects in years of potential experience and the cohort national unemployment rate, $UR_{c,g}$. These scars can be interpreted as the deviations from the typical European experience profile of outcome, Y. I flexibly model the scarring process by using fixed effects in potential experience. This allows me to estimate a detailed profile of scars from career commencement to a decade into an employee's career[11]. The scarring estimates can be interpreted causally if the cohort national unemployment is exogenous- this is an identifying assumption. I assume people do not account for conditions in the national labour market when deciding when to complete education.

I also estimate additional regression equations which allow for more heterogeneity in how outcomes, Y, evolve across countries. In Equation 1, an average experience profile for European countries is estimated. Average European wide scarring effects are then identified as deviations from this average experience profile induced by spikes in cohort national unemployment rates in individual countries. I augment Equation 1 by also estimating regressions which fit country specific experience profiles alongside an average European experience profile. This approach allows for experience profiles of wages and other outcomes to be estimated at the country level, while wage scarring effects are measured as a European average. Lagkos et al., (2018) show that there is substantial variation in wage-experience profiles across developed countries. Appreciating this stylised fact and allowing returns to experience to vary at a national level, while estimating aggregate European scarring effects is an important robustness check in a cross-country wage scarring study. In contrast, most of the wage scarring literature examines a single country and exploits variation in unemployment rates of regional labour markets (states in the case of the US or municipalities of varying definitions in Europe). In a given country, there will be less variation in the returns to experience across regions than will be the case across countries.

[11] Another option is to interact cohort unemployment rates with a linear trend in experience. This implies that the scarring process is constant at each of experience however.

As such, the inclusion of unit specific returns to experience is important in a cross-country setting but less so in a country level study. In Equation 2 I include a country specific experience trend and in Equation 3 I include a series of country-experience fixed effects. In estimating all these models, I cluster my standard errors at the country-cohort level to account for serial correlation of outcomes of individuals beginning their careers in the same economic setting. I estimate Equations 1, 2 and 3 for my entire sample of employees. I also examine whether scarring effects are heterogenous by estimating the three models separately by educational attainment[12] and by country type[13].

$$\bar{Y}_{c,t,g,e,d} = a + B_c + \partial_t + \gamma_e + \delta_g + \rho_d + B + \sum_{c=1}^{c=13} \beta_{e,c} \left(Country_c X\ Pot.Exp_e \right) + \sum_{e=1}^{e=10} \beta_{e,s} \left(UR_{c,g} X\ Pot.Exp_e \right) \quad (2)$$

$$\bar{Y}_{c,t,g,e,d} = a + B_c + \partial_t + \gamma_e + \delta_g + \rho_d + B + \sum_{e=1}^{e=10} \sum_{c=1}^{c=13} \beta_{e,c} \left(Country_c X\ Pot.Exp_e \right) + \sum_{e=1}^{e=1} \beta_{e,s} \left(UR_{c,g}\ X\ Pot.Exp_e \right) \quad (3)$$

Results

Full Sample

I estimate Equations 1, 2 and 3 for my full sample of employees. I refer to Equation 1 as my baseline model as it is a specification common to the literature. Equation 2 augments the baseline model with a country specific experience trend. Equation 3 adds a series of country experience fixed effects to the baseline model.

The scarring estimates for these three models are plotted for log hours worked, log hourly wage and log weekly earnings in Figure 1. These are also in tabular form in Appendix Table A1. In the baseline model scars on earnings and wages are small and not statistically different from zero in the first four years after graduation. The baseline scars are close to 1% for every 1 percentage

[12] Those with and without a college degree.
[13] Those who experienced a harsh sovereign debt crisis during the financial crisis-Portugal, Italy, Ireland, Greece and Spain as compared to all other countries in my sample.

point (ppt.) increase in national unemployment rate (UR) at graduation from years five to ten. Once a country specific experience effect, either trend or fixed effect, are added the results vary. These result in larger losses, of 2% for every 1 ppt. increase in UR at graduation in year one. These losses decrease rapidly in experience and are not statistically different from zero after three years at the 95% confidence level.

There is also a noticeable labour supply effect, with hours worked decreasing by 0.5% for every 1 ppt. increase in UR at graduation. This reduction in hours worked effect decrease in experience and are present for six years in the baseline model and five years in models with country specific experience profiles. In all models there is a spike in hours worked of close to 0.5% nine to ten years after graduation for every 1 ppt. increase in UR at graduation. This increase in hours worked is likely a supply side response. As hourly wage scars tend to zero, hours worked increase in response to a higher real wage.

The hourly wage scars I estimate in Panel B of Figure 1 are very similar to those estimated in a recent comparable study of a broad class of employees in the United States by Schwandt & von Wachter (2019). Schwandt & von Wachter found that a 1 ppt. increase in the state UR at graduation led to just over a 1% decrease in hourly wages for the first five years of experience, with losses of close to 0.5%for the next five years. My point estimates are similar to these, although with much larger standard errors, once experience variants across countries are accounted for. Despite the noise around the estimates, it is surprising that hourly wage losses in the face of a common shock, 1 ppt. increase in unemployment, results in similar effects on wages years later. This highlights that wages for new workers in the European labour market are quite flexible and can adjust downward in the face of an adverse shock.

[[Figure 1 near here]]

Schwandt & von Wachter found that annual earnings losses were much larger than hourly wage losses. This effect was amplified by both weeks worked per year and usual weekly hours being reduced in the face of an unemployment shock at graduation. The earnings scars I calculate are based on weekly earnings and are smaller than US estimates as I cannot incorporate decreases in weeks worked which may likely be incurred by recession cohorts.

While on aggregate, the wage and earnings scar estimated seem non-trivial, the standard errors on the estimates are quite large meaning these estimates are typically not different from zero at the 95% confidence level. In addition, the results vary across models. These noisy estimates for a broad class of work could mask large negative effects certain workers face. To assess if this is the case I estimate how these wage scarring effects vary for employees based on educational attainment- a common theme in the literature, and across countries- a margin unique to a cross-country study.

Educational Attainment

I estimate Equations 1-3 separately for those who have a college degree and those who do not. This is equivalent to estimating these equations with a set of dummies for educational attainment interacted with each variable. This allows experience, year, country and scarring effects to vary based on educational attainment. The estimated scarring effects have a within-group interpretation. They are the penalties incurred, at each level of experience, for a ppt. increase in UR for college (non-college) graduates compared to college (non-college) graduates who did not incur this UR increase at graduation.

My results indicate that scarring is very different based on educational attainment. In Figure 2, I plot scarring estimates for both educational groups. These are also tabulated in Appendix Table A2. What's clear is that losses for college graduates, in both hourly wages and weekly earnings, are large, persistent and very similar in all three models estimated. Hourly wages are lower by 2% for the first three years and close to 1.5% for years four through nine for every ppt. increase in UR at graduation. By year ten, the estimates are smaller than 1% and not different from zero. Earnings losses tend to be larger in early years of experience, due to a decrease in hours worked in the first two years of experience worked- 0.5% for every 1 ppt. increase in UR. As hours worked increase in years eight to ten, by just under 0.5% for every 1 ppt. increase in UR at graduation, earnings[14] losses tend to converge to zero faster than wages.

[[Figure 2 near here]]

There is no evidence of any income losses for lower skilled labour owing from starting their career in a weaker labour market. For wages and earnings, all three models suggest scars for non-

[14] Earnings are defined as weekly here: weekly earnings=hourly wage x hours worked

college educated employees are not statistically different from zero and point estimates are generally small. These results complement research by Cockx & Ghirelli (2016) who found that college educated workers incurred larger and more persistent income losses from beginning their career in a recession in Flanders. Minimum wages in Europe act as a wage floor and truncate losses, offering additional protection to low-skilled labour during a recession who find employment.

Crisis countries

European countries had very different experiences in the aftermath of the 2008 financial crisis. Between 2008 and 2012, the Greek labour market saw unemployment rates rise from 7% to 24%. Spain experienced a comparable spike while Ireland, Italy and Portugal saw rates rise by over 5 percentage points. In contrast, Austria saw next to no change in unemployment while Belgium, Finland and France had very little upward movement. Germany even experienced a decrease in unemployment over the crisis- with unemployment rates falling from 7.4% in 2008 to 5.4% by 2012. I examine possible differences emerging across countries by grouping countries based on how severely they were affected by the Great Recession. I define crisis countries as Portugal, Italy, Ireland, Greece and Spain - the so called "PIIGS" during the downturn. These countries had the most severe sovereign debt crises during the Great Recession alongside the largest loss in employment. I compare scarring dynamics in these crisis countries with the other countries in my sample by estimating Equations 1-3 separately by country type. I only examine college graduates in these country type regressions. From Figure 2 it's apparent that income scars are levied at college graduates and not less educated workers.

These regression results are displayed in Figure 3. For crisis countries, a 1 ppt. increase in UR at graduation is associated with a 2% decrease in earnings/wages in year one. These losses decrease slightly by year six. In years seven they increase, and by year ten statistically significant losses of over 1% are still evident. All three models estimated yield very similar results on this front.

Scarring estimates on wages and earnings tend to be larger for non-crisis countries. These have a far larger confidence interval however, so it's unlikely that scars in crisis and non-crisis will be statistically different from one another. Income losses over 3% are evident in the first year of experience in the baseline specification. Including additional controls for country-experience effects brings this estimate closer to 2%. For all other years of experience, scars vary based on

model specification. However, scarring point estimates from years two to ten always exceed 1% and are typically as large as 2% for every ppt. increase in UR at graduation.

[[Figure 3 near here]]

These results indicate that young workers in crisis and non-crisis countries both face income penalties when faced with rising unemployment on labour market entry. However, a reader should not conclude that the effects of the Great Recession in crisis and non-crisis countries are comparable. Unemployment rates increased significantly more in crisis countries than in non-crisis countries, therefore the total impact of the Great Recession will be much larger in crisis countries. From 2007-2012, unemployment rates increased by 10.87 percentage points in crisis countries. This was much lower, at just 1.05 percentage points in non-crisis countries[15]. I simulate the effect that these unemployment changes would have on hourly wages by rescaling the scarring estimates from the baseline model (Equation 1) in Figure 3 (B1 and 2), for crisis and non-crisis countries by the average jump in unemployment rates in crisis and non-crisis countries from peak to trough of the Great Recession (2007-2012). These simulated wage scars are presented in Figure 4. It's clear that cohorts in crisis countries face much larger wage losses, of over 20% in year one, before decreasing below 15% by year six and subsequently hovering around 20% in years seven to ten. Losses are much smaller, close to 3% in any given experience year for cohorts in non-crisis countries. These estimates show that the Great Recession had differential effects across Europe, with very large penalties likely to be borne for cohorts in crisis countries.

[[Figure 4 near here]]

Sensitivity Analysis

Possible sources of bias

The scarring parameters I estimate can be biased from endogenous labour market entry and cyclical migration. These are issues in country specific studies such as in the United States- see Schwandt & von Wachter (2019), these will also need to be accounted for in a cross-country study. In short, both these sources of endogeneity could lead to variation in cohorts over the business cycle.

[15] These average unemployment rate jumps are a simple average of the change in unemployment rates across each component country.

Endogenous labour market entry: People may choose to alter their educational attainment if they wish to avoid a weak initial labour market. Micklewright, Pearson, & Smith (1989) argue that high unemployment interacts with educational attainment in three ways. Firstly, high unemployment may decrease the opportunity cost of education and will encourage remaining in full-time education. Secondly, unemployment of other household members may encourage individuals to leave education and look for work. Thirdly, high unemployment may generate more uncertainty about the returns to education and will lead risk averse individuals to reduce their optimal schooling. Overall, these effects are conflicting and the effect of a recession on schooling rates will vary depending on the relative strength of each channel.

It's clear though, that if educational attainment is linked to the business cycle this increases the likelihood that individuals starting their careers in a recession may be systematically different on some traits (observable or otherwise). While ex ante, we cannot determine the sign the bias, nevertheless we ought to be aware of the possibility. This would introduce a self-selection bias to the estimated scarring effects as there could be underlying productivity differences between those workers who chose to continue in education and those entering the labour force in a recession.

Endogenous migration: Another form of selection bias could be introduced if international emigration occurs in response to adverse economic conditions. If this occurs, there is likely to be substantial bias embedded in the country level data I use for my analysis. This may be particularly true of smaller European countries, with the Irish case during the financial crisis springing to mind. The number of people leaving Ireland rose threefold from 2006 to 2012 in the aftermath of the Great Recession (Central Statistics Office, 2019). In the UK, Ireland's nearest neighbour, fewer people migrated in 2012 as compared to 2006[16] (Office of National Statistics, 2019).

Strategic labour market entry

Up to this point I have assumed that the cohort unemployment rate was exogenous, meaning the business cycle did not affect educational attainment rates. This is an identifying assumption, but I can get a sense of its validity by plotting cohort educational attainment rates against lagged

[16] 36,000 emigrate Ireland in 2006, rising to 83,000 by 2012. In the UK 341,000 emigrated in 2006 with this number falling to 286,000 by 2012.

unemployment rates. I do this in Figure 5, where I plot the portion of each cohort[17] with a college degree against the unemployment rate one and four years prior to graduation. In the first case, if cohort college attainment rates are correlated with the lagged unemployment rate, this indicates that college graduates are likely prolonging their time in college by completing master's degrees etc. This would result in the probability of being a college graduate being acyclical, but across college graduates there would be cyclical variation in years of education. However, if attainment rates are more correlated with lagged unemployment rates four years prior to graduation, this would indicate that the unemployment rates at high school completion influence a young person's decision to attend college. If such a pattern emerged, one could reasonably conclude that the decision to attend college is itself very cyclical. This would result in substantial cyclical variation in cohort quality, which would bias identified scarring estimates.

I use cohorts from 2003 to 2013 to isolate how educational attainment rates may have been affected by the Great Recession. From Figure 5 it is clear that there is variation in college attainment. At the lowest point, 45% of new employees in 2006 had a college degree in contrast to the high of 57% in 2013. The most striking pattern is the steady rise in college completion rates for new employees from 2010 to 2013, rising by 10 percentage points. This pattern is highly correlated with unemployment rates the year before graduation and seemingly unrelated to unemployment rates four years prior to graduation. Based on this evidence, I assume that education is related to the business cycle. However, I conclude that patterns in unemployment rates do not lead individuals to pursue a college education. Rather, those who would already receive a college education increase their years of schooling- by completing a masters degree, PhD etc. As such, I assume that the types of people emerging as college graduates (broadly defined) is not cyclical.

[[Figure 5 near here]]

I integrate this conclusion into an instrumental variable strategy to assess the possible bias that this cyclical variation in years of schooling may introduce. I instrument actual year of graduation with a simulated year of graduation. For college graduates, I instrument the national unemployment rate at age 22 for the cohort unemployment rate. For non-college graduates, the

[17] These are just based on employees on my sample. I do not consider the educational attainment rate of unemployed youth.

national unemployment rate at age 18 instruments for the cohort unemployment rate. I limit my sample of college graduates to be aged between 23 and 32, so that I now estimate scarring parameters up to ten years since simulated graduation year (or equally since age 22). I do the same for non-college educated, with the sample comprising of those aged 19 to 28. In Figure 6 I plot this age-educational attainment UR against the cohort UR. It's clear that the two variables are highly correlated, meaning the instrument will be very strong. I estimate the model via two-stage least squares regression. My first stage regression is shown in Equation 5. I use the same cell average approach as in Equations 1, 2 and 3. I pool college and non-college educated together and predict the cohort unemployment rate $UR_{c,g}$ based on cohort (c), year (t), experience (e), educational attainment (e) and the cell average age-educational attainment unemployment rate, $\overline{UR}_{c,18,22}$. In the second stage, the predicted values from the first stage are used to estimate scarring parameters arising from the simulated graduation year. This set-up is identical to Equation 1 and I also estimate models which include country specific experience trends and fixed effects as per Equations 2 and 3. In estimating these models I just examine log hourly wages. My key assumptions in this set-up are:

- The exclusion restriction holds, namely cov(($\widehat{UR_{c,g}}$, $\varepsilon_{c,t,g,e,d}$)=0. It's reasonable to assume that national unemployment rates young workers face at specific ages are exogenous. A person may be able to manipulate their cohort unemployment rate by adjusting their time in education, but as a person cannot adjust their age, age-based unemployment rates will be exogenous. As a result, these won't be correlated with unobserved factors captured in the error term of the second stage wage regression.
- I assume that unemployment rates at 18 don't influence the likelihood that an individual completes college. Recessions can lead non-college graduates to stay in high school until graduation or forego completing high school, while they lead college graduates to adjust their years of college education. Educational attainment is cyclical on the intensive margin in this set-up, while types (non-college/ college graduate) are acyclical.

$$UR_{c,g} = a + B_c + \partial_t + \gamma_e + \delta_g + \rho_d + B + \overline{UR}_{18,22} \quad (5)$$

$$\bar{Y}_{c,t,g,e,d} = a + B_c + \partial_t + \gamma_e + \delta_g + \rho_d + \sum_{e=1}^{e=10} \beta_{e,s} \left(\widehat{UR_{c,g}}\ X\ Pot.Exp_e\right) + \varepsilon_{c,t,g,e,d} \quad (6)$$

In Appendix Table A3, I show reduced form estimates from Equation 6 and in Appendix Table A4 I show instrumental variable results from estimating Equations 5 and 6. For all specifications, wage scars for non-college educated workers are small and not different from zero. Similarly, the reduced form and instrumental variable results for college graduates are comparable to my main estimates (show in Appendix Table A1). This indicates that possible endogenous entry into the labour market does not materially impact my findings.

Endogenous international migration

The ECHP and SILC do not contain a full migration history of individuals. I also do not observe workers who leave the country after an unemployment shock. Using national level data to estimate scarring effects on a sample of "stayers" would result in biased estimates if there are systematic differences between those who emigrate and those who stay after a recession. However, it's likely that migration is less of an issue in a cross-country setting. Flows of people will likely be lower across countries than across local labour markets such as US states. As such, an advantage of this research design is that estimates are less likely to be biased by flows of people across countries in response to unemployment shocks.

In any case, I make an allowance for international migration and assess how it affects my scarring estimates for hourly wages. I estimate the stability of native population in each of my sample countries. I do so by using the World Bank Global Bilateral Migration database[18]. For a given country, this database shows where all migrants residing in the country were born. These data are predominantly based on census data, but population registers and nationally representative surveys are occasionally used. For all 13 countries in my sample I construct a measure of how mobile each country's native population is. This the number of natives not living in the country divided by the national population. Formally, for a given country *a,* in year *t*, I create a migration rate *R* as:

[18] These data are freely available at: https://datacatalog.worldbank.org/dataset/global-bilateral-migration-database . I select all possible country of destination combinations and only select country of origin for the countries in my sample.

$$R_{a,t} = \frac{\sum_i^j Natives_{a,t}}{Population_{a,t}} \quad (7)$$

This is the sum of all natives of a country a living in all other countries *i* to *j* globally, in year *t*. I divide by the population of country *a* in year *t* to get a sense of scale of migrants globally. These migration rates are stocks rather than estimates of flows- as I do not know when a native of country *a* emigrated to another country. I calculate the ratios in ten-year intervals from 1970-2000. I then average these estimates to get a long-run average of population mobility. These migration rates are displayed in Table 2.

[[Table 2 near here]]

Ireland (30.2%), Portugal (16.2%) and Greece (11.4%) have the most migratory native populations. As a robustness check I estimate my IV models but exclude these three high migration countries. The results for college graduates are very similar, a 1 ppt. increase in UR decreases wages by close to 2% in year one, scars of 1% are present ten years later. For non-college graduates, there is no evidence of negative wage scarring. These results are displayed in Appendix TableA4. From this I conclude that migration does not bias my main scarring estimates.

Conclusions

The effects of recessions have interested economists, policy makers and the public. The academic discourse on wage scarring in Europe has been varied, with substantial variation in the magnitude and persistence of negative penalties across countries.

In this paper I find that wage scarring in the European labour market is only applicable to high skilled labour in the form of college graduates. Wage scars are large initially, at 2% for every percentage point increase in unemployment at graduation. These losses fade to zero over a ten-year horizon- in line with findings from the US and Canada.

I also simulate the effect of the Great Recession for new college graduates in Europe. I find that wages decrease by over 20% a year after graduation for workers in countries most severely affected by the recession. These losses are large in ensuing years, and a wage penalty of 20% are

present ten years after graduation. These findings are important as they show the blunted financial outcomes of unlucky cohorts in the years after they face an unemployment shock.

These results show that the wages of higher skilled new workers are very sensitive to macroeconomic circumstance. Unlucky cohorts, beginning their careers in a recession, bear large and persistent losses to the wages. From a policy perspective, the large recessions which will emerge in Europe from the coronavirus pandemic will result in large employment losses. However, policy makers ought to bear in mind that young college graduates who do find employment will have dampened career prospects for up to a decade.

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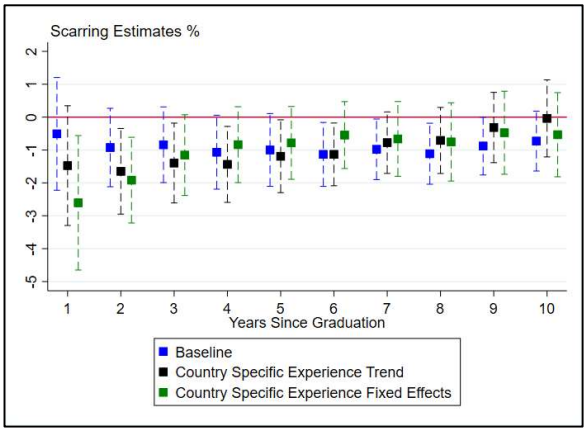
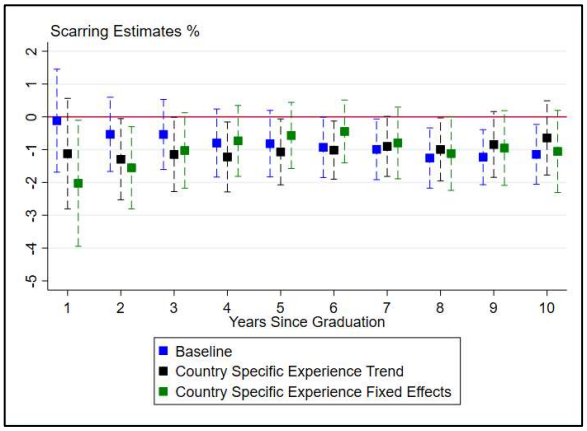
Figures

Figure 1: Scarring estimates of a 1 ppt. increase in national UR at graduation, full sample

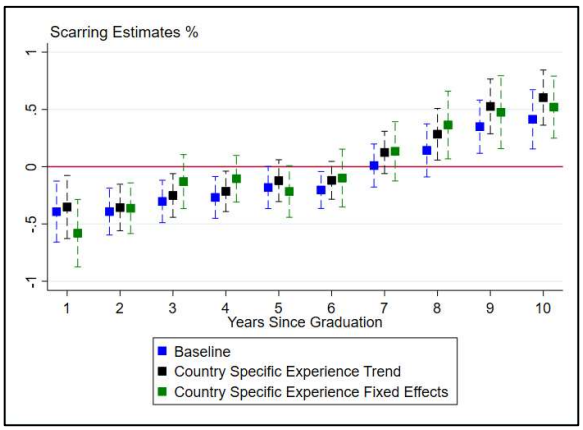
A. Log earnings



B. Log hourly wage



C. Log hours worked



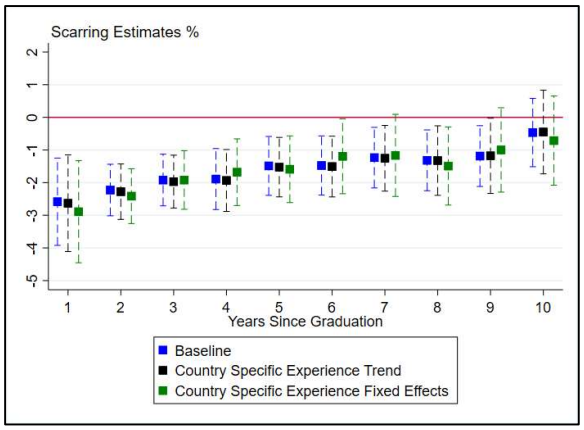
Source Author's analysis using ECHPS 1995-2001 and SILC 2004-2015 for 1987-2014 graduation cohorts.

Notes:

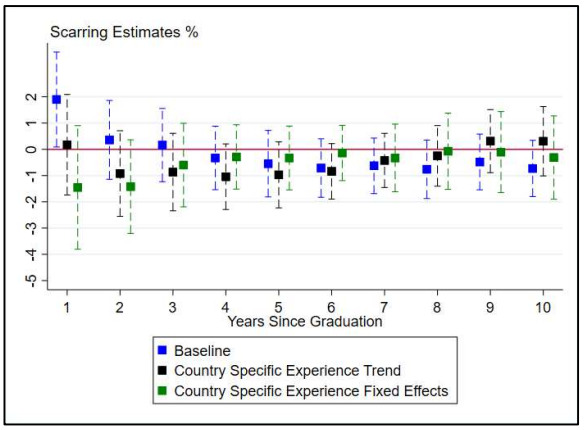
a. The shapes plot scarring estimates (rescaled to be expressed in percentage terms), with associated 95% confidence interval from Equations 1-3.
b. "Baseline" is Equation 1. "Country Specific Experience Trend" is Equation 2. "Country Specific Experience Fixed Effects" is Equation 3.
c. Standard errors are clustered at the country-cohort level. Only employees are included.

Figure 2: Scarring estimates of a 1 ppt. increase in national UR at graduation, by educational attainment

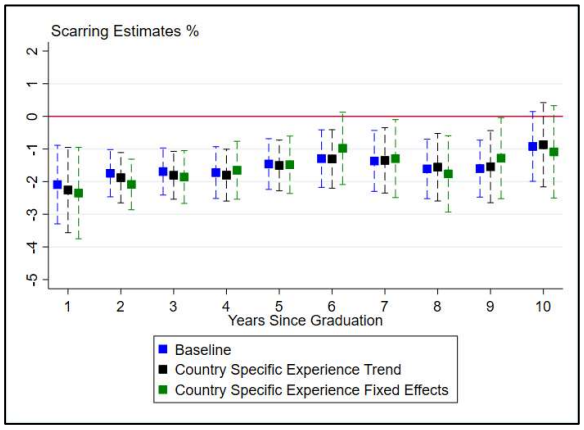
A1. Log earnings: college graduate



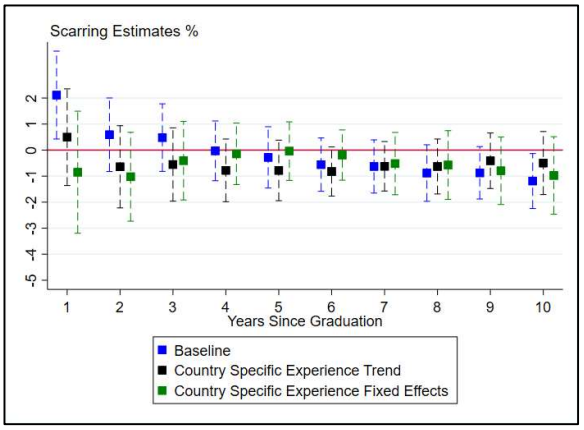
A2. Log earnings: non-college



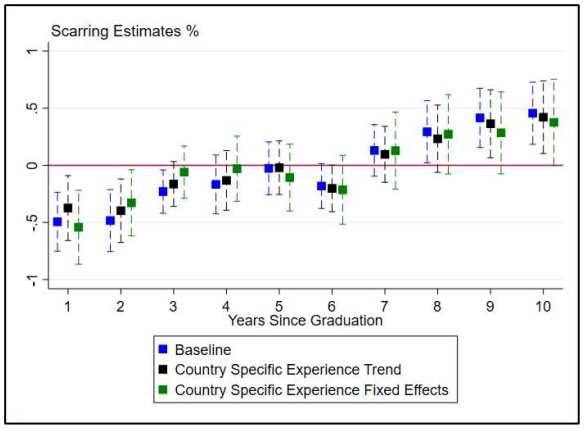
B1. Log hourly wage: college graduate



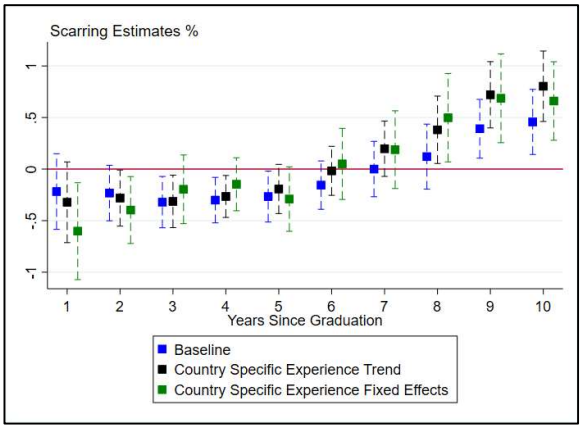
B2. Log hourly wage: non-college



C1. Log hours worked: college graduate



C2. Log hours worked: non-college

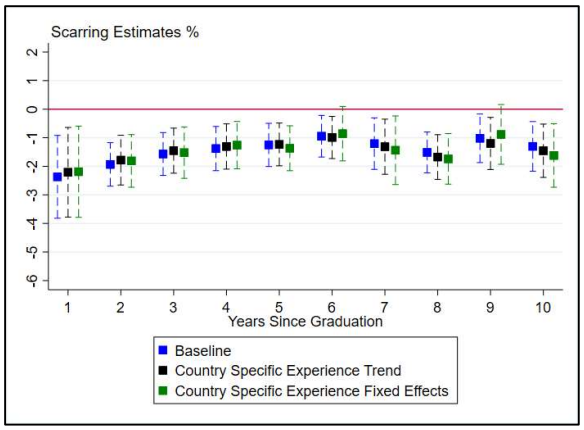


Source Author's analysis using ECHPS 1995-2001 and SILC 2004-2015 for 1987-2014 graduation cohorts.
Notes:

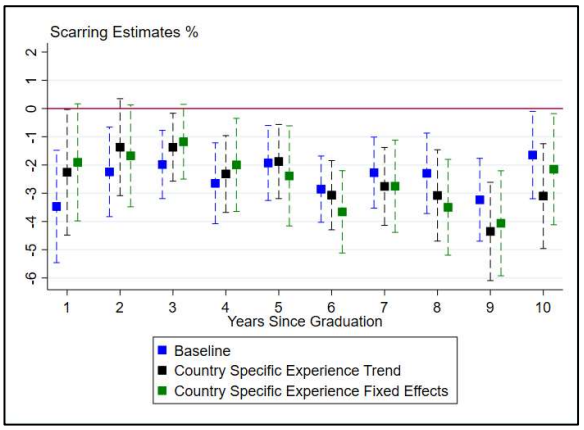
a. The shapes plot scarring estimates (rescaled to be expressed in percentage terms), with associated 95% confidence interval from Equations 1-3.
b. "Baseline" is Equation 1. "Country Specific Experience Trend" is Equation 2. "Country Specific Experience Fixed Effects" is Equation 3. Each equation is estimated separately for employees with college degrees and those without college degrees.
c. Standard errors are clustered at the country-cohort level. Only employees are included.

Figure 3: Scarring estimates of a 1 ppt. increase in national UR at graduation, for college graduates by country type

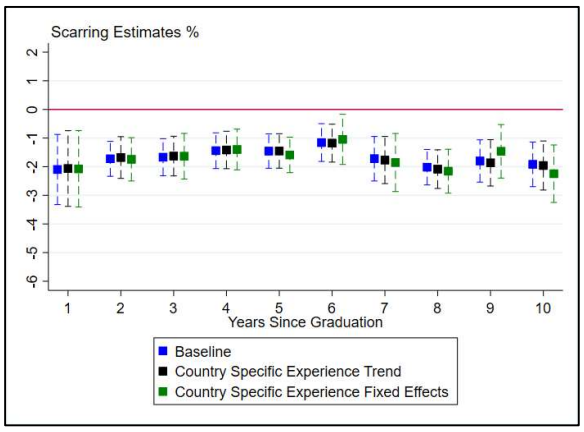
A1. Log earnings: crisis



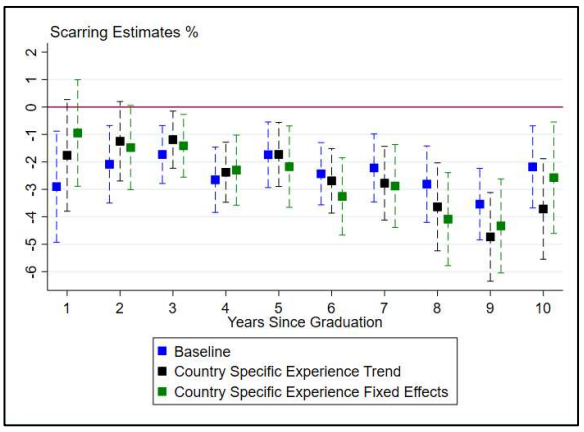
A2. Log earnings: non-crisis



B1. Log hourly wage: crisis

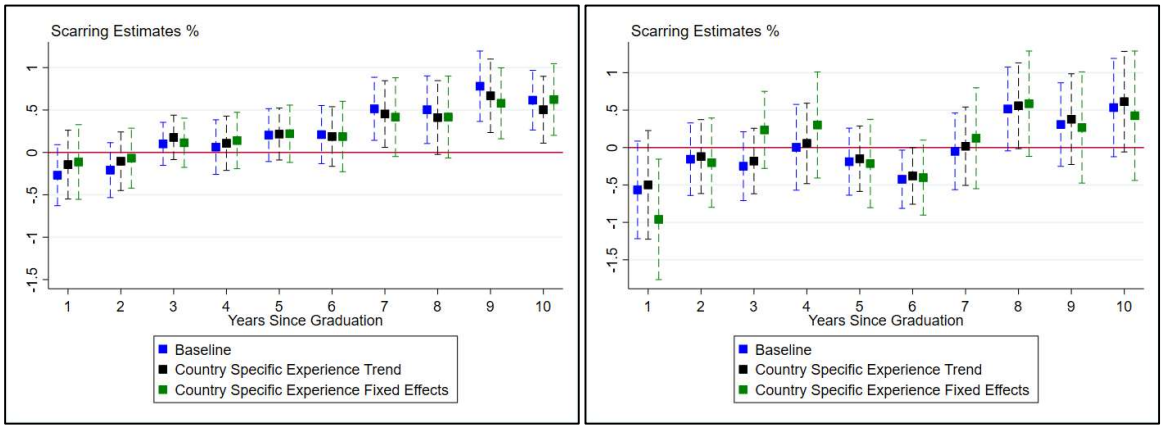


B2. Log hourly wage: non-crisis



C1. Log hours worked: crisis

C2: Log hours worked: non-crisis

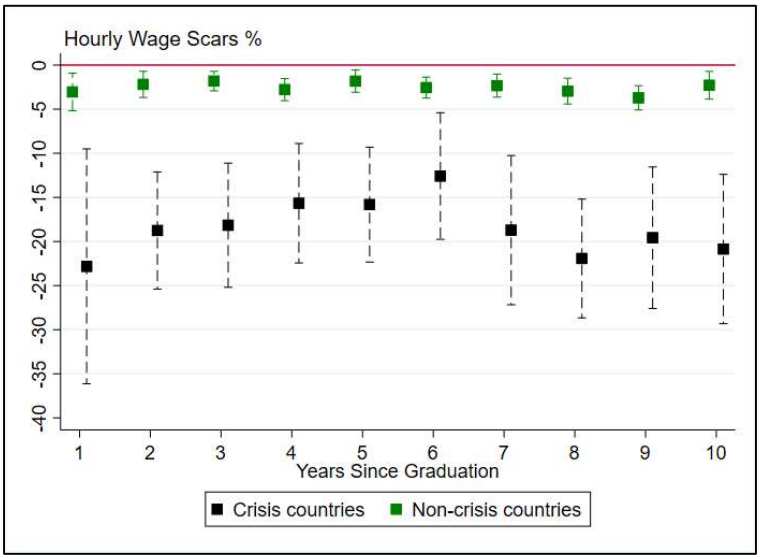


Source Author's analysis using ECHPS 1995-2001 and SILC 2004-2015 for 1987-2014 graduation cohorts.

Notes:

a. The shapes plot scarring estimates (rescaled to be expressed in percentage terms), with associated 95% confidence interval from Equations 1-3.
b. "Baseline" is Equation 1. "Country Specific Experience Trend" is Equation 2. "Country Specific Experience Fixed Effects" is Equation 3.
c. Crisis countries are Portugal, Italy, Ireland, Greece and Spain. Non-crisis countries are the remaining countries in my sample. I estimate Equations 1-3 separately for each country type
d. Standard errors are clustered at the country-cohort level. Only employees with a college degree are included.

Figure 4: Simulated hourly wage scars for Great Recession cohorts- baseline model estimates



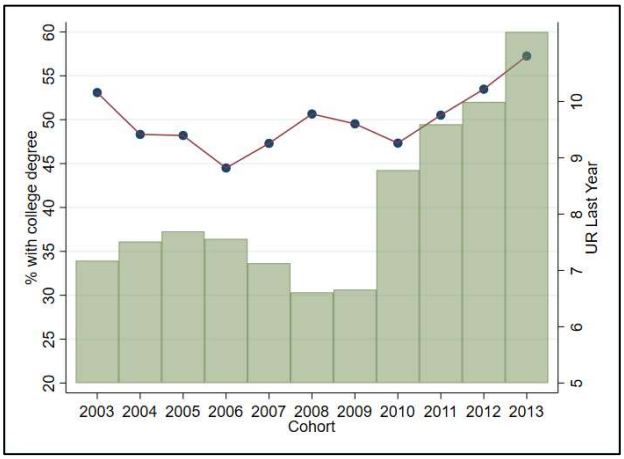
Source Author's analysis using ECHPS 1995-2001 and SILC 2004-2015 for 1987-2014 graduation cohorts.

Notes:

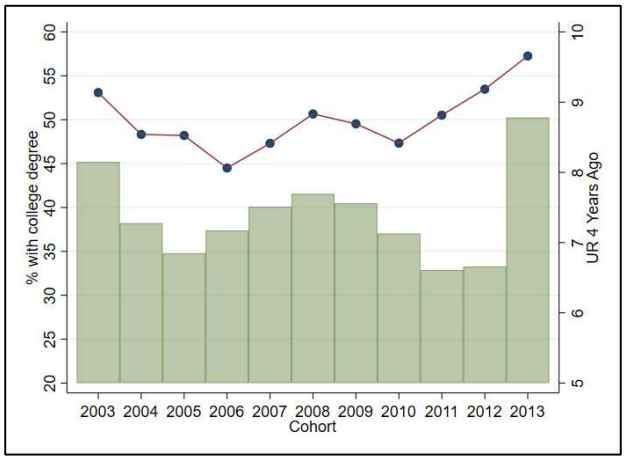
a. The shapes are point estimates, with associated 95% confidence interval.
b. These are the hourly wage scarring estimates for college graduates in crisis and non-crisis countries from Equation 1 (baseline model results from Figure 2, B1 & B2) rescaled by the average jump in unemployment rates in crisis (10.87 percentage points) and non-crisis (1.05 percentage points) countries from 2007-2012.
c. Crisis countries are Portugal, Italy, Ireland, Greece and Spain. All other countries are classified as non-crisis.

Figure 5: Cohort educational attainment and lagged unemployment rates

A. Attainment plotted against the average unemployment rate the year prior to graduation

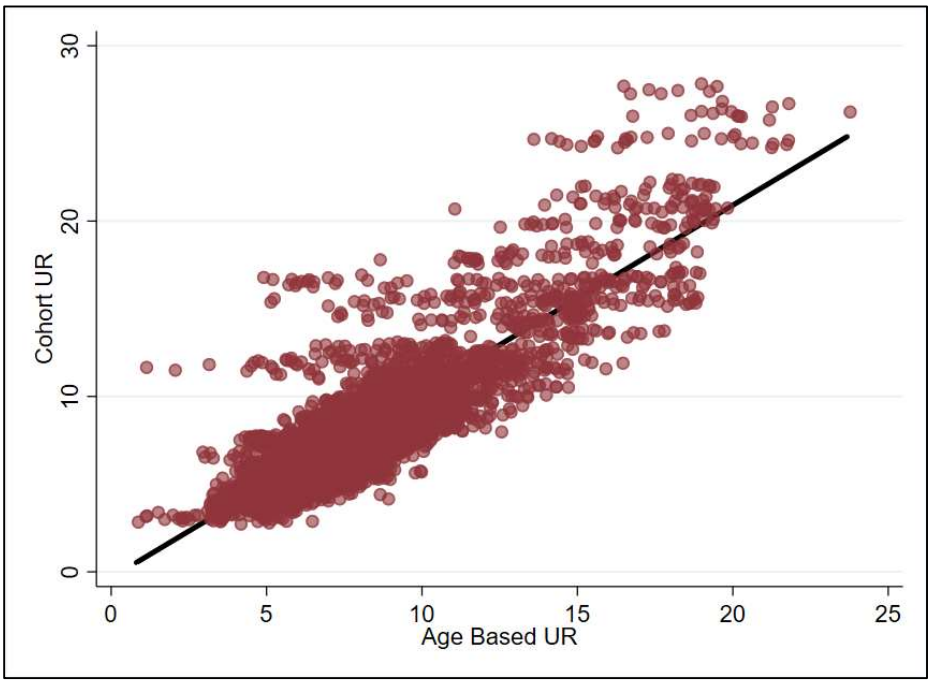


B. Attainment plotted against the average unemployment rate four years prior to graduation



Source Author's analysis of SILC 2004-2017
Notes: The dots are the portion of a given cohort in employment one year after graduation who have a college degree. The bars are the lagged cohort unemployment rates. In A this is the unemployment rate the year before the cohort finished education. In B this is the unemployment rate 4 years before the cohort finished education.

Figure 6: Plot of cohort unemployment rates and age-educational based unemployment rates



Notes: The cohort unemployment rate is on the Y-axis. The instrument, age-educational unemployment rate is on the X-axis. A line of best fit plots the correlation between the instrument and cohort unemployment rates.

Tables

Table 1: Cohort unemployment rates for sample countries, 1987-2014

Country	Average (%)	Standard Deviation (%)
Spain	16.4	5.2
Greece	13.7	6.6
Ireland	10.6	4.7
France	10.0	1.4
Finland	9.5	3.5
Italy	9.4	1.7
Belgium	8.1	1.0
Portugal	8.1	3.4
Germany	7.6	1.9
UK	7.0	1.7
Denmark	6.0	1.6
Netherlands	5.7	1.4
Austria	4.5	0.7

Table 2: Migration rates among sample countries

Country	Migration Rate (%)
France	2.6
Germany	3.9
Belgium	4.2
Denmark	4.3
Spain	4.7
Netherlands	5.1
UK	7.2
Finland	7.3
Austria	7.4
Italy	7.5
Greece	11.4
Portugal	16.2
Ireland	30.2

Source World Bank Global Bilateral Migration database

Notes: The migration rates are estimated for 1970, 1980, 1990 and 2000 using Equation 7. The average of these values is shown. These represent the long-run ratio of natives living in all other countries globally to the population of their home country.

Appendix

Table A1: Scarring estimates, full sample

	Earnings			Log Hours Worked			Log Hourly Wage		
Years Since Graduation	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
1	-0.005	-0.015	-0.026	-0.004	-0.004	-0.006	-0.001	-0.011	-0.020
	[-0.585]	[-1.612]	[-2.530]	[-2.916]	[-2.532]	[-3.909]	[-0.144]	[-1.328]	[-2.093]
2	-0.009	-0.017	-0.019	-0.004	-0.004	-0.004	-0.005	-0.013	-0.016
	[-1.539]	[-2.520]	[-2.922]	[-3.804]	[-3.486]	[-3.247]	[-0.935]	[-2.079]	[-2.467]
3	-0.008	-0.014	-0.012	-0.003	-0.003	-0.001	-0.005	-0.012	-0.010
	[-1.446]	[-2.286]	[-1.878]	[-3.268]	[-2.631]	[-1.118]	[-0.991]	[-2.004]	[-1.774]
4	-0.011	-0.014	-0.008	-0.003	-0.002	-0.001	-0.008	-0.012	-0.007
	[-1.880]	[-2.468]	[-1.432]	[-2.936]	[-2.445]	[-1.032]	[-1.520]	[-2.270]	[-1.333]
5	-0.010	-0.012	-0.008	-0.002	-0.001	-0.002	-0.008	-0.011	-0.006
	[-1.786]	[-2.124]	[-1.389]	[-1.988]	[-1.352]	[-1.908]	[-1.587]	[-2.096]	[-1.099]
6	-0.011	-0.011	-0.005	-0.002	-0.001	-0.001	-0.009	-0.010	-0.004
	[-2.301]	[-2.337]	[-1.045]	[-2.517]	[-1.445]	[-0.793]	[-1.988]	[-2.245]	[-0.902]
7	-0.010	-0.008	-0.007	0.000	0.001	0.001	-0.010	-0.009	-0.008
	[-2.097]	[-1.625]	[-1.132]	[0.073]	[1.302]	[0.988]	[-2.106]	[-1.922]	[-1.411]
8	-0.010	-0.006	-0.007	0.001	0.002	0.003	-0.011	-0.009	-0.010
	[-2.276]	[-1.252]	[-1.123]	[0.827]	[2.082]	[2.078]	[-2.484]	[-1.785]	[-1.716]
9	-0.008	-0.002	-0.004	0.003	0.005	0.005	-0.011	-0.007	-0.008
	[-1.801]	[-0.382]	[-0.577]	[3.079]	[4.514]	[3.122]	[-2.727]	[-1.455]	[-1.476]
10	-0.007	0.001	-0.004	0.004	0.006	0.005	-0.011	-0.005	-0.010
	[-1.459]	[0.095]	[-0.682]	[3.275]	[5.077]	[3.914]	[-2.383]	[-0.967]	[-1.537]
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Experience FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cohort FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Education FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-Experience Trend	No	Yes	No	No	Yes	No	No	Yes	No
Country-Experience FE	No	No	Yes	No	No	Yes	No	No	Yes
Observations	5,229	5,229	5,229	5,229	5,229	5,229	5,229	5,229	5,229
R-Squared	0.820	0.828	0.835	0.365	0.428	0.442	0.846	0.858	0.863

Source Author's analysis using ECHPS 1995-2001 and SILC 2004-2015 for 1987-2014 graduation cohorts.

Notes:

a. These are the scarring estimates from Equations 1-3 for wages, earnings and hours worked for all employees in my sample.

b. The equation estimated is the column number. T-statistics are in parentheses. Standard errors are clustered at the country-cohort graduation level.

Table A2: Hourly wage scarring results, main estimates by educational attainment

	Non-College			College		
Years Since Graduation	(1)	(2)	(3)	(1)	(2)	(3)
1	0.021	0.005	-0.009	-0.021	-0.023	-0.024
	[2.475]	[0.509]	[-0.725]	[-3.419]	[-3.412]	[-3.321]
2	0.006	-0.007	-0.010	-0.017	-0.019	-0.021
	[0.820]	[-0.819]	[-1.197]	[-4.754]	[-4.826]	[-5.337]
3	0.005	-0.006	-0.004	-0.017	-0.018	-0.019
	[0.730]	[-0.789]	[-0.546]	[-4.607]	[-4.853]	[-4.528]
4	-0.000	-0.008	-0.001	-0.017	-0.018	-0.016
	[-0.059]	[-1.293]	[-0.245]	[-4.263]	[-4.456]	[-3.647]
5	-0.003	-0.008	-0.000	-0.015	-0.015	-0.015
	[-0.478]	[-1.334]	[-0.071]	[-3.681]	[-3.787]	[-3.286]
6	-0.006	-0.008	-0.002	-0.013	-0.013	-0.010
	[-1.077]	[-1.715]	[-0.383]	[-2.872]	[-2.840]	[-1.707]
7	-0.006	-0.006	-0.005	-0.013	-0.013	-0.013
	[-1.228]	[-1.291]	[-0.848]	[-2.852]	[-2.617]	[-2.090]
8	-0.009	-0.006	-0.005	-0.014	-0.013	-0.015
	[-1.626]	[-1.134]	[-0.812]	[-2.788]	[-2.363]	[-2.354]
9	-0.008	-0.003	-0.007	-0.014	-0.014	-0.011
	[-1.691]	[-0.653]	[-1.142]	[-3.275]	[-2.459]	[-1.788]
10	-0.011	-0.004	-0.009	-0.008	-0.008	-0.010
	[-2.198]	[-0.695]	[-1.189]	[-1.573]	[-1.182]	[-1.435]
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Experience FE	Yes	Yes	Yes	Yes	Yes	Yes
Cohort FE	Yes	Yes	Yes	Yes	Yes	Yes
Education FE	N/A	N/A	N/A	N/A	N/A	N/A
Country-Experience Trend	No	Yes	No	No	Yes	No
Country-Experience FE	No	No	Yes	No	No	Yes
Observations	2,622	2,622	2,622	2,607	2,607	2,607
R-Squared	0.809	0.844	0.853	0.879	0.883	0.887

Source Author's analysis using ECHPS 1995-2001 and SILC 2004-2015 for 1987-2014 graduation cohorts.

Notes:

a. These are the scarring estimates from Equations 1-3 for wages for employees with and without college degrees.
b. Models are estimated separately for college and non-college educated employees. The equation estimated is the column number.

c. T-statistics are in parentheses. Standard errors are clustered at the country-cohort graduation level.

Table A3: Wage scarring results, reduced form estimates by educational attainment

	Non-College			College		
Years Since Simulated Graduation	(1)	(2)	(3)	(1)	(2)	(3)
1	0.025	0.022	0.023	-0.019	-0.015	-0.016
	[1.989]	[1.729]	[1.571]	[-2.223]	[-1.510]	[-1.458]
2	0.006	0.004	0.005	-0.015	-0.012	-0.016
	[0.665]	[0.322]	[0.381]	[-2.491]	[-1.752]	[-2.287]
3	0.014	0.009	0.008	-0.016	-0.014	-0.016
	[1.601]	[0.971]	[0.713]	[-2.834]	[-2.428]	[-2.305]
4	0.009	0.005	0.006	-0.017	-0.016	-0.012
	[1.264]	[0.637]	[0.665]	[-2.980]	[-2.872]	[-1.631]
5	0.004	0.000	-0.000	-0.014	-0.014	-0.014
	[0.656]	[0.084]	[-0.015]	[-2.941]	[-3.056]	[-2.234]
6	0.001	-0.002	-0.002	-0.013	-0.014	-0.008
	[0.230]	[-0.464]	[-0.249]	[-2.515]	[-2.670]	[-1.091]
7	0.001	-0.002	-0.006	-0.012	-0.014	-0.016
	[0.196]	[-0.425]	[-0.848]	[-2.480]	[-2.625]	[-2.205]
8	-0.002	-0.005	-0.004	-0.014	-0.017	-0.022
	[-0.348]	[-0.798]	[-0.471]	[-2.776]	[-2.762]	[-2.874]
9	-0.002	-0.004	-0.005	-0.014	-0.019	-0.016
	[-0.301]	[-0.629]	[-0.682]	[-3.146]	[-2.879]	[-2.251]
10	-0.006	-0.006	-0.006	-0.008	-0.014	-0.016
	[-1.116]	[-0.965]	[-0.776]	[-1.455]	[-1.755]	[-2.042]
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Experience FE	Yes	Yes	Yes	Yes	Yes	Yes
Cohort FE	Yes	Yes	Yes	Yes	Yes	Yes
Education FE	N/A	N/A	N/A	N/A	N/A	N/A
Country-Experience Trend	No	Yes	No	No	Yes	No
Country-Experience FE	No	No	Yes	No	No	Yes
Observations	2,453	2,453	2,453	2,435	2,435	2,435
R-Squared	0.821	0.848	0.856	0.884	0.890	0.894

Source Author's analysis using ECHPS 1995-2001 and SILC 2004-2015 for 1987-2014 graduation cohorts.

Notes:

a. These are the scarring estimates from Equations 1-3 for wages for employees with and without college degrees. Models are estimated separately for college and non-college educated employees. The equation estimated is the column number.
b. The cohort unemployment rate is replaced with the instrument, an age-educational based unemployment rate.
c. T-statistics are in parentheses. Standard errors are clustered at the country-cohort graduation level.

Table A4: Wage scarring results, instrumental variable estimates by educational attainment

	Non-College			College		
Years Since Simulated Graduation	(1)	(2)	(3)	(1)	(2)	(3)
1	0.007	0.006	0.003	-0.015	-0.013	-0.016
	[0.786]	[0.617]	[0.295]	[-2.547]	[-1.932]	[-2.361]
2	0.012	0.009	0.003	-0.016	-0.015	-0.016
	[1.463]	[0.995]	[0.277]	[-2.943]	[-2.635]	[-2.535]
3	0.009	0.006	0.007	-0.017	-0.016	-0.012
	[1.431]	[0.891]	[0.846]	[-3.011]	[-2.948]	[-1.824]
4	0.005	0.002	0.003	-0.015	-0.015	-0.012
	[0.799]	[0.272]	[0.430]	[-2.966]	[-3.097]	[-2.171]
5	0.002	-0.002	0.000	-0.013	-0.014	-0.009
	[0.316]	[-0.402]	[0.034]	[-2.594]	[-2.734]	[-1.248]
6	0.001	-0.003	-0.004	-0.013	-0.015	-0.017
	[0.179]	[-0.537]	[-0.645]	[-2.640]	[-2.728]	[-2.379]
7	-0.002	-0.006	-0.005	-0.014	-0.017	-0.021
	[-0.445]	[-1.030]	[-0.682]	[-2.930]	[-2.860]	[-2.990]
8	-0.003	-0.006	-0.008	-0.014	-0.018	-0.016
	[-0.535]	[-0.973]	[-1.095]	[-3.192]	[-2.888]	[-2.292]
9	-0.006	-0.009	-0.009	-0.008	-0.013	-0.016
	[-1.194]	[-1.277]	[-1.115]	[-1.627]	[-1.812]	[-2.207]
10	-0.011	-0.004	-0.009	-0.008	-0.008	-0.010
	[-2.198]	[-0.695]	[-1.189]	[-1.573]	[-1.182]	[-1.435]
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Experience FE	Yes	Yes	Yes	Yes	Yes	Yes
Cohort FE	Yes	Yes	Yes	Yes	Yes	Yes
Education FE	N/A	N/A	N/A	N/A	N/A	N/A
Country-Experience Trend	No	Yes	No	No	Yes	No
Country-Experience FE	No	No	Yes	No	No	Yes
Observations	2,453	2,453	2,453	2,435	2,435	2,435
R-Squared	0.823	0.850	0.858	0.884	0.890	0.894

Source Author's analysis using ECHPS 1995-2001 and SILC 2004-2015 for 1987-2014 graduation cohorts.

Notes:

a. These are the wage scarring estimates from estimating Equations 5 (first stage) and 6 (second stage) by 2SLS for employees with and without college degrees. The age-educational unemployment rate is used as an instrument for the cohort unemployment rate.
b. Models are estimated separately for college and non-college educated employees.
c. T-statistics are in parentheses. Standard errors are clustered at the country-cohort graduation level.

Table 7: Wage scarring results, IV estimates without high migration countries

	Non-College			College		
Years Since Simulated Graduation	(1)	(2)	(3)	(1)	(2)	(3)
1	0.039	0.045	0.062	-0.019	-0.016	-0.020
	[2.529]	[2.425]	[3.055]	[-2.066]	[-1.386]	[-1.566]
2	0.009	0.014	0.009	-0.014	-0.011	-0.014
	[0.814]	[0.938]	[0.542]	[-2.077]	[-1.413]	[-1.637]
3	0.014	0.015	0.007	-0.015	-0.014	-0.016
	[1.358]	[1.176]	[0.467]	[-2.425]	[-2.022]	[-2.045]
4	0.011	0.010	0.010	-0.016	-0.015	-0.010
	[1.314]	[1.075]	[1.003]	[-2.465]	[-2.328]	[-1.310]
5	0.006	0.004	0.005	-0.013	-0.013	-0.011
	[0.765]	[0.500]	[0.580]	[-2.346]	[-2.434]	[-1.624]
6	0.001	-0.002	-0.001	-0.012	-0.013	-0.008
	[0.211]	[-0.299]	[-0.070]	[-2.054]	[-2.219]	[-0.921]
7	0.000	-0.004	-0.006	-0.011	-0.013	-0.015
	[0.071]	[-0.588]	[-0.774]	[-2.016]	[-2.195]	[-1.909]
8	-0.003	-0.008	-0.007	-0.013	-0.016	-0.021
	[-0.465]	[-1.131]	[-0.817]	[-2.387]	[-2.434]	[-2.658]
9	-0.004	-0.009	-0.011	-0.013	-0.017	-0.015
	[-0.590]	[-1.200]	[-1.255]	[-2.532]	[-2.438]	[-1.946]
10	-0.008	-0.013	-0.011	-0.007	-0.012	-0.015
	[-1.226]	[-1.518]	[-1.247]	[-1.185]	[-1.495]	[-1.881]
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Experience FE	Yes	Yes	Yes	Yes	Yes	Yes
Cohort FE	Yes	Yes	Yes	Yes	Yes	Yes
Education FE	N/A	N/A	N/A	N/A	N/A	N/A
Country-Experience Trend	No	Yes	No	No	Yes	No
Country-Experience FE	No	No	Yes	No	No	Yes
Observations	1,928	1,928	1,928	1,912	1,912	1,912
R-Squared	0.807	0.835	0.844	0.885	0.891	0.894

Source Author's analysis using ECHPS 1995-2001 and SILC 2004-2015 for 1987-2014 graduation cohorts.

Notes:

a. These are the wage scarring estimates from estimating Equations 5 (first stage) and 6 (second stage) by 2SLS for employees with and without college degrees. The age-educational unemployment rate is used as an instrument for the cohort unemployment rate.

b. Models are estimated separately for college and non-college educated employees. I exclude countries with the most international mobile native populations- Greece, Portugal and Ireland,

c. T-statistics are in parentheses. Standard errors are clustered at the country-cohort graduation level.