Demographic bulges and labour market outcomes

Ștefania Ramona Simion[*]

Abstract

This paper assesses the impact of the cohort size on labor market outcomes. Using exogenous variation and micro-level data for France, the UK and the US, we study the effect of supply shocks on unemployment, wages, education and migration. The results show that ballooning generations spent less time in school and face persistent high unemployment rates: a 10% increase in the cohort size increases unemployment rate by around 0.35 - 1.1 percentage points. Moreover, once we account for lower levels of education there is little impact of large cohorts on wages. Among individuals with lower education levels, immigration rates also decrease with the size of the cohort.

JEL codes: J21, J310, J640.
Keywords: Labour supply, Wage, Unemployment Rate.

[*]PhD candidate - Queen Mary University of London. Email address: *s.r.simion@qmul.ac.uk*

1 Introduction

Differential patterns in mortality, fertility and immigration rates have contributed over time to changes in the population age structure of various countries. Changes in the age distribution of the population have salient implications for the labour market as workers in one age group are imperfect substitutes for workers in another age group. History shows that a demographic bulge can turn either into a demographic dividend - the large working-age population in East Asia between 1965 and 1990 played a major role in driving the East Asian economic miracle (Bloom & Williamson (1998)) - or into a demographic burden, contributing even to a country's political stability - the large young population in the Arab region in the last decades played a major role in the recent Arab Spring uprise (Campante & Chor (2012)).

In economics it is a puzzle as to what direction the effects will go. The theory predicts that on the one hand a youth bulge can turn into a demographic dividend if firms respond to increases in youth relative supply by creating more jobs and consequently, spurring economic growth. On the other hand, a youth bulge can turn into into a demographic burden if firms do not extend their capacities, as high capital investments may not be motivated in the long run. Consequently, the actual effect of cohort enlargement on labour market outcomes is an empirical question.

This paper uses detailed micro-level data for three large economies (France, the UK and the US) to causally estimate the effect of demographic bulges on the behaviour of each birth cohort. In particular, we use an instrumental variable model to exploit variations in the timing and magnitude of cohort sizes within a country to identify the effect of the size of the cohort, at early ages, on a set of cohort-specific outcomes.

The relationship between age structure and labour market outcomes has received a great deal of attention in the literature in the last decades, yielding mixed results. On the one hand, the literature on the impact of the cohort size on earnings finds unamiously a negative effect in the short run ((Welch (1979), Freeman (1979), Card & Lemieux (2001), Fitzenberger & Kohn (2006), Brunello

(2010))[1], but there is no clear agreement regarding the persistency of the effect on earnings (Welch (1979) and Wright (1991) find temporary effects, while Berger (1985) concludes that large cohorts face only temporary reductions in wages). On the other hand, the literature on the impact of cohort sizes on unemployment rates finds that the impact is either positive (Bloom, Freeman & Sanders (1988), Korenman & Neumark (2000), Jimeno & Rodriguez-Palenzuela (2002), Garloff, Pohl & Schanne (2013), Newhouse & Wolff (2014))[2] or negative (Shimer (2001), Skans (2005))[3]. This paper offers a possible reconciliation of the puzzle regarding these differential results found in the literature. Firstly, it controls for endogenous educational choice, which has been previously overlooked in the literature. Secondly, it tests empirically the trade-off between wages and unemployment rates. Thirdly, it analyses the effects on the labour market both in the short and the long run. And finally, it also studies the migration decision.

In the existing literature the relative cohort size of youth bulges is defined as a share of the population size of youngsters aged 16-24 relative to the population size of individuals ages 16-64. One aspect not taken into account in these estimations is the fact that the an individual's investments in education is

[1]Welch (1979) and Freeman (1979) use the entry of the American baby-boomers on the labour markets to find that individuals belonging to larger cohorts face reductions in earnings rates, with a magnitude increasing with the level of schooling. Brunello (2010) shows that although the cohort size has a negative impact on wages in 11 European countries larger for older workers, earnings tend to be more sensitive to changes in cohort sizes in countries with higher employment protection (i.e. Southern European countries). Moreover, Card & Lemieux (2001) provide evidence that the slowdown in the growth of college-educated labor for younger cohorts in the US, UK and Canada did not keep up with the steady skill bias in labour demand, triggering a rising return to college for younger men. Building on the work of Card & Lemieux (2001), Fitzenberger & Kohn (2006) show that Germans belonging to large cohorts experience wage reductions ranging from 8.8 to 12.2% and increase for the lower-skilled employees.

[2]Bloom, Freeman & Sanders (1988) provide a review, while Korenman & Neumark (2000) use the older cohorts as a control group for younger workers to show that the cohort size has a positive effect on the unemployment rates of young workers. Jimeno & Rodriguez-Palenzuela (2002) conclude that in OECD countries fluctuations in cohort size positively associated with changes in relative youth unemployment rates. Newhouse & Wolff (2014) also find similar positive effects in developing countries, while Garloff, Pohl & Schanne (2013) postulate that shrinking youth cohorts trigger lower overall unemployment rates in the economy.

[3]Shimer (2001) and Skans (2005) use variation at subnational level and find that youth unemployment rates fall as cohort sizes increase in the US and Sweden, respectively. They argue that companies moved to those areas with larger youth cohorts because there is a larger pool of well-educated graduates available to hire.

endogenous and can be one of the channels through which individuals manage their timing of entry into the labour market, due to the larger sizes of the cohort. By considering only individuals aged at least 25 - age by which most of people have finished education, this issue of endogeneity is addressed. Results presented in the empirical analysis in the current paper show indeed that individuals belonging to ballooning generations spend less time in education as a result of their cohort sizes and are more likely to have ended education with at most a high school or an equivalent degree.

Secondly, the paper tests empirically the trade-off between wages and unemployment rates. Even though there is a large literature on the impact of the cohort size on wages and a large literature on the impact of the cohort size on unemployment rates, the different estimation strategies and datasets used across the two streams of literature make it difficult to understand if those belonging to large generations are not only likely to face lower wages in the short-run, but also/instead of unemployment rates. This paper bridges these two streams of literature by testing empirically the effect of the cohort size on both unemployment rates and wages, using the same estimation strategy and dataset. The findings suggest that the impact on unemployment rates outweights the one on wages.

Moreover, the paper analyses the impacts both in the short-run and the long-run. While part of the literature on wages analyses the long run effects of the impact, to our knowledge, the literature on the effect of unemployment rates does not address the persistency of the effect. Thus, by analysing the persistency of the impact of the cohort size on both wages and unemployment rates, this paper concludes that both effects are temporary, with longer spans for wages.

Finally, the paper is novel in studying the migration decision. Given that the current population size of a given cohort is mainly a function of the number of live births, the number of deaths and the immigration waves, the decision of a cohort to migrate may also be affected by their cohort size. Thus, by using only the sample of natives the migration decision can be analysed it will be accounted for the fact that immigrants and natives tend to be perceived as imperfect substitutes on the labour market (Manacorda, Manning & Wadsworth (2012)). Immigration

rates are found to be decreasing due to larger cohort sizes among those individuals who have ended education with less than an undergraduate degree.

The results show heterogeneity both across countries and genders. In France, where there are more rigid labour market institutions, the magnitude of the impact on women's wages is much higher, compared to the UK and the US. Women also face much more persistent impacts in all countries. Once it is accounted for the fact that larger generations have lower levels of education, it is only in the US that wages are negatively affected by the cohort size at age 25. Moreover, men face a larger penalty regarding the number of years spent in school compared to women, especially in France: a 10% increase in the cohort size triggers a decrease of around 0.45 years among men and of approximately 0.27 years among women. As for immigration rates, it is in the UK that the magnitudes are larger.

The remainder of the paper is organised as follows. The next section presents a simple theoretical model to rationalise the relationship between the age composition of labour supply and labour market outcomes across different age groups. Section 3 describes the data and identifies the baby-boom generations. The following section presents the estimation strategy used, while section 5 discusses the results. Section 6 concludes.

2 Theoretical model

A useful framework for analysing the effect of the cohort size on labour market outcomes is to consider demographic bulges as outward shifts in the labour supply. In such a theoretical model, the aggregated output at time t (Y_t) is produced using aggregated labour(N_t) as an input:

$$Y_t = A_t N_t^{\alpha} \tag{1}$$

where A_t is the total factor productivity and α is the share of labour in the aggregated output. N_t is a CES type aggregate of the quantities of labour N_{it} in

various age categories, i:

$$N_t = \left[\sum_i (\theta_{it} N_{it})^{\frac{\sigma_a - 1}{\sigma_a}} \right]^{\frac{\sigma_a}{\sigma_a - 1}} \tag{2}$$

where N_{it} represents the number of individuals of age i employed at time t; θ_{it} captures the productivity of workers of age i; σ_a denotes the elasticity of substitution between workers of different ages. The lower it is, the more difficult it is to substitute workers of different ages. The disaggregation of the production function by many working groups, implies the assumption that workers within the same age group are perfect substitutes, but workers across age groups are imperfect substitutes.

If labour markets are perfectly competitive and clear in every period, each age group N_{it} is paid a wage (w_{it}) equal to their marginal product of labour:

$$\ln N_{it} = \delta_t + (\sigma_a - 1) ln\ \theta_{it} - \sigma_a ln\ w_{it} \tag{3}$$

where $\delta_t = \sigma_a \left(ln\ \alpha A_t + (\alpha - 1 + \frac{1}{\sigma_a}) ln\ N_t \right)$ denotes a common time-specific component shared by all age groups.

Following closely the approach of Card (2001), an upward sloping log-linear labour supply for each age groups is considered:

$$\frac{N_{it}}{P_{it}} = w_{it}^{\varepsilon} \tag{4}$$

with $\varepsilon > 0$ and P_{it} denotes the total cohort size of group of age i measured at time t.

Solving for the equilibrium, equations (3), (4) lead to the below expressions for the wage and employment rate of age i measured at time t:

$$ln\ w_{it} = \frac{1}{\varepsilon + \sigma_a} \left(\delta_t + (\sigma_a - 1) ln\ \theta_{it} - ln\ P_{it} \right) \tag{5}$$

and

$$ln\ er_{it} = ln\left(\frac{N_{it}}{P_{it}} \right) = \frac{\varepsilon}{\varepsilon + \sigma_a} \left(\delta_t + (\sigma_a - 1) ln\ \theta_{it} - ln\ P_{it} \right) \tag{6}$$

These last two equations show that wages and the employment rate are in effect determined by three factors: a common time component(δ_t), an age and time-specific productivity shock(θ_{it}) and the population size of each age group measured at time t (P_{it}). Moreover, given the relation unemployment rate can also be expressed in a similar form, using the fact that $ln\ \frac{N_{it}}{L_{it}} = ln(1-ur_{it}) \approx -ur_{it}$, where L_{it} is the total active labour force of age i measured at time t and that $ln\ pr_{it} - ln\ er_{it} \approx ur_{it}$ - where L_{it} is the total active labour force and and pr_{it} is the participation rate among workers of age i at time t, it can be concluded that the unemployment and the participation rate are also in effect determined by the same three factors mentioned above.

If it is assumed that the productivity component can be decomposed as: $\theta_{it} = \theta_i + \theta_t + \theta_{it}^{'}$, where θ_i represents a common age effect, θ_t is a common time-effect and $\theta_{it}^{'}$ is an age and time-specific productivity term, the labour market outcomes can be expressed as functions of an age and a common time component and the population size of each age group. The time- and age-fixed effects absorb any time or age components that might affect the labour market outcomes and any age-time specific unobserved productivity shocks will enter in the error term. In particular, the labour outcome variable y_{it} can be expressed as:

$$y_{it} = m_t + m_i + \beta ln\ P_{it} + m_{it} \tag{7}$$

where m_t is time-fixed effect; m_i is age-fixed effect; m_{it} are unobserved factors which depend on $\theta_{it}^{'}$ and β is a function of σ_a and ε.

3 Data and descriptive statistics

3.1 *Data*

The data used in the analysis is represented by repeated cross-sections of the Labour Force Surveys of three countries: the UK Labour Force Survey, the French Labour Force Survey - L'enquete Emploie- and the US March Current Population Survey. Even though these data sets cover quite extended periods of time, due to data limitations on wages and the country of birth, the empirical

analysis is based on the following samples: in the UK - the second quarter of the LFS for 1993-2013[4]; in France, the annual surveys between 1990-2002, all four quarter surveys for 2003-2011, but 2012, for which only the 1st quarter is used[5]; in the USA, the March CPS between 1994-2013.

The main sample used is represented by natives, defined as individuals born in the country under analysis, aged 25-60 and born between 1940 and 1980. Only individuals aged at least 25 years old are considered in order to account for the potential endogeneity of education- some people might delay entry on the labour market due to higher competition experienced by ballooning generations. Yet, by the age of 25 most individuals have finished at least their first degree education.

Through using the micro-level data, individuals are grouped into cells based on age, time and birth cohort (a cohort c is defined as the cohort born in year c) - leading to a total of 745 observations for France, 692 for the UK and 663 for the USA. In other words, all individuals born in the UK in 1950 and aged 47 in 2007, form one age-year-cohort cell. Within each age-year-cohort cell, the cohort size is determined as the population size and used as a measure of the labour supply. As mentioned in the previous section, the population size of a given age-cohort grouped as measured at survey time can be endogenous. The instrumental variable considered is the number of live births registered for each birth cohort considered, as reported in various sources: UN Demographic yearbooks for the UK; the French National Institute of Statistics[6] for France and the 2005 US National Vital Statistics Report[7] for the USA. These figures denote both natives and immigrants born in a given year within a country.

In all three countries, the employment status refers to one's main occupation at survey time. In the UK and France, the unemployed are identified by the ILO unemployment definition: are either out of work but are actively looking for a job or are out of work and are waiting to start a new job in the following two weeks.

[4]Due to the small rotation in these labour force surveys, the use of one quarter along with the weights ensures the accuracy of the actual number of people and reduces the magnitude in measurement errors.

[5]The quarterly data and the one which includes all quarters, have different weights, such that the data will be representative for the population.

[6]Source: `http://www.insee.fr/en/themes/detail.asp?ref_id=ir-sd2005&page=irweb/sd2005/dd/sd2005_nais.htm`

[7]Vol. 53, No. 20, June 14, 2005

In the USA, unemployed people those who did no work for pay or profit, did not have a job from which they were briefly absent, and answered yes to a question about whether they had been looking for work in the past four weeks. People who were temporarily laid off from a job were also classified as unemployed. In determining wages, the weighted mean of the gross weekly wages, expressed in PPP 1998 USA dollars is used and all wage, salary and self-employed full-time workers are included (see Appendix B for details).

In the British Labour Force Survey, native whose response is that their highest qualification is in the "other qualifications" category almost certainly has a low level of education, as all the major UK educational qualifications are covered by the alternative categories. Yet, immigrants who are classified as being in the "other qualifications" category are more likely to have high levels of qualifications (Manacorda, Manning & Wadsworth (2012), Saleheen & Shadforth (2006)). Thus, in the UK the educational outcomes are defined using the age at which full-time education has been achieved. In particular the number of years spent in school is defined as age at which full-time education has been achieved minus five (the starting school age in the UK). As for the highest educational level attained, the sample into two categories: those with less than an undergraduate degree (defined as those who left full time education at age 20 or earlier) and those with at least an undergraduate degree (defined as those who left full time education at age 21 or later). For France and the USA the average number of years spent in school is imputed based on the highest qualification declared. Regarding the highest educational level attained, the two categories (those with less than an undergraduate degree and those with at least an undergraduate degree) are also defined using the highest qualification declared.

3.2 *Descriptive statistics*

Table (1) shows that there is considerable variation across countries and gender in the outcome variables. As expected, in France native men have lower unemployment rates on average and less volatile, compared to women. Yet, in the UK and the USA, on average men have higher and more volatile unemployment rates than women. Due a mechanical negative relationship

between the employment rates and the participation rates defined as ratios of the cohort size at survey time, these two outcome variables are defined throughout the paper as ratios of the number of live births[8] (see section 4.2 for details). For these two labour market outcomes, women fare worse than men, given that the higher absolute values for logarithms of participation and employment rates, which are variables between zero and one, correspond to lower values of the participation and employment rates. Finally, men have higher weekly wages and tend to spend more time in school on average than women, in all countries, but the USA, women tend to spend the slightly more time in school (the difference between the two is statistically significant different from zero at 5% significance level).

The empirical identification relies on variations across age-year-cohort cells within a country. These shifts in the demographic structure of a country across time can be identified by noticing that the size of the cohort c measured at time of survey t is a function of the number of live births registered for that cohort, as well as the deaths and emigration rates registered by cohort c up to year t. In other words, the size of the cohort c of natives measured at survey time, denotes as P_{ct} can be expressed as a function of cohort, age and time effects:

$$ln\ P_{ct} = \beta_c + \beta_a + \beta_t + \upsilon_{ct} \tag{8}$$

So, demographic bulges are represented by the cohort effect, so all is needed is to disentangle the three effects. Yet, due to the perfect co-linearity between age, cohort and time- age is determined as time minus cohort - the regression expressed in (8) cannot be identified. One way to do this is to normalize one of the variables (Deaton (1997)), but for the purpose of this paper it is preferred to run the regression:

$$ln\ P_{ct} = \alpha_0 + \alpha_a + \alpha_t + \mu_{ct} \tag{9}$$

and use its residuals to identify the variation in the size of the cohort that is unrelated to either time or age effects. Figure (1) plots these residuals when regression (9) is estimated with standard errors clustered at cohort level. The

[8] $ln\ er_{ct} = ln(\frac{N_{ct}}{P_{c_0}})$ and $ln\ pr_{ct} = ln(\frac{L_{ct}+U_{ct}}{P_{c_0}})$, where P_{c_0} is defined as the number of live births for cohort c(born in year c).

clustering is at this level as most of the variation in the dependent variables is across cohorts, rather that within cohorts. Moreover, as the cohort size P_{ct} is very likely to be endogenous (see next section), figure (1) also plots the residuals of a similar regression to equation (9), but in which the dependent variable is the number of live births for each cohort:

$$ln\ P_{c0} = \gamma_0 + \gamma C + \eta_{c0} \tag{10}$$

As the total number of live births of a given cohort is constant across time and ages, equation (10) includes only a cohort trend C.

The two plotted residuals follow a similar trend and identify the baby-boom generations. These are depicted in the graph by the shaded areas and it is easy to observe the heterogeneity across countries in both the magnitudes and the timing of the ballooning generations. In France, the baby-boom (1946-1967) peaked in late 1940s and culminated with the Neuwirth Law which legalized contraception in late 1960s. The UK experienced two post-war baby booms, peaking twice: in 1947 and 1964. Apart from the war participation rate of the British army forces in the World War II, the pill also played an important role in the timing of the baby boom. Although it was introduced in the UK in 1961, it was prescribed only to already mothers, and it took full effect only after its use was open to single women as well in the early 1970s. In the USA, the baby-boom generation started as early as 1946 and reached its peak in late 1950s-early1960s. Yet, the introduction of the contraceptive pill in 1960 and its quick diffusion among married women as well as among single women in the late 1960s(Goldin & Katz (2002)) determined an earlier baby boost.

4 Identification Strategy

4.1 *Baseline model*

Starting from equation (7) developed in section 2, the identification strategy is using the variation in the timing and magnitude of birth cohorts. Thus, the effect of the cohort size on labour market outcomes at early ages is estimated using the

following specification:

$$y_{ct} = \beta_0 + \beta_1 ln\, CS_{ct} + \beta_2 ln\, CS_{ct}(age - 25) + \beta_a + \beta_t + \varepsilon_{ct} \tag{11}$$

where y_{ct} is a labour market outcome measured in year t for a birth cohort c; $ln(CS_{ct})$ is the cohort size of birth cohort c measured in year t; the age (β_a) and time (β_t) fixed effects control for any age and time specific characteristics that may affect the outcome. The main coefficient of interest, β_1, captures the impact of the cohort size at early ages (at age 25 more specifically) for cohort c.

4.2 *Challenges*

The size of the cohort at survey time can be determined from the data for each cohort-year cell, but this measure is very likely to be endogenous with respect to the outcome variables. This could happen because members of a particular cohort change their behaviour, just as a response of belonging to that specific cohort. A potential solution to this is to replace the cell specific cohort size by the overall cohort size (Wright (1991)). Yet, even the overall cohort size is not exogenously determined, as people are very likely to be mobile, responding to labour market conditions. Specifically, the size of the cohort measured at the time of the survey can be endogenously affected through the number of people who are migrating from the country as a response to the size of their cohort or the labour market conditions.

The solution to this is to find an instrument for the cohort size, that is exogenous and sufficiently correlated with the endogenous explanatory variable. A potential candidate for this instrument is the number of live births registered for the given cohort in the year of birth in each specific country. For the exogeneity of the instrument, it seems plausible to assume that parents' decision to relocate is not caused by anticipated labour market conditions made at least twenty-five years ahead. The correlation of the instrument with the endogenous variables can be empirically tested. The first stage results presented in table (6) show that the instrument is strong for all countries, with an F-statistics clearly above the threshold value of 10 (see Appendix A). Thus, in the subsequent

section, results will be presented for the estimation of equation (11), where the cohort size of cohort c measured at survey year t is instrumented by the number of live births registered in the year of birth of the specific cohort.

As the results are presented separately for men and women, it is worth mentioning that following the approach of Korenman & Neumark (2000), both the endogenous variable and the instruments for each gender are defined as the total cohort size and the total number of live births, respectively, rather than the separate measures by gender. This choice is motivated by the fact that the sex ratio is relatively stable over time and that young men and women do not compete in entirely distinct labour markets.

Moreover, apart from the fact that the size of the cohort measured at time of survey is very likely to be endogenous there is also a mechanical negative relation between it and the employment and participation rates[9]. Thus, throughout this paper, the employment and participation rates refer to proxies constructed for each of them, and represented by the share of employment to the number of live births and the share of active labour force to the number of live births, respectively[10]. These outcome variables are bias free.

5 Results

Table (2) provides a view of the results by estimating the effects of the size of the cohort measured at time of survey on four different labour market outcomes, at age 25: the unemployment rate, the employment rate, the participation rate and weekly wages. The two estimates presented in each panel are coefficients β_1 and β_2 from equation (11), obtained when the cohort size is instrumented by the total number of live births and the outcome variable is one of the four specified above.

Panel A shows that in the UK and the USA, the cohort size has a statistically positive impact on the unemployment rate at young ages: a 10% increase in the size of the cohort triggers an positive change of 0.35 percentage points in the men unemployment rate. This magnitude is not negligible, given that the average

[9]The size of the cohort measured at time of survey is the denominator in the equations determining both the employment and the participation rates.

[10]For instance, for men born in year c, the employment rate at time t is defined as: $ln\ \frac{N^m_{ct}}{P^m_{c0}}$

unemployment rate among men is around 5.3% in both countries. Women face even higher impacts, of 0.37 and 0.41 percentage points increases due to a 10% increase in the cohort size in the UK and the US, respectively. As for France, it seems that even though men do not face higher unemployment rates at age 25, among women, an increase of 10% in the cohort size triggers an increase of 1.06 percentage points in the unemployment rates. The much larger magnitude among French women is in line with the existing empirical literature on the negative impact of rigid labour market institutions on job creation and their association with higher levels of unemployment rates (Nickell (1997), Elmeskov & Scarpetta (1998) and Nunziata (2002), Belot & van Ours (2004), Bassanini & Duval (2064)). In other words, the more flexible American and British labour market helped keep the impact of increasing cohort sizes on unemployment rates among women lower than in France. Moreover, it is worth noticing that in all three countries [11], the statistically significant coefficient of $Ln\ CS * Age$ shows that the older a cohort gets, the lower the impact gets (baseline group is age 25).

Panel B clearly shows that it is only in France and the US where, for both men and women, increases in the cohort size determine decreases in the weekly wages. The magnitudes are larger in the US compared to France, and among men compared to women in both countries. Specifically, a 10% increase in cohort sizes determines a decrease of 1.75% and of 3.97% in weekly wages among French and American men, respectively. On the other hand, among women the impact is much lower: a 10% increase in the cohort size triggers a decrease in weekly wages of 1.46% and of 2.40% in France and the US respectively.

Panel C presents results for the employment rate. Women seem to be the only ones affected by the cohort size: a 10% increase in the cohort size triggers an statistically significant decrease of 1.43%, 1.16% and of 2.99% in employment rates in France, the UK and the US, respectively. Yet, it is only in the US and France that at older ages individuals seem to catch up. Yet, given than women are the primary child caretakers and are also responsible for various housework related tasks, which can prevent them from seeking paid employment, the employment rate may under-count women who do not consider their work as "employment" or are not perceived by others as "working". Thus, the impact

[11] Except in the case of French men.

could be even larger for women if the employment rate is underestimated for women. Furthermore, Panel D shows, that the participation rate is not affected by the size of the cohort at early ages, but among American women, who are negatively affected.

5.1 Persistency

Even though the coefficient β_2 from equation (11), identified by the second line in each panel of table (2), shows how the effect of cohort size changes as cohort c ages, the persistency of the impact as a cohort ages can be better captured at each specific age. This can be done by plotting the coefficients of the interaction between the cohort size and age dummies in the below specification:

$$y_{ct} = \alpha_0 + \alpha_1 ln\, CS_{ct} + \alpha_2 ln\, CSD_a + \alpha_a + \alpha_t + \omega_{ct} \tag{12}$$

where D_{age} is a dummy variable vector that includes a set of 35 dummy variables, each corresponding to ages between 26 and 60. The baseline group is age 25.

Given the above identified results of the impacts of the cohort size, y_{ct} is used as either the unemployment rate or the weekly wages. Specifically, figure (2) shows that French men do not face statistically higher unemployment rates due to belonging to ballooning generations at any ages. Yet, among British men the impact of the cohort size on unemployment rates is statistically significant at the 95% significance level until the age of 39. On the other hand for American men the impact is much shorter lived, disappearing as one reaches their late 20s. What is of interest is that both in the UK and the US, as one reaches their 50s the impact of the cohort size turns negative and statistically significant. This reverse trend can be due to delayed retiring ages experienced by these countries, as a result of increasing dependency rates. Figure (3) shows that women not only face higher unemployment rates at age 25 due to belonging to larger cohorts, but the effect is also more persistent than in the case of men: in France it disappears as one reaches their mid-50s, in the UK it dissipates during one's early 40s, while in the USA it becomes statistically insignificant during one's late 40s.

Moreover, figures (4) and (5) show that the impact on weekly wages is more persistent among men in both France and the US: it becomes statistically insignificant during one's early 50s for men versus one's early 40s for women, in both countries. For the UK, the impact is not statistically significant at any age for both men and women.

5.2 Robustness checks

Given the large literature on the impact of the state of the economy at graduation on earnings (Oreopoulos, von Wachter & Heisz (2012), Kahn (2010), Genda, Kondo & Ohta (2010)), the analysis is further extended to understand if the impact of the cohort size disappears once this additional variable is controlled for. The state of the economy is proxied by the cyclical components of the real GDP[12]- obtained through a Hodrick-Prescott Filter[13], with a smoothing parameter equal to 6.25, for annual data (Raven & Uhlig (2001)). Due to the endogeneity of education, the GDP is measured when a cohort is 25, rather than at graduation time.

Table (3) show how the impact of the cohort size changes, when this measure of the state of the economy is added among the control variables. Results shows in all panels are very similar to the results shown in table (2), leading to the conclusion that once the labour supply shock is controlled for, it captures the entire impact of the labour market dynamics and the impact of the cohort size is not affected by the state of the economy at age 25.

[12]The data on the GDP figures are taken from the Federal Reserve Economic Data(FRED), published by the Federal Reserve Bank of St. Louis: `http://research.stlouisfed.org/fred2/categories/32264`. All figures represent real values and they are defined in millions of 2011 U.S. Dollars6.

[13]The HP filter identifies the longer term fluctuations as part of the growth trend while classifying the more jumpy fluctuations as part of the cyclical component. It basically identifies the business cycles for each country: large positive deviations(above 0) are peaks and relatively large negative deviations are troughs. A series of positive deviations leading to peaks are booms, and a series of negative deviations leading to troughs are recessions.

5.3 Education

Household investment in education is one of the channels through which larger cohorts can manage their timing into the labour market. Specifically, if the substitution effect dominates, the declining wages due to larger cohort sizes, could lead young people to stay for longer in school, postponing their entry into the labour market. Higher levels of education could also give them an edge into the competition on the labour market - higher returns to education or even higher chances to get a job for which one is overqualified. Yet, if tighter budgets prevent individuals from continuing their schooling (for instance, in the UK and the US the tuition fees are very high) or if larger cohorts compete for limited educational public resources (for example, heavily regulated places available in universities), baby boom generations may actually spend less time in schooling.

As the theory fails to predict how the size of the cohort affects educational attainment, in this section this issue will be addressed empirically. For this, equation (11) is estimated, using various education related outcomes as dependent variable. Table (4) presents these IV estimates. Panel A looks at the impact of the cohort size on the average number of years spent in school. The results are consistent across countries and gender, showing a statistically significant decrease in the number of years spent in education due to larger cohort sizes. For instance, in France a 10% increase in the cohort size triggers a decrease of around 0.45 years among men and of approximately 0.27 years among women. The lowest magnitudes are registered in the UK, where a 10% increase in the cohort size leads to a decrease of around 0.18 and 0.17 among men and women, respectively. Panels B and C offer further insights regarding the actual highest level of education attained by baby boom generations, by estimating the same equation (11), but when the outcome variable is the proportion of people in a given cohort less than an undergraduate degree or at least an undergraduate degree, respectively. According to the estimates presented in panels B baby boomers from all countries are more likely to be either high school dropouts or to end education with a high school or some college degree in all three countries, UK registering the highest magnitudes. Panel C further supports these outcomes, by providing evidence, that belonging to a ballooning

generation is decreasing one's probability to graduate at least an undergraduate degree and these results are consistent across countries and genders. The results obtained for the UK and the US are in line with the findings of Card & Lemieux (2001), who show that, in these two countries, people born between early 1950s and late1960s, were more likely to end education with a high school degree, compared to older generations -i.e. the baby boomers had a lower growth of the share of college graduates to high school graduates.

The empirical findings are interpreted as supporting the theoretical model of Bound & Turner (2007) in which universities do not increase enrolments when the cohort sizes increase. The reason for this is that the higher education markets in all countries are dominated by public and non-profit production, and universities receive considerable subsidies from the state and private source. Thus, consumers pay only a fraction of the costs faced by universities and the changes in demand due to higher cohort sizes are unlikely to be fully accommodated by tertiary education institutions without significant increases in non-tuition revenues.

The question to be raised at this point in the analysis is if the reduction in the number of years spent in school can be propagated on the labour market outcomes. In other words, is it the case that the reduction in wages due to larger cohort sizes in France and the US documented section 5.1 is a result of the lower number of years spent in schooling? One way of checking if the negative impact of the cohort size on wages is triggered by the lower educational attainment of baby boomers or by both lower educational attainment and higher cohort sizes is to do a back-of-the-envelope calculation. This can be done by comparing the ratio of the coefficient of the cohort size when the dependent variable is the logarithm of the wages (coefficient in the first line of Panel B, table (2)) and the coefficient of the cohort size when the dependent variable is the number of years spent in schooling (coefficient in the first line of Panel A, table (4)) to the already agreed upon returns to education. Specifically, the literature on the returns to education identifies an increase in annual adult income of 7-12% from spending one extra year in school (Bound, Jaeger & Baker (1995), Angrist & Krueger (1992), Ashenfelter & Krueger (1994)). So, a ratio of the coefficients, as identified in the current paper, larger than 7-12% stands as a proof that the impact

of cohort size on wages is not solely explained by worse educational attainment. In the US, for men, the ratio of the coefficients is 16.55%[14], while for French men it is around 3.4%[15]. Therefore, it seems that it is only in the US that the impact of cohort size persists for wages, while in France the impact identified before is only due to the lower educational levels attained by the baby boomers.

5.4 Immigration

The results discussed so far show that the cohort sizes have a negative impact on unemployment rates (in all three countries) and a positive one on wages (in the US), while also decreasing educational attainment. In this section the analysis goes one step forward, in considering how immigration rates respond to the size of the total number of live births registered by that specific birth cohort. If large cohorts struggle on the job market at early ages, it is expected that there would be lower incentives for immigrants to move in any of the three countries considered, given that one of the main underlining reasons for migration is to join the labour market.

Table (5), shows the results from a reduced form of regression(11), in which the main independent variables are the number of live births is run, and the dependent variable is the immigration rate, defined as the share of immigrants from a given birth cohort to the current population size of both natives and immigrants. Panel A, shows that on average larger number of births in a given cohort decrease immigration rates across countries and gender, when all educational levels are considered. The following two panels analyses the heterogeneity of the impact by the highest education level attained. In particular, panel B looks at those individuals that have at least a high school or some college degrees. The results show that in all three countries, there are statistically significant, at the 1% significance level, negative effects of the cohort size on immigration rates among the less educated individuals. For instance, a 10% increase in the number of live births among men triggers a statistically significant decrease in the immigration rates of men of around 0.15 percentage points, 0.25

[14]Identified as the ratio between -0.397 and -2.398
[15]Identified as the ratio between -0.175 and -4.469

percentage points and 0.16 percentage points in France, the UK and US respectively. As for women, the magnitudes are slightly lower in France and the US, but slightly larger in the UK. Panel C presents the results when only those with at least an undergraduate degree are considered. No statistically significant impacts are found in any of the three countries across genders. This finding supports the results found in table (4), that most of the baby boomers do not have an undergraduate degree. Thus, the higher competition on the labour market at lower educational levels discourages immigrants of similar educational levels, but has no impact on the immigrants who have at least an undergraduate degree.

6 Conclusion

This paper uses variation in the population age structure registered in France, the UK and the US to assess the impact of the cohort size on various outcomes as a cohort ages. The empirical results obtained in an instrumental variable estimation show that cohort sizes at age 25 have a statistically significant positive impact on unemployment rates. The impact has the highest magnitude among women, who also fare much more persistent impacts, lasting up until they reach their early 50s in France, early 40s in the UK and late 40s in the US. Once it is accounted for the fact that larger generations have lower levels of education, it is only in the US that wages are negatively affected by the cohort size at age 25. The impact on wages is larger in magnitude for men and lasts for longer for men (around 27 years) compared to women (around 20 years). Moreover, the size of the cohort seems to have no impact on employment rates among men or on participation rates across both genders. The paper also shows that immigration rates are negatively affected by the cohort size, measured as the number of live births, among those who have ended education with less than an undergraduate degree.

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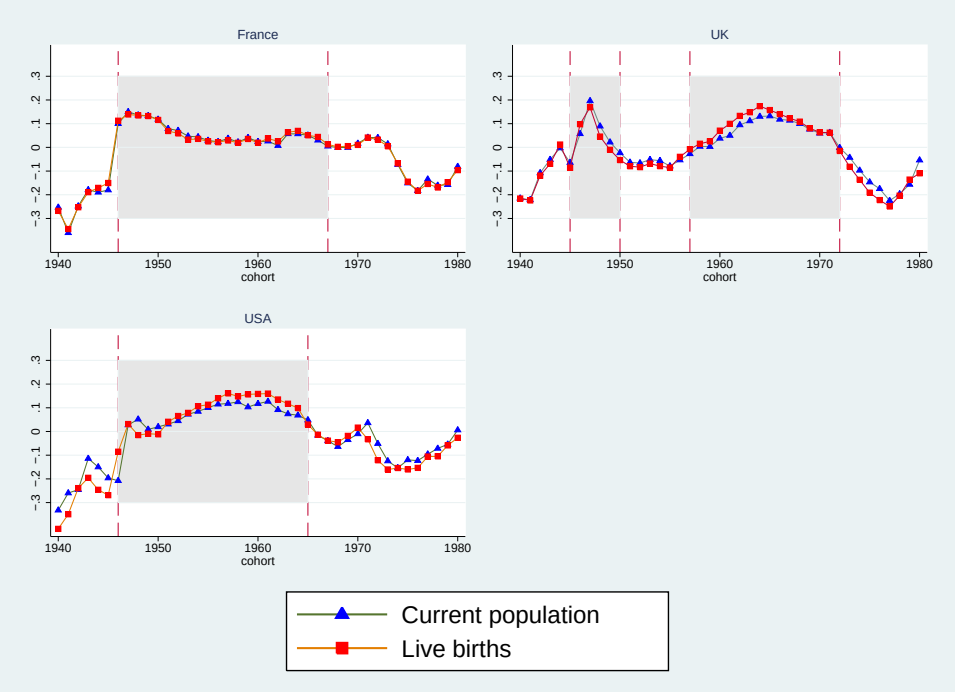
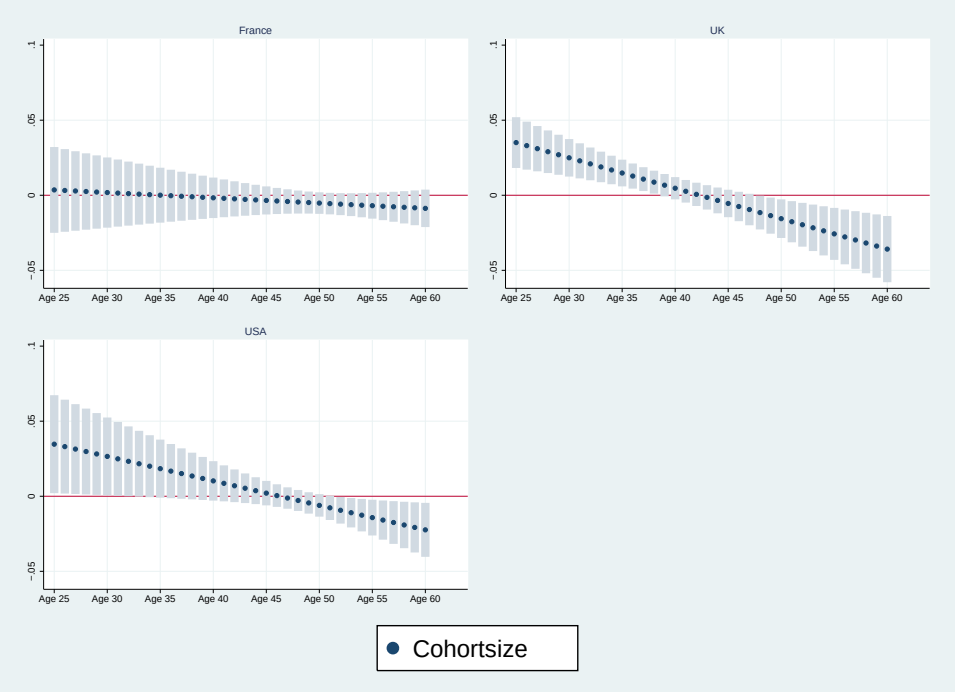
Figure 1: Baby boom cohorts



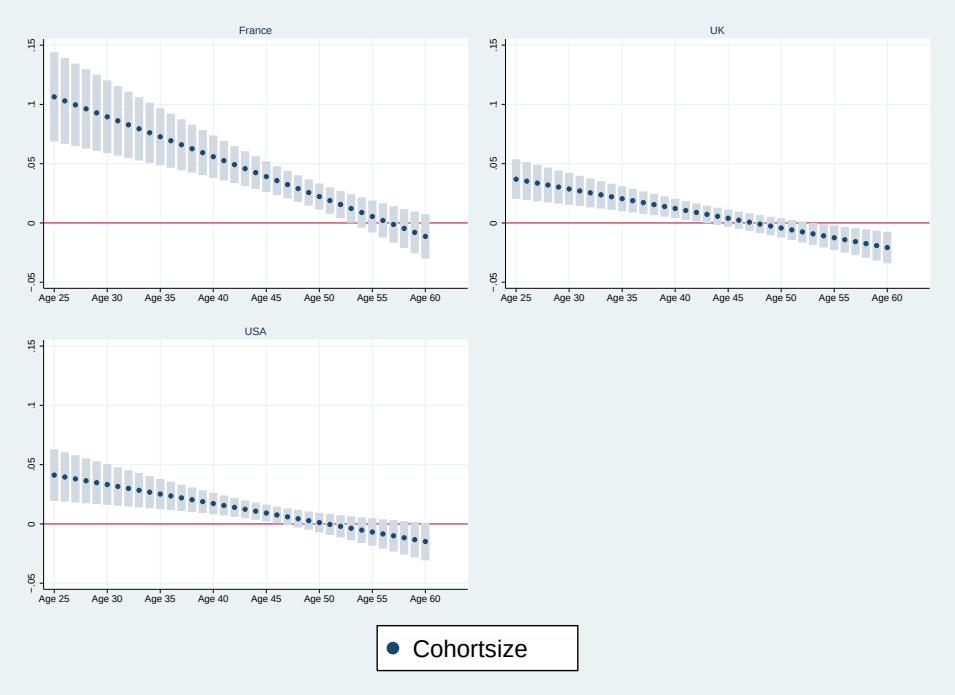
Note: The line corresponding to the current population plots the residuals from running equation (9), with standard errors clustered at cohort level. The line corresponding to the live births, plots the residuals or equation (10), with standard errors clustered at cohort level. The shaded areas identify the baby boom generations.

Figure 2: Persistency of impact on unemployment rates, for men



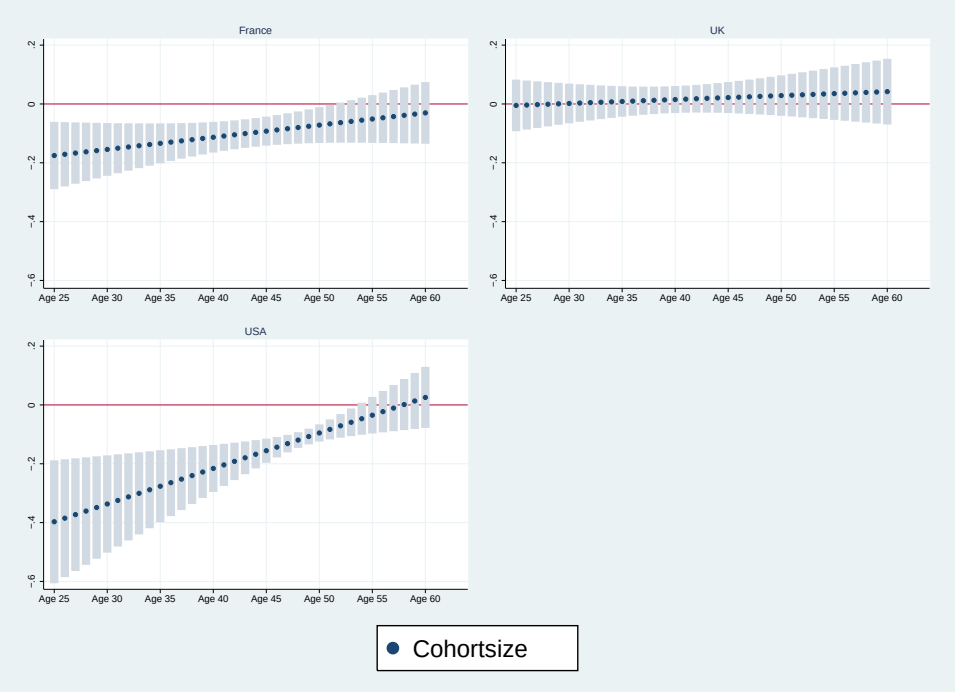
Notes: Each point represented in the graph is the coefficient α_2 obtained in the estimation of equation (12), when the D_{age} dummy corresponds to each age group, identifying the impact of the cohort size at that specific age. Standard errors are clustered at cohort level. The shaded areas identify the limits of the 95% Confidence intervals.

Figure 3: Persistency of impact on unemployment rates, for women



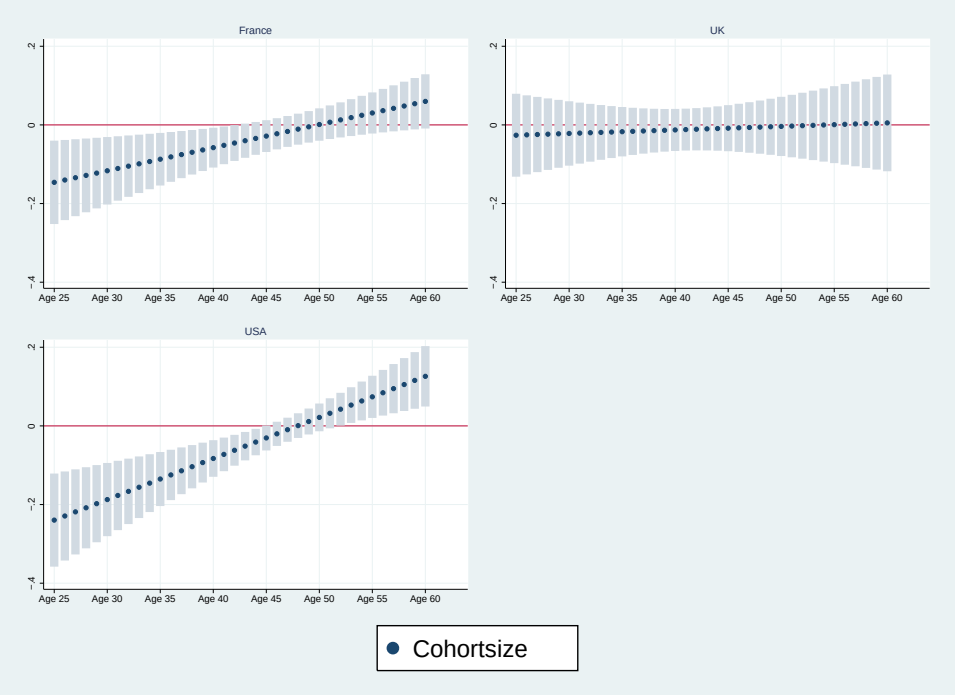
Notes: Each point represented in the graph is the coefficient α_2 obtained in the estimation of equation (12), when the D_{age} dummy corresponds to each age group. Standard errors are clustered at cohort level, identifying the impact of the cohort size at that specific age. The shaded areas identify the limits of the 95% Confidence intervals.

Figure 4: Persistency of impact on weekly weekly wages, for men



Notes: Each point represented in the graph is the coefficient α_2 obtained in the estimation of equation (12), when the D_{age} dummy corresponds to each age group, identifying the impact of the cohort size at that specific age. Standard errors are clustered at cohort level. The shaded areas identify the limits of the 95% Confidence intervals.

Figure 5: Persistency of impact on weekly weekly wages, for women



Notes: Each point represented in the graph is the coefficient α_2 obtained in the estimation of equation (12), when the D_{age} dummy corresponds to each age group, identifying the impact of the cohort size at that specific age. Standard errors are clustered at cohort level. The shaded areas identify the limits of the 95% Confidence intervals.

Table 1: Descriptive statistics

	France		UK		US	
	Mean	SD	Mean	SD	Mean	SD
Panel A. Men						
Unemployment rate	0.063	0.025	0.053	0.023	0.054	0.023
Employment rate	-0.355	0.216	-0.359	0.083	-0.362	0.116
Participation rate	-0.289	0.221	-0.305	0.083	-0.306	0.116
Weekly wages	5.928	0.156	6.126	0.146	6.815	0.271
Number of years in schooling	9.806	0.839	12.269	0.581	13.760	0.221
Panel B. Women						
Unemployment rate	0.089	0.033	0.040	0.016	0.044	0.017
Employment rate	-0.462	0.197	-0.437	0.088	-0.395	0.110
Participation rate	-0.369	0.204	-0.395	0.086	-0.350	0.113
Weekly wages	5.743	0.103	5.840	0.160	6.560	0.304
Number of years in schooling	9.685	1.299	12.187	0.678	13.783	0.331

Notes: The number of observations by country are France - 745, the UK - 692, the US - 663. The logarithm of weekly wages, employment and participation rates are reported. The employment/participation rate are defined as the ratio between employed peopl/total active labour force over the number of live births. Wages are expressed in 1998 US dollars.

Table 2: Labour market outcomes - IV estimates

	Men			Women		
	France	UK	US	France	UK	US
Panel A: Unemployment rate						
Ln CS	0.004	0.035***	0.035**	0.106***	0.037***	0.041***
	(0.013)	(0.008)	(0.015)	(0.018)	(0.008)	(0.010)
Ln CS *Age	-0.000	-0.002***	-0.002**	-0.003***	-0.002***	-0.002***
	(0.001)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)
R-squared	0.857	0.837	0.801	0.872	0.759	0.768
Panel B: Weekly wages						
Ln CS	-0.175***	-0.005	-0.397***	-0.146***	-0.026	-0.240***
	(0.054)	(0.041)	(0.098)	(0.050)	(0.049)	(0.055)
Ln CS*Age	0.004	0.001	0.012***	0.006***	0.001	0.010***
	(0.003)	(0.002)	(0.004)	(0.002)	(0.003)	(0.002)
R-squared	0.941	0.872	0.989	0.906	0.830	0.991
Panel C: Employment rate						
Ln CS	0.042	-0.058	-0.214*	-0.143**	-0.116**	-0.299**
	(0.058)	(0.045)	(0.130)	(0.069)	(0.051)	(0.129)
Ln CS*Age	0.005*	-0.005	0.012**	0.017***	-0.001	0.017***
	(0.003)	(0.003)	(0.005)	(0.004)	(0.004)	(0.005)
R-squared	0.951	0.773	0.804	0.939	0.747	0.770
Panel D: Participation rate						
Ln CS	0.048	-0.014	-0.177	-0.015	-0.073	-0.256**
	(0.063)	(0.043)	(0.123)	(0.069)	(0.054)	(0.126)
Ln CS*Age	0.005	-0.008**	0.010**	0.013***	-0.004	0.015***
	(0.003)	(0.003)	(0.005)	(0.004)	(0.004)	(0.005)
R-squared	0.952	0.782	0.825	0.942	0.752	0.791

Notes: Each panel refers to a different outcome variable. All regressions estimate equation (11), including age and time fixed effects. Robust standard errors, clustered at cohort level are reported in parentheses. The logarithm of weekly wages, employment and participation rates are reported. The employment/participation rate are defined as the ratio between employed peopl/total active labour force over the number of live births. *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

Table 3: Labour market outcomes -state of the economy at age 25 - IV estimates

	Men			Women		
	France	UK	US	France	UK	US
Panel A: Unemployment rate						
Ln CS	0.003	0.035***	0.035**	0.106***	0.037***	0.041***
	(0.013)	(0.008)	(0.015)	(0.018)	(0.008)	(0.010)
Ln CS*Age	-0.000	-0.002***	-0.002**	-0.003***	-0.002***	-0.002***
	(0.001)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)
Ln GDP	-0.036	-0.001	0.013	-0.051	-0.000	-0.005
	(0.039)	(0.020)	(0.024)	(0.069)	(0.021)	(0.025)
R-squared	0.857	0.837	0.801	0.872	0.759	0.768
Panel B: Weekly wages						
Ln CS	-0.173***	-0.005	-0.397***	-0.146***	-0.029	-0.240***
	(0.057)	(0.041)	(0.097)	(0.050)	(0.046)	(0.055)
Ln CS*Age	0.004	0.001	0.012***	0.006***	0.001	0.010***
	(0.003)	(0.002)	(0.004)	(0.002)	(0.002)	(0.002)
Ln GDP	0.321	-0.011	0.102	0.069	0.408***	-0.034
	(0.279)	(0.136)	(0.146)	(0.212)	(0.155)	(0.138)
R-squared	0.942	0.872	0.989	0.906	0.831	0.991
Panel C: Employment rate						
Ln CS	0.042	-0.059	-0.213	-0.144**	-0.116**	-0.298**
	(0.058)	(0.044)	(0.131)	(0.069)	(0.051)	(0.130)
Ln CS*Age	0.005	-0.005*	0.012**	0.017***	-0.002	0.017***
	(0.003)	(0.003)	(0.005)	(0.003)	(0.004)	(0.006)
Ln GDP	0.014	0.240**	0.171	-0.145	0.194	0.208
	(0.333)	(0.107)	(0.315)	(0.392)	(0.176)	(0.379)
R-squared	0.951	0.773	0.805	0.939	0.747	0.771
Panel D: Participation rate						
Ln CS	0.048	-0.014	-0.176	-0.016	-0.073	-0.255**
	(0.063)	(0.042)	(0.123)	(0.070)	(0.054)	(0.127)
Ln CS*Age	0.005	-0.008**	0.010**	0.013***	-0.004	0.015***
	(0.003)	(0.003)	(0.005)	(0.004)	(0.004)	(0.005)
Ln GDP	-0.026	0.244**	0.185	-0.202	0.209	0.204
	(0.335)	(0.100)	(0.315)	(0.409)	(0.172)	(0.384)
R-squared	0.952	0.783	0.825	0.942	0.752	0.792

Notes: Each panel refers to a different outcome variable. All regressions include age and time fixed effects. Ln GDP is measured by the logarithm of Hodrick-Prescott Filter of real GDP at age 25. Robust standard errors, clustered at cohort level are reported in parentheses. The logarithms of weekly wages, employment and participation rates are reported. The employment/participation rates are defined as the ratio between employed peopl/total active labour force over the number of live births. *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

Table 4: Educational outcomes - IV estimates

	Men			Women		
	France	UK	US	France	UK	US
Panel A: Average number of years in school						
ln CS	-4.469***	-1.761***	-2.398***	-2.739***	-1.688***	-1.761***
	(0.903)	(0.193)	(0.413)	(0.734)	(0.209)	(0.307)
ln CS*Age	0.152***	0.056***	0.106***	0.095***	0.048***	0.087***
	(0.035)	(0.011)	(0.018)	(0.028)	(0.009)	(0.012)
R-squared	0.860	0.951	0.588	0.963	0.974	0.874
Panel B: Proportion- less than an undergraduate degree						
ln CS	0.287***	0.381***	0.372***	0.284***	0.462***	0.339***
	(0.065)	(0.033)	(0.076)	(0.086)	(0.028)	(0.059)
ln CS*Age	-0.008***	-0.012***	-0.014***	-0.007**	-0.013***	-0.013***
	(0.003)	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)
R-squared	0.623	0.887	0.458	0.816	0.924	0.826
Panel C: Proportion - at least an undergraduate degree						
ln CS	-0.287***	-0.375***	-0.372***	-0.284***	-0.454**	-0.339***
	(0.065)	(0.032)	(0.076)	(0.086)	(0.027)	(0.059)
ln CS*Age	0.008***	0.012***	0.014***	0.007**	0.013***	0.013***
	(0.003)	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)
R-squared	0.623	0.882	0.458	0.816	0.922	0.826

Notes: Panel A estimates the impact on the average number of years in school. Panel B estimates the impact on the proportion of people who have less than an undergraduate degree. Panel C estimates the impact on the proportion of people who have at least an undergraduate degree. Age and time fixed effects are included in all regressions. Robust standard errors, clustered at cohort level are reported in parentheses. *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

Table 5: Immigration rates by education level - RF estimates

	Men			Women		
	France	UK	US	France	UK	US
Panel A: All schooling levels						
Ln Live births	-0.127***	-0.235***	-0.118***	-0.097***	-0.241***	-0.110***
	(0.024)	(0.018)	(0.028)	(0.024)	(0.019)	(0.034)
Ln Live births*Age	0.002**	0.005***	0.001	0.002**	0.005***	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
R-squared	0.839	0.887	0.895	0.636	0.879	0.883
Panel B: Less than an undergraduate degree						
Ln Live births	-0.145***	-0.186***	-0.163***	-0.134***	-0.200***	-0.151***
	(0.023)	(0.014)	(0.029)	(0.026)	(0.015)	(0.034)
Ln Live births*Age	0.002***	0.003***	0.002*	0.004***	0.004***	0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
R-squared	0.828	0.820	0.885	0.628	0.816	0.873
Panel C: At least an undergraduate degree						
Ln Live births	-0.026	-0.076*	-0.011	0.067	-0.017	-0.025
	(0.086)	(0.038)	(0.053)	(0.070)	(0.045)	(0.047)
Ln Live births*Age	0.004	-0.002	-0.002	-0.003	-0.002	-0.003
	(0.004)	(0.003)	(0.002)	(0.003)	(0.004)	(0.002)
R-squared	0.346	0.635	0.684	0.275	0.534	0.652

Notes: Panel A estimates the impact on immigration rates for all individuals. Panel B estimates the impact on immigration rates only for individuals who have less than an undergraduate degree. Panel C impact on immigration rates only for individuals who have at least an undergraduate degree. Age and time fixed effects are included in all regressions. Robust standard errors, clustered at cohort level are reported in parentheses. *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

Appendix A

Table 6: First Stage

	France	UK	US
Panel A: ln CS_{ct}			
ln CS_{c0}	1.074***	0.970***	0.970***
	(0.037)	(0.055)	(0.114)
Panel B: ln $CS_{ct}(age-25)$			
ln $CS_{c0}(age-25)$	1.134***	0.925***	1.002***
	(0.043)	(0.135)	(0.097)
F-test	1150.256	53.110	118.914

Notes: All regressions are clustered at cohort level and include age and time fixed effects. Robust standard errors in parentheses. 2SLS F statistic is based on the Kleinbergen-Paap Wald F statistic.*** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

Appendix B: Data

Construction of weekly wages

For all three countries considered, the cohort size is measured by the total number of people in the year-age-cohort cell considered, measured using the appropriate weight given in the LFS. As for the mean of the wages, this is calculated as the weighted mean of the wages for the year-age-cohort-sex/education cell. All wage and salary and self-employed workers age 25 to 60 who work fulltime are included.

For the US, the gross weekly wages of full-time workers are calculated by dividing annual wage and salary earnings by the number of weeks worked in the previous year for individuals. In order to calculate the hourly wages, the reported number of hours per week that respondents usually worked if they worked during the previous calendar year is used. The sample includes full-time wage and salary workers who were employed during the previous calendar year prior to the March survey and worked at least thirty-five hours a week. Moreover, people between 15-24 enrolled in full or part time studies are discarded - this will not affect the results, as the sample considered is at least 25 years old. Even though wages information is available from 1976 onwards, the information on current enrolment in education is available only from 1986 onwards. Wages are converted to 1998 US dollars. For the annual wage and salary earnings as well as the number of hours, the "NOT IN UNIVERSE" values are coded as "." (i.e. missing). Those with wages below 50 and above 2500 1998 dollars are dropped from the sample.

The French LFS information on the previous monthly wages (usually March) are available only from 1990 onwards and the values are converted to 1998 Euros. In order to determine the weekly wages, the monthly wages are multiplied by $\frac{12}{52}$. All wages are recalculated in 1998 Euros, using the CPI provided by the French National Institute of Statistics (INSEE)[16] and the pegged value. It is also worth mentioning that in 1999, the French Franc was partially

[16]Source:
http://www.bdm.insee.fr/bdm2/affichageSeries?idbank=000639203&page=informations&codeGroupe=142&recherche=criteres

replaced by the Euro, and in 2002, the Euro became the official currency of France. The French Franc was pegged to Euro at the value of 6.55957 Francs. The sample includes people working full-time in their main job the previous month and it excludes those enrolled in studies. Moreover, all weekly wages below 50 and above 2000 1998 euros are dropped. Wages are for those fulltime employed and with nonzero earnings.

For the UK data, weekly gross wages, identified as the weekly earnings in the main job in the reference week are available from 1993 onwards. The values are calculated in 1998 GB, using the CPI from ONS[17]. Only people in full-time employment during the reference period are kept and those in employment who are still in education (whether full or part time). Weekly wages less than 50 and higher than 2000 in 1998 GB pounds are discarded.

Wages in all three countries are finally expressed in PPP 1998 US dollars, using the PPP calculated by the World Bank[18].

[17]Source: `http://www.ons.gov.uk/ons/datasets-and-tables/data-selector.html?cdid=D7BT&dataset=mm23&table-id=1.1`

[18]Source: `http://data.worldbank.org/indicator/PA.NUS.PPP`