The impact of education on the demographic dividend

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Abstract

The impact of population structure on economic growth has been studied in recent decades using different methods to estimate the so-called demographic dividend. Besides, education has been pointed out as a key factor in economic growth. We propose a decomposition of the demographic dividend, into age and education effects. We illustrate the potentialities of the method, deriving an application to Mexico and Spain over the period 1970-2100. To that end, we estimate the National Transfer Accounts age profiles by schooling level and apply them to recently available population projections stratified by education level. Our results confirm the role of population age structure in the demographic dividend, but also reveal that education attainment can be even more crucial. Moreover, we find that how both age and education effects finally impact on economic growth depends to a great extent on the specific consumption and labor income age profiles in each country.

1. Introduction

The effect of the population age structure on economic growth has been extensively studied over the last two decades, mainly motivated by the demographic transition from high to low mortality and fertility rates that most countries are experiencing as they develop. Previous research was focused on the link between population size and growth, but the influential work of Bloom and Williamson (1998) explicitly introduced age structure into the analysis, finding that this was an important mechanism by which demographic variables affect economic growth. The concept of *demographic gift*, later re-named as *demographic dividend*, first appeared in Bloom and Williamson's work to refer to the positive effect that the demographic transition can have on economic growth. During this process, there is a temporary stage where the working-age population grows faster than the rest; that is, the support ratio –the share of working-age population in total population– grows. Consequently, per capita income can increase as there are fewer economic dependents in the population. Nevertheless, this effect will vanish some years later, when baby boomers reach retirement age, leading to an increase in old dependency ratios, i.e. population aging.

The demographic transition has coincided in time with a significant educational expansion that occurred in virtually every country in the world during the 20th century, especially after the 1960s. Certainly, important differences remain between areas, but all of them show general improvements in education (UNESCO, 2011). This means that the empirically observed effects of population age structure on economic growth are probably influenced by improvements in the education level of the population. Since the late 1960s, a vast branch of economic research has being studying the return to education, on the level of both micro-effects of education on individual earnings and macro-effects on economic growth (Johnes and Johnes, 2004). Micro-labor literature, based on the Mincerian human capital earnings function (Mincer, 1974), produced estimations of the rates of return to schooling. From a macro-economic perspective, several cross-country studies have investigated the effects of educational attainment on the GDP growth rate. However, as Psacharopoulos and Patrinos (2004) point out, the weakest point of the macroeconomic growth models is the requirement of substantial data, due to the difficulties in constructing comparable inter-temporal and inter-country human capital data, including comparability problems of National Accounts figures. As a result, the empirical evidence about the positive effect of education on earnings observed at the micro level cannot always be corroborated at the macro level. Nevertheless, micro level results are clear and solid enough to justify the profitability of investment in education. As Stevens and Weale (2004) state, if people with more education earn more the same should occur for a group of individuals, and particularly for a country.

Summarizing, two strands of literature analyzing the determinants of economic growth have evolved separately during recent decades. On the one hand, there is the research about the demographic dividend, trying to elucidate the effects of the population age structure on economic growth, but without paying specific attention to changes in educational level, only on the investment in human capital of children (Lee and Mason, 2010, Mason et al., 2016). On the other hand, a longstanding branch of economic research has been devoted to disentangling the relationship between economic growth and the educational attainment of the population, but without special regard to the population age composition. A recent paper by Crespo-Cuaresma et al. (2014) acts as a kind of meeting point between the two previous research lines, as they try to disentangle the roles of age structure and education in economic growth by using panel data. As they point out, research on the demographic dividend was initially linked to education, but its role was not analyzed in depth (Bloom and Williamson, 1998), or it was found to be not significant (Kelley and Schmidt, 2005). Crespo-Cuaresma et al. (2014) estimate a macroeconomic growth model using a newly available dataset on human capital, containing information about educational attainment distribution by age and sex for more than 100 countries for the period 1980-2005.[i] They conclude that, when correcting for educational expansion, the effect of population age structure on GDP per capita is reduced significantly, that is to say that the so-called demographic dividend is mainly an education effect. Education and age composition of the population are treated as two separate factors in the regressions, as if the education level of the population was not related to the age structure of the same population.

In our study, we link education attainment to the evolution of the population age structure using a different method. We propose an extension of the methodology developed by Mason (2005) and Mason and Lee (2006), in order to decompose the growth in the support ratio – the demographic dividend – into two different components: age and education. These authors combined demographic information with the age profiles of consumption and labor income, estimated following the National Transfer Accounts (NTA) method. We follow the same strategy, taking it one step further. We first estimate the NTA age profiles by education level and then we adapt the method to incorporate education variability. Second, in order to illustrate the potentialities of this methodological extension, we perform a simulation exercise for Mexico and Spain, for which we were able to construct the NTA profiles by level of education [ii] . Likewise, they represent two different contexts in terms of demographic transition and educational achievements of their populations, allowing for an interesting comparison. Our simulation will recover the history of population back to 1970 and projecting it into the future. We are thus able to evaluate the impact of population age structure on the support ratio, but taking into account that changes in education also influence the production and consumption level.

The rest of the paper is structured as follows. In the next section, after a brief review about the estimation of the demographic dividend, we propose the decomposition into two different factors, age and education effects. The third section is devoted to describing and constructing the data needed for the estimation – including population projections by level of education and the age profiles of consumption and labor income by education level for Mexico and Spain. The fourth section shows the main results of different simulation exercises, estimating the proposed decomposition of the demographic dividend. Finally, conclusions are in the last section.

2. Decomposing the demographic dividend by age and education level

Following Mason (2005), the concept of the demographic dividend can be formally derived starting from the following decomposition of per capita income at year *t*:

$$\frac{Y(t)}{N(t)} = \frac{W(t)}{N(t)}\frac{Y(t)}{W(t)} \qquad (1)$$

With *Y* being income, *N* total population and *W* working-age population (hereinafter workers). The first term on the right-hand side, the ratio of workers to total population, represents the support ratio (*SR*). The second term on the right-hand side is income per worker (productivity, *l*). Hence, income per capita depends on these two factors: the support ratio (SR) and productivity (*l*). Expressing Eq (1) as growth rates (g), it can be derived that support ratio changes and productivity growth rates determine per capita income growth:

$$g\left(\frac{Y(t)}{N(t)}\right) = g(SR) + g(l) \quad (2)$$

The demographic dividend is captured by the evolution of the support ratio. Bloom and Williamson (1998) were among the first authors to estimate it. Using regression analysis, they concluded that the demographic transition contributed to the so-called economic miracle observed in East Asia over the period 1965-1990. Kelley and Schmidt (2001) and Bloom and Canning (2003) also carried out other empirical studies using cross-country aggregate data. Mason (2005) and Mason and Lee (2006) derive an alternative estimation process for the evolution of the support ratio, combining demographic and economic information. By using the per capita age profiles of labor income and consumption, they obtain the number of effective consumers (*C*) and producers (*L*) instead of *N* and *W* in Eq (1). With c_i and ly_i being the per capita age profiles of consumption and labor income, respectively, *C* and *L* can be obtained as follows:

$$C(t) = \sum_i N_i(t) \cdot c_i \quad (3)$$

$$L(t) = \sum_i N_i(t) \cdot ly_i \quad (4)$$

In this way, the pure demographic support ratio in Eq. (2) is redefined as an economic support ratio that we will be referring to as support ratio (*SR*), as it considers not only demographic effects of population age structure, but also economic variables, such as labor and consumption patterns. Estimations of the demographic dividend based on the *SR* are available for many countries (Mason, 2005; Mason and Lee, 2006; Oosthuizen, 2015; Patxot et al., 2011; Prskawetz and Sambt, 2014). Results show that, for most developed countries, the demographic dividend started in around the

1970s and lasted for about three decades, but some differences can be observed depending on the specific demographic and economic characteristics of each country.

In order to consider the effect of education explicitly in the estimation of the demographic dividend, we further break down Eqs (3) and (4) by educational group, represented by *j*:

$$C(t) = \sum_j C_j(t) = \sum_i \sum_j N_{ij}(t) \cdot c_{ij} \quad (5)$$

$$L(t) = \sum_j L_j(t) = \sum_i \sum_j N_{ij}(t) \cdot ly_{ij} \quad (6)$$

Once the economic profiles have been differentiated by both age and education, it is possible to measure the contribution of each of these two factors to the demographic dividend, estimated as the growth of *SR*. First, we follow the method of Das Gupta (1993) in order to decompose the annual growth of effective producers (*L*) into a rate-effect (*R*), an age-effect (*A*) and an education-effect (*E*), as[iii]:

$$L(t+x) - L(t) = \underbrace{[\bar{R}(t+x) - \bar{R}(t)]}_{rate-effect} + \underbrace{[\bar{A}(t+x) - \bar{A}(t)]}_{age-effect} + \underbrace{[\bar{E}(t+x) - \bar{E}(t)]}_{education-effect} \quad (7)$$

$\bar{R}(t)$ in Eq [7] refers to the age and education standardized rate-effect in year *t* (and *t*+*x*) and is measured as:

$$\bar{R}(t) = \sum_{i,j} \frac{\frac{N_{ij}}{N}(t+x) + \frac{N_{ij}}{N}(t)}{2} ly_{ij}(t) \quad (8)$$

Where N_{ij}/N represents the share of people of age *i* and education level *j* relative to the total population, and ly_{ij} is the labor income profile by age and educational level.

Likewise, $\bar{A}(t)$ corresponds to a rate and education standardization of the age-effect:

$$\bar{A}(t) = \sum_{i,j} \frac{ly_{ij}(t+x) + ly_{ij}(t)}{2} \cdot \frac{e_{ij}(t+x) + e_{ij}(t)}{2} \cdot a_{ij}(t) \quad (9)$$

With a_{ij} and e_{ij} being the age and education effects, respectively. They can be isolated from the age and education level structure of the population in year *t* as:

$$\frac{N_{ij}(t)}{N(t)} = \underbrace{\left(\frac{N_{ij}(t)}{N_{.j}(t)} \cdot \frac{N_{i.}(t)}{N(t)}\right)^{\frac{1}{2}}}_{a_{ij}(t)} \cdot \underbrace{\left(\frac{N_{ij}(t)}{N_{i.}(t)} \cdot \frac{N_{.j}(t)}{N(t)}\right)^{\frac{1}{2}}}_{e_{ij}(t)} \quad (10)$$

The last term in Eq [7], *E(t)*, is estimated as the rate and age standardization of the education effect:

$$\bar{E}(t) = \sum_{i,j} \frac{ly_{ij}(t+x)+ly_{ij}(t)}{2} \cdot \frac{a_{ij}(t+x)+a_{ij}(t)}{2} \cdot e_{ij}\,(t) \quad (11)$$

Secondly, consumption is decomposed in the same way as labor income, into rate, education and age effects.

Finally, the decomposition of labor income and consumption obtained in the three effects mentioned is introduced into the estimation of the *SR* growth rate as:

$$g(SR) = g(L) - g(C) = \frac{L(t+x) - L(t)}{L(t)} - \frac{C(t+x) - C(t)}{C(t)} = \frac{\dot{R}_L+\dot{A}_L+\dot{E}_L}{L(t)} - \frac{\dot{R}_C+\dot{A}_C+\dot{E}_C}{C(t)} \quad (12)$$

To carry on the decomposition explained here, we need age profiles of consumption and labor income by education level and to apply them to the population over several years. Population data, therefore, also need to be disaggregated by age and education level. We perform the decomposition for Mexico and Spain from 1970 to 2100, taking one base year for the economic profiles. This implies that the rate effect described above (Eq. 8) will not be captured.

3. 1 Data requirements: population data by level of education

We used population projections by level of education, available from the Wittgenstein Centre for Demography and Global Human Capital (WICD). [iv] The WICD has produced, for the first time, projections of educational level by age and sex for 195 countries for the period 1970-2100, using exhaustive information and analyses of recent trends on fertility, mortality, migration, and educational level for the different areas of the world (Lutz et al., 2014). They also consider other scenarios in their projections. We will use two of them for the sensitivity analysis. On the one hand, the CER (constant enrolment rate) scenario considers that enrollment rates remain constant over time from 2015 onwards, in both countries; therefore, no significant improvements in education level are expected beyond the coming decades. On the other hand, the FT (Fast Track) scenario assumes that enrollment rates improve faster than in the central projection.

In order to observe the evolutions of the age structure in both countries, Figure 1 shows the dependency ratios (using data only by age and year) obtained from WICD data for 1970-2100. First, child dependency has experienced a clear decline in both countries but with different patterns. For Mexico, the demographic transition started later than in Spain, but it has been much more pronounced as the initial level of fertility was higher. At the beginning of the century child dependency was still over 50%, but it will continue to decrease until 2050, when it will stabilize at around 25%. In the case of Spain, child dependency reached its minimum (slightly above 20%) in the early 2000s and is expected to remain at around that level until 2040. After that year, it will increase to 25% and will remain at around that level for the rest of the century.

[Figure 1]

Second, demographic patterns are also different regarding old dependency. In Mexico, it will increase especially after 2030 and will continue to grow over the rest of the century. In the case of Spain, it starts to grow earlier and will peak at 69% by 2050, a level that Mexico will never reach during the period. The whole process is strongly driven by the evolution of the fertility rate, which was 2.15 in Mexico in 2015 (CONAPO, 2015), while it was only 1.3 in Spain in 2013 (INE, 2015). Projections for Mexico predict that the fertility rate will remain higher than in Spain, and consequently the increase in its old dependency ratio will be slower (UN, 2015). Finally, it is worth noting that during the first part of the period analyzed – until 2010 in Spain and 2030 in Mexico - the total dependency ratio was mainly driven by the evolution of child dependency. Conversely, old dependency will become the main driver of total dependency in the future. Note also that the minimum level of the total dependency expected in Mexico (48% in 2030) is slightly higher than in Spain (44% in 2005-2009).

Figure 2 displays population projections by level of education (percentage of adult population in each education level) for the baseline scenario (the medium case), as well as the alternative scenarios for the period 1970-2090.

[Figure 2]

We observed that Mexico and Spain have experienced great improvements in their level of education in recent decades, reducing the share of adults with less than primary education and increasing the amount of people with higher education levels. Nevertheless, important differences exist between them. According to the OECD (2013), in 2011 Mexico was clearly behind the OECD average in terms of people aged 25-34 who had completed at least upper secondary education (55% compared to 82% in OECD) and who had attainted tertiary education (23% compared to 39% in OECD). Those figures were significantly better in the case of Spain (65% of people aged 25-34 with upper secondary education and 39% with tertiary education). According to Lutz et al. (2014) projections, the differences will remain in the future. For example, in Spain adults with less than primary school practically banish in 2035 (they will be below 3% of total population), but this will only occur 20 years later in Mexico. Regarding post-secondary education, by 2100 53% of Spaniards but only 41% of Mexicans will have post-secondary education.

When observing both alternative scenarios, significant differences between educational attainment in Mexico and Spain remain. However, we can observe that the CER scenario stops improving education attainment of the population after 2050 in both countries. In the FT scenario, post-secondary education proportions increase faster, and not only proportions of people with less than primary but also with primary education are reduced to very low levels. Nevertheless, by 2090, Spain continues to have a higher proportion of population with post-secondary education than Mexico.

3.2 Data requirements: Constructing age profiles of consumption and labor income by level of education

We briefly describe the procedure to construct economic profiles by age and educational level for Mexico and Spain. We are basically interested in two profiles: labor income and consumption. The labor income profile will be used to obtain the number of effective producers (Eq 3), and the consumption profile to estimate the number of effective consumers (Eq 4). The difference between labor income and consumption age profiles defines the so-called lifecycle deficit (*LCD*) in the National Transfer Accounts (NTA) methodology. The *LCD* shows how production and consumption vary over the lifecycle. Typically, individuals consume more than they produce during two periods – at the beginning and at the end of their lives -, and the opposite occurs for working-age individuals. The length of these three periods, together with the amount of the corresponding deficit –consumption higher than labor income– or surplus –consumption lower than labor income– varies among countries (Mason and Lee, 2011).

We followed the NTA methodology (UN, 2013) to construct economic profiles that are estimated through surveys and official data, and then adjusted to aggregate data from National Accounts. The labor income profile is comprised of the sum of earnings and self-employment income profiles among total population by age and education level, and the consumption profile includes a profile of both public and private consumption. We go beyond the standard NTA methodology by differentiating age profiles by education level. We consider four levels of education – 1) Less than primary; 2) Primary completed; 3) Secondary completed; 4) Higher education – similar to Mejía-Guevara (2015), but using individual education instead of the education level of the household head.[v]

Data for Mexico are from the year 2004. Micro data on labor and private consumption are extracted from the Income and Expenditure Survey (ENIGH), while public consumption data come from administrative records (SHCP, 2004). In the case of Spain, data are for 2006 and come from different sources. Private consumption data come from the Household Budget Survey (EPF), labor income data are extracted from the EU-SILC and public consumption data come from different public administration statistics (INE, IGAE). Specific details on the construction process of profiles for each country are described elsewhere (Mejía-Guevara, 2011, 2014a for Mexico; Patxot et al., 2011a, 2011b for Spain).

Figures 3 and 4 show the per capita age profiles of labor income and consumption by level of education from Mexico and Spain, respectively. To make them comparable, they have been divided by the average labor income for ages 30 to 49 in the same country. Although with differences, both average economic profiles (black lines in the Figures) present the typical shape by age: while consumption remains quite stable over the lifecycle for adults, labor income is clearly concentrated in the middle years of working age (Lee & Ogawa, 2011; Tung, 2011). Nevertheless, the differentiation of those profiles by educational attainment brings significant new features. First, in both countries labor income profiles present higher differences than consumption profiles; that is, labor income is more unequal according to level of education than consumption. In Spain, the labor income profile peaks at around ages 50-54 for higher education levels (post-secondary and secondary education), while it peaks at younger ages for lower levels of education. The per capita labor income at age 50-54 for people with post-secondary education level represents more than double the average labor income for ages 30-49. Regarding population with primary education, their labor income profile is practically flat for ages 30-55 - around 80% of the average income at 30-49. Finally, individuals with less than primary education earn the maximum at 30-34 – around 50% of average income for ages 30-49. The pattern is quite similar in Mexico, although a much higher difference is observed for individuals with the higher level of education: their per capita labor income for ages 30-65 is over 3 times the average labor income at 30-49. On average, labor income of individuals from age 30 to 59 with post-secondary education in Mexico is 8.6 times that of the individuals with less than primary studies, while that ratio is 5.1 in Spain.

Second, regarding consumption profiles, the differences by level of education are again clearly higher in Mexico. Consumption of highly educated individuals more than doubles average consumption, while consumption of the less educated is half that of average consumption. For Spain, consumption profiles by level of education are much more similar, and consumption of highly educated individuals is 60% higher than consumption of less educated individuals among ages 30 to 59. It is worth noting that the average consumption profile observed in Spain among the middle age groups (30 to 49) is 66% of the average labor income for ages 30-49, significantly lower than in Mexico, where it is around 90%.

[Figure 3]

[Figure 4]

The per capita lifecycle deficit (*LCD*) profiles for both countries are shown in Figure 5. In general, Mexico presents higher deficits than Spain because, as seen in previous Figures, its consumption profiles are clearly higher than in Spain at every level of education, while labor income profiles are not. Interestingly, it can be observed that in Mexico only individuals with at least secondary education can generate a surplus (labor income over consumption) during their lifecycle. This surplus is much more significant in the case of individuals with higher education, while very modest for individuals with secondary studies. On the contrary, people with less than secondary education present a continuous deficit (they consume more than they produce) over their whole lifecycle. In Spain, the picture is slightly better: individuals with primary or higher education experience a surplus during part of their working-age years, being clearly longer and bigger than in Mexico.

[Figure 5]

5. The role of education in the demographic dividend

5.1. Baseline results

Figure 6 shows the results of the demographic dividend (defined as the rate of growth of the support ratio) for the period 1970 to 2100 in Mexico and Spain, distinguishing the education and age effects. As explained above, the education effect captures the impact on the demographic dividend of changes in the population composition by education level, while the age effect estimates the impact of changes in the age population structure. If we just look at the evolution of the total *SR* growth (black line) we observe that, for Mexico, it reached the highest growth rate in 1985 and from then it initiates a progressive decrease until it becomes negative in 2040, remaining in negative values for the rest of the century. In the case of Spain, the evolution is somewhat different. The support ratio peaks a decade later – in 1995-99 – but decreases faster, becoming negative by 2030-34. Negative values are clearly higher in Spain than in Mexico, but they last until 2055, when the growth of the support ratio becomes positive again for a short period of 20 years.

Regarding the age effect, both in Mexico and Spain, the estimated positive effect will last until 2020 and will remain negative for the whole century. In Spain, the negative age effect will peak in 2040 (coinciding with the full retirement of the baby boom generation) and will improve from then on. In the case of Mexico, the negative effect of age increases continuously along the period, but it is never as important as in Spain, due to the different time path of their demographic transitions.

[Figure 6]

While the age effect closely follows the evolution of the total dependency ratio, the education effect is positive as the education level of the population continues to increase, this occurs throughout the period for both Mexico and Spain. Hence, the growth of the support ratio will remain positive if the positive education effect is higher than the negative age effect.

It is worth noting that, although the Spanish population is expected to reach higher education levels than Mexican population, it also exhibits a much more negative age effect, which holds back the positive effect of education. Therefore, it is true that education expansion can partly overcome the negative impact of an increasing dependency ratio on the demographic dividend, but the population age structure continues to be crucial in the evolution of the SR.

[Table 1]

As mentioned above, the demographic dividend measures the effects of changes in age structure (age effect) and educational attainment (educational effect) on economic growth. In order to explore this relationship, Table 1 shows past trends of the demographic dividend decomposed for the two factors (age and education), together with the annual *GDP* growth observed, both in per capita and per effective consumer terms.[vi] Mexico has registered an average annual growth of the support ratio of 1.90% over the period 1970-2015, due to a positive age structure and especially to a very favorable education effect. However, although annual *GDP* per capita growth was 3.27%, *GDP* per effective consumer only grew by 1.92%, due to the unfavorable relations between labor income and consumption. Of upmost importance, during the most favorable period in terms of *SR* growth (1980-95) the *GDP* has grown well below. This result indicates that Mexico was not taking full advantage of its favorable demographic and educational background.

In Spain, the demographic dividend was also positive (1.47%) throughout the period 1970-2015, although the age effect is zero in the last years. This accounted for 70% of *GDP* per effective consumer growth. However, during some periods (1980-85; 1990-95 and 2005-15), the Spanish economy clearly grew below the demographic dividend, meaning that the opportunities offered by the population structure in terms of age and education level were also neglected. Hence, it seems that in the past Spain, and especially Mexico, were not able to fully benefit from having a significant demographic dividend. This is particularly worrying provided that the demographic dividend will be much lower, and even negative, in the future.

In order to evaluate the robustness of our results, we perform two sensitivity exercises. First, we evaluate the impact of the education projections by using two alternative scenarios to our central hypothesis, as described in the third section. Second, we try to evaluate the impact of the economic profiles of consumption and labor income employed, by exchanging the profiles estimated for both countries.

5.2. Sensitivity analysis (I): Changing education projection scenarios

As a sensitivity test, we re-estimate our results of the demographic dividend decomposed with two alternative scenarios of population distribution by level of education, also available in WICD (2015), as described in the third section. As mentioned, the CER scenario considers very little improvements in the educational attainment of both countries, while the FT scenario assumes a faster education expansion than in the central projection. Both alternative scenarios use the same assumptions as the baseline scenario, except for the education enrollment rates. However, as demographic components depend on the education level of the population, different population age structures result in each of these alternative scenarios.

Results obtained with the two alternative education scenarios, together with our baseline estimation, are shown in Figures 7 (Mexico) and 8 (Spain). As expected, in the CER scenario the education effect is clearly lower for both countries, becoming zero around 2040 in both cases, and remaining close to a null value from then and onwards. The decline of the education effect means that the demographic dividend becomes dependent mostly on the age effect, and turns negative earlier and much deeper than in the baseline scenario. Results using FT projections are the opposite. In this case, the education effect is much more positive during the first half of the projection. After 2060 in Mexico and 2070 in Spain, the education effect is lower than in the baseline scenario, probably because the population will have almost exhausted the capacity to improve its education level. Once a majority of the population is already enrolled in school until tertiary education, improvements are necessarily smaller. Therefore, the consequences are very positive in the medium term, but puzzling further into the future. In the case of Mexico, under the faster education expansion the demographic dividend remains positive until later, but then the age effect decreases sharply, driving the *SR* to very negative values in 2060. In Spain, the negative *SR* from 2020-2050 almost disappears, overcoming the baby-boom generation aging.

Overall, the results of both scenarios make it clear that improvements in education attainment of the population are crucial in the evolution of the demographic dividend, both by their direct impact and also by their effect on the demographic components influencing the *age effect*.

[Figure 7]

[Figure 8]

5.3. Sensitivity analysis (II): The effect of the economic profile

As explained in the fourth section, estimated economic profiles of labor income and consumption (and hence of *LCD*) are significantly different by level of education within each country, but there are also disparities between countries. Spain presents more favorable profiles in terms of *LCD*, as its relative consumption profiles are clearly lower than in Mexico for all education levels, while its relative labor income profiles are slightly higher. In order to evaluate the impact of the economic profiles on the demographic dividend, a simulation exercise is created by exchanging the estimated profiles for both countries. Therefore, we estimate the evolution of the demographic dividend in Mexico if it had the economic profiles of Spain, and vice versa, the demographic dividend in Spain with the labor income and consumption profiles of Mexico (Figure 9).

The results show that both age and education effects are affected by economic profiles. In Mexico, more favorable economic profiles would imply a considerably higher demographic dividend, which would not become negative in the period considered. This means that, *ceteris paribus*, a better per capita lifecycle deficit profile in Mexico would be sufficient to overcome the negative effects of aging in its economy. As for Spain, the opposite is observed: worse lifecycle deficit profiles – with higher deficits and lower surpluses– than those observed in Mexico would lead to a scenario where the demographic dividend would become negative earlier and would remain below zero for longer. Hence, the same conclusion is confirmed in both cases: worse (better) lifecycle deficit profiles would improve (worsen) the demographic dividend evolution, as a combination of effects in both age and education components.

[Figure 9]

6. Conclusions

The potential positive effects of a favorable population age structure on economic growth have been investigated in recent decades through the estimation of the demographic dividend. This research was mainly motivated by the demographic transition that most countries are facing as they develop. The first estimations of the demographic dividend looked into the relations between the working-age population and the economically dependent individuals, namely the support ratio. In a first stage of the demographic transition the working-age population grows faster than the rest of the population, having a positive effect on economic growth. The opposite occurs in a second stage, when the aging process arrives and the support ratio growth becomes negative. However, it turned out that the first stages of demographic transition coincided in time with a significant education expansion in most countries, which also interacts with this process. This means that economic growth is not only influenced by age structure changes, but also by the improvements in the education attainment of the population. In this paper we propose to disentangle both effects through the decomposition of the demographic dividend.

The estimation of the decomposition requires population data by age and education for the past and projections for the future, as well as estimations of per capita profiles of labor income and consumption, also by age and level of education. The former was obtained from a recently available dataset (WICD, 2015; Lutz et al., 2014; Speringer et al. 2015). Regarding the economic profiles, the NTA project provides them for a wide range of countries, but no data are yet available by education level. Hence, we focus our estimation on two specific countries, Mexico and Spain, estimating their economic profiles by age and level of education.

Our results reveal interesting insights. First, the positive age effect in Mexico starts before 1970, peaks in around 2000 and finishes in around 2020, when it will become negative. In the case of Spain, the age effect starts later (in 1980) but ends by 2020, as well. Second, the education effect is clearly higher than the age effect in the past in both countries, and remains positive throughout the period observed. When adding the education component to the demographic dividend, the future negative effect of aging on the support ratio is partly offset. This implies that education is an important mechanism to reduce the adverse effects of aging, as education expansion delays the starting point of the negative growth of the *SR*). Nevertheless, it is important to take into account that a higher education also implies a faster aging in the future, turning the age effect more negative, as the sensitivity scenarios showed. Third, we showed that economic profiles by age and level of education could also have important effects on the demographic dividend: *ceteris paribus*, the better (worse) the lifecycle deficits the better (worse) the support ratio growth. Quite interestingly the sensitivity scenarios show that, if Mexico had consumption and labor income age profiles similar to those for Spain, it could completely avoid negative growth of the support ratio. The reason is that the education improvement would be sufficient to offset a milder aging process.

These findings also offer guidance on how to approach the demographic transition from a policy point of view. The demographic dividend could be expanded through policy mechanisms that focus not only on reducing population aging but also on expanding education attainment and improving the lifecycle deficit surplus. This gives governments more options to overcome the potential negative impact of aging. In the case of developing countries, in the first stage of the demographic transition education policy seems to be the best way to take advantage of, or even extend, the period during of the demographic dividend.

In any case, further research is needed in order to investigate the interaction between economic and demographic evolution, from both the theoretical and the empirical perspective. On the one hand, there is a clear need to obtain time series estimates of the age profiles in order to refine the analysis undertaken. On the other hand, from a more general perspective, the interactions between demographic and economic variables are diverse and still quite unknown, being as crucial as the links between fertility, mortality, education and economic wellbeing.

Tables

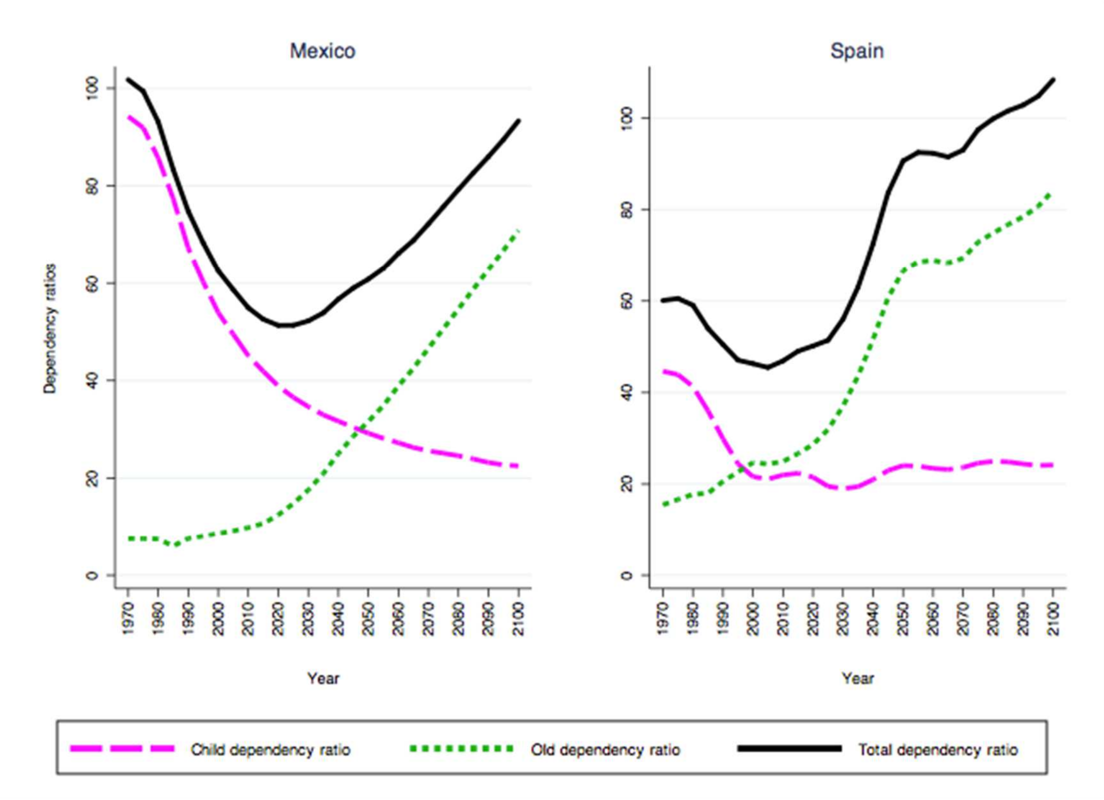
Table 1 The *GDP* growth and the demographic dividend decomposed by age and education (1970-2015) (Percentage average annual growth rates)

	Period	GDP per capita	GDP per consumer	*SR*	Education effect	Age effect
MEXICO	1970-75	6.54	4.45	1.35	1.23	0.13
	1975-80	5.15	3.52	2.03	1.56	0.49
	1980-85	1.94	0.39	2.56	1.60	1.02
	1985-90	2.15	0.43	2.53	1.61	0.97
	1990-95	1.66	-0.01	2.50	1.35	1.21
	1995-2000	5.05	3.73	2.18	1.19	1.03
	2000-05	1.42	1.50	1.77	0.97	0.83
	2005-10	2.86	2.37	1.26	0.85	0.42
	2010-15	2.77	1.05	0.91	0.72	0.20
	1970-2015	**3.27**	**1.92**	**1.90**	**1.23**	**0.70**
SPAIN	1970-75	4.46	4.65	0.70	0.93	-0.24
	1975-80	1.52	1.60	0.72	0.82	-0.10
	1980-85	1.07	1.21	2.32	1.82	0.53
	1985-90	3.90	4.04	1.27	1.10	0.18
	1990-95	1.51	1.37	2.67	2.02	0.70
	1995-2000	3.41	3.44	1.83	1.09	0.77
	2000-05	2.81	2.71	1.69	1.01	0.70
	2005-10	1.06	0.86	1.10	0.70	0.41
	2010-15	-0.54	-0.81	0.64	0.64	0.00
	1970-2015	**2.12**	**2.10**	**1.47**	**1.15**	**0.34**

Source: Authors' calculations. *GDP* data from OECD statistics.

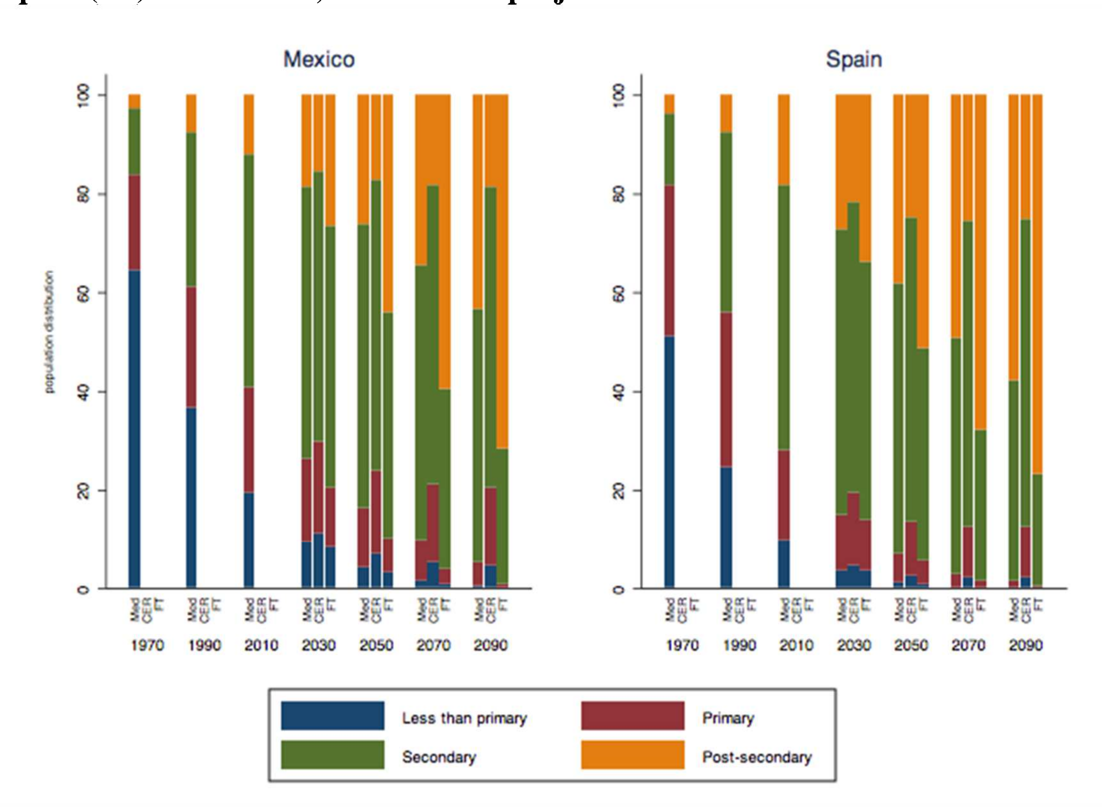
Figures

Figure 1 Population dependency ratios in Mexico and Spain 1970 – 2100



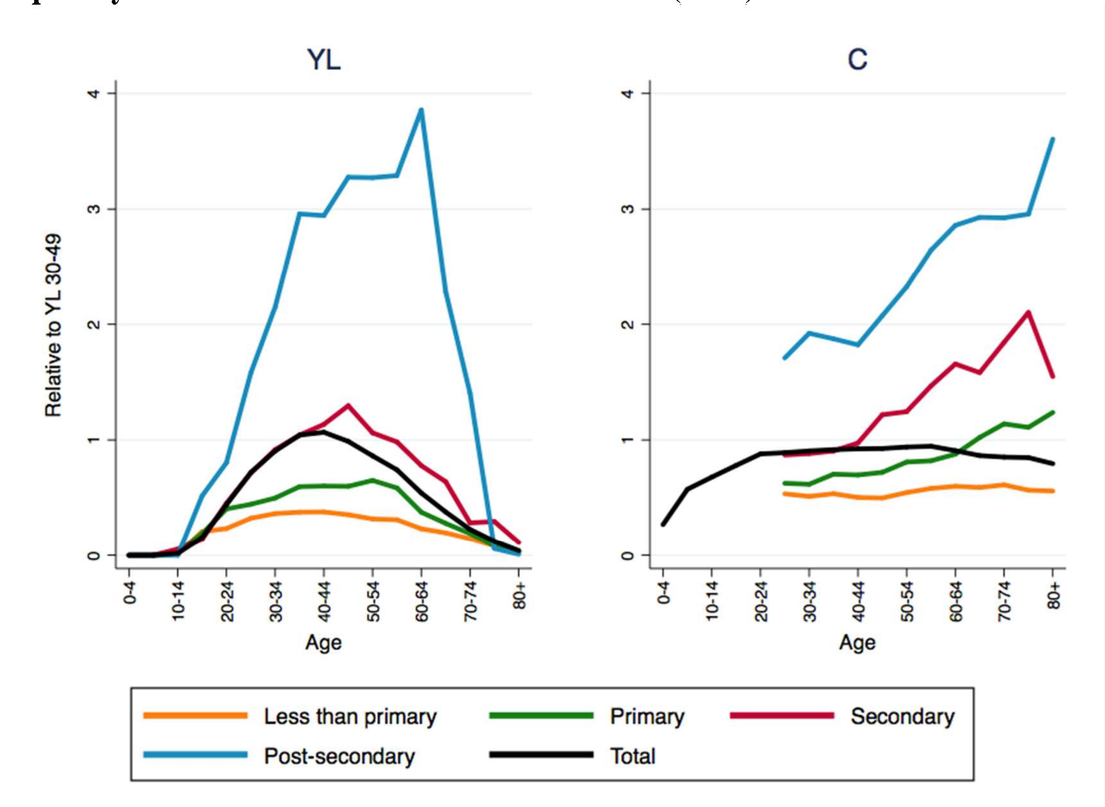
Source: Authors' calculations based in WICD (2015)

Figure 2 Distribution of the population by education level in Mexico (MX) and Spain (ES) 1970 – 2100, for different projection scenarios



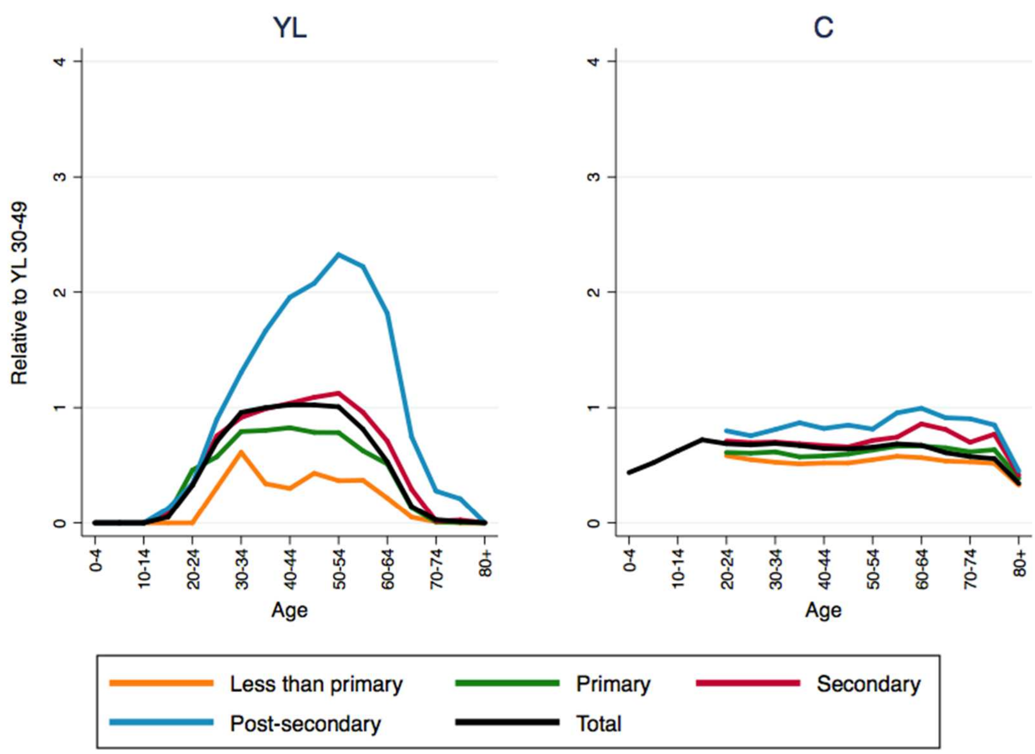
Source: Authors' calculations from Lutz et al. (2014)

Figure 3 Economic profiles (Labor income – YL and Consumption – C) per capita by individual level of education in Mexico (2004)



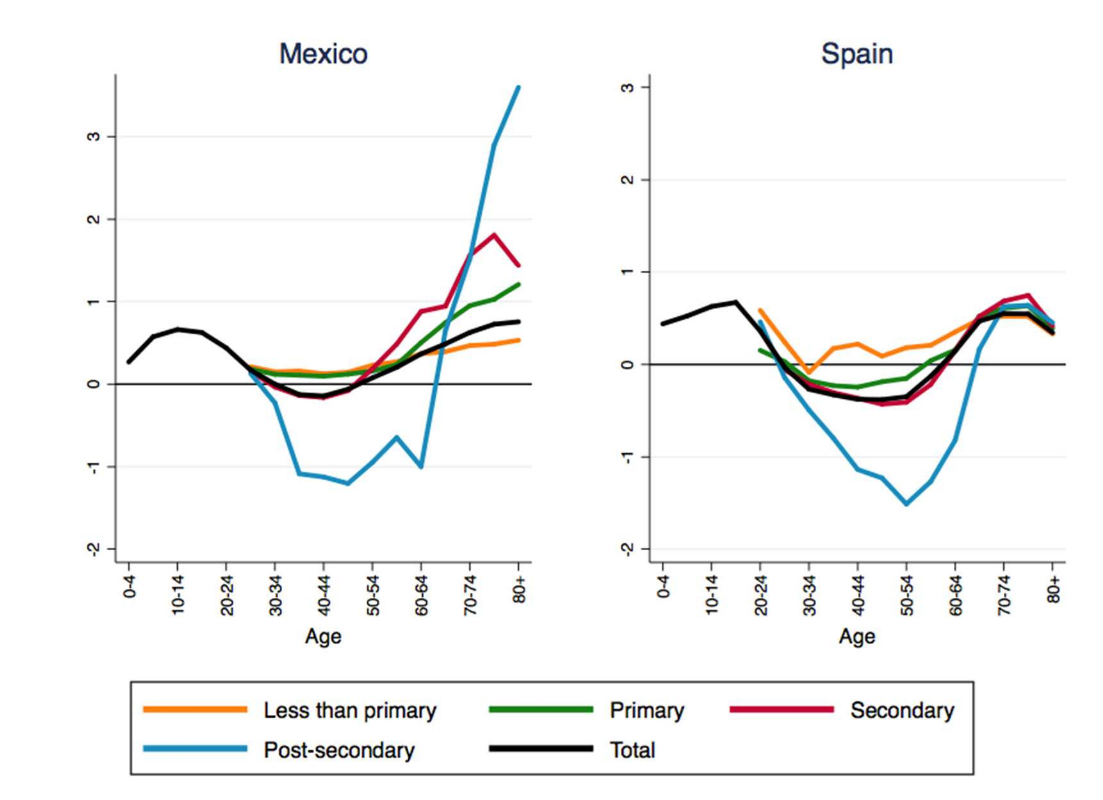
Source: Authors' calculations

Figure 4 Economic profiles (Labor income – YL and Consumption – C) per capita by individual level of education in Spain (2006)



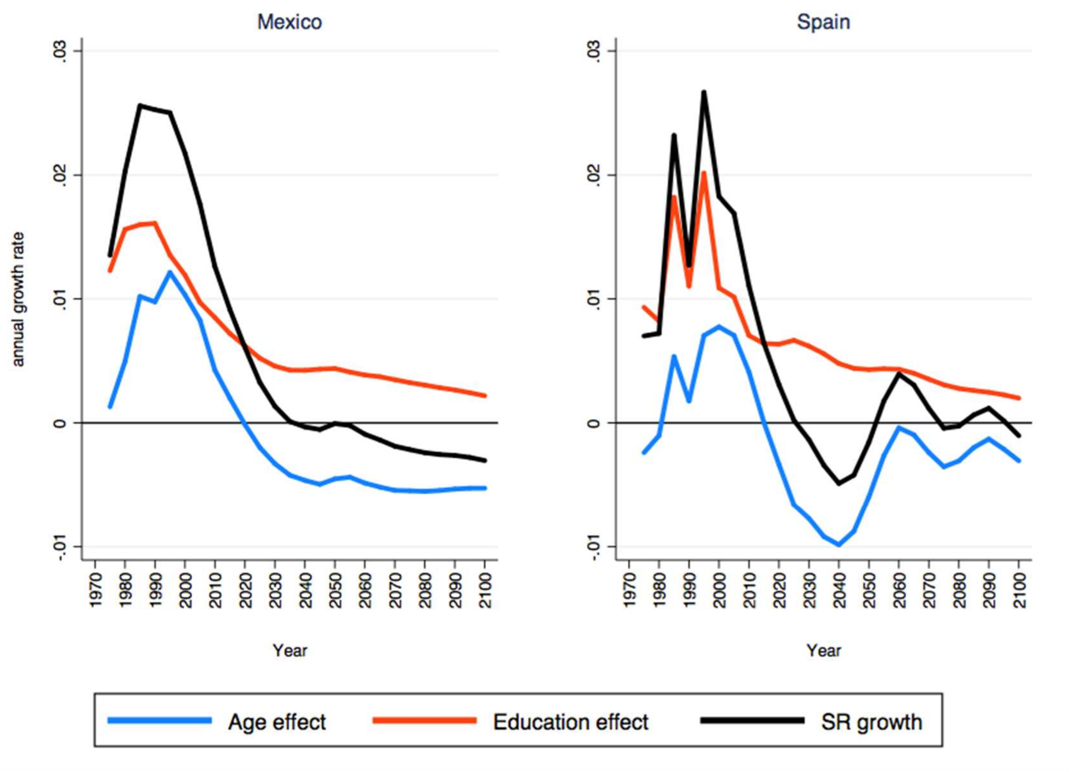
Source: Authors' calculations

Figure 5 The lifecycle deficit (*LCD*) profiles by level of education



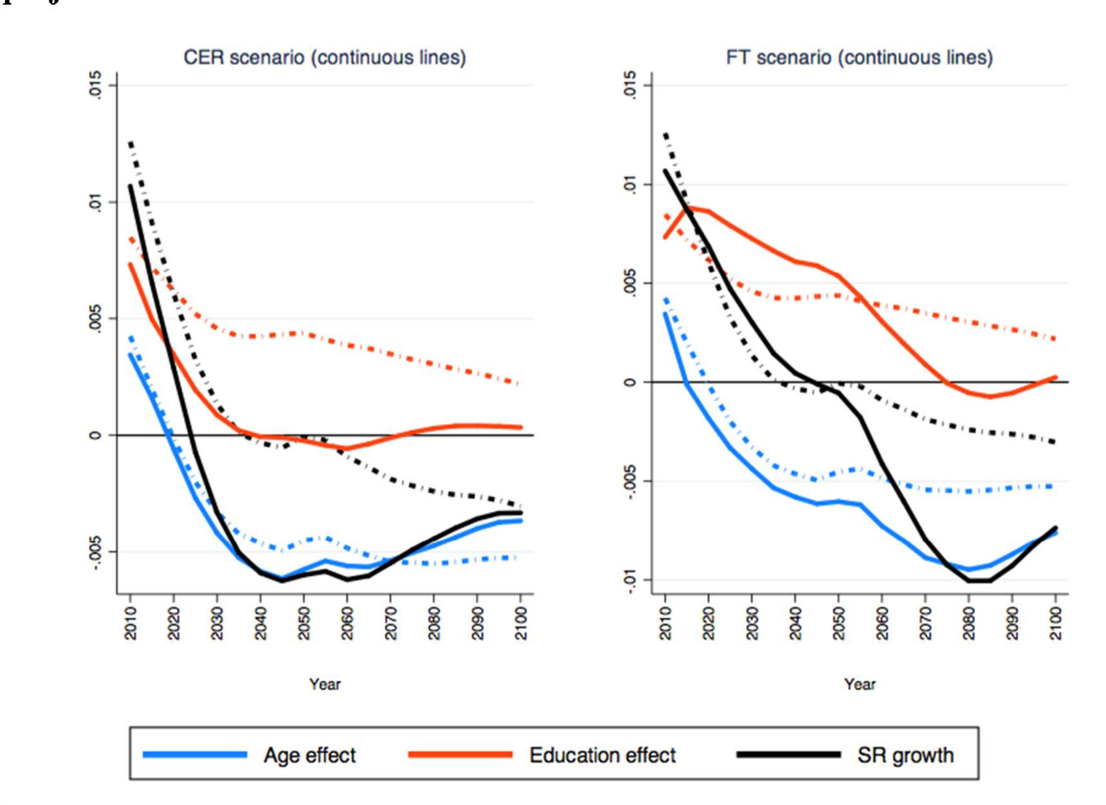
Source: Authors' calculations

Figure 6 Decomposition of the demographic dividend by age and education in Mexico and Spain, 1970-2100



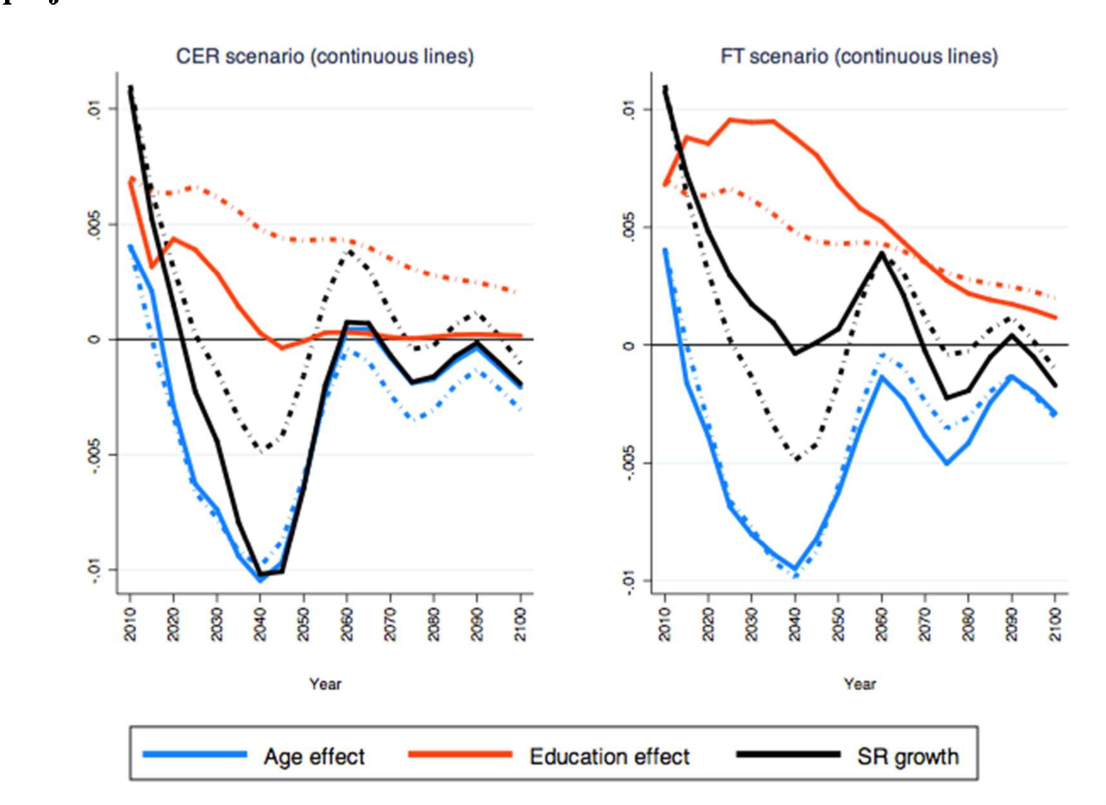
Source: Authors' calculations

Figure 7 The demographic dividend in Mexico with alternative education projection scenarios



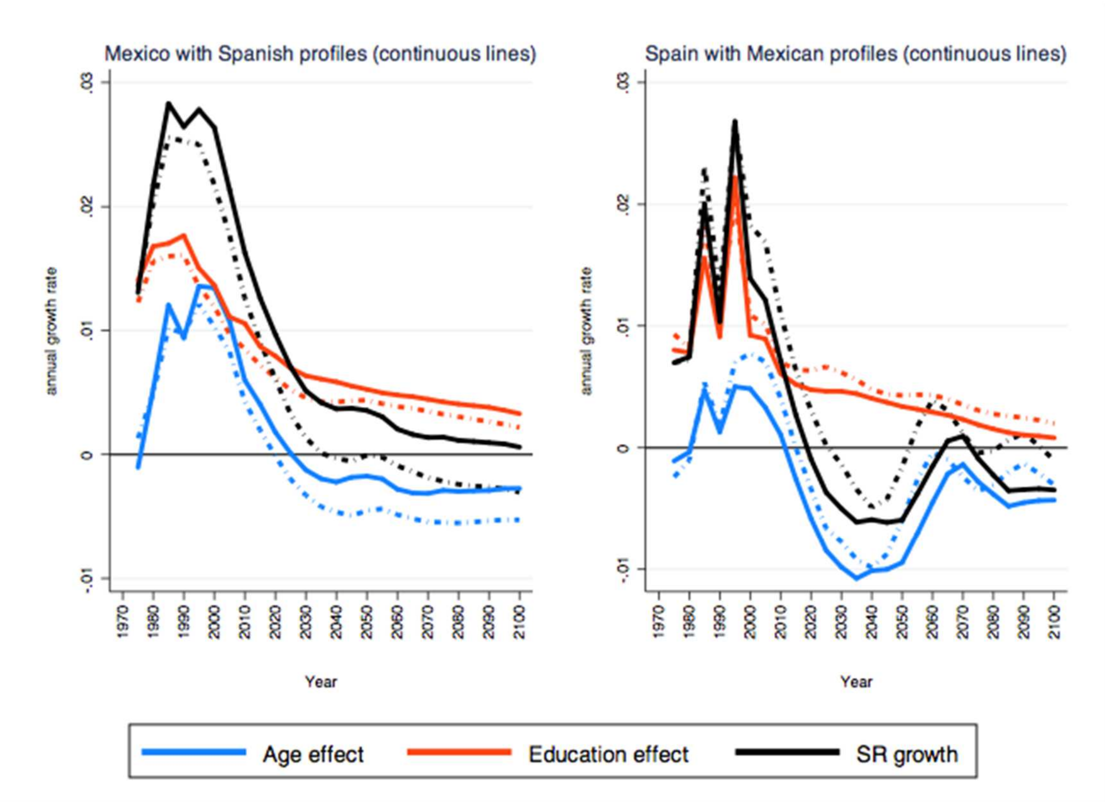
Source: Authors' calculations

Figure 8 The demographic dividend in Spain with alternative education projection scenarios



Source: Authors' calculations

Figure 9 The demographic dividend in Mexico and Spain using economic profiles from the other country



Source: Authors' calculations

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[i] The data set was constructed by the International Institute for Applied Systems Analysis at the Vienna Institute of Demography (IIASA-VID).

[ii] The age NTA profiles for Mexico are built upon Mejía-Guevara (2015), though estimated at individual instead of at household level of education. Recently, NTA profiles by level of education have been obtained also for Austria (Hammer, 2015).

[iii] See Das Gupta (1993) chapter 5 pp. 55-96.

[iv] We used the newest version of the WICD data, including both past data and future projections of population distribution by educational level from 1970 to 2100 (Lutz et al., 2014).

[v] This difference is made to allow the application of the economic profiles to population projections by age and education. We assign the average level of household consumption to those individuals under age 25, given that a great proportion of them have not finished their studies. Therefore, any educational effect coming from the consumption side of the population under 25 is suppressed.

[vi] The *GDP* per effective consumer weights population by the estimated consumption profile in the corresponding country. We use the consumption profile estimated in Section 4, updated to the corresponding year.