The Impact of Changes in Population Age Structure on the Economic Growth of Spain

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Concepció Patxot
Universitat de Barcelona
Elisenda Rentería
Universidade Federal de Minas Gerais (CEDEPLAR)
Miguel Sanchez Romero
University of California at Berkeley
Guadalupe Souto
Universitat Autònoma de Barcelona

During the last two centuries a great majority of countries have experienced, in different manners, what is called the demographic transition. This demographic phenomenon describes the process wherein high fertility and mortality rates characterize the beginnings of a demographic pattern and end with low fertility and mortality rates. Usually, mortality rates decrease before fertility rates, which greatly increase the growth rate of the entire population.

As fertility rates drop and the number of elderly people that survived previous generations of high mortality remains low, the population undergoes a period characterized by a low proportion of dependents (children and elderly). That is, age groups eligible to participate in the workforce increase relative to other age groups. If the productivity of workers and their participation in the labor market remain the same, a growth of the labor force relative to the whole population would inevitably lead to an increase in the growth of per capita income. This is what Lee and Mason (2006) call the first demographic dividend. Other authors have shown how the interaction between changes in population age-structures and declines in fertility and mortality rates add to economic development (Cutler et al, 1990; Bloom, Canning and Sevilla, 2003). Bloom &

Williamson (1998) showed that part of the Asian economic miracle was explained because the working-age population grew at faster rates than the dependent population from 1960 to 1995. Furthermore, Cutler et al. (1990) pointed out that the changing age-structure has the potential to yield benefits to a society for two reasons. First, it lowers the dependency ratio, which means that more resources can be invested in the economy. Second, the increase in longevity improves the population's savings behavior, thus creating positive effects on income levels.

At the end of the demographic transition, the aging process begins. More specifically, sustained levels of low fertility rates and higher life expectancies increase the proportion of elderly in the population. Governments are extremely worried about aging because it highlights concerns surrounding the sustainability of the welfare state and how are they going to support a growing proportion of the elderly. Aging implies rising costs of medical care, long-term care, and the increase of pensions; so it is seen, usually, as a burden for the population.

On the other hand, as Mason and Lee (2006) present, population aging can increase the amount of savings in the economy, as the elderly have to finance their longer, inactive lives. This is called the second demographic dividend. This dividend is related to the accumulation of wealth that arises in response to population aging. The magnitude of this effect depends on how this wealth is created (Mason, 2005). If the elderly rely on large transfers from younger generations, private or public, it will mean a lower increase in capital accumulation. It is only when capital-deepening prevails that the effects of population aging will ultimately increase the output per effective consumer (Lee, Mason and Miller, 2002; Mason and Lee, 2006).

It can be easily deduced that both demographic dividends are not automatic and depend on institutions and policies to transform changes in population age-structure into economic growth (Bloom and Canning, 2001; 2004). For example, the labor market must create sufficient opportunities for the growing working-age population. Additionally, the financial market should offer possibilities to fulfill individual's willingness to save (Mason, 2005).

This kind of study is extremely important in countries like Spain, which has experienced rapid economic development and is undergoing one of the fastest aging processes among European

countries. This is because Spain has seen a late demographic transition and with very different characteristics (Perez, 2001). For example, the baby boom in Spain started only in the sixties, ten years later after its counterparts in Europe and the US (Cabré and Perez, 1995). Moreover, the situation nowadays of Spain is critical, in that it is one of the countries with lowest fertility rates globally. It plummeted to 1.16 in 1998 (Cabré et al, 2002), although in 2006, it recovered to 1.38, due to an increase of immigrants with higher fertility rates. Finally, Spain has one of the highest life expectancies in the world, especially amongst women, which was 83.5 years in 2005 (INE).

The most recent literature about this subject in Spain has focused on the impact of aging on public expenditures, which includes health expenditures (Ahn et al., 2005), long-term care (Linda Pickard et al., 2007; Costa and Patxot, 2004) and public pensions programs (Gil et al., 2007), or even among the implications that aging has on the entire public sector (Gil and Patxot, 2002; Bonin and Patxot, 2005). Similarly, some studies have tried to analyze how international migration could alleviate the burden of aging in the society.

Moreover, it is also important to analyze the nature of the impact that the demographic transition and its subsequent process of aging has had and will have on Spain's economic growth. From this, we can observe if the economy has taken advantage of this unique opportunity offered by demographic changes. It will also illuminate the fact that aging can have great and positive impacts on future economies, if adequate policies are adopted.

In this study, we seek to analyze how shifts in Spain's age-structure have impacted its economic growth in the XX and XXI century. We use the methodology proposed by Mason and Lee (2006) and Mason (2007) to estimate the first and second dividend for Spain from 1910 to 2060, as has been applied in other countries like Brazil (Queiroz et al., 2006). Our results indicate that the country has benefit in some part from the first demographic dividend during the 80s and the 90s. However, these results also show the promise of a second dividend; meaning that Spain has the potential to positively benefit even more from its aging population, if adequate policies are created.

Demographic Dividends

We follow Mason and Lee (2006) and Mason (2007) to formalize the demographic dividends. According to these authors, output per effective consumer can be expressed by equation 1:

$$\frac{Y(t)}{N(t)} = \frac{L(t)}{N(t)} \cdot \frac{Y(t)}{L(t)}, \qquad (1)$$

where Y_t is the total output, N_t is the effective number of consumers, and L_t is the effective number of producers. In order to calculate the effective number of consumers and producers, we have to construct the age profile of consumption and production of the population in the year t (Cutler et al., 1990; Mason, 2005) for Spain. The support ratio corresponds to the ratio of producers (L(t)) to consumers (N(t)).

If we do the natural log of equation 1 and derive it regarding to time, we obtain

$$\dot{y}_t = \left(\dot{L}_t - \dot{N}_t\right) + \dot{y}_t^l . \qquad (2)$$

Therefore, the growth rate of output is equal to the sum of two components, which are the equivalents to the two demographic dividends. The first dividend corresponds to the growth of the support ratio, in that case, the difference between the growth of effective producers and the growth of effective consumers. The second dividend should be the rate of growth of productivity, and is calculated by the growth of the ratio of income per worker.

The first dividend will last only since the contingent of producers grows faster that the amount of consumers in the population. It is, then, a temporary dividend and not always positive (Mason, 2007; Mason and Lee, 2006). As population ages and the share of the elderly grows faster than the working age group, output growth will be depressed, too.

The second dividend comes in succession to the first dividend and is related to the creation of

wealth that arises in response to population aging (Mason and Lee, 2006; Mason, 2005). An increasing proportion of aged people and the expectation of living longer would raise the amount of capital available in the economy. This is because older people carry larger amounts of capital than the youngest. Moreover, the expectation of living longer stimulates the working-age population to accumulate assets for the future inactive years, unless they rely on public and private transfers.

In order to estimate the second dividend it is important to do a forward looking exercise, as we have to estimate the present value of the wealth needed to finance the excess of future consumption over the labor income in each cohort. To simplify we will restrict this estimation of wealth to those people aged 50 and older. The justification comes from the fact that at age 50 we can assume that individuals are in a moment of higher capital accumulation, where their responsibilities from childbearing are over and their earnings have arrived to a peak (Mason, 2005).

Assuming that there are no bequests, the present value of future wealth at the moment *t* for those individuals with age *a* or older should be the excess of the present value of future consumption over the present value of future production:

$$W(\geq b,t) = \bar{c}(t) \cdot PVN(\geq a,t) - \bar{y}^{l}(t) \cdot PVL(\geq a,t), \quad (3)$$

where $PVN(\geq a,t)$ and $PVL(\geq a,t)$ are the present value in year t of future life time consumption and production of the individuals aged *a* or over at moment *t*. $\bar{c}(t)$ is the consumption per effective consumer and $\bar{y}^{l}(t)$ is the production or income per effective producer in year *t*.

The estimation of future life time consumption and production is done using the formulas

$$PVN(\geq a,t) = \int_{t}^{t+w} e^{(g_c - r)(s-t)} N(\geq a,s)\,ds \qquad (4)$$

$$PVL(\geq a,t) = \int_{t}^{t+w} e^{(g_y - r)(s-t)} L(\geq a,s)ds \qquad (5)$$

where $N(\geq a,t)$ and $L(\geq a,t)$ are the number of effective consumers and producers in the population with age a or over at time t, and g_c and g_y are the rates of growth of each group, assuming that the consumption and income profile is fixed.

The ratio of wealth to total labor income would be

$$w(\geq a,t) = \frac{W(\geq a,t)}{Y^l(t)} \qquad (6)$$

or

$$w(\geq a,t) = \left[\frac{C(t)}{Y^l(t)}\right]\frac{PVC(\geq a,t)}{N(t)} - \frac{PVL(\geq a,t)}{L(t)} \qquad (7)$$

Following Mason (2007) we assume that the rates of growth g_c and g_y are constant and equal to 0.015 and the rate of interest is 0.03 to simplify the estimation.

However, only if the wealth is comprised by capital, the increase in the wealth-to-labor income will lead to an increase in productivity (measured as the capital-to-labor ratio or capital-deepening). Mason (2007) shows that wealth is composed by two components: capital and transfer wealth. Transfer wealth would be the share of wealth ($\tau(t)$) coming from intergenerational transfers, private or public, and we assume that this proportion is constant over time,

$$K(t) = (1 - \tau(t))W(t) \qquad \tau(t) \leq 1 \qquad (8)$$

If $\tau(t)$ is constant, capital-deepening will be determined by the same rate of growth that the wealth-to-total income. However, if intergenerational transfers are changing over time, this share

will change, and thus population aging will possibly affect the accumulation of capital, but to analyze these changes it is necessary to use complex simulation models that are far beyond the scope of this study (Lee et al., 2003). Assuming a constant $\tau(t)$ and given the assumptions that output depends on capital and effective labor and that the production is represented by a Cobb-Douglas function with constant returns to scale, it can be deducted that the growth in output per worker (the second dividend) is proportional to the growth in the ratio of capital to labor income. Therefore, it is also proportional to the growth in the ratio of wealth to total labor income:

$$\dot{y}^{l} = \frac{\beta}{1-\beta}\dot{k}, \qquad (9)$$

where we assign a value of one third to β, the elasticity of output with respect to capital (Solow, 1956).

Data and Profile Estimations

Data sources are from two household surveys collected in 2000 for Spain, and government data about public health and education. Also, we adjust the profiles using the publications of National Accounts in 2000 for Spain.

To estimate the consumption age profile we use the Households' Budget Survey (ECPF). It is a survey that collects information about expenditures inside the household. The ECPF, conducted by the INE, is carried out quarterly and follows up a family for eight quarters (two years). We selected only those families that had participated during the four quarters of 2000, so that our sample comprises 3,766 households and 11,842 individuals.

To estimate the labor income profile, we used the Household Panel from the European Union for Spain (PHOGUE) conducted by the European Commission, as the EPCF didn't include any question about income at the individual level. This survey includes 46,045 individuals distributed in 15,614 households.

In order to calculate the demographic dividends over an interval of time sufficiently big to observe how demographic changes have affected economic growth, we are using a range of time between 1910 and 2060. Population estimates come from different sources. From 1910 to 1996 we use the Human Mortality Database estimates (www.mortality.org), from 1996 to 2007 we use the estimates provided by the National Statistical Institute (www.ine.es), and finally, for the future population projections we use the data estimated by the Eurostat (www.eurostat.com), choosing the baseline projection. The estimations of GDP growth come from the National Statistical Institue (INE).

To construct the consumption and labor profiles by individual age groups, we used the methodology to construct national transfers accounts proposed by the Lee and Mason (2004), and described in several studies (Mason et al., 2006, Lee et al., 2006). We have to construct different profiles for each component of consumption (health, education, other, etc), separating between public and private consumption, and for labor income (earnings and self-employment income). Depending on availability of data, we use different methods of allocation by age. All these profiles are adjusted in a consistent manner with National Accounts for Spain.

For private consumption on education and health we use school and utilization rates to construct the profile. For other kind of private consumption we use the allocation rule proposed by Lee et al. (2006), inspired in the allocation of consumption proposed by Deaton (1997). Although those goods and services related to adult consumption, like tobacco or alcohol, were allocated only to adults.

For the allocation of public health expenditure by age we follow Ahn, García, and Herce (2005) using the profile of hospital care expenditure by age provided by the Ministry of Health and Consumption. For the long-term care age profile we follow the methodology used by Costa and Patxot (2004 and 2005), Pickard et al. (2007) and Comas-Herrera et al. (2006). We estimate service utilization rates by age from a survey of older persons conducted in 1998 by the Center of Sociological Research (CIS). With regard to public expenditures on education we use the information provided by the Ministry of Education and Culture about the expenditures on public

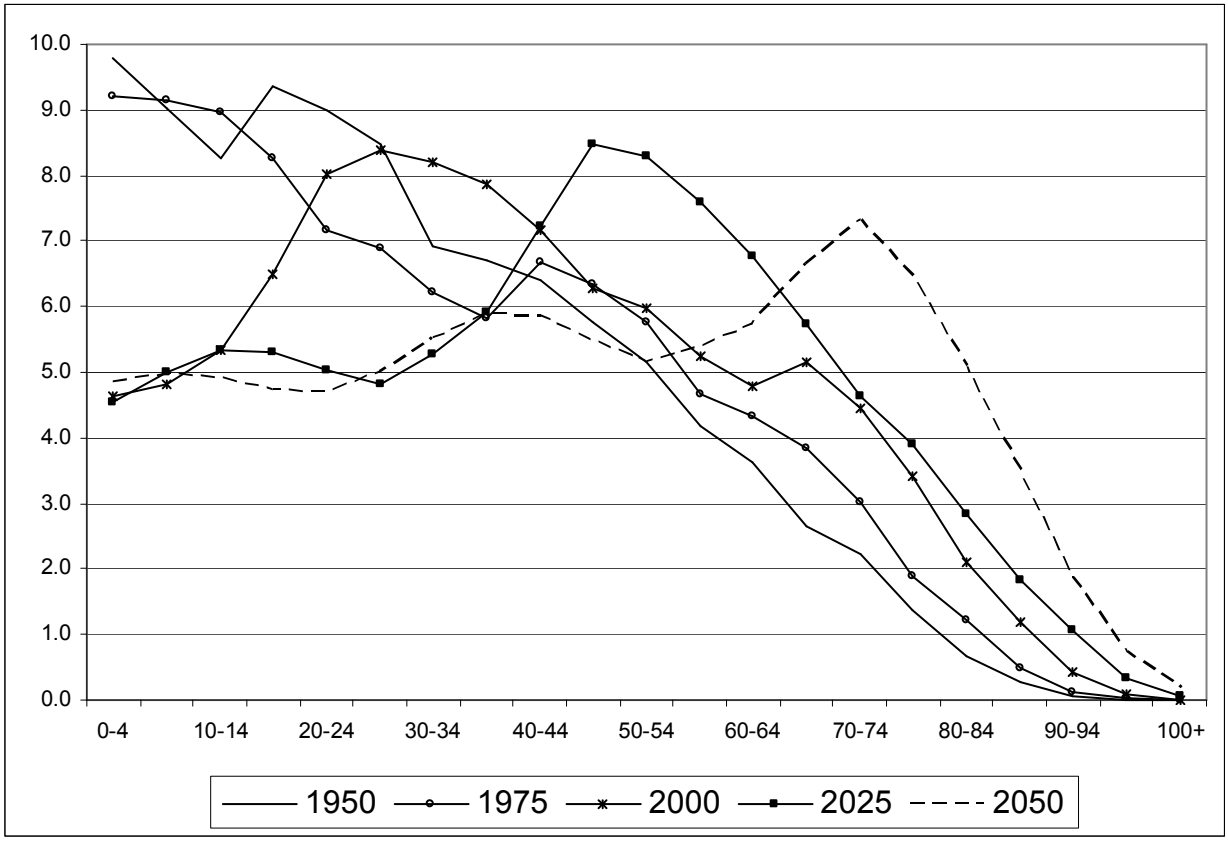
schools by level of education and about the number of students enrolled. In addition, the ministry has information about cost per enrolled university student. Finally, we estimate a simple per capita profile, not allocated by age, for "other" public consumption.

We apply the same consumption and labor income age profiles to the age structure of population through all the years in order to estimate the number of effective consumers and producers for each year.

Results

We first present the evolution of age structure in Spain in Figure 1 to show how the demographic transition evolved during the XX century and how aging started and expands into the future. Compared with its neighbors, Spain has experienced a late demographic transition (Perez, 2001). As a result, not only the aging process started later but also the baby boom in Spain was ten years later (around the sixties) than the rest of occidental countries. In Figure 1 it can be seen that by 1975 the last cohorts of baby-boomers were being born. In 1970 Spain had the second highest fertility rate in Europe (only behind that of Ireland), However, the pace of the decline in fertility during recent decades has been quite dramatic, having, nowadays, one of the world's lowest fertility rates (Grant et al., 2004). It reached 1.16 births per woman in 1996, although by 2006 it had raised again to 1.38, mostly due to recent migration trends. Moreover, Spain has one of the highest life expectancies in the world—for women in 2005 it was 83.5 years—something that reinforces aging trends. The combination of rapid fertility decline and greater longevity causes a fast aging process if compared with other European countries. In Spain it took only 45 years for the proportion of people aged 65 and over to rise from 7 to 14 percent, whereas in France it took 115 years to reach that proportion (Kinsella and Velkoff 2001: 13). By 2000 the proportion of people older than 65 was already greater than the proportion of people younger than 15. This was happening only in other five other countries in the world—Bulgaria, Germany, Greece, Italy, and Japan (Kinsella and Velkoff 2001:10).

Figure 1: Population structure of Spain in 1970, 1990, 2010, 2030 and 2050



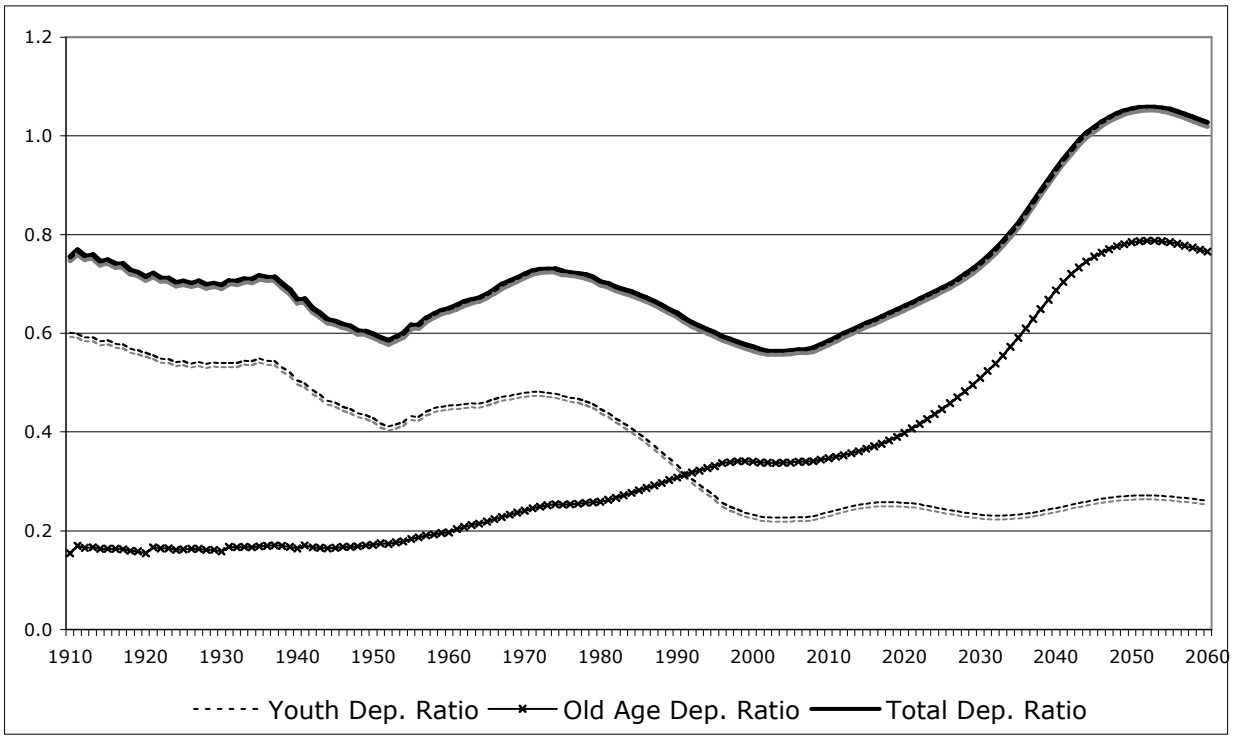
Source: United Nations

In Figure 2 we present the evolution of the dependency ratios in Spain, that account for the ratio between dependent age groups (0-14 years old and 60 years old and over) and the active age group (15 to 59 years old), representing the youth and old dependency ratio, and the total dependency ratio. Before 1992, young people represented the highest share in the dependency ratio, but since then, their proportion relative to the working-age group has continued to decrease. On the other hand, the proportion of elderly relative to the working-age population have been increasing since 1950 and won't stop rising until 2050 where there will be 8 people aged 60 and over for each 10 people in the working-age group.

This aging process has been slowed recently by recent migration trends. The stock of immigrants

in Spain jumped from fewer than 1 million in 1997 to more than 5 million in 2006, and now they represent more than 10 percent of the total population (Collado et al., 2004). Although immigration can help to overcome the effects of the aging process by reducing the share of elderly individuals in a population and by increasing the fertility rate, most of Spain's immigrants are close to baby boomers in age. This means that in the near future those individuals could accelerate the aging process in Spain.

Figure 2: Dependency ratios for Spain 1910-2060



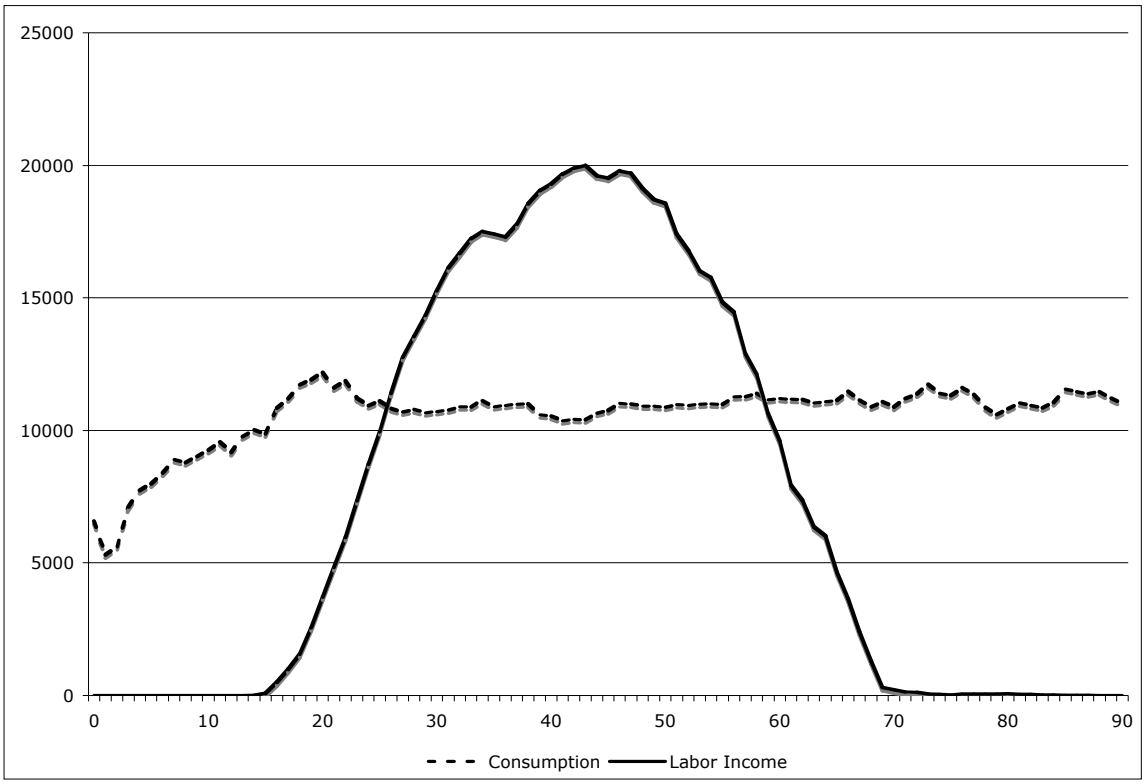
Source: Human Mortaliy Database, INE, Eurostat

We can see in Figure 3 the economic lifecycle of Spain in 2000, with the per capita consumption and the labor income profile by age. As a constant in all societies, children and youth consume less than the rest of the other age groups, but more than they produce. Working age groups produce more than they consume, and after retirement, the elderly stop working and producing, and only consume, sometimes more than the rest of the population.

In the case of Spain, the labor income exceeds consumption from age 26 to age 59, being 33

years of negative life cycle deficit (consumption less labor income). The consumption profile starts low for children and after the twenties it turns very flat, without any difference between the consumption of adults and the elderly. This is a pattern quite similar with other southern and eastern European countries, but not with northern Europe or US, where the consumption of the elderly doesn't stop rising (NTA).

Figure 3: Lifecycle deficit for Spain, 2000

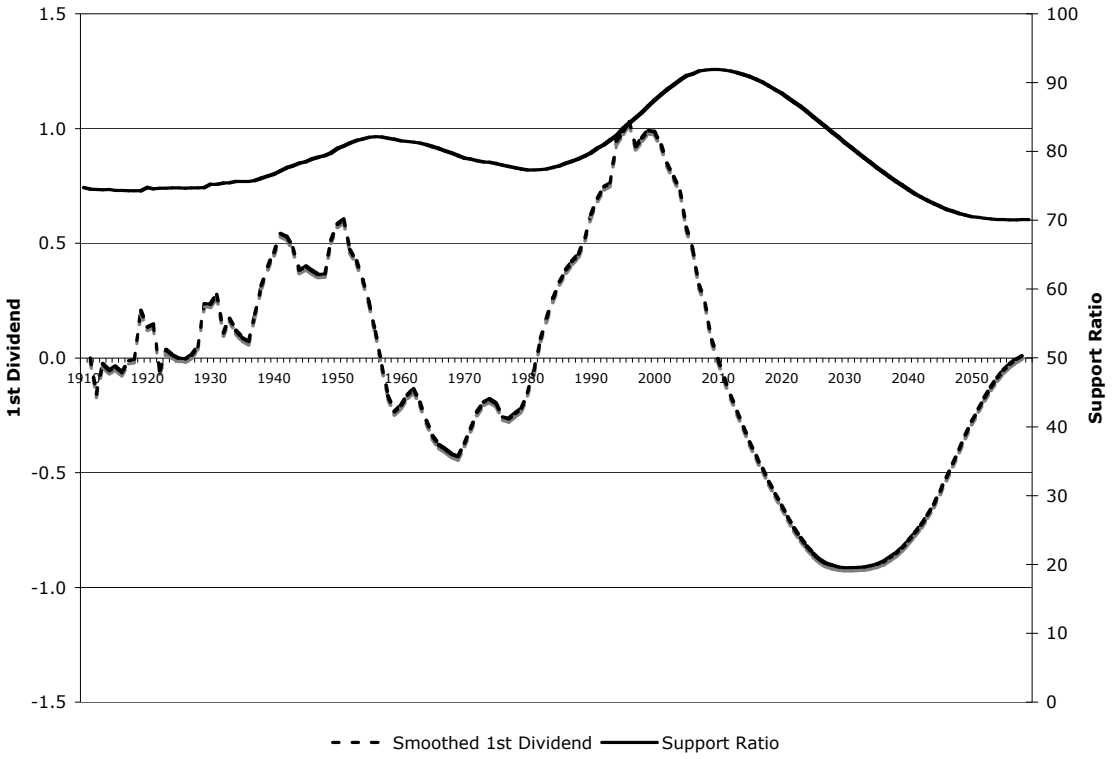


Source: Author's calculations

Once the life cycle deficit is found, it is possible to estimate the evolution of the first and the second demographic dividends. The first dividend is represented jointly with the evolution of the support ratio in Figure 4. As the support ratio increases, the 1st dividend starts being positive, and when the support ratio decreases the dividend turns negative. In the case of Spain, the country experienced two positive periods in the 1st dividend during the XX century. The first one started before the Civil War (1936-1939), partly due to the decreasing trends in fertility rates that started at the end of the XIX century followed by a decrease in the number of births during

the war and the post-war because of the poor living conditions of individuals. This dividend ends with the beginning of the Spanish baby-boom in 1958. This baby-boom jointly with the decrease in overall mortality rates are the cause of a second first dividend from 1982 to 2011. Therefore, as a difference between other European countries or US (Mason, 2007), Spain is still undergoing a period of relative growth of the working-age population.

Figure 4: 1st Dividend and Support Ratio for Spain, 1910-2060

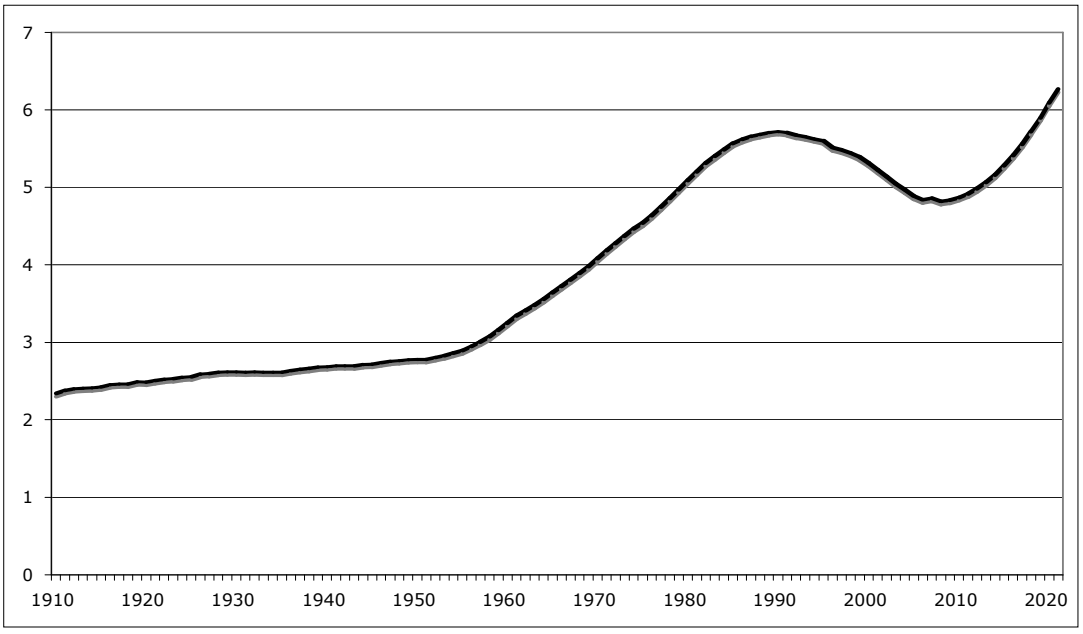


Source: Author's calculations

To estimate the second demographic dividend, we use the ratio of wealth per labor income. The evolution of this ratio is shown in Figure 5. This ratio is intrinsically related to the level of the old-age dependency ratio. Therefore, as it could be seen in Figure 2, the old-age dependency ratio starts increasing in the middle of the 50's in Spain, just when the wealth per output starts rising. It also has a decrease when the 1st dividend caused by baby-boomers is in its peak. However, just when the 1st dividend has finished, the wealth per labor income ratio starts a rising tendency that, in principle, would not stop until the old-age dependency ratio stops increasing.

Once the two dividends are estimated it can be seen what has been their contribution to the economic growth in Spain during the last decades. In Table 1 we compare the rate of growth of GDP per consumer with the 1st and 2nd dividend. During the decade between 1975 and 1984 and the decade between 1985 and 1994, the dividends contributed in great proportion in the economic growth of Spain. In fact, during the first decade exposed here, the second demographic dividend was higher than the real economic growth of per capita GDP, indicating that the economy could have taken greater advantage from the prevalent age structure of population. From 1985 to 1994, the demographic dividends contributed to 29% of the total growth of GDP per capita. At the end of the 1st demographic dividend in the period between 2005 and 2008, and with a negative second dividend, the contribution has been small. However, projections of the dividends into the future show that the second dividend could contribute even more to economic growth in the next years.

Figure 5: The ratio of the wealth from people aged 50 and over to labor income in Spain, 1910-2020



Source: Author's calculations

Table 1: GDP per consumer, 1st and 2nd Dividend for Spain, 1975-2018

	GDP per consumer	1st dividend	2nd dividend	Total Dividends	Dividend / Actual
1975-1984	0.686	-0.130	1.049	0.919	1.339
1985-1994	2.100	0.552	0.066	0.618	0.294
1995-2004	2.363	0.957	-0.665	0.292	0.124
2005-2008	0.674	0.531	-0.245	0.286	0.425
2009-2018		-0.222	0.930	0.709	

Source: GDP per consumer calculated with data from INE

Conclusions

We have presented several estimates that show how changes in demographic structures can affect economic growth. It is important to highlight that this is only a theoretical exercise and that there are other important components that determine the economic growth in the country during the period analyzed. In Spain, results from the 1st and 2nd demographic dividend show that changes in the age structure of the population can have contributed to the past economic growth in this country during the 80s and the 90s, but also, that aging can have great and positive impact in the future of the economy.

There are some peculiarities about the Spanish case that are important to point out. The peculiar demographic transition has brought two first demographic dividends in Spain. One derived from the decline of fertility rates that started in the XIX century, and another one as a result of a late baby-boom in the 60s that will last until 2011. As we don't have estimates of GDP before 1970, we couldn't saw how the first one impacted on the economic growth in Spain. However, we could see how this second first dividend, which started to be positive in 1982, contributed to the growth of GDP per capita overtaking the negative impact of the second dividend during the end of the XX century and the beginning of the XXI century.

Furthermore, this study tends to emphasize that the undergoing aging of population does not need to be seen necessarily as a problem thanks to the possibility of a second demographic dividend. We are showing that it can be quite important in the future economic growth. However, this dividend is only going to become a motor of economy if the adequate policies are applied. This means that governments have to be aware of the importance of stimulating saving among the working population to increase capital accumulation. A system where the elderly rely in a great part on transfers from young people would lose the opportunity to transform this dividend in higher growth. In 2000, the population aged 60 and over was financing a 40% of its consumption with public transfers and presented a negative 6% of private transfers (Patxot et al, forthcoming). This means that the elderly in Spain don't rely so much as other countries in public transfers, and they are net givers of private transfers, instead of receivers.

Further research should refine all the estimates presented here, like for example, taking into account that the lifecycle deficit is supposed to change over time, and it is not necessarily fixed. Also, it would be important to implement simulation models that would change the share of transfers inside the amount of wealth demanded by the elderly, showing how different policies can affect to future economy in Spain.

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ANNEX: Statistical Sources for Macro Aggregates and Age Profiles

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