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Item 11 – Demographic sustainability and consistency with macroeconomic assumptions

Integrating labour market in population projections

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Introduction

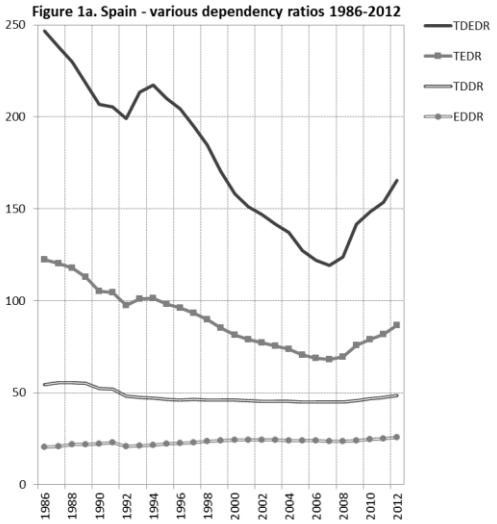
Population projections play an outstanding role in many aspects of social and economic governance. Although they cannot be considered as predictions, they are credited with the capacity of reducing uncertainty over the future more efficiently than forecasts in other social fields. They are crucial when planning future needs and costs in education, health services and ascertaining the future financial situation of pension systems and, in general, of all welfare systems. Debates arising over these topics often rely on the projected trend of demographic based dependency ratios. All existing population projections predict a continuing increase of population ageing and, in particular, an increase, both in relative and absolute terms, of the elderly and a simultaneous decrease of the working age population. These are the raw facts upon which a growing dependency ratio is supposed to lead to financial imbalances in pension and other welfare systems. It is generally agreed that demographic ratios need to be completed with information from the labor market. For instance, in a given time, part of the working age population is not actually at work and, consequently, unable to support dependents and should rather be counted themselves as dependents. To our knowledge, these important clarifications have never been explicitly included in the making of population projections. This paper presents a model in which the demand for work, a variable from the economic sector, determines the number of employed persons. Our approach takes into account the impact of the labor market on population thru changes in the employment rate and in immigration. We apply the model to five

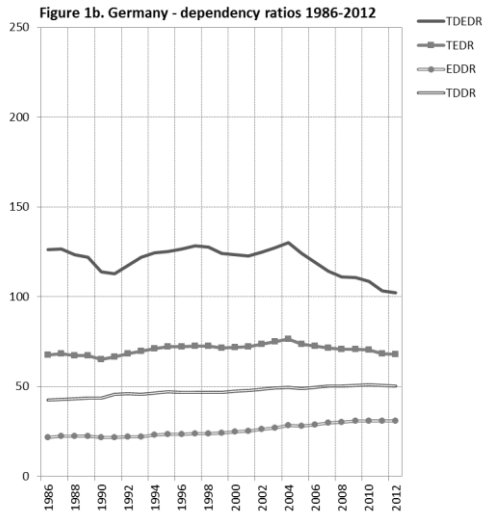
European Union countries (Spain, France, Germany, Italy and Sweden), comparing results to the most recent Eurostat population projections of 2010.

1. Why integrating labor market information in population projections.

The more frequently used dependency ratio is obtained by dividing the elderly population, usually those aged 65 and over, by the working age population, either the 15-64 or the 20-64 population, a ratio that will be called here the elderly demographic ratio (EDDR) but is often alluded simply as the "dependency ratio". Projections of this ratio show that, in the future, an increasing number of elderly will be dependent for their survival on a decreasing number of younger people able to work. This widely accepted fact leads to foreseeing an unavoidable financial crisis of public systems based on a pay-as-you-go rule, considered as extremely sensitive to the above ratio. Other ratios that take into account the important changes in the labor market in the recent past have behave quite differently, obliging to be more cautious with forecasts.

In Annex 1, we compare for five EU countries the values over the period 1986-2012. The total demographic dependency ratio (TDDR) includes as dependents both the elderly and the children population and shows, over that period, a shift from children dependency to elderly dependency. It is not our aim here to analyze the social and economic consequences of this shift, but only to show how the total demographic burden has behaved in recent past, leaving aside the social and economic adaptation to the fact. We show the trend followed by the elderly economic dependency ratio (EEDR) that relates elderly population to economically employed population, the total economic dependency ratio (TEDR) which adds the children to EEDR, and the total dependents economic dependency ratio (TDEDR) using as dependents all non-employed persons.





We have add to the usual set of dependency ratios those obtained by using the employed population as denominator. By this, we take into account the fact that the burden of the dependents falls really on only part of the working age population, those actually at work, a group that could eventually increase in the future, whereas all existing projections foresee a shrinking of the 15-64 age group. The question is therefore whether, and to what extent, the employed population could increase in a particular country, given the expected evolution of the working age population, the margin for further increase in the employment rates and the demand for work.

Projections do not usually explicitly ascertain if future population will be able to meet labor market requirements, nor if a feedback from the labor market could have an effect on population's volume and structure. This amounts to treating population as an autonomous variable regarding the economy. Recent past trends of demographic variables are the main basis for components forecast while future economic prospects are treated, at most, as qualitative inputs. As long as the working population is growing, either by natural increase or by immigration, current economic growth will meet no opposition. In past decades, this has been the situation and there was no harm in treating population as an autonomous variable. This will no longer be the case for most of EU countries in the future. Will a declining working age population be sufficient to allow continuous economic growth in the future? The answer depends on the labor demand resulting from the rate of economic growth and the progress of labor productivity. It also depends on the existence of a corresponding labor offer. We assume, based on overwhelming past evidence, that labor shortage will never prevent economic growth in the EU countries. If the economy is able to create jobs, there will be workers, either by

an increase of employment rates or by the coming of immigrants. In the long term, attracting immigrants may become more difficult, when countries of origin reach demographic maturity and needs for their own economic growth increase. However, this is not the present situation nor will it be in a few decades from now.

Taking recent Eurostat population projections assumptions, we find that in many EU countries the natural increase of the working age population will not be enough to cover the present number of jobs, allowing for no job creation in the future. Including immigration, as projected by Eurostat, allows for a certain growth of employed population. However, for three of the five EU countries for which we have run our projection keeping constant the activity rates by sex and age (Spain, France and Italy) the employed population could only grow at a maximum annual average rate of 0.3% to 0.4%, well below recent prior crisis performances. For Italy, no increase is possible in the above conditions and for Germany, the projected 15-64 population appears to be under the present employed population, which means that a decrease of the working population is expected.

It could be argued that labor productivity may increase in an extent that will allow for a growing Gross Domestic Product (GDP) with a decreasing population at work. For some EU countries, this would mean a tremendous change in productivity growth performance compared to previous trends showing a continuous but moderate growth. However, even allowing for this possibility would entail important economic and social changes, shifting the focus to the distribution of a growing product among a population with few workers and many dependents.

Linking population projections to the future of the labor market appears as necessary in a context of decisive changes in the age structure of the population. It seems then advisable to widen the scope of dependency ratios to take into account the accompanying changes in the labor market.

2. Basic assumptions and parameters of the projection

We rely on the assumption that the labor demand, i.e. the extra workers the economic system needs to employ at a given time is solely determined by economic and technical factors. In our globalized world, the demand for goods and services does not follow demographic evolution in a particular country, at least not in the short and medium term. Competitiveness and the situation prevailing in the rest of the world are far more important variables for the production system and thus for the labor demand.

2.1 Basic parameters

We base our projection on the assumption that the annual demand for labor as well as the activity rates by sex and age are exogenous to the model. We also assume that an equilibrium is always reached in the labor market, with demography adapting to the production sector needs. Labor offer (persons ready to take the jobs) will equal the labor demand, thru an increase (or decrease) of employment rates and, if needed, the arrival of additional immigrants. However, in our model, a demand of labor shortage will not be met by an increase of emigration but only by an adjustment of the unemployment rate. In countries with very high unemployment rates, like Spain for instance, emigration induced by the labor market has been a slow starting process, not related or even negatively related to the importance of past immigration. The process has to be more deeply analyzed in order to include induced emigration in future extensions of the model.

We have projected, for each year from 2012 (initial population, taken from Eurostat´s Europop2010 convergence scenario) to 2061, the population by sex, age and activity status (active, employed, unemployed). In order to compare our results to Eurostat 2010 projections, we have adopted for every year, the parameters for fertility, mortality and emigration used by Eurostat in its projection. We have also kept in our projection, as a minimum number of entries, the annual number of immigrants included in Eurostat projections, allowing for the existence of a certain amount of autonomous immigration, more related to previous trends and to past immigration than to the present economic situation. By doing this, our results will only differ from Eurostat's if more immigrants than their projected number are needed by the labor market. Our estimates replicate exactly Eurostat results when no new immigrants are added.

For the exogenous parameters, four projection scenarios have been implemented, by combining values for the annual variation of the labor demand and values for the activity rates by sex and age for the period 2012-2060.

2.2 Annual labor demand

The annual variation of labor demand is determined by the growth rate of GDP and the rate of labor productivity increase

Productivity is the ratio of output to inputs in production. In its most conventional form, GDP is used as a measure of output and labor as a measure of input, to get the labor factor productivity, or simply productivity:

$$Prod_t = \frac{GDP_t}{E_t}$$

In terms of its growth rate:

$$\Delta Prod_t = \frac{Prod_t}{Prod_{t-1}} - 1 = \frac{GDP_t/E_t}{GDP_{t-1}/E_{t-1}} - 1 = \frac{1 + \Delta GDP_t}{1 + \Delta E_t} - 1 = \frac{\Delta GDP_t - \Delta E_t}{1 + \Delta E_t}$$

By rearranging terms, we can express employment growth as a direct function of GDP and productivity growths:

$$\Delta E_t = \frac{\Delta GDP_t - \Delta Prod_t}{1 + \Delta Prod_t}$$

We have developed three scenario of combined growth rate of GDP and productivity. We are only interested, at this stage, with the result on the employment growth rate, approximately equal to the difference between GDP and productivity growth rates, as we have shown above. However, the impact on average income and, consequently on the countries capacity to support dependents, is higher when GDP and productivity are high. This is not considered when estimating the dependency ratios, where every person in the population, employed or dependent, is counted as one, irrespective of his or her productivity.

The first scenario is taken from a recent OECD report. The other two are aimed at illustrating contrasting futures in relation with trends in job creation.

a) OECD long-term global growth prospects:

In November 2012, OECD published an "Economic Policy Paper" titled "Looking to 2060: Long-term global growth prospects". It presents the results of a new model for the economic growth of OECD countries for the next 50 years, showing that the crisis has only reduced the level of trend GDP, currently and over the next few years, and has had no permanent effects on trend growth rates (OECD, 2012, p.9). Taking into account the expected evolution of the basic determinants of economic growth, the report provides a projection of the average growth rate of GDP for the period 2011-2060 (see below). According to this report, Germany will show in average for the next fifty years a declining demand for labor, compensated by a higher than

others increase in productivity. All four other countries considered here will demand an increasing number of persons in employment, growing at rates from 0.4% in Italy to 0.6% in Spain (Table 1). What we want to ascertain are the consequences on the employment rates and on the need for immigrants of these expected increases of persons in employment (a decrease in the case of Germany) and compare them to the existing projection.

Table 1
Average annual growth rate for 2011-2060 of GDP, productivity and employment in OECD economic scenario

Country	GDP	Prod.	Empl.
Spain	1,7%	1,1%	0,6%
France	1,6%	1,1%	0,5%
Germany	1,1%	1,4%	-0,3%
Italy	1,4%	1,1%	0,4%
Sweden	1,9%	1,3%	0,6%

Source: GDP and Prod.: OECD(2012)

b) A job friendly scenario

We have picked from the OECD report mentioned above the case of the United States of America for which annual average growth rates of 2.1% for GDP and 1.2% for productivity are projected, leading to an employment growth rate of 0.9%. We can see that the productivity growth rate is close to those for the five EU countries considered here. The difference lies in a higher growth of GDP because of a higher increase of the employed population. How would our five countries' demography behave if such an increase of employed were targeted?

c) A job neutral scenario

We have modified the USA scenario using a smaller GDP growth rate of 1.2%, equivalent to the productivity increase. No new job is created in this scenario and economic growth relies exclusively on productivity.

2.3 The offer of labor: activity rates by sex and age

. The volume and the sex and age structure of the population (P) together with the activity rates (RA) determine the active population (A), representing the offer of labor of a country at a given moment. Activity rates measure in each sex and age group

the proportion of people at work (the employed population) plus those looking for a job[1] (the unemployed population).

We have for sex s, age x and time t, $A_{s,x,t} = RA_{s,x,t}P_{s,x,t}$

and $A_{i,s,x,t} = W_{i,s,x,t} + U_{i,s,x}$ with W representing the employed population and U the unemployed.

For 2012, the initial year, activity rates by sex and ages are taken from the Labor Force Surveys published by Eurostat (xx). Two scenarios are developed. In one of the scenarios, activity rates remain constant at their value of 2012. In the second one, each country will converge to a unique set of rates, equivalent to the maximum observed in 2012, namely those for Sweden. Rates for each year are estimated by linear interpolation between the value in 2012 and the corresponding Swedish rate assigned to the year 2060. For technical reasons rates, initially estimated as average for the year have been assigned to 1-1 of each year.

2.4 The four projection scenario

By combining the above employment growth and activity rates values we have formed the projection scenario shown in the following Table (Table 2).

Table 2 Projection scenarios

Scenario	Growth of GDP	Growth of Productivity	Activity rates
A	OECD	OECD	constant
B	OECD	OECD	convergent
C	2.1%	1.2%	constant
D	1.2%	1.2%	convergent

3. The projection model

In Annex 2, we present a diagram showing the functioning of the projection model. The projection for each year has been divided in two steps. The first one deals with the normal renewal of the labor force, with older workers leaving and young entering it. We will call this process the "demographic renewal" because it is caused by mortality, emigration and retirement. The second step deals with the equilibrium of the

[1] The Labor Force Surveys give a precise definition of this category.

labor market adjusting to the new labor demand. Here we estimate how the needs are covered by a possible increase of employment rates in the country (or a decrease) with the possible addition of new immigrants.

3.1 The demographic renewal of the labor force

In the first step, we estimate the survivors at the end of the year of the initial population and of autonomous immigrants arrived during the year by applying the mortality and emigration parameters for that year. We also project the survivors in each activity group: actives, employed and unemployed by applying the same mortality and emigration rates and by estimating exit from activity to inactivity for both occupied and non-occupied population[2].

$$P'_{s,x+1,t+1} = P_{s,x,t}(1-k_{s,x,t})(1-e_{s,x,t}) + AI_{s,x,t}(1-\frac{k_{s,x,t}}{2})(1-\frac{e_{s,x,t}}{2})$$

AI represents the autonomous immigration equivalent to the number of immigrants included in EUROPOP 2010.

The probabilities of leaving the active population to become non-active, for all sex-age groups, are estimated using the activity rates:

$\forall x, 15 \le x < \omega - 1$

if $RA_{i,s.x+1,t+1} < RA_{i,s,x,t} \rightarrow vl_{i,s,x,t} = \dfrac{RA_{i,s,x,t} - RA_{i,s.x+1,t+1}}{RA_{i,s,x,t}}$

if $RA_{i,s.x+1,t+1} \ge RA_{i,s,x,t} \rightarrow vl_{i,s,x,t} = 0$

with

$RA_{i,s,\mathrm{x}<15,t} = 0$

y $RA_{i,s,\mathrm{x}\ge\omega,t} = 0$

The first problem is to estimate the number employed persons not surviving as employed at the end of the year (W').

$$W'_{s,x+1,t+1} = W_{s,x,t}(1-k_{s,x,t})(1-e_{s,x,t})(1-vlw_{s,x,t})$$

Where, vlw_0 is the probability of leaving the active population to join the non-active for employed persons, and vlu_0 is the corresponding probability for the unemployed.

[2] We assume that the probabilities of emigration and of death do not vary with the working status. We also accept the more dubious assumption that retirement (the probability of leaving the active population) is the same for the occupied and for the unemployed.

$vlu_{s,x,t} = (1+\alpha)vlw_{s,x,t}$ with $\alpha > -1$

For α>0 the probability of retiring is higher among unemployed

For α=0 retiring has the same probability in both subpopulations

For $-1 < \alpha < 0$ employed person show a higher probability of retiring

In our projection, we have assumed that the same probability of retiring applies to both occupied and unemployed population ($\alpha = 0$). Thus $vlw_{s,x,t} = vlu_{s,x,t} = vl_{s,x,t}$.

After $\{W'_{s,x,t+1}\}$ and $W'_{t+1} = \sum_s \sum_x W'_{s,x,t+1}$, we estimate the subsisting actives $\{A'_{s,x,t+1}\}$ and A'_{t+1}, subsisting non-actives $\{NA'_{s,x,t+1}\}$ and NA'_{t+1}, and the subsisting unemployed $\{U'_{s,x,t+1}\}$ and U'_{t+1}.

The difference ($W_t - W'_{t+1}$) is equivalent to the number of jobs deserted by persons dying, emigrating or retiring and will all be occupied by the remaining actives[3]. They represent the normal renewal of active population and we have assumed that redistribution of these jobs among the actives is part of the renewal of the active population as young non-actives enter from the education system. We will then distribute ($W_t - W'_{t+1}$) in proportion to the entries of the young in the active population up to the maximum employment for each sex-age, defined below. We are aware that the assumption that only the young occupy jobs left does not agree with the fact that in many countries they are experimenting the higher unemployment rate due to the present crisis. We assume that, in the future, if the crisis is overcome, special policies will be implemented in favor of young employment. Once reached a normal situation of routine renewal, the process will mean the exit of older workers and the entry of young ones. In order to be able to simulate different situations, we added a variable in our model ($K_{i,t}$) that gives the maximum age for the redistribution of jobs in country i at time t. In this case we have adopted K=35 as unique value for all countries and all years, allowing for late arrival to the active population.

Probability of entering the active populations ve_0 for all sex-age group,

[3] The fact that some of these jobs may become extinct will appear later when considering the net variation of the demand for labor.

$\forall x, 15 \leq x < \omega$

if $RA_{i,s.x+1,t+1} > RA_{i,s,x,t} \rightarrow ve_{i,s,x,t} = \dfrac{RA_{i,s.x+1,t+1} - RA_{i,s,x,t}}{1 - RA_{i,s,x,t}}$

if $R_{i,s.x+1,t+1} \leq RA_{i,s,x,t} \rightarrow ve_{i,s,x,t} = 0$

Entries in the labor force in year t, for sex s and age x: $NA'_{s,x+1,t+1}\, ve_{s,x,t}$ and the total will be: $\sum_s \sum_x NA'_{s,x+1,t+1}\, ve_{s,x,t}$. In each sex-age group the maximum employment is attained when the unemployment rate reaches the fixed minimum $RUm_{s,x,t}$, considered as the frictional unemployment in a situation of full employment. In our model, the minimum unemployment rate equals 2% for all sex, ages and countries. Maximum employment in each group is then: $P'_{s,x,t+1}\, RA_{s,x,t+1}(1 - RUm)$.

New employment for the young will be:

$$XW_{s,x,t+1} = (W_t - W'_{t+1}) \frac{NA'_{s,x,t+1}\, ve_{s,x,t}}{\sum_s \sum_x NA'_{s,x,t+1}\, ve_{s,x,t}} \text{ or } = (P'_{s,x,t+1}\, RA_{s,x,t+1}(1 - RUm)) - W'_{s,x,t+1}$$

if the maximum is attained.

At the end of this first step of the projection, a new estimate of employed population is obtained:

$W''_{s,x,t+1} = W'_{s,x,t+1} + XW_{s,x,t+1}$ and the total for year t: $W''_{t+1} = \sum_s \sum_x W''_{s,x,t+1}$.

W''_{t+1} will be equal to W_t if all deserted jobs have been covered. If young entries fail to occupy all jobs, $W''_{t+1} < W_t$. In both cases, the sex and age structure could vary, depending on the trend followed by activity rates.

We are now able to estimate the existing unmet labor offer (NMO) during year t by the population, which is smaller than the number unemployed due to the fixed minimum unemployment rate RUm:

$$NMO_{s,x,t} = (P'_{s,x,t+1}\, RA_{s,x+1,t+1}(1 - RUm)) - W''_{s,x+1,t+1}$$

$$NMO_t = \sum_s \sum_x \left((P'_{s,x,t+1}\, RA_{s,x+1,t+1}(1 - RUm)) - W''_{s,x+1,t+1} \right)$$

3.2 Economic adjustment of the labor force

As we have repeatedly stated, demand for labor is an exogenous variable in our model. At the beginning, on 1-1 of the initial year (2012, in this case) the demand for labor is taken as equal to the employed population: $D_t = W_t$. In the present step we ensure that $D_{t+1} = W_{t+1}$ and so on. Needs of the labor market, the non covered demand (NCD) in year t are expressed as the difference between the total demand for labor and the existing employment:

$$NCD_t = D_{t+1} - W''_{t+1}$$

The non covered demand during year t needs to be met by a corresponding unmet offer in the population. By comparing the previously estimated offer NMO_t, with NCD_t we will determine if the market equilibrium will be ensured by a decrease of the unemployed, an addition of new immigrants or a combination of both.

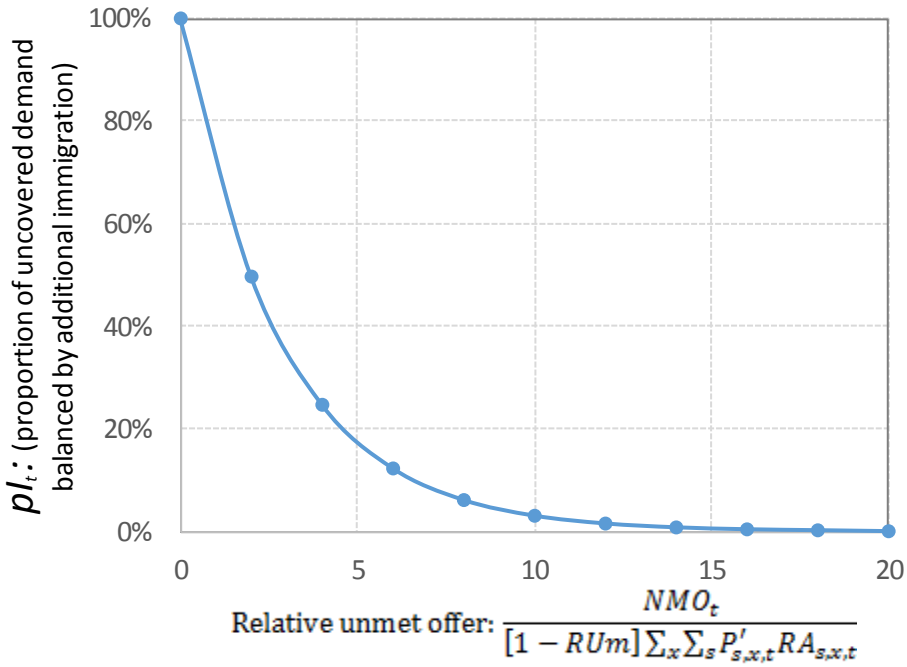
The proportion of uncovered demand which is compensated by additional immigrations is a decreasing monotone function of the unmet offer of labor $pI_t = f\left(NMO_t\right)$.

More specifically, $pI_t = exp\left[-\beta\left(\frac{NMO_t}{[1-RUm]\sum_x\sum_s P'_{s,x,t}RA_{s,x,t}}\right)\right]$

Being compositional data which must add to one, (uncovered demand is totally balanced either by unemployed residents, additional immigrants or both) we restricted possible values to the unit interval [0;1], with unemployed share of non covered demand equal to $1 - pI_t$.

In our projection, we set $\beta = 0.35$. Therefore, additional immigrants are required only when unmet offer is close to zero (figure 2).

Figure 2. Proportion of uncovered demand balanced by additional immigration.



XUW_t is the employment increase covered by unemployment and XIW_t with $NCD_t = XUW_t + XIW_t$.

If $(1-pI_t)NCD_t < NMO_t$ i.e. if the demand expected to be covered by unemployed residents is less than the unmet labor offer, $(1-pI_t)NMO_t$ will be distributed in proportion to the unmet offer in each sex-age group with a maximum imposed by the fixed minimum employment rate RUm .

$$XUW_{s,x,t} = (1-pI_{i,t})NCD_t \frac{NMO_{s,x,t}}{NMO_t}$$

If $(1-pI_t)NCD_t \geq NMO_t$ i.e. if the demand expected to be covered by unemployed residents equals or exceeds the unmet labor offer the new employment covered by unemployed will be:

$$XUW_{s,x,t} = NMO_t \frac{NMO_{s,x,t}}{NMO_t} = NMO_{s,x,t}$$

This leads to a tendency to equal rates of unemployment by sex and age until the minimum rate is reached in all groups.

The total employment for previous unemployed is:

$$XUW_t = \sum_s \sum_x XUW_{s,x,t} \ .$$

The rest is to be covered by new immigrants:

$$XIW_t = NCD_t - XUW_t$$

XIW_t represent additional employed immigrants. However, one must not forget that he total immigrants arriving include also non working dependents. To estimate the total new incoming population, we adopt here the sex and age distribution of immigrants $\{ci_{s,x,t}\}$ in the Eurostat projection and consider that new immigrants have the same activity rates $\{RA_{s,x,t}\}$ than the resident population at the time of their arrival. As immigration is induced by the labor market, we consider that the unemployment rate of these new immigrants is equal to the fixed minimum RUm.

$\{ci_{s,x,t}\}$ with $\sum_s \sum_x ci_{s,x,t} = 1$ (sex and age composition of additional immigrants)

$\sum_s \sum_{x=15}^{\omega-1} ci_{s,x,t}$ (the proportion of working age in new immigrants)

$\sum_s \sum_{x=15}^{\omega-1} ci_{s,x,t} \ RA_{s,x,t}$ (the proportion of active persons in new immigrants)

$(1 - RUm_{s,x,t}) \sum_s \sum_{x=15}^{\omega-1} ci_{s,x,t} \ RA_{s,x,t}$ (the proportion employed in new immigrants)

Total new immigrants: $XI_t = \dfrac{XIW_t}{(1 - RUm\ ) \sum_s \sum_{x=15}^{\omega-1} ci_{s,x,t} \ RA_{s,x,t}}$

$$XI_{s,x,t} = XI_{t+1} c_{s,x,t}$$
$$XAI_{s,x,t} = XI_{s,x,t} RA_{s,x,t}$$
$$XIW_{s,x,t} = XAI_{s,x.t}(1 - RUm)$$

Total immigration during year t is obtained by adding the new immigrants to autonomous immigration: $I_t = AI_t + XI_t$

We finally arrive to the projected population in t+1 and its components:

$$B_t = \sum_{x=13}^{x=49} \left[f_{x,t} P_{1,x,t} + \tfrac{1}{2}(f_{x,t} I_{1,x,t}) \right] \qquad B_{1,t} = 0.485 N_t \text{ and } B_{2,t} = 0.515 N_t$$

$$P_{s,0,t+1} = B_{s,t}(1-k_{s,B,t})(1-e_{s,B,t})$$

$$P_{s,x+1,t+1} = P_{s,x,t}(1-k_{s,x,t})(1-e_{s,x,t}) + I_t(1-\tfrac{1}{2}k_{s,x,t})(1-\tfrac{1}{2}e_{s,x,t}) \qquad \forall x \geq 0$$

$$A_{s,x,t+1} = P_{s,x,t+1} RA_{s,x,t+1}$$

$$W_{s,x,t+1} = W''_{s,x,t+1} + XUW_{s,x,t} + XIW_{s,x,t}$$

$$RW_{s,x,t+1} = \frac{W_{s,x,t+1}}{A_{s,x,t+1}}$$

$$U_{s,x,t+1} = A_{s,x,t+1} - W_{s,x,t+1}$$

$$RU_{s,x,t+1} = \frac{U_{s,x,t+1}}{A_{s,x,t+1}}$$

4. Projection results

In our projection, integrating the labor market, two types of results are obtained. On the one hand, total, and sex and age structure of the population, together with usual components of its dynamics (births, deaths, emigration and immigration) on an annual basis. On the other, some variables related to the labor market: absolute number and rates for activity, employment and unemployment. By assuming that the population depend to a certain extent of the outcomes of the labor market, we obtain results that differ from those of the Eurostat projection, including the dependency ratios. We will now present, first the volume and structure of the population and next, changes in employment and its consequences for the support of the dependents.

Total population and immigration

By examining Table 3 and Figure 2 below, one may see that Eurostat 2010 projections are not compatible with almost all the economic and employment growth scenarios we have developed. OECD GDP growth prospects scenarios lead to a higher than Eurostat's projection total population when activity rates remain constant at 2012 level (scenario A) and still higher, although closer, in all countries (except Spain), when activity rates are allowed to converge towards a maximum (scenario B) which means growing except in Sweden where they remain constant. The closer to Eurostat results is scenario D, that allows for no new job creation (employment will remain at the same level thru 2061) and for increasing activity rates. All countries, except Germany, are

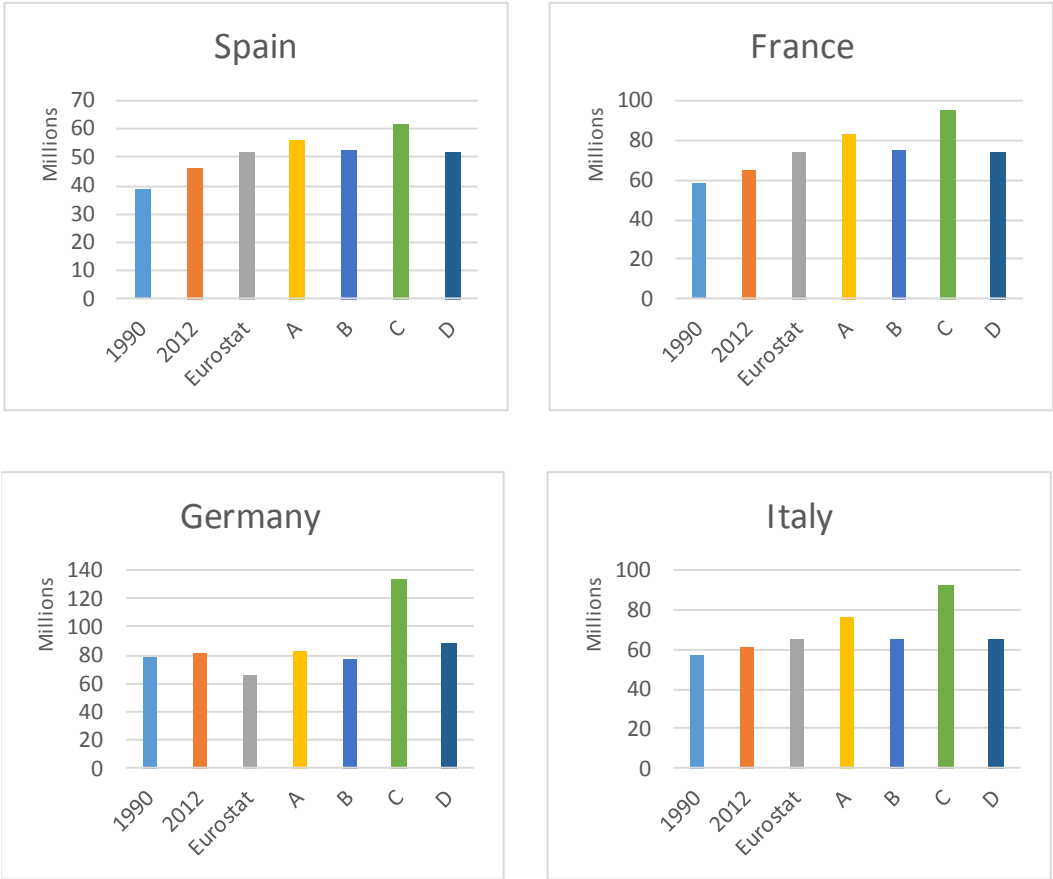
able to confront a scenario of steady GDP growth (at the average annual rate of 1.2%) based exclusively on increasing labor productivity, without more immigrants than the Eurostat forecast. This is achieved by increasing the population participation in production, offsetting the decline of the working age population. Germany is the exception: to achieve the modest goal this country will need more immigrants than the number projected by Eurostat and its total population will be 33% higher than the Eurostat projection. A scenario based on OECD prospects for the USA, with high GDP growth and moderate productivity increase, and no increase in activity rates (scenario C) would entail considerable population growth, thru immigration. Differences between countries are important. They reflect differences in their present situation. A country like Spain with a very high unemployment rate (around 25%) and relatively low activity rates may draw longer on its own resources before turning to immigration for sustained employment growth. This is also the case, to a lesser extent, of Italy, France and Sweden, if we compare them to Germany. The latter will need massive immigration in this scenario and its expected population by 2061 will double the one projected by Eurostat.

Table 3 Population projections (in x1000) for some countries of the EU Eurostat 2010 and four scenarios based on labour demand

Country	Population		Population projection 1-1-2061				
				Population projections based on labour demand			
	1990	2012	Eurostat	A	B	C	D
Spain	38.826	46.353	52.196	55.916	52.362	61.688	52.196
France	58.313	65.389	73.782	83.108	75.572	95.545	73.783
Germany	79.113	81.427	65.950	82.401	77.757	133.029	87.851
Italy	56.694	60.970	64.871	75.932	65.223	92.701	64.870
Sweden	8.527	9.503	11.550	13.585	13.585	15.099	11.663

Source: Eurostat and own elaboration
See text for scenario definitions

Figure 3 **Total population projections in various scenarios compared to population in 1990 and 2012**



Source: Eurostat and own elaboration
See text for scenario definitions

It appears that the future economic trend will have a non-negligible impact on EU countries population. With a declining working age population, immigration emerges as the only way to allow for economic growth, especially in countries where employment rates are already high and have little margin for further increase. For a sustained economic growth without employment growth, we will need higher than recent increases in productivity. This scenario or, to a greater extent, one with declining employment offset by higher productivity gains, will mean a very different society than the present one, as a declining proportion of highly productive paid workers will keep growing the GDP. The main problem will then be the redistribution of income among a growing proportion of dependents. Will we have very high salaries with high taxes for the public attendance of dependents needs, or less taxes and more private organization of care? Will we keep low salaries and high taxes for corporations? Many other options are probably possible, but the matter would make us wander far from our present goal.

According to Eurostat projection, only France, out of the four most populated countries, will experience a positive natural growth of population (together with Sweden in our sample of five countries). Italy and Spain will be able to counter their negative natural growth with net immigration and Germany will receive net immigration but will end with a negative growth of its population by 2061 (Table 4). Natural change in Table 4 includes the indirect effect of immigrant's births. Without immigration, the decline in German population would be higher than indicated.

Table 4 **Average annual change in 2012-2061 in population and its components for some EU countries - Eurostat 2010 and four scenarios based on labour demand**

in thousands

	EUROSTAT	Population projections based on labour demand			
		Scenario A	Scenario B	Scenario C	Scenario D
Change in total population					
- Spain	119	195	123	313	119
- France	171	362	208	615	171
- Germany	-316	20	-75	1.053	131
- Italy	80	305	87	648	80
- Sweden	42	83	83	114	44
Natural change					
- Spain	-107	-98	-106	-78	-107
- France	91	139	100	209	91
- Germany	-416	-343	-362	-142	-321
- Italy	-231	-191	-230	-130	-231
- Sweden	15	26	26	34	16
Migration change					
- Spain	226	293	229	391	226
- France	80	222	108	407	80
- Germany	100	363	287	1.195	452
- Italy	311	497	317	778	311
- Sweden	27	58	58	80	28

Source: Eurostat and own elaboration

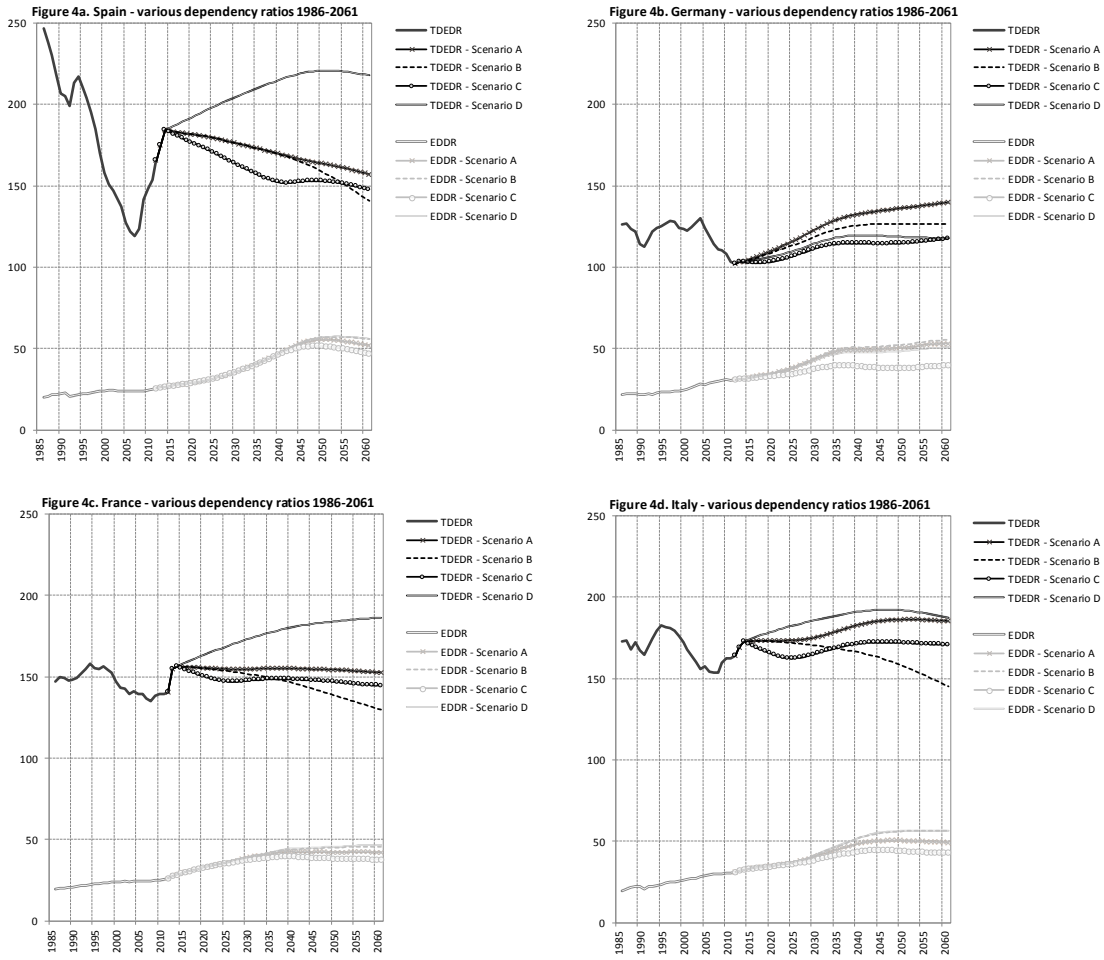
Note: see table 2 for scenarios definitions

The scenarios developed in this paper only confirm the importance of immigration for the economic future of these countries, which appears already in the Eurostat projection. If we accept scenario B, based on OECD prospects and increasing activity rates, only Germany lags behind and will need almost three times the number of immigrants projected by Eurostat. To avoid a negative on the growth of German GDP, productivity should increase more than expected by OECD or immigration should be higher than expected by Eurostat.

The dependency ratios

Population is an inevitable prospect, but future immigration will somewhat reduce its impact due to the younger age composition of newcomers. In all four scenarios the EDDR (population 65+ / population 15-64) increases from 2012 to 2061.

However, all our scenarios implying more immigration than the Eurostat scenario (or at least the same),



Source: Eurostat and own elaboration
See Table 2 for scenario definitions

the ratio is always lower (or at least equal) for all countries (see Annex 1). In the most extreme scenario (C), the difference with the Eurostat projection in 2061 lies around 10% but reaches more than 20% in the case of Germany (Eurostat: 59.8% in 2061, scenario C: 39.7%). The same effect is observed in the other demographic dependency ratio.

Economic dependency ratios cannot be estimated from the Eurostat projection. From our scenarios we deduct that their evolution does not follow the demographic ratios trend (see Figure 4). Changes in the dependency ratios relating working population to non-working population could be more meaningful in the future, than the expected changes in the demographic ratios.

Conclusions

Some of the main features of future population trends, according to all demographic projections, are population ageing and the decline of the working age group. Maintaining a sufficient economic growth in EU countries will suppose in the future higher productivity gains and immigration. In this paper, we have developed a few labor market scenarios and integrated them in corresponding population projections. We find that current practices in population projections do not seem compatible with increasing employment, at least for the five countries examined here. More immigration than usually forecasted will be necessary if some reliable economic prospects prove right. Integrating labor market requirements in population projection appears now as an advisable option. Labor market equilibrium will also rely on higher labor participation rate of the population. For this reason, dependency ratios should take into account the resulting changes in the relative importance of workers and dependents, in order to complete and qualify the vision provided by the demographic ratios.

Annex 1 **Elderly Demographic Dependency Ratio (EDDR) and Total Dependents Economic Dependency Ratio (TDEDR)**

Past trend 1986-2011 and values projected 2021-2061 in four projection scenarios

	EDDR					TDEDR				
Year	Spain	France	Germany	Italy	Sweden	Spain	France	Germany	Italy	Sweden
1986*	20,4	19,7	21,6	19,6	27,6	246,6	147,2	126,4	172,6	121,7
2001	24,3	24,1	25,3	26,7	26,6	151,0	143,3	122,5	167,6	104,8
2011	25,0	25,4	30,7	30,7	28,8	153,6	139,6	103,3	162,7	103,6
Projection Scenario A										
2021	29,8	33,9	35,6	35,6	34,0	181,4	155,4	110,9	173,3	109,2
2031	37,0	39,9	44,9	41,9	36,9	175,8	154,7	124,0	175,6	112,5
2041	48,7	43,4	50,1	49,7	38,4	169,1	155,0	132,9	183,3	113,0
2051	56,5	43,0	51,5	51,2	38,9	163,3	154,2	136,5	186,3	113,5
2061	52,8	42,9	54,1	50,1	42,0	157,2	152,7	139,9	185,3	116,3
Projection Scenario B										
2021	29,8	34,0	35,8	35,7	34,0	181,4	155,0	109,6	172,7	109,2
2031	37,0	40,4	45,9	42,8	36,9	175,8	151,4	119,5	170,1	112,5
2041	48,8	45,0	51,5	53,3	38,4	168,8	145,9	125,9	165,7	113,0
2051	58,1	45,9	53,3	57,1	38,9	157,4	138,0	126,7	157,3	113,5
2061	56,8	46,6	56,1	57,3	42,0	140,8	129,8	126,4	145,1	116,3
Projection Scenario C										
2021	29,8	33,8	33,7	35,4	33,8	175,7	149,6	103,7	164,5	106,6
2031	37,0	38,5	38,5	39,6	35,7	162,6	147,6	111,9	165,6	109,3
2041	48,0	40,4	39,7	44,8	36,5	151,9	148,4	114,7	171,6	109,2
2051	52,3	39,0	38,8	44,8	36,3	152,8	146,7	114,8	171,9	109,0
2061	47,9	38,5	40,3	43,5	39,0	147,7	144,5	117,6	170,8	111,6
Projection Scenario D										
2021	29,8	34,0	35,1	35,6	34,3	193,3	164,4	108,4	179,7	116,5
2031	37,0	40,5	43,1	42,6	38,2	205,2	174,1	120,0	188,0	127,5
2041	48,8	45,3	47,0	52,5	41,1	215,7	181,2	126,6	196,5	134,4
2051	58,1	46,5	47,6	55,5	42,6	220,8	184,8	128,8	201,0	141,7
2061	57,1	47,6	49,8	55,1	47,3	217,7	186,9	131,9	201,0	147,8

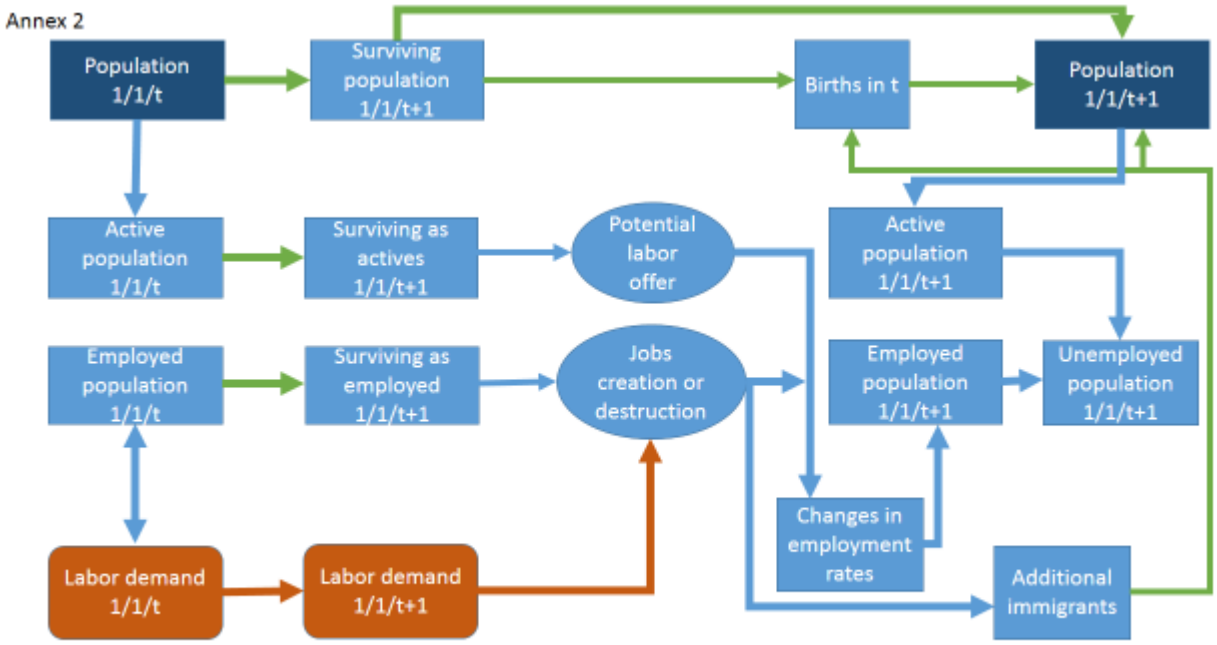
Source: Eurostat and own elaboration

(*) First data for Sweden corresponds to 1996

EDDR Population 65+ / Population 15-64

TDEDR Nor-working population / employed population

Annex 2


Population 1/1/t
Surviving population 1/1/t+1
Births in t
Population 1/1/t+1
Active population 1/1/t
Surviving as actives 1/1/t+1
Potential labor offer
Active population 1/1/t+1
Employed population 1/1/t
Surviving as employed 1/1/t+1
Jobs creation or destruction
Employed population 1/1/t+1
Unemployed population 1/1/t+1
Changes in employment rates
Labor demand 1/1/t
Labor demand 1/1/t+1
Additional immigrants