INE

INSTITUTO NACIONAL DE ESTADISTICA

Project for the short-term population projection of Spain

October 2007

1. Introduction

The availability of future population evolution perspectives constitutes an element of structural relevance in any analysis or planning exercise, both in that carried out within the scope of public power, and in that which takes place in current private activity. Therefore, the preparation of estimates and population projections has always constituted a compulsory objective of producing public statistics, regarded as such by the INE in its regular activity over the last few decades.

Traditionally, the INE has compiled its population projections using the so-called component method, whose application scheme consists of starting with the population deduced from the latest Population Census conducted, and establishing hypotheses regarding the future evolution of the three basic demographic components (fertility, mortality and migration), which will determine its growth and future distribution according to given basic demographic characteristics, such as sex and age. Thus, the availability of projections of the future population has taken place in parallel with the subsequent Population Censuses, conducted every ten years.

Therefore, due to the special demographic situation that Spain has been experiencing since the end of the 90s, as a result of the demographic effects caused by the intense, sustained and difficult to predict flow of foreign immigration, it has been regarded as appropriate to embark on a new action strategy as regards preparing and updating present and future population estimates and projections, materialised in the periodical compilation of two types of statistical operation: estimates of the population resident in Spain present at each moment in time (Population Now Cast [1]), and projection exercises on the short and long-term future population.

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[1] For further information, www.ine.es/inebase/cgi/um?M=%2Ft20%2Fp259&O=inebase&N=&L=

2. Need for the project

This project thus constitutes one of the basic pillars of this new strategy followed by the INE in order to deal with the enormous challenges that the current demographic evolution of Spain presents as per the prospective analysis of the population.

In fact, the strong intensity in the entry of the foreign population that has occurred in Spain since the end of the 90s is causing, not only a drastic modification in its growth patterns, but also an essential change in its structure, which is affecting the behaviours observed in each one of the demographic phenomena. In addition, there is the enormous uncertainty existing regarding the evolution, followed by the current migratory dynamism in the years to come, which requires an ongoing monitoring of the phenomenon using all of the sources available: variations registered in the Municipal Register, the analysis of the results of the expiry process in the Municipal Register of those non-community foreign nationals without a permanent residence permit in force since 2005, the growing acquisitions of Spanish nationality, the granting of residence permits, etc., as well as the most updated forecasts of the future economic dynamic.

Moreover, the entry into force thereof is motivated by the special interest shown from different economic institutions and organisations of the State Administration, on having population projections for a time horizon of 5 or 7 years available, conveniently updated to the most recent evolution of the demographic phenomena, on which to base their respective macroeconomic forecast and planning exercises. Such demand is justified by the urgent need for revision that the latest scenarios present [2] for the future population projected by the INE, based on the results of the 2001 Population Census, which have become obsolete, mainly in the short term, as a direct result of the unforeseen intensity and persistence observed in the immigration movement in recent years.

In response to all the above, the new strategy followed by the INE will include the annual compilation of a population projection by sex, age and nationality (Spanish and foreign) of the population resident in Spain, its Autonomous Communities and its provinces, to a time horizon of 7 years. The annual nature of the exercise will allow for an annual update thereof, according to the most recent demographic evolution and the forecasts that most adjust to the evolution of the Spanish economy itself, which in addition, maintains perfect consistency with the population now cast that the INE uses at every given moment as the reference population in its diverse statistical production, thus providing the coherence necessary for all official statistical information.

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[2] For further information, www.ine.es/inebase/cgi/um?M=%2Ft20%2Fp251&O=inebase&N=&L=

3. Objectives

Beginning in 2008, the short-term projections of the population of Spain will be compiled, with a projection horizon to 7 years, which will provide the forecasts regarding the size of the population resident in Spain, its Autonomous Communities and provinces, broken down by sex, age and nationality (Spanish and foreign). This would provide, at the very least, the following information:

- Population by sex and simple age (up to the open group of 100 years old and over), at 1 January for each year of the projection period.

- Classification by nationality (total Spaniards and foreign nationals).

- Geographical scopes: National, Autonomous Community and Province totals.

Moreover, the annual update of the exercise will enable extending the objectives thereof (projections by nationality group, according to place of birth, household, etc.) in its future editions, based on whether the base demographic information available on which to base the prospective analysis is considered to be sufficient, and the pertinent projection methodologies are consolidated.

4. Phases of development

The execution of the project will be carried out in different phases:

- Methodological development and analysis: during the year 2007, the methodological research and demographic analysis tasks are being carried out regarding each one of the influential demographic phenomena, focusing especially on the monitoring of the migratory flows using the variations registered in the respective Municipal Registers, and on the development of new methods for the future projection thereof, as well as on the effect that such flows are having on the population volume and structure of Spain. For such work, the INE has worked in close collaboration with the Centre for Demographic Studies, by virtue of the contract signed by the INE with said organisation [3].

- Pilot exercise for the projection of the total population of Spain in the short term: for the purpose of making a first approximating to the projection exercise, to practice the methodology designed and test the hypotheses established regarding the demographic evolution of Spain in the coming years, in the months of September and October 2007, a pilot exercise for the projection of the total population of Spain for the next seven years has been carried out. Moreover, said exercise will serve to meet the interest shown by the Ministry of Economy and Tax in having, in the last quarter of the year, a conveniently updated projection of the population of Spain in the short term, and on which to base its analysis and macroeconomic forecast for the following five-year period.

- Execution of the project: throughout 2008, the INE will compile the projections of the population of Spain in the short term, with a projection horizon at 1 January 2015, in joint coherence with the population estimates for the present moment and the long-term projections thereof.

In addition, the annual repetition of the exercise will enable having projections available that are permanently updated to the recent evolution of each one of the demographic phenomena for the following seven years, while simultaneously enabling the extension of the projection objectives when deemed necessary.

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[3] **"*Performance of complementary demographic analyses with regard to the medium and long-term estimates of the Spanish population,*"** 2007.

Annex I. Pilot exercise for the projection of the population of Spain in the short term. Methodological summary.

The calculation methodology designed in order to carry out the projections of the population of Spain in the short there as of 2008, tested in the pilot exercise presented, intends to include the most updated information available up until the first six months of 2007 regarding the behaviour of the demographic phenomena influencing the evolution of the size and structure of the population in the near future.

The basis of said methodology lies in the application of the component method. The application of the said method is in response to the following schema: beginning with the population resident in a certain geographical scope, and with the data observed for each one of the basic demographic components, death, fertility and migration, the goal is to obtain the corresponding population at subsequent dates according to certain hypotheses regarding the evolution of those three phenomena, which are those that determine its growth by age and other basic demographic characteristics.

The population figures, by sex and age, which have constituted the starting population, have been deduced from what is considered to be the best approach, for the moment, to the population resident in Spain at 1 January 2007, which is provided by the Population Now Cast, which guarantees the necessary coherence with the latter.

In this first pilot exercise for the compilation of hypotheses regarding the evolution of each one of the relevant demographic phenomena, the following steps have been followed:

a. Analysis and projection of fertility

The observation of the recent evolution of the fertility of the women resident in Spain enables foreseeing a growing evolution of the intensity of the phenomenon as a result of the growth of the foreign female population. At the same time, this change in population structure is leading to a gradual reduction in the average age at maternity of the women resident in Spain.

in any case, the main innovation in this migratory exercise has been the analysis of the fertility of the different generations, and not only their observation as indicators of each period and by birth order, for the purpose of understanding the recent behaviour and being able to estimate and modulate the final offspring more coherently.

For these purposes, for the estimation of the projection parameters of the phenomenon, the process below has been followed:

- Modelling, in the recent past, of the fertility rates of the generations, by age and birth order, based on a logarithmic model of the rates based on time.

- Estimation, using the above modelling, of the complete series of fertility rates for the generations.

- Transformation of the generation rates in specific fertility rates for the entire projection period.

b. Analysis and projection of mortality

The projection of the evolution of mortality in Spain for the coming seven years has been carried out using the establishment of hypotheses regarding the long-time evolution of the phenomenon, as this enables the greatest inertial nature thereof. Thus:

- This establishes a normative value of life expectancy at birth in the long term (2050) of 83 years for males and 88.5 years for females, bearing in mind the ascending trend of behaviour for said indicator, as well as the most recent projections thereof that have been made in countries in our area. Subsequently, the evolution of the indicator for the entire period is interpolated.

- An estimate is made of the profile, by age, that mortality will present in 2050, using an adjustment of the Helligman-Pollard function to the behaviour expected for the long run, of said phenomenon, in each age group.

- An interpolation is made of an extensive series of mortality tables, coherent with the series of life expectancies at birth projected for the long term.

c. Analysis and projection of foreign migrations:

The estimation of the future evolution of migrations implies the challenge with the greatest impact on the final results, and due to the nature of the phenomenon itself, the inertial of past measurements cannot be applied easily, nor can a long series of events with the same quality as in the case of births and deaths be made available.

Bearing in mind the part of the foreign migratory flow that is now induced by the dynamic of the labour market and economic growth, we have consciously opted for seeking support, in general, through the projection of the future economic scenarios presented now by the Ministry of Economy and Tax, as well as the analyses of other Spanish and international economic organisations. With this approximation, a partial support is achieved in determining an input (foreign immigrants) that cannot be deduced using the maintenance of the relative incidence of the phenomenon in the pas, since its denominator is the population of the rest of the world. Measures have also been taken, which will be mentioned below, in order to avoid an undesirable self-referencing circularity, derived from the fact that the producers of this type of economic estimation use, in their hypothetical scenarios regarding the growth of the population as a basic input for their estimation of the strength of future work.

Thus, in order to determine the nucleus of the migration hypotheses, the flows of foreign immigrants, we have borne in mind that the extension of the macroeconomic scenarios of the Government, carried out by the Ministry of Economy and Tax for the INE in an approximation still show a strong growth of GDP, though it is descending for the period until 2015, and what is more important, that a very noteworthy difference in population scenarios does not have much sensitivity in the aggregated economic results.

Using this information, the following reasoning has been created:

a) The macroeconomic horizon is marked, in accordance with specialists on these issues, by a strong economic dynamic that would predictably continue in the period until 2013, and therefore it is not expectable, bur rather a slightly descending trend of the foreign migratory flows induced by the labour market.

b) However, the continuation of this trend seems difficult in a seven-year period, and therefore, this has implied a cyclical inflection that predictably would begin to show effects starting in 2010.

c) Information is not available that enables modelling the final intensity and the rhythm of each drop, mainly because no information is available regarding the characterisation of said flows, but it has been necessary to adopt some criterion, as mentioned below.

A normative value of 500,000 entries of foreign nationals and 50,000 entries of Spaniards has been established in the projection horizon, with a slight decrease of such flows from the levels observed currently until 2010, in accordance with the persistence of favourable economic perspectives, which at the time of carrying out the exercise, remained for the coming three-year period.

The distribution of the entries of Spaniards and foreign nationals, by sex, is obtained using a parabolic adjustment that links the historical series with a normative value established in 2014, reflecting a feminisation of foreign immigration, due to a greater presence of flows from Latin America and a growing relevance of family regrouping, and a masculinisation of Spanish entries, to stand at average values for the 1992-2006 period.

Regarding distribution by age, immigrants have been applied with a calendar deduced from that observed in the 2004-2006 period, albeit adapted to the anticipated feminisation of flows and to a relative increase in age of adults as a result of the family regrouping flow. In turn, the age structure of Spanish immigrants has remained constant in the values observed for the 1998-2005 period.

On the other hand, the analysis of the flows registered in the Register of departures from Spain of the foreign population, and of the results of the expiry process therein affecting non-community foreign nationals without a permanent residence permit, enables deducting that a certain percentage of the entering foreign population ends up leaving the country subsequently, with greater intensity in the years immediately after entry. With this basis, the hypothesis has been established that 20% of the foreign population that enters Spain eventually leaves in subsequent years, according to a given time profile. In addition, a level of departures of 27,500 Spaniards in 2014 has been forecast, to which it gently evolves from current levels to slightly lower ones.

The distribution, by sex, of departures of Spaniards and foreign nationals has been obtained through a parabolic adjustment of the percentage of men in the total flow of departures that links the series observed from 2002 to 2006, with normative values established in the projection horizon for each group that reflect a slight recovery in the masculinisation of the departures.

Emigrants, by sex and nationality, are subsequently distributed according to a specific pattern, by age, established using the average for the years 2004 and 2005.

The retrospective analysis of each one of the phenomena and the hypotheses established regarding the future evolution thereof enables establishing specific fertility rates by age, and mortality tables, projected for the entire projection period, as well as an approximation to the foreign migratory flows during that same period. With this, the application of survival probabilities to the population, by starting age, at 1 January, and to the flows of births and immigrants for each year, provides the number of survivals, by age, at the end of said year.

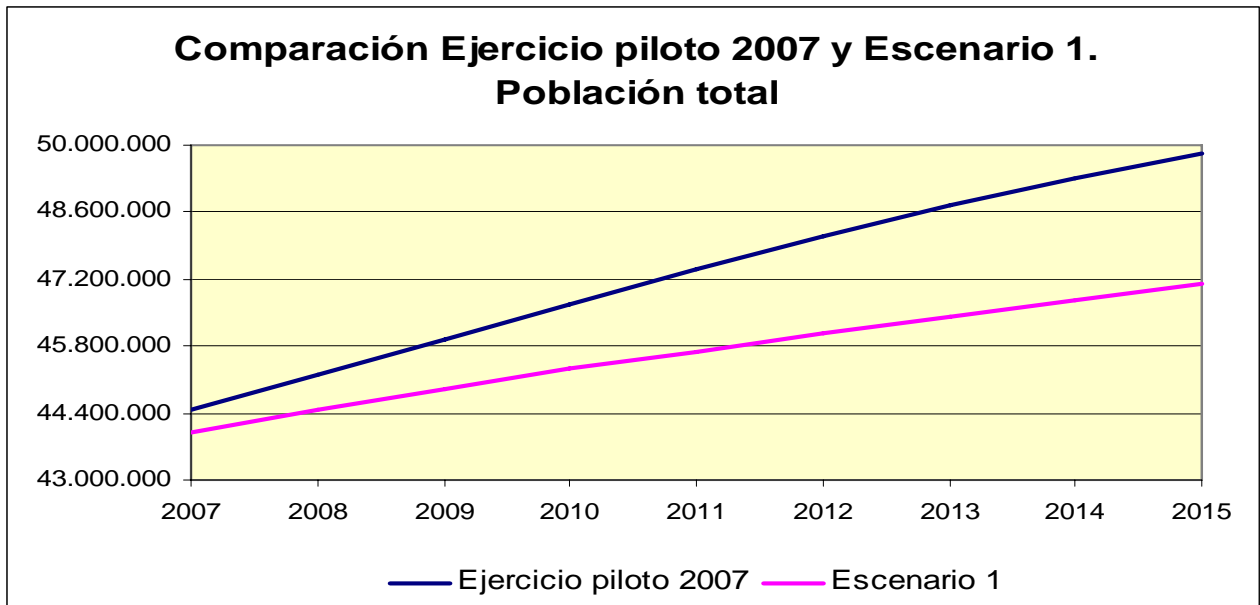Specifically, I= sex, J = age and K = year, yielding:

$$P_{i,j,k} = (P_{i,j-1,k-1} + PEX_{i,j-1,k-1}) * T_{i,j-1,k-1}$$

where $P_{i,j,k}$ is the figure for the population resident in Spain of sex i, age j at 1 January of year k; $PEX_{i,\ j-1,\ k-1}$ is the net population entry flow of foreign nationals of sex i and age j during year k-1; and $T_{i,j-1,k-1}$ is the projected probability of survival during year k-1, for an individual of sex i with age j-1 at 1 January of year k-1.

Annex II. Pilot exercise for the projection of the population of Spain in the short term. Results.

Evolución de la población según el Ejercicio piloto de proyección a corto plazo y el Escenario 1

	Poblaciones a 1 de enero		Crecimientos	
	Ejercicio piloto	Escenario 1	Ejercicio piloto	Escenario 1
2007	44.474.631	43.995.097		
2008	45.212.206	44.468.541	737.575	473.444
2009	45.952.934	44.906.328	740.728	437.787
2010	46.685.986	45.311.954	733.052	405.626
2011	47.400.474	45.686.498	714.488	374.544
2012	48.085.227	46.055.829	684.753	369.331
2013	48.728.228	46.418.431	643.001	362.602
2014	49.318.673	46.772.984	590.445	354.553
2015	49.844.737	47.118.532	526.064	345.548

Comparación Ejercicio piloto 2007 y Escenario 1. Población total

— Ejercicio piloto 2007   — Escenario 1

Comparación Ejercicio piloto 2007 y Escenario 1. Varones y Mujeres

Legend:
- Ejercicio piloto 2007 varones
- Escenario1 Varones
- Ejercicio piloto 2007 mujeres
- Escenario 1 mujeres
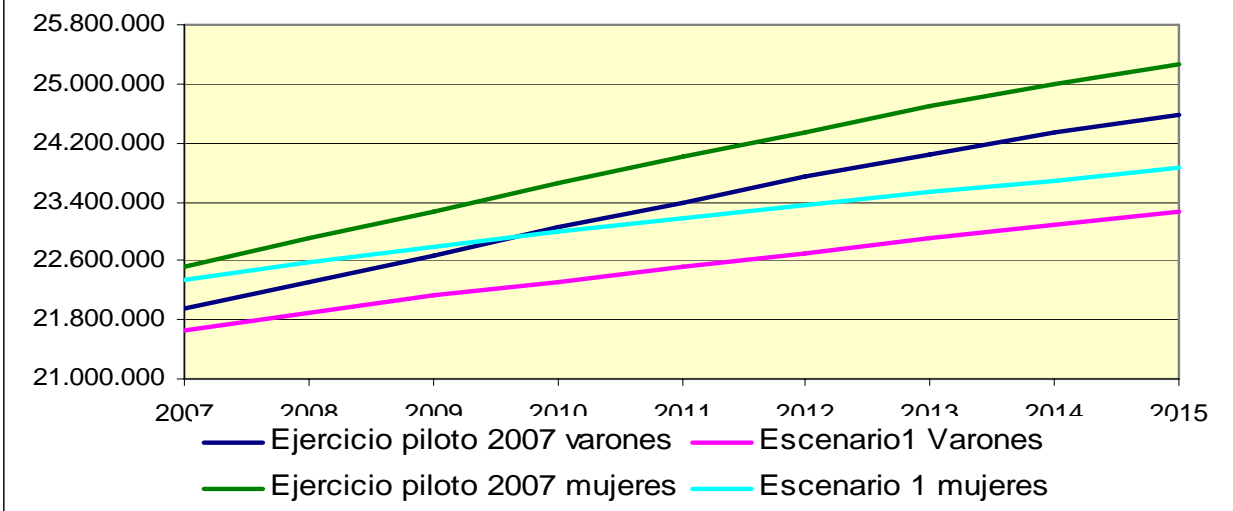
Evolución de la población por grupos de edad, según el Ejercicio piloto de proyección a corto plazo y el Escenario 1

Ejercicio piloto	2007	2008	2009	2010	2011	2012	2013	2014	2015
Ambos Sexos									
Total	44.474.631	45.212.206	45.952.934	46.685.986	47.400.474	48.085.227	48.728.228	49.318.673	49.844.737
0-15	6.896.922	7.049.155	7.215.639	7.392.572	7.576.112	7.761.391	7.941.194	8.110.644	8.261.212
16-40	16.735.809	16.835.390	16.915.979	16.968.073	16.986.470	16.967.361	16.906.642	16.797.433	16.639.314
41-64	13.434.483	13.809.579	14.187.577	14.560.009	14.928.285	15.292.906	15.659.030	16.036.360	16.416.525
65 y mas	7.407.417	7.518.082	7.633.739	7.765.332	7.909.607	8.063.569	8.221.362	8.374.236	8.527.686
Varones									
Total	21.942.724	22.313.398	22.682.392	23.045.004	23.396.240	23.731.527	24.045.073	24.332.388	24.588.067
0-15	3.544.914	3.621.558	3.705.213	3.794.002	3.886.494	3.980.200	4.071.351	4.157.668	4.234.149
16-40	8.614.193	8.669.522	8.712.024	8.736.982	8.741.685	8.725.014	8.685.539	8.620.016	8.529.297
41-64	6.646.359	6.835.091	7.026.229	7.216.442	7.406.329	7.596.109	7.787.998	7.986.819	8.188.533
65 y mas	3.137.258	3.187.227	3.238.926	3.297.578	3.361.732	3.430.204	3.500.185	3.567.885	3.636.088
Mujeres									
Total	22.531.907	22.898.808	23.270.542	23.640.982	24.004.234	24.353.700	24.683.155	24.986.285	25.256.670
0-15	3.352.008	3.427.597	3.510.426	3.598.570	3.689.618	3.781.191	3.869.843	3.952.976	4.027.063
16-40	8.121.616	8.165.868	8.203.955	8.231.091	8.244.785	8.242.347	8.221.103	8.177.417	8.110.017
41-64	6.788.124	6.974.488	7.161.348	7.343.567	7.521.956	7.696.797	7.871.032	8.049.541	8.227.992
65 y mas	4.270.159	4.330.855	4.394.813	4.467.754	4.547.875	4.633.365	4.721.177	4.806.351	4.891.598
Escenario 1	2007	2008	2009	2010	2011	2012	2013	2014	2015
Ambos Sexos									
Total	43.995.097	44.468.541	44.906.328	45.311.954	45.686.498	46.055.829	46.418.431	46.772.984	47.118.532
0-15	6.883.005	6.981.492	7.082.259	7.185.654	7.290.098	7.397.841	7.503.404	7.603.850	7.693.217
16-40	16.373.007	16.303.689	16.202.436	16.068.211	15.902.241	15.721.581	15.528.325	15.321.677	15.106.400
41-64	13.334.825	13.656.287	13.971.364	14.272.609	14.563.388	14.851.825	15.145.201	15.454.364	15.772.683
65 y mas	7.404.260	7.527.073	7.650.269	7.785.480	7.930.771	8.084.582	8.241.501	8.393.093	8.546.232
Varones									
Total	21.650.643	21.893.797	22.118.524	22.326.654	22.518.809	22.708.477	22.894.898	23.077.387	23.255.467
0-15	3.537.629	3.588.957	3.641.449	3.695.238	3.749.815	3.806.201	3.861.497	3.914.322	3.960.867
16-40	8.388.556	8.359.480	8.312.579	8.247.282	8.164.079	8.072.257	7.973.214	7.866.604	7.755.566
41-64	6.591.835	6.755.952	6.918.206	7.075.585	7.229.356	7.383.410	7.540.950	7.706.840	7.877.904
65 y mas	3.132.623	3.189.408	3.246.290	3.308.549	3.375.559	3.446.609	3.519.237	3.589.621	3.661.130
Mujeres									
Total	22.344.454	22.574.744	22.787.804	22.985.300	23.167.689	23.347.352	23.523.533	23.695.597	23.863.065
0-15	3.345.376	3.392.535	3.440.810	3.490.416	3.540.283	3.591.640	3.641.907	3.689.528	3.732.350
16-40	7.984.451	7.944.209	7.889.857	7.820.929	7.738.162	7.649.324	7.555.111	7.455.073	7.350.834
41-64	6.742.990	6.900.335	7.053.158	7.197.024	7.334.032	7.468.415	7.604.251	7.747.524	7.894.779
65 y mas	4.271.637	4.337.665	4.403.979	4.476.931	4.555.212	4.637.973	4.722.264	4.803.472	4.885.102

Diferencias absolutas entre el Ejercicio piloto y el Escenario 1

|	2007	2008	2009	2010	2011	2012	2013	2014	2015
Ambos Sexos									
Total	479.534	743.665	1.046.606	1.374.032	1.713.976	2.029.398	2.309.797	2.545.689	2.726.205
0-15	13.917	67.663	133.380	206.918	286.014	363.550	437.790	506.794	567.995
16-40	362.802	531.701	713.543	899.862	1.084.229	1.245.780	1.378.317	1.475.756	1.532.914
41-64	99.658	153.292	216.213	287.400	364.897	441.081	513.829	581.996	643.842
65 y mas	3.157	-8.991	-16.530	-20.148	-21.164	-21.013	-20.139	-18.857	-18.546
Varones									
Total	292.081	419.601	563.868	718.350	877.431	1.023.050	1.150.175	1.255.001	1.332.600
0-15	7.285	32.601	63.764	98.764	136.679	173.999	209.854	243.346	273.282
16-40	225.637	310.042	399.445	489.700	577.606	652.757	712.325	753.412	773.731
41-64	54.524	79.139	108.023	140.857	176.973	212.699	247.048	279.979	310.629
65 y mas	4.635	-2.181	-7.364	-10.971	-13.827	-16.405	-19.052	-21.736	-25.042
Mujeres									
Total	187.453	324.064	482.738	655.682	836.545	1.006.348	1.159.622	1.290.688	1.393.605
0-15	6.632	35.062	69.616	108.154	149.335	189.551	227.936	263.448	294.713
16-40	137.165	221.659	314.098	410.162	506.623	593.023	665.992	722.344	759.183
41-64	45.134	74.153	108.190	146.543	187.924	228.382	266.781	302.017	333.213
65 y mas	-1.478	-6.810	-9.166	-9.177	-7.337	-4.608	-1.087	2.879	6.496

Evolución de la población total de 0 a 15 años
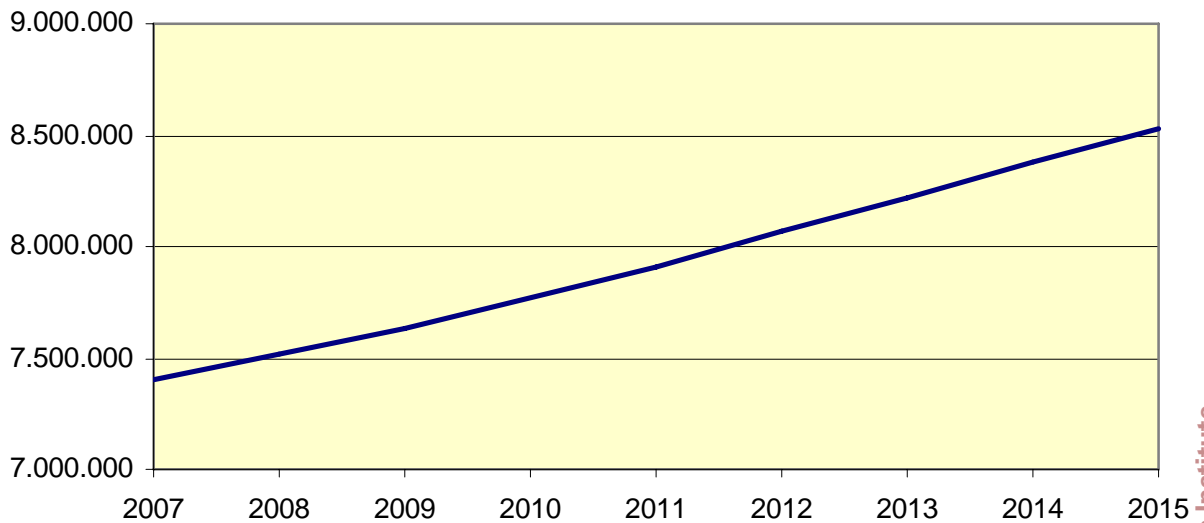**Ejercicio piloto**
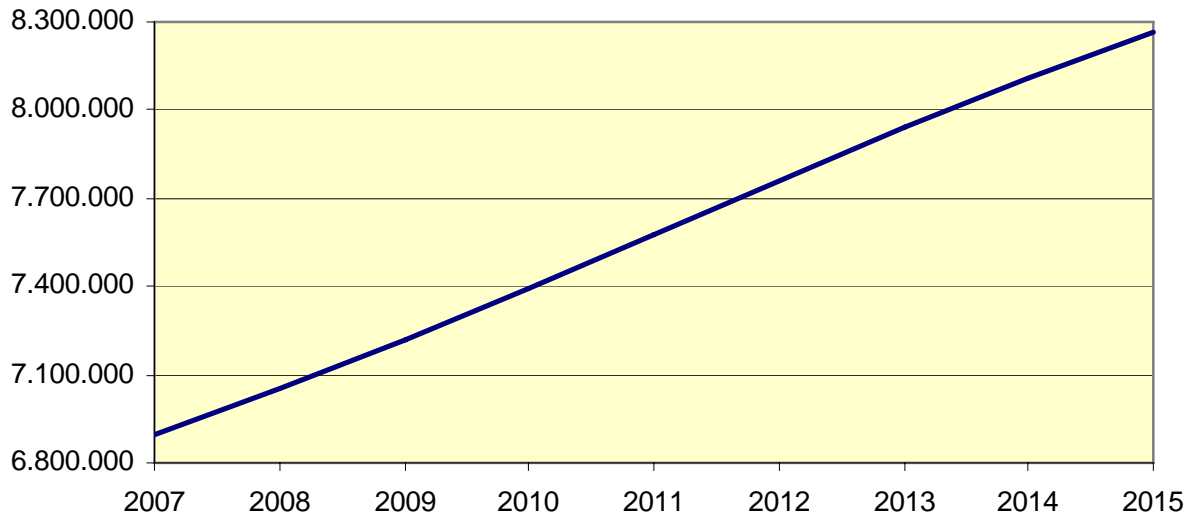
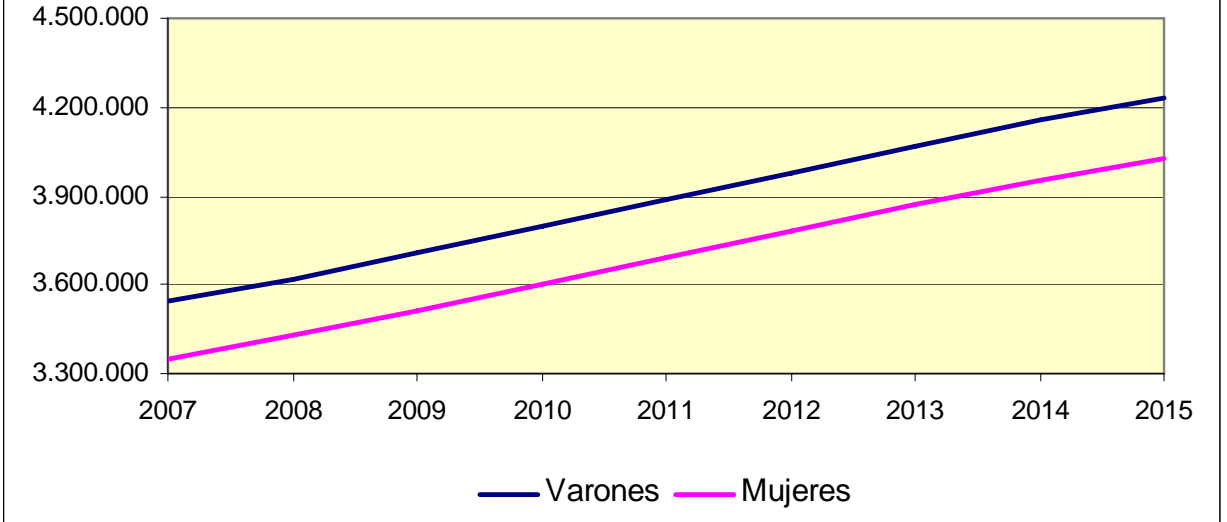**Evolución de la población total de 16 a 40 años**
Ejercicio piloto
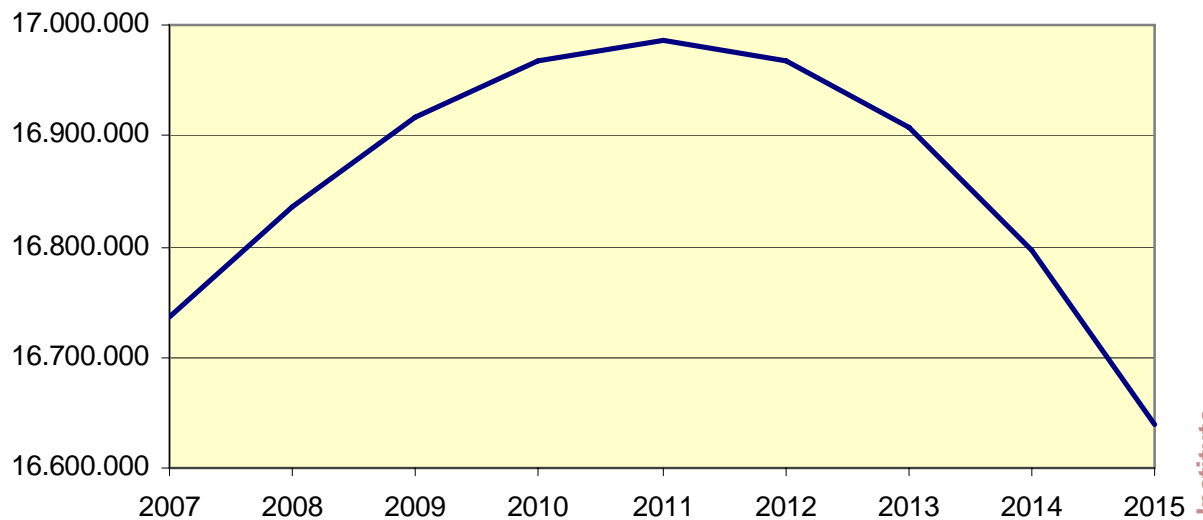
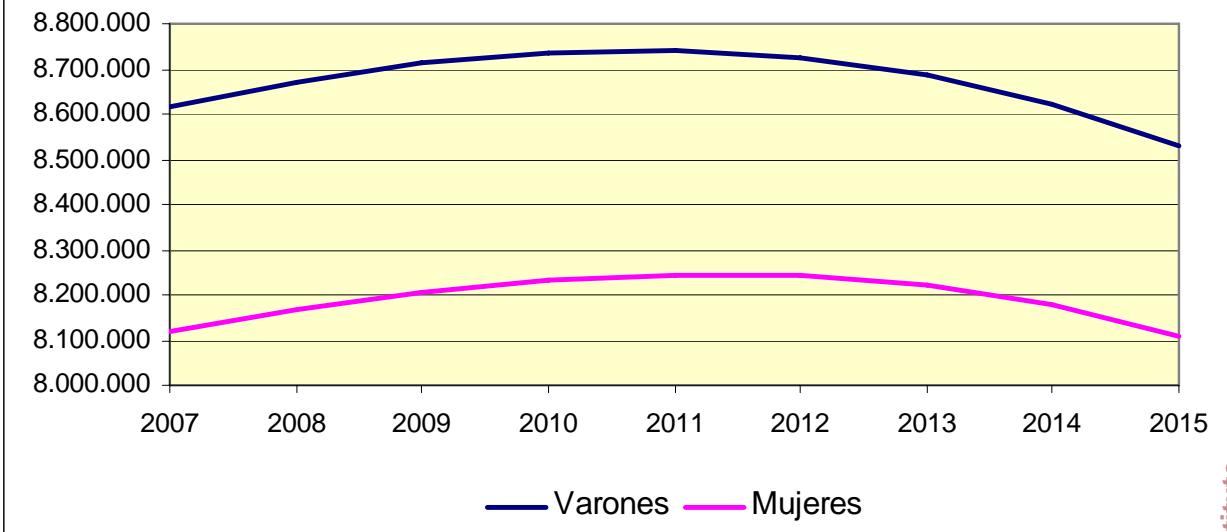## Evolución de la población total de 41 a 64 años
Ejercicio piloto
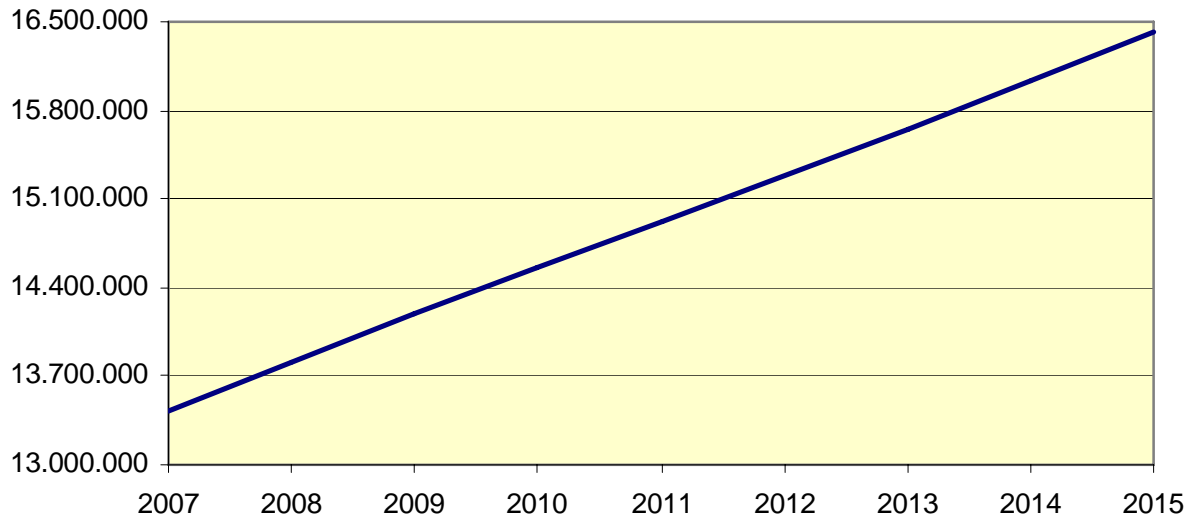
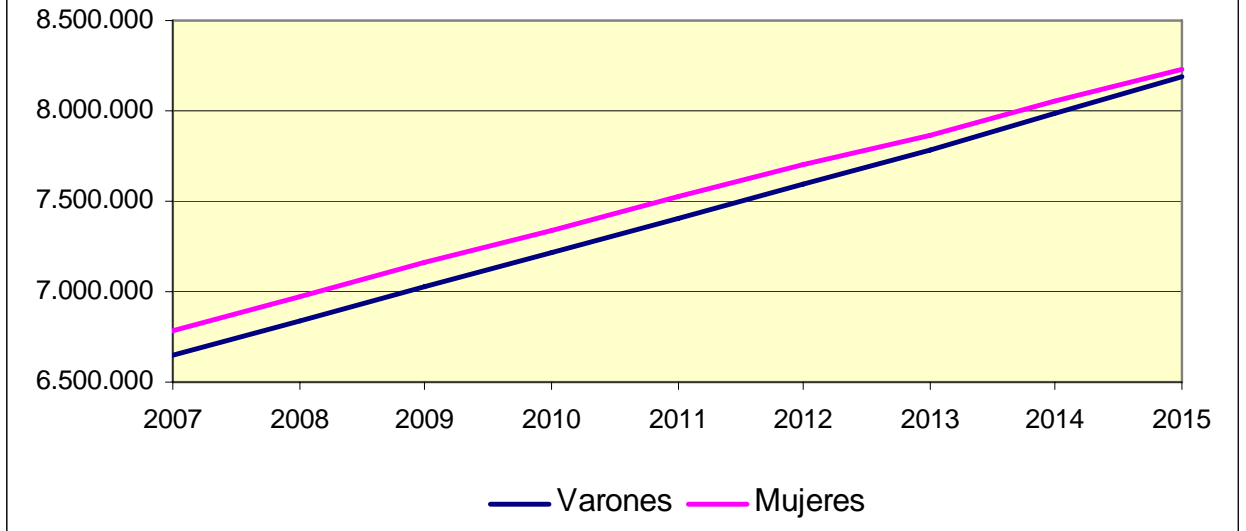## Evolución de la población total de 65 y más años
Ejercicio piloto

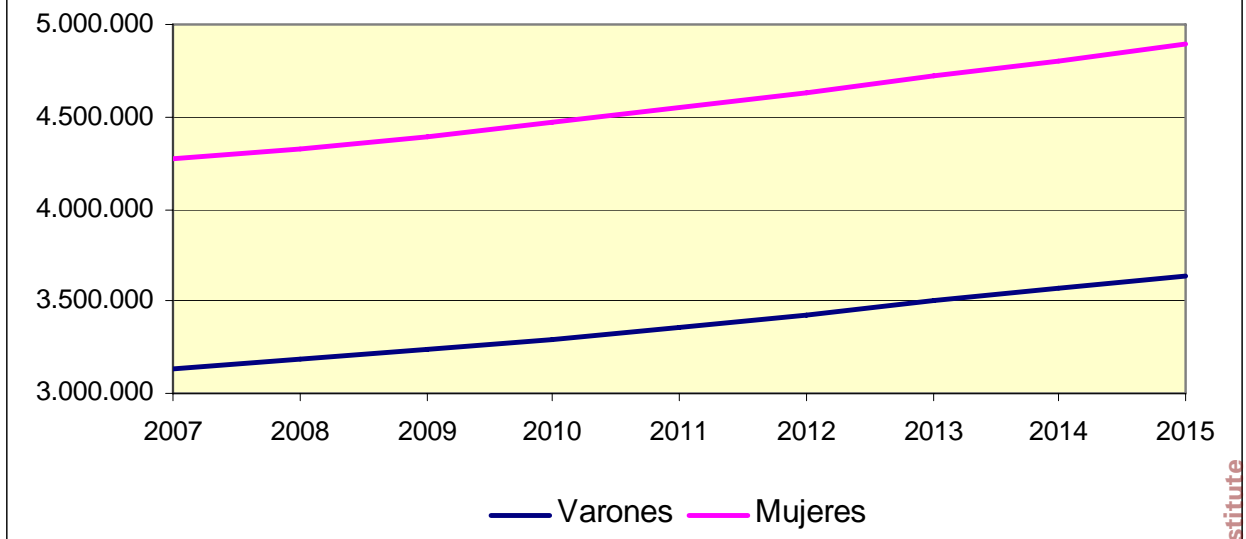## Evolución de la población de 0 a 15 años por sexo
Ejercicio piloto

Varones — Mujeres

Evolución de la población de 16 a 40 años por sexo
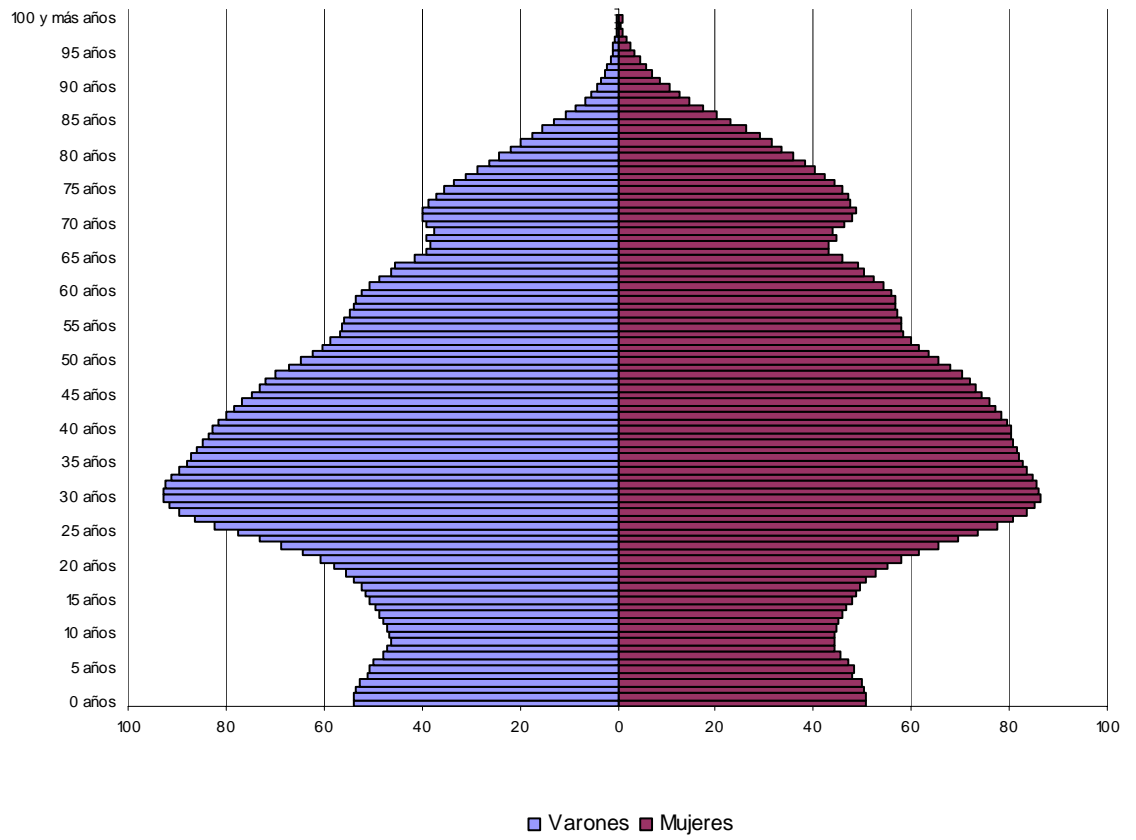### Ejercicio piloto

Varones — Mujeres

**Evolución de la población de 41 a 64 años por sexo
Ejercicio piloto**

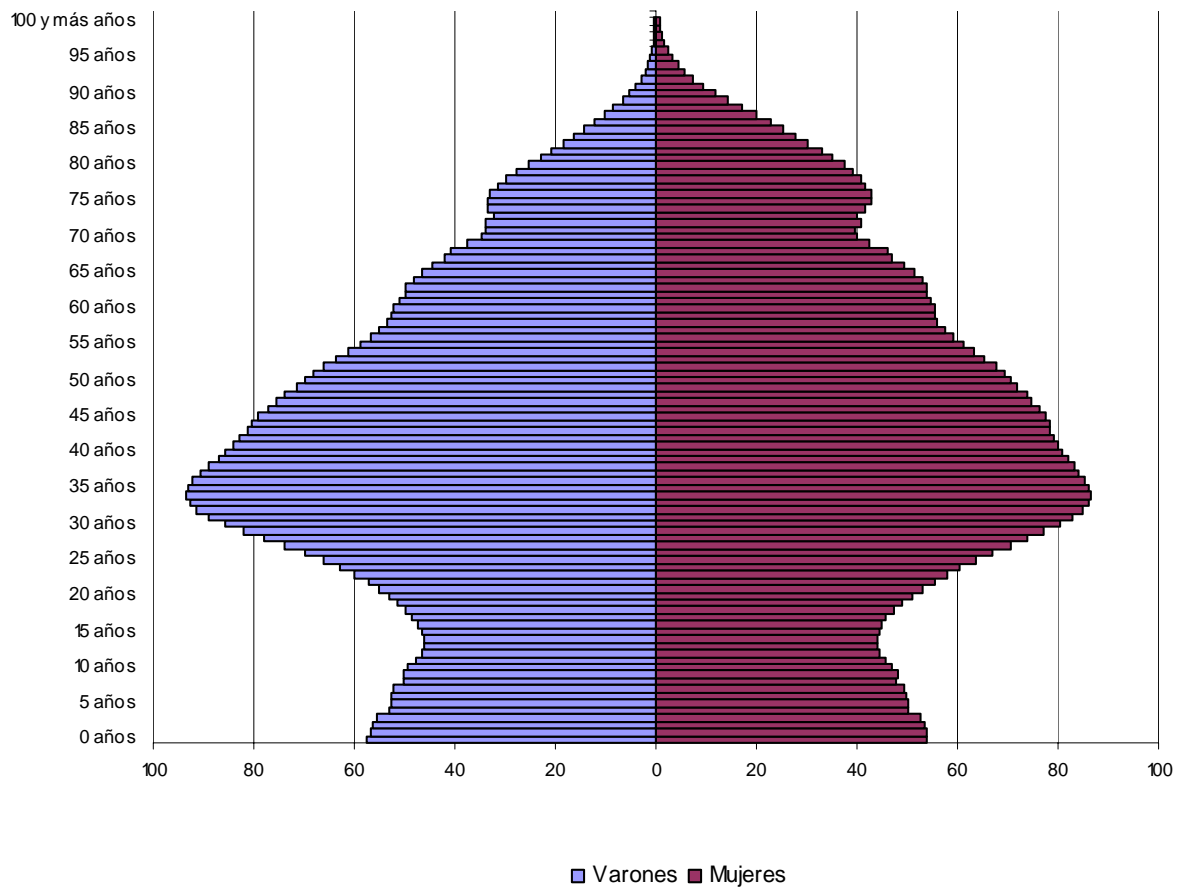**Evolución de la población de 65 y más años por sexo
Ejercicio piloto**

INE. National Statistics Institute

Pirámide Año 2007. Ejercicio piloto 2007

Pirámide Año 2011. Ejercicio piloto 2007

Varones ■ Mujeres

Pirámide Año 2015. Ejercicio piloto 2007

□ Varones ■ Mujeres