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Immigration and Regional Growth in Spain *

by

J. Ignacio Conde-Ruiz**

Juan Ramón García***

Maria Navarro***

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** FEDEA y Universidad Complutense de Madrid. J. Ignacio Conde-Ruiz, Fundación de Estudios de Economía Aplicada (FEDEA); Calle Jorge Juan 46; Madrid 28001; Tel.: +34 914350401; e-mail: conde-ruiz@fedea.es

*** FEDEA), e-mail: juanramongarcialopez@gmail.com, mnavarro@fedea.es

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Jorge Juan, 46
28001 Madrid -España
Tel.: +34 914 359 020
Fax: +34 915 779 575
infpub@fedea.es

N.I.F. G-78044393

Resumen: El objetivo de este artículo es calcular, los efectos de la inmigración sobre los tres factores que determinan la renta per-cápita (factor demográfico, tasa de empleo y productividad) a nivel regional. Encontramos que la inmigración ha tenido un efecto positivo sobre los dos primeros, pero negativo sobre la productividad. En términos cuantitativos, para el conjunto de España la inmigración ha tenido un impacto neto neutro sobre la renta per-cápita (0,05 puntos en promedio anual) sin embargo encontramos diferencias significativas a nivel regional. El impacto de la inmigración sobre el PIB es mucho más positivo. A nivel nacional más del 38% del crecimiento medio del PIB anual se puede asignar a la inmigración. Además, el impacto sobre el PIB regional es muy positivo en todas las CCAA.

Abstract: The aim of this paper is to compute, using an accounting exercise, the effect of immigrants over the three factors, which determine the income per capita (demographic factor, employment rate and productivity). We saw that immigration has had a positive effect over the two first, but negative over the productivity. Quantitative, for Spain, the immigration has had a neutral net effect over the per capita growth (0.05 points on annual average). However, at regional level we found important differences. Further, the total effect of immigration over the GDP growth rate is very positive. At national level we can say that more than 38% of the average annual growth rate can be assigned to immigrants. In this case the impact over the regional GDP has been very positive in all regions.

Keywords: Immigration, GDP growth, Spanish Regions
JEL Classification: R10, R11, J10, O40

1. Introduction

Traditionally, Spain has been an emigrant country. But the influx of immigrants has been so intense for the last decade that now it can be considered an immigrant country. Since the turn of the century, the migratory influx has reached an average of 600,000 new arrivals per year. As a result, the number of immigrants has increased from a mere 0.9 million (a 2.2 percent of the population) in the year 2000 to 4.7 millions (a 10.5 percent of the total population) in the year 2007. Such an increase of the migratory influx has no parallel in any other of the OCDE countries for the last decades. In fact, the 10 percent of all the immigrants to OCDE countries for the period 2000-2004 have chosen Spain as their destination country.

This large influx of migrants experienced from the year 2000 onwards has made possible for Spain to attain its highest population growth rate for the last hundred years. The population growth in Spain, it is interesting to note, has been higher in the period 2000-2006 (4.2 millions) than in the previous two decades (3.4 millions of inhabitants). But this immigrant-led population growth has not been uniform throughout the whole national territory, with more than a 60 percent of immigrants concentrated in the Mediterranean coastal regions (Cataluña, Valencia and Murcia) and the Comunidad de Madrid. As we will see in this paper, this recent migrant influx has made possible the attainment growth rates previously unknown in most Spanish regions: only Madrid, Cataluña and País Vasco experienced similar growth rates during the 1950s and 1960s when large sections of the population in the countryside moved to the new developing industrial and urban centres (intra-territorial movements).

The main aim of this paper is to examine the (direct) impact of immigration on the growth of the per capita income in the different autonomous regions (CCAA) during the period 2000-2006. What we mean by direct impact is the analysis of immigration from a purely accounting perspective, without taking into consideration any other causal implications usually associated with this phenomenon. This kind of methodological exercise, we believe, offers a starting point for a rigorous, objective assessment of the actual impact of immigration on the Spanish economy.

To calculate the impact of immigration on the per capita income, we are going to examine separately its effects on the three factors which determine the per capita income: *i*) the productivity (i.e. production per employment unit); *ii*) the employment rate (i.e. the ratio between those employed and the working age population from 16 to 64 years old); and *iii*) the demographic factor (i.e. the ratio between the working age population and the total population). As we will discuss in greater detail below, the main results of our accounting exercise indicate a lower bound, on a medium term, of the rate of impact of immigration on growth. But, if we adapt a complementary approach, which also takes into account other indicators derived from a causal analysis (i.e. an analysis in which indirect effects are duly quantified), the results will be much more positive than the one presented here.

The main results of this paper can be summarised as follows: immigration has a largely positive impact on the demographic factor because the great majority of the new-comers (more than the 87 per cent) are of working age. As a result, it is not surprising to find that they have arrived in greater numbers to those regions with an increasing ageing native population. The employment rate has also been benefited from the influx of immigrants largely because the employment rate among them is greater than among the native population (68 percent compared to 65.5 percent).

The impact of immigration on the Spanish labour market has been also quite significant: a 47 percent of all the new jobs created during the period 2000-2006 have been occupied by immigrants. It is also interesting to note that women participation in the labour market has increased more in those regions where the influx of migrants has been greater.

Regarding productivity, however, the impact of immigration has been largely negative. More specifically, we can see how the regions where job creation has been greater (i.e. where more immigrants have arrived) have also had the lowest increases in productivity. Although the economic (or causal) explanation for this inverted relationship is much more complex and falls beyond the scope of this paper, we can advance two alternative hypotheses. On the one hand, what we might be witnessing here is a process by which the arrival of immigrants on a particular region drives the employment costs down. As the work factor becomes more intensive in such particular economy, the productivity decreases accordingly. On the other hand, it may well be the case that in the regions where there have been important technological advancements for the increase of productivity, the demand for immigrants is more limited due to their relatively low working skills (human capital).

In quantitative terms and for the country as a whole, the influx of immigrants has had a positive net impact on the per capita income of a 0.05 points on the annual average for the period 2000-2006. There are, however, important differences from one region to another. On the one hand, we have CCAA like La Rioja, Murcia, Castilla la Mancha, Canarias, and Andalucia where the overall impact of immigration on the per capita income growth rate has been largely positive. In other regions like Madrid, Navarra, Cataluña, Baleares or Aragon, on the other hand, the impact has been negative. For other CCAA the impact can be considered to have been almost negligible. At a national level and for the period under consideration, however, an average increase of a 38 percent of the annual GDP can directly be attributed to the influx of immigrants. In this case, the impact of immigration has been positive for all CCAA.

This paper is organized as follows: we examine in section two the impact of immigrants on the three factors which determine the per capita income, that is, on the demographic factor, employment rate, and productivity. In section three, the main results of this analysis are discussed in relation to the per capita income and the GDP. Section four will conclude with a brief discussion of the main findings of our research.

2. The Direct Impact of Immigration on Regional Economic Growth

The main aim of this section is to examine the (direct) impact of immigration on the per capita income growth in different CCAA during the period 2000-2006.What we mean by direct impact is the undertaking of a purely accounting analysis in which no causal implication of any type are taking into account.

As can be seen below in Table 1 almost all CCAA have experienced an increase both in their GDP and their per capita GDP. The only exception is Baleares where, despite of having the greatest increase in population of all CCAA, the GDP growth has been below the average: it is, in fact, the only region where there has been a decrease in the per capita income. The reason for this, as we will see below, is that a great majority of these new-comers are on retirement age (not economically active).

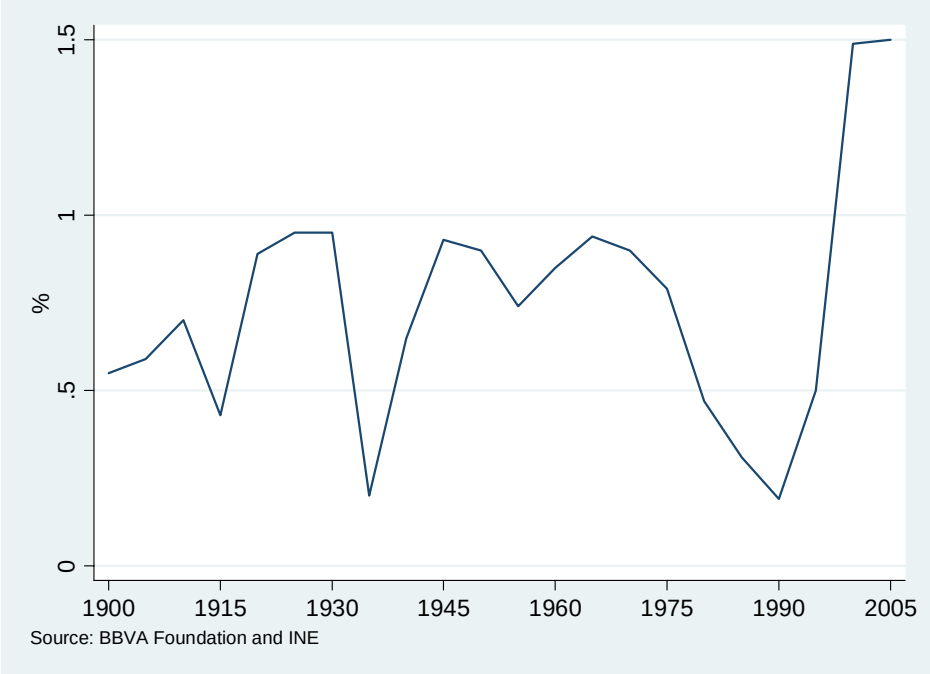
Table 1. Breakdown of the GDP growth per CCAA

2000-2006	tv(GDP)[1]	tv(GDPpc)	Population		
			tv(Population)	Natives	Immigrants
Andalucía	3,72	2,40	1,30	0,53	0,77
Aragón	3,33	2,36	0,95	-0,14	1,08
Asturias	2,83	2,92	-0,08	-0,54	0,46
Islas Baleares	2,30	-0,71	3,04	0,92	2,12
Canarias	3,41	0,93	2,46	1,03	1,43
Cantabria	3,44	2,53	0,89	0,17	0,73
Castilla y León	3,18	3,03	0,15	-0,39	0,54
Castilla La Mancha	3,52	1,87	1,62	0,62	1,00
Cataluña	3,21	1,26	1,93	0,30	1,62
C. Valenciana	3,33	0,78	2,53	0,50	2,03
Extremadura	3,50	3,28	0,21	-0,10	0,31
Galicia	3,08	2,90	0,18	-0,16	0,34
Madrid	3,51	1,17	2,31	0,33	1,98
Región de Murcia	3,88	1,25	2,59	0,64	1,95
Navarra	3,20	1,91	1,26	-0,08	1,34
País Vasco	3,08	2,71	0,36	-0,20	0,56
La Rioja	2,87	0,83	2,03	0,23	1,80
Total	3,34	1,78	1,53	0,29	1,25

Source: INE

As it can be expected, the regions with the greater influx of immigrants have experienced the greatest population growth. Due to this large influx of immigrants, it can be noted, the population growth rate in Spain has reached its highest level for the last century (See Graph 1).

Graph 1. Development of population growth rate in Spain



[1] *tv* is the growth rate for the period

Likewise, the regional population growth rates have also reached record levels for the last hundred years in all the CCAA, as can be seen below in Graph 2.

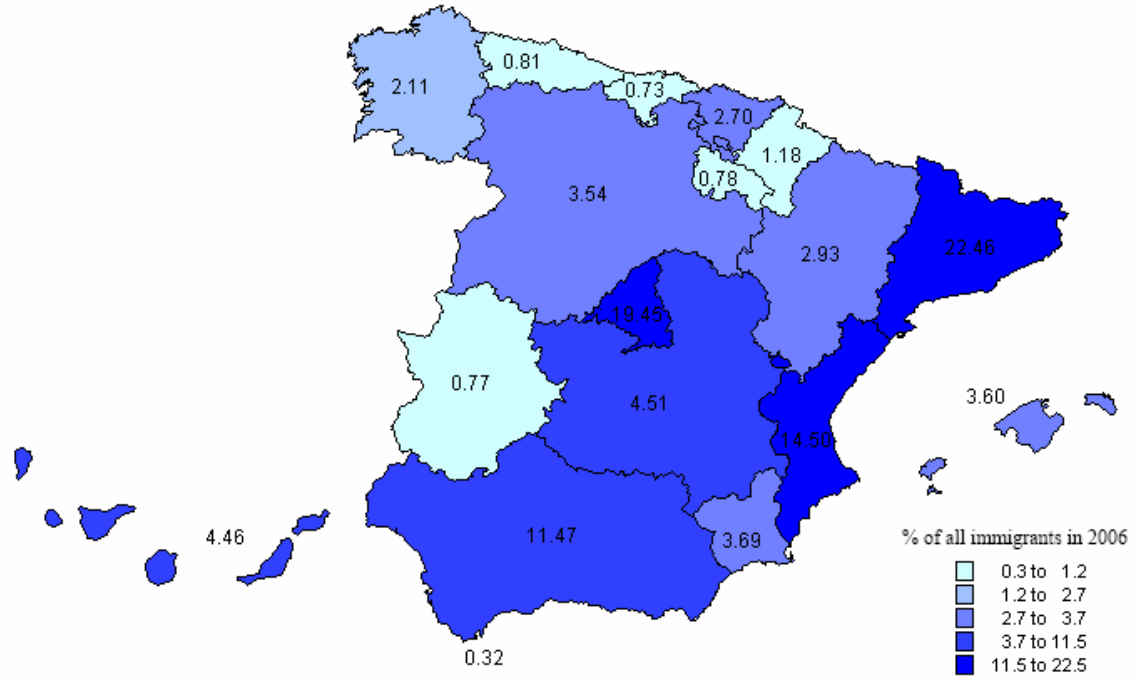
Only in regions like Madrid, Cataluña and País Vasco, these population growth rates were not completely unfamiliar: they had already experienced similar increases during the population exodus from the countryside to the urban and industrial centres which took place in Spain during the second half of the last century, especially in the decades of 1960s and 1970s.

Graph 2. Development of population growth rate by CCAA

Source: BBVA Foundation and INE

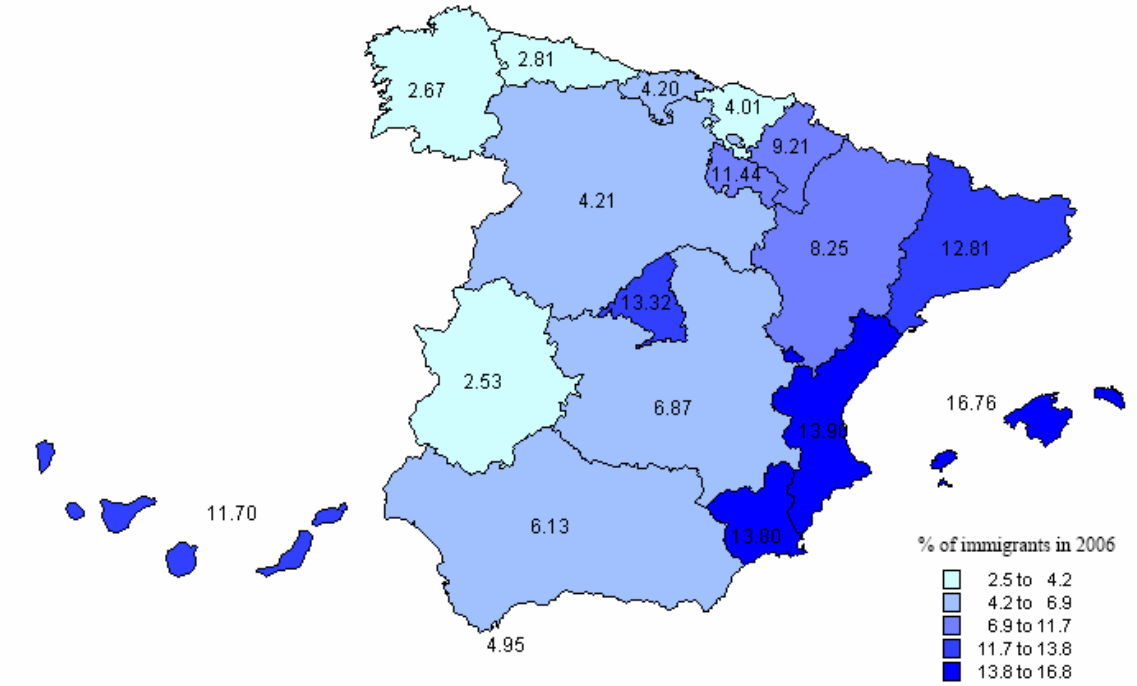
Clearly, the distribution of the newly arrived immigrants has been far from uniform throughout the whole national territory. As we can see below in Graph 3, the 55 percent of immigrants who came to Spain during the period 2000-2006 are settled in three CCAA: Madrid with a 19.45 percent, Cataluña with a 22,46 percent, and Valencia with a 14.4 percent. This unequal distribution has given rise to regions where the immigrants made up a high percentage of the total population as it can be seen in Graph 4: Baleares (16.7 percent), Madrid (13.3 percent), Comunidad Valenciana (13.9 percent), Murcia (13.8 percent), Cataluña (12.81 percent). In contrast, this percentage has remained relatively low in other regions like in Galicia (2.67 percent), Extremadura (2.53 percent), Cantabria (2.81 percent), Pais Vasco (4 percent) or Asturias (4.2 percent).

Graph 3. Distribution of immigrants by CCAA



Source: Spanish Labour Force Survey (INE)

Graph 4. Percentage of immigrants in each CCAA



Source: Spanish Labour Force Survey (INE)

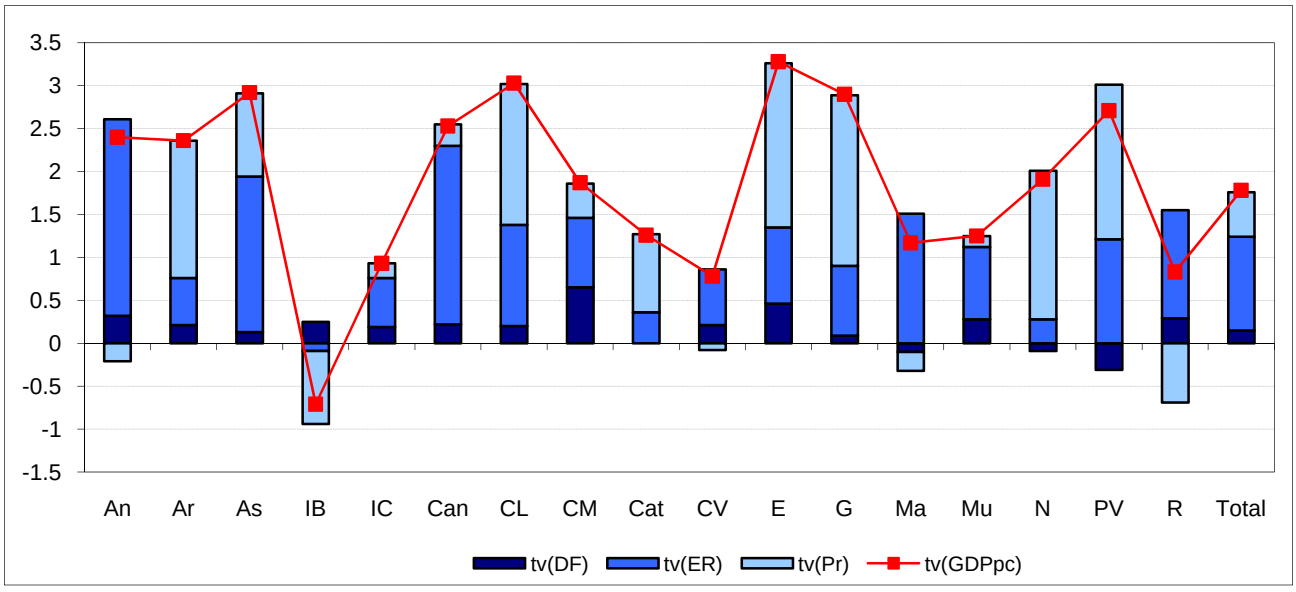
If we want to assess the direct impact of immigration on the regional growth, the simplest way to do it will be to examine the development of the three factors which completely determine its development. By means of an accounting identity, the per capita GDP can be broken down as the outcome of: *i*) productivity *–Pr-* (i.e. production per employment unit); *ii*) employment rate *–ER-* (i.e. ratio between the employed and the working age population from 16 to 64 years old); *iii*) the demographic factor *-DF-* (the ratio between the working age population and the total population).

$$\underbrace{\frac{PIB}{Pop}}_{\text{Per capita GDP}} = \underbrace{\frac{PIB}{L}}_{\text{Productivity (Pr)}} \quad \underbrace{\frac{L}{Pop^{16-64}}}_{\text{Employment Rate (ER)}} \quad \underbrace{\frac{Pop^{16-64}}{Pop}}_{\text{Demographic Factor (DF)}}$$

As we can see below in Figure 1, the impact of these three factors on the per capita income varies dramatically between different regions. On the one hand, we find several regions like Andalucia, Asturias, Cantabria, Canarias, Comunidad Valenciana, Madrid, Murcia and La Rioja where increases in the per capita income can be largely attributed to the growth of the employment rate factor (ER). On the other, the per capita income growth is primarily the result of productivity improvements in the case of regions like Aragon, Baleares, Castilla y León, Extremadura, Cataluña, Galicia, Navarra and País Vasco.

Figure 1. Contribution of the three GDP components to the per capita income

	tv(GDP_{pc})	tv(DF)	tv(ER)	tv(Pr)
Andalucía	2.4	0.32	2.29	-0.21
Aragón	2.36	0.21	0.55	1.6
Asturias	2.92	0.13	1.81	0.97
Islas Baleares	-0.71	0.25	-0.09	-0.85
Canarias	0.93	0.19	0.57	0.17
Cantabria	2.53	0.22	2.08	0.25
Castilla y León	3.03	0.2	1.18	1.64
Castilla La Mancha	1.87	0.65	0.81	0.4
Cataluña	1.26	0	0.36	0.91
C. Valenciana	0.78	0.21	0.65	-0.08
Extremadura	3.28	0.46	0.89	1.91
Galicia	2.9	0.09	0.81	1.99
Madrid	1.17	-0.1	1.51	-0.22
Región de Murcia	1.25	0.28	0.84	0.13
Navarra	1.91	-0.09	0.28	1.73
País Vasco	2.71	-0.31	1.21	1.8
La Rioja	0.83	0.29	1.26	-0.69
Total	1.78	0.15	1.09	0.52



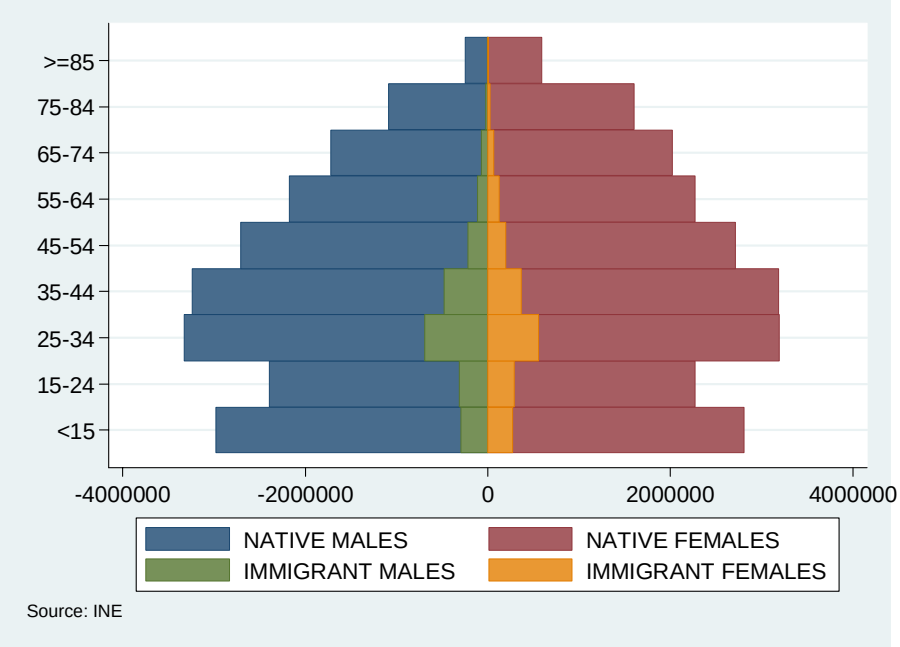
Source: Own elaboration

2.1. The Impact of Immigration on the Demographic Factor

The demographic factor is here defined as the percentage of working age population in relation the total population (i.e. the ratio between the 16 to 64 years old population and the total population). As we can see from the demographic pyramid in Graph 5, a great majority of all the immigrants coming to Spain are of working age, more precisely a 87.05 percent of them. Their distribution by age is relatively similar throughout all the different regions[2].

[2] See appendix for the respective demographic pyramids of native and immigrant population.

Graph 5. Demographic Pyramids (natives vs. immigrants) for the year 2006

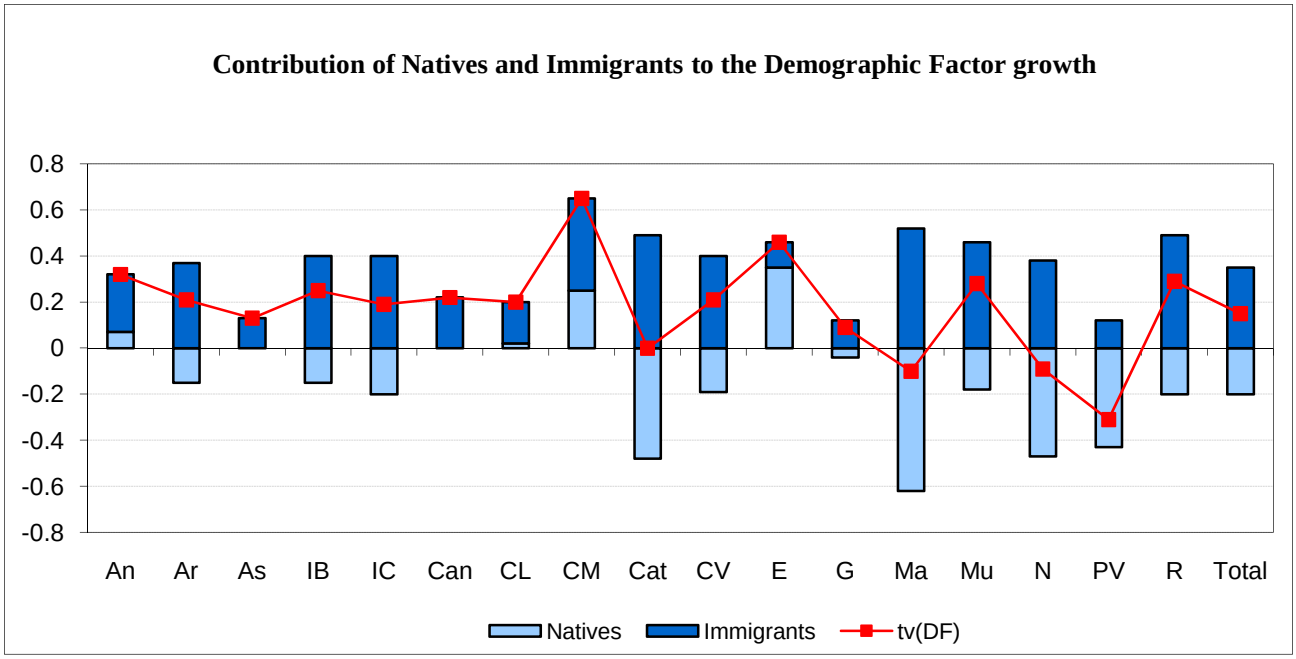


As we can see from Figure 2[3], if there had been no arrivals of immigrants, the ratio between the working age and total population would have only increased in just four regions: Castilla y León, Castilla La Mancha, Extremadura and Andalucía. And, given the gradual process of ageing population, the ratio would have diminished dramatically in all the rest of the regions. Consequently, the impact of immigration on the demographic factor can be said to have been largely positive in all the CCAA. More specifically, this positive impact has been quite intense in regions like Madrid (0.52), Cataluña (0.49), Murcia, (0.46), Comunidad Valenciana (0.4) and the two insulars regions of Canarias (0.4) and Baleares (0.5).

[3] See Technical Appendix for the methodology employed in the breakdown of Figure 2.

Figure 2. Breakdown of demographic factor growth

	Total	Natives	Immigrants
Andalucía	0,32	0,07	0,25
Aragón	0,21	-0,15	0,37
Asturias	0,13	0	0,13
Islas Baleares	0,25	-0,15	0,4
Canarias	0,19	-0,2	0,4
Cantabria	0,22	0	0,22
Castilla y León	0,2	0,02	0,18
Castilla La Mancha	0,65	0,25	0,4
Cataluña	0	-0,48	0,49
C. Valenciana	0,21	-0,19	0,4
Extremadura	0,46	0,35	0,11
Galicia	0,09	-0,04	0,12
Madrid	-0,1	-0,62	0,52
Región de Murcia	0,28	-0,18	0,46
Navarra	-0,09	-0,47	0,38
País Vasco	-0,31	-0,43	0,12
La Rioja	0,29	-0,2	0,49
Total	0,15	-0,2	0,35



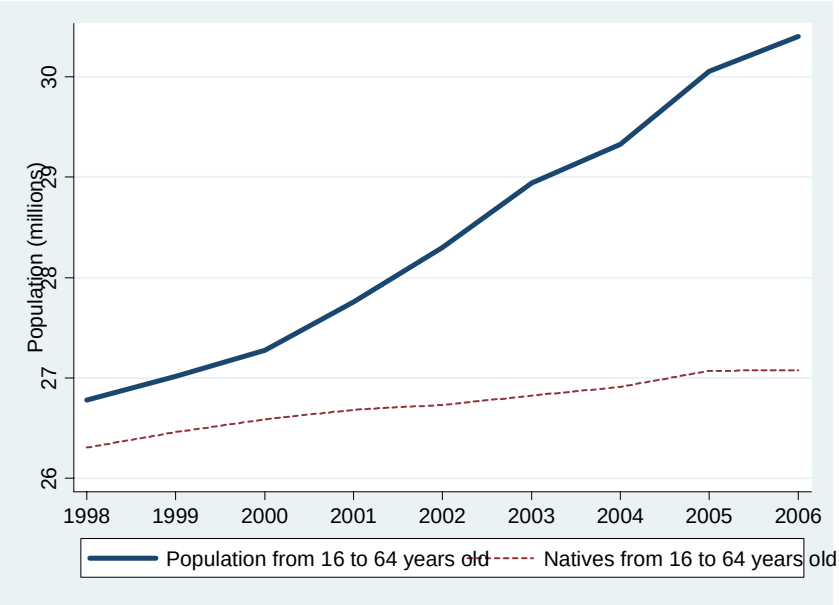
Source: Own elaboration

Ceteris paribus at a national level the positive impact of immigrants on the demographic factor has made possible an annual increase of the per capita income of 0.35 decimals in the period 2000-2006. At a regional level, except in the three regions of Navarra, País Vasco and Comunidad de Madrid, the demographic factor has increased due to the impact of immigration. The autonomous regions where the demographic factor of natives have seen signs of ageing during the period are Cataluña (-0.48 percent), Madrid (-0.62 percent), Navarra (-0.47 percent), and País Vasco (-0.43 percent).

In this respect, the case of the Comunidad de Madrid is relatively significant: in spite of being a region where immigration has had one of the greatest positive impacts on the demographic factor, the dramatic ageing of the native population means that the demographic factor is finally negative (i.e. without the new arrivals the per capita income in the Comunidad de Madrid would have fallen by a 0.62 percent).

It is interesting to note the existence of a correlation of –0.60 between the contribution of immigrants to the demographic factor growth rate and the contribution of the natives. What this correlation tells us is that immigrants use to go to those regions where there is greater ageing native population (i.e. where the negative impact of natives on the demographic factor is greater). As we can clearly see in Graph 6, the working age population, that is the population from 16 to 64 years old, has hardly increased among the natives during the period under study; only the arrival of immigrants in large numbers has made possible such intense growth of the working age population at a national level[4].

Graph 6. Evolution of working age population from 16 to 64 years old in Spain (Natives vs. Immigrants)



2.2 The impact of Immigration on the Employment Rate

As we have seen in the previous section, the immigration influx experienced by Spain in the last few years has dramatically increased its labour force, particularly because the great majority of these immigrants who have arrived to the country are of working age. In this section, we are going to examine the direct impact of immigration on the employment rate. To do so, we presume in this analysis that the employment rates both for natives and immigrants work independently from one another[5].

[4] See data appendix for an analysis by CCAA.

[5] This analysis leaves aside a series of factors whose indirect impact on the employment rate are not clearly demonstrated. On the one hand, the increase in the immigrant employment rate might have a negative impact on the employability of natives, if there is a process of employment substitution between both of groups. On the other hand, this impact might be positive if both of them complement each other in the productive process or if we consider the immigrant impact on the employability in the domestic sector in relation to women employment rates.

To begin with, we are going to describe briefly the evolution of the labour market for the period under study. We know that the employment rate can be broken down into:

Employment rate = Activity Rate (1- Unemployment Rate)

On the hand, the activity rate for immigrants (see Table 2) is much higher than for natives in all regions. On the other, the unemployment rate among immigrants is higher than natives in all regions. As a result, it is the extent of both factors what determines whether the employment rate for immigrants would be higher or lower than for natives. When compared to natives, the employment rate for immigrants is lower in the regions of Baleares, Cataluña, Comunidad Valenciana, Galicia, Navarra, Pais Vasco and Ceuta and Melilla.

Table 2. Employment rates for year 2006. (Population between 16-64 years old)

CCAA	Activity Rate		Unemployment Rate		Employment Rate	
	Natives	Immigrants	Natives	Immigrants	Natives	Immigrants
Andalucía	65.98	79.99	12.58	13.80	57.69	64.33
Aragón	72.82	80.38	4.89	10.33	69.26	71.35
Asturias	65.07	80.21	8.94	16.76	59.25	63.45
Islas Baleares	76.26	77.96	5.62	9.69	71.98	65.99
Canarias	69.65	82.21	11.23	13.93	61.83	66.79
Cantabria	69.51	78.74	6.15	12.69	65.24	67.33
Castilla y León	70.24	80.47	7.75	13.60	64.79	67.99
Castilla La Mancha	69.33	80.13	8.19	14.20	63.66	68.32
Cataluña	76.48	80.81	5.51	12.10	72.26	68.59
C. Valenciana	72.44	77.85	7.62	12.06	66.91	60.99
Extremadura	66.00	74.55	13.24	19.60	57.27	58.44
Galicia	70.35	75.36	8.15	16.19	64.62	60.53
Madrid	74.88	85.36	5.78	8.86	70.55	76.60
Región de Murcia	69.03	79.82	7.58	9.00	63.80	70.99
Navarra	75.28	82.01	4.54	11.23	71.87	70.63
País Vasco	73.14	79.99	6.38	16.93	68.48	64.46
La Rioja	73.73	83.91	4.86	12.75	70.15	72.86
Total	71.29	80.89	8.03	11.78	65.57	68.05

Source: Spanish Labour Force Survey (2006 annual average)

It is interesting to note, as we can see in the graph below, that the 47.63 percent of all the newly created jobs have been taken by immigrants (See Table 3). When we look to job distribution by sectors, immigrants have taken a 60.66 percent (0.5 million jobs) in the construction sector and a 35.56 percent (1.1 million jobs) in the service sector. At the same time, there has been a reduction in the number of native people employed in the primary sector as well as in construction. In the agricultural sector, for example, with the net disappearance of almost 87,000 jobs during the period under study, the native population has been almost replaced by immigrants. Likewise, in the construction sector, immigrants have not only taken the more than 200,000 newly created jobs, but also the other 30,000 jobs left by the native population.

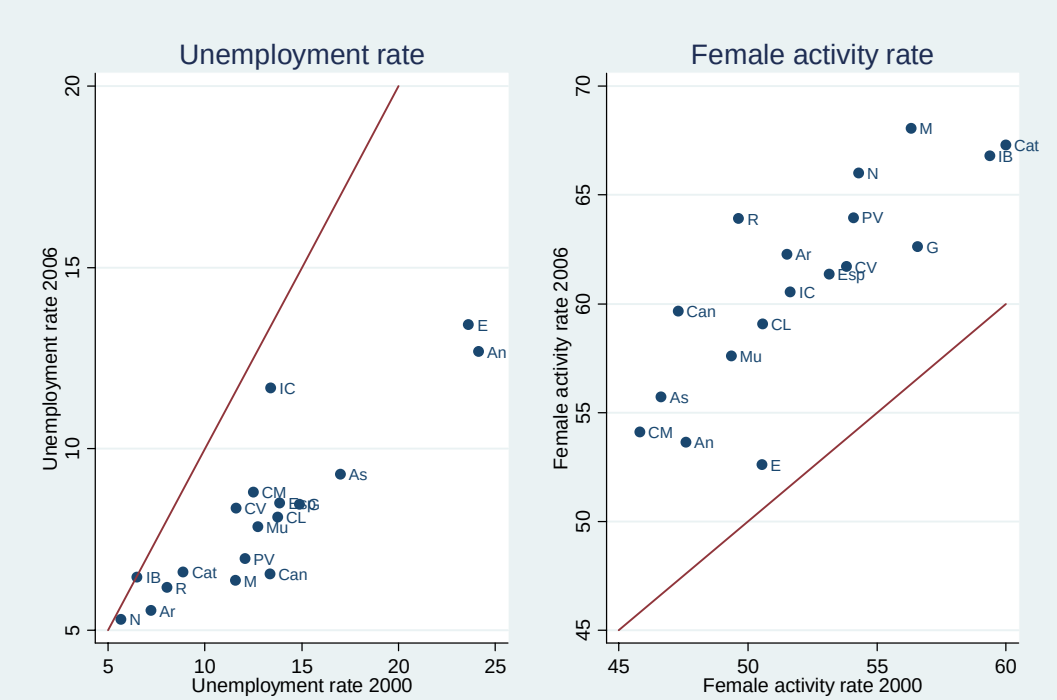
Table 3. Net employments created by sector. Employments and percentage of them taken by immigrants (2000-2006). Regional Analysis

	Total	Primary Sector	Industry	Construction	Services
	819269	2821	28386	193067	594995
Andalucía	223312	35218	11973	50646	125475
	(27.26%)	(-)	(42.18%)	(26.23%)	(21.09%)
	92903	2051	-8334	12741	86444
Aragón	50634	3941	10461	11920	24312
	(54.50%)	(-)	(-)	(93.56%)	(28.12%)
	71070	-8343	3093	9672	66649
Asturias	17273	1749	2356	1515	11653
	(24.30%)	(-)	(76.19%)	(15.66%)	(17.48%)
	114426	929	2027	15115	96354
Islas Baleares	67141	319	4115	17376	45330
	(58.68%)	(34.36%)	(-)	(-)	(47.05%)
	204378	-12261	11092	33245	172303
Canarias	109205	3622	7512	14171	83900
	(53.43%)	(-)	(67.72%)	(42.63%)	(48.69%)
	57815	-3863	2370	11350	47959
Cantabria	14640	0	850	4653	9136
	(25.32%)	(0)	(35.88%)	(41%)	(19.05%)
	159720	-4192	12473	30159	121280
Castilla y León	51503	2911	8848	13806	25938
	(32.25%)	(-)	(70.93%)	(45.78%)	(21.39%)
	181225	-8601	32389	39819	117618
Castilla La Mancha	68422	8914	14690	15005	29812
	(37.76%)	(-)	(45.36%)	(37.68%)	(25.35%)
	650630	14494	20912	140288	474936
Cataluña	413011	15644	68256	111067	218044
	(63.48%)	(-)	(-)	(79.17%)	(45.91%)
	515898	-19678	60277	115936	359363
C. Valenciana	301574	11173	47870	81444	161086
	(58.46%)	(-)	(79.42%)	(70.25%)	(44.83%)
	6160	289	7733	7885	45698
Extremadura	10417	1513	1124	414	7366
	(16.91%)	(-)	(14.53%)	(5.25%)	(16.12%)
	150009	-6349	33010	19040	161454
Galicia	33294	831	2095	6776	23592
	(22.19%)	(-)	(6.35%)	(35.59%)	(14.61%)
	764477	14474	-15585	119682	645905
Madrid	468726	6744	29280	119638	313064
	(61.31%)	(46.59%)	(-)	(99.96%)	(48.47%)
	152422	970	15241	47978	88233
Región de Murcia	87476	18193	8941	27770	32572
	(57.39%)	(-)	(58.66%)	(57.88%)	(36.92%)
	42393	-3069	-1678	7977	39163
Navarra	28560	1294	4875	6936	15455
	(67.37%)	(-)	(-)	(86.95%)	(39.46%)
	137007	1431	-4109	8168	131517
País Vasco	41017	1049	3575	6513	29880
	(29.94%)	(73.27%)	(-)	(79.74%)	(22.72%)
	35993	-670	4532	3409	28722
La Rioja	19248	1316	3883	4759	9290
	(53.48%)	(-)	(85.67%)	(-)	(32.35%)
	4213199	-86994	203105	815395	3281692
Total	2006927	114431	230896	494627	1166972
	(47.63%)	(-)	(-)	(60.66%)	(35.56%)

Source: Spanish Labour Force Survey (INE)

Simultaneously to this intensive process of job creation taken by immigrants, there has been: *i*) a reduction in the native unemployment rate, and *ii*) a dramatic increase in the activity rate among native women (see Table 7). Although it falls beyond the scope of this paper to establish any causal link between both developments, Conde-Ruiz, Estrada and Pérez-Quiros (2008) have shown how the large influx of immigrants can help to explain the substantial increase in women employment participation during the last decade.

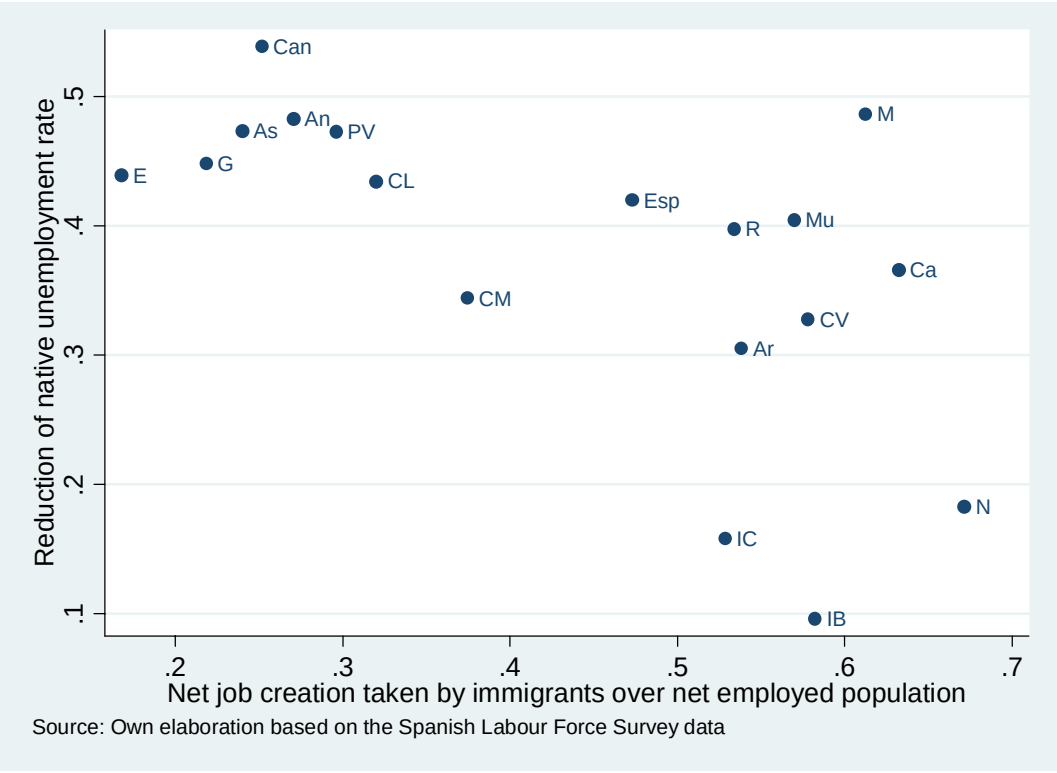
Graph 7. Development of women activity rate and native unemployment rate (2000 vs. 2006)



Source: Own elaboration based on the Spanish Labour Force Survey data

It is also important to note (see Graph 8) that, while the arrival of immigrants to the labour market has been largely compatible with a simultaneous reduction of the unemployment rate in all CCAA, the regions where immigrants have taken more jobs in net terms have not necessarily experienced the greater reduction in the unemployment rates among natives. In fact, there is a correlation of –0.62 between the reduction of the native unemployment rate and the percentage of newly created jobs taken by immigrants during the period 2000-2006.

Graph 8. Relationship between the reduction of native unemployment rate and the net job creation taken by immigrants in relation to net employed population



Source: Own elaboration based on the Spanish Labour Force Survey data

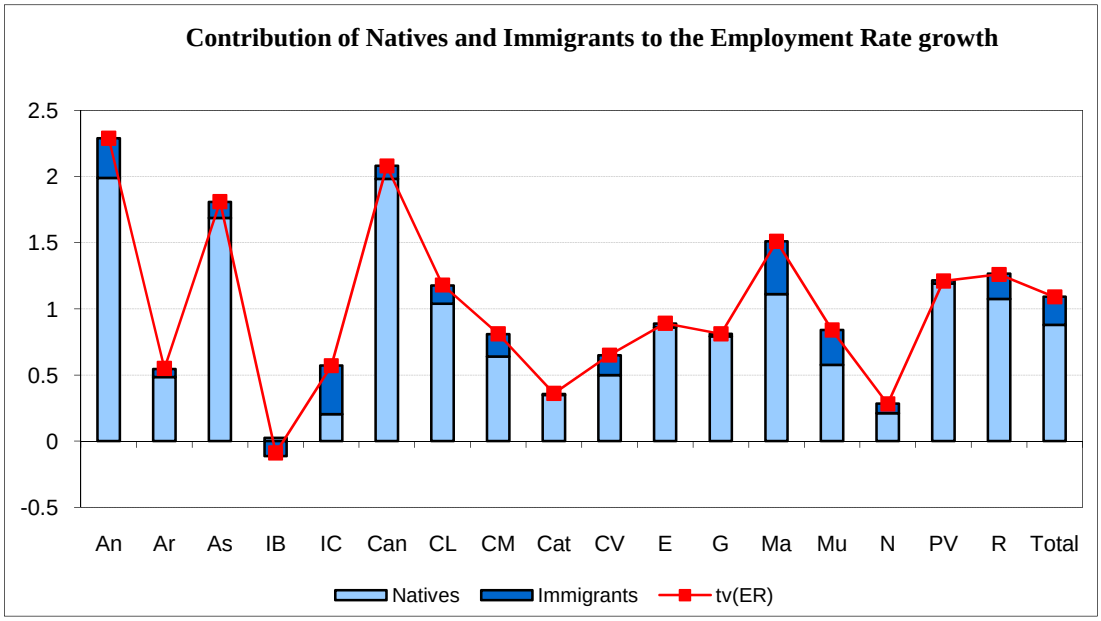
A plausible explanation for this simultaneous reduction in the native unemployment rate can be found, as we have suggested above, in the incentives immigration create for the entrance of native women in the labour market, a process which increases women activity rate and reduces native unemployment rate. Thus, the entrance of large number of immigrants to work in the domestic service brings down the cost of such service, reduces the reserve salary of the family care-takers (mainly women), and increases the participation of native women in the labour market.

The contribution of immigrants to the growth rate of the Employment Rate (ER) is shown below in Figure 3[6].

[6] In order to maintain an accounting identity (1) when breaking down the growth rate we have normalised the employed turning them into the National Statistics' time equivalent employments (*empleos a tiempo equivalente*).

Figure 3. Breakdown of employment rate growth

	Total	Natives	Immigrants
Andalucía	2,29	1,99	0,30
Aragón	0,55	0,48	0,06
Asturias	1,81	1,69	0,12
Islas Baleares	-0,09	0,02	-0,11
Canarias	0,57	0,20	0,37
Cantabria	2,08	1,98	0,10
Castilla y León	1,18	1,04	0,14
Castilla La Mancha	0,81	0,64	0,17
Cataluña	0,36	0,35	0,01
C. Valenciana	0,65	0,50	0,15
Extremadura	0,89	0,86	0,03
Galicia	0,81	0,79	0,02
Madrid	1,51	1,11	0,40
Región de Murcia	0,84	0,58	0,26
Navarra	0,28	0,21	0,07
País Vasco	1,21	1,19	0,03
La Rioja	1,26	1,07	0,19
Total	1,09	0,88	0,21



Source: Own elaboration

Ceteris paribus at a national level the influx of immigrants has contributed to the annual growth of 0.2 points of the per capita income during the period 2000-2006 due to its positive impact on the employment rate. It is important to note, however, that the contribution of natives to the employment rate have been much more significant than that of immigrants, especially in regions like La Rioja, País Vasco, Madrid, Castilla y León, Cantabria, Asturias and Andalucía. The explanation, as we have mentioned before, lays in the two main developments which have characterised the Spanish labour market for the last decade: *i*) the reduction of the unemployment rate to historical low levels, and *ii*) the dramatic increase in women participation in the labour market.

The positive impact of immigration on the employment rate is particularly noticeable for regions like Madrid, Murcia, Canarias and Andalucia.

2.3. The Impact of Immigration on productivity

In contrast with the two previous factors, the impact of immigration on productivity is much more difficult to measure as we do not have any direct information about workers individual output, let alone differences of productivity which may exist between various nationalities. In addition to this, if we want to measure productivity taking into account such key components like the contribution of capital accumulation or total factor productivity, we are required to make certain assumptions which cannot be supported with the statistical information currently available at a regional level. However, it is still possible to obtain certain quantitative approximation to the impact of immigration on productivity, if we adopt a similar methodological approach as the one developed by Jimeno (2005).

Any aggregated measure of work productivity can be expressed by the weighted average of the productivity of the different type of workers. In order to measure productivity, we need to classify the different type of workers in relation to their activity sector, the CCAA where they work, and their country of origin.

More specifically, for the economy of each CCAA and by classifying workers according to their nationalities, it is easy to obtain the productivity of natives - $pr_t^{N,s,CCAA}$ - for the sector *s* for the year *t* in each CCAA.

$$pr_t^{CCAA,s} = (1-\alpha_t^{CCAA,s})\,pr_t^{CCAA,N,s} + \alpha_t^{CCAA,s}(1-\delta^{CCAA,s})\,pr_t^{CCAA,N,s} = pr_t^{CCAA,N,s}(1-\alpha_t^{CCAA,s}\delta^{CCAA,s})$$

$$\Rightarrow pr_t^{CCAA,N,s} = \frac{pr_t^{CCAA,s}}{(1-\alpha_t^{CCAA,s}\delta^{CCAA,s})}$$

where $pr_t^{CCAA,s}$ is the productivity of the sector *s* in a CCAA, $\alpha_t^{CCAA,s}$ is the percentage of immigrants in the sector *s* during the period *t*, and $\delta^{CCAA,s}$ is the productivity differential between natives and immigrants in the sector *s* of a particular CCAA.

In sum, the aggregated productivity for a CCAA[7], pr_t^{CCAA} in the period *t* will be:

$$pr_t^{CCAA} = \sum_S \lambda_t^{CCAA,s} pr_t^{N,CCAA,s}\left(1-\alpha_t^{CCAA,s}\delta^{CCAA,s}\right)$$

where $\lambda_t^{CCAA,s}$ is the specific sector weight *s* in the total employment in such particular CCAA during the period *t*. (Data taken from the Labour Force Survey (EPA)). The difference in productivity between native and immigrant workers $\delta^{CCAA,s}$ is equated with the differences in wages between the median wages of natives and immigrants in each sector of the same CCAA[8].

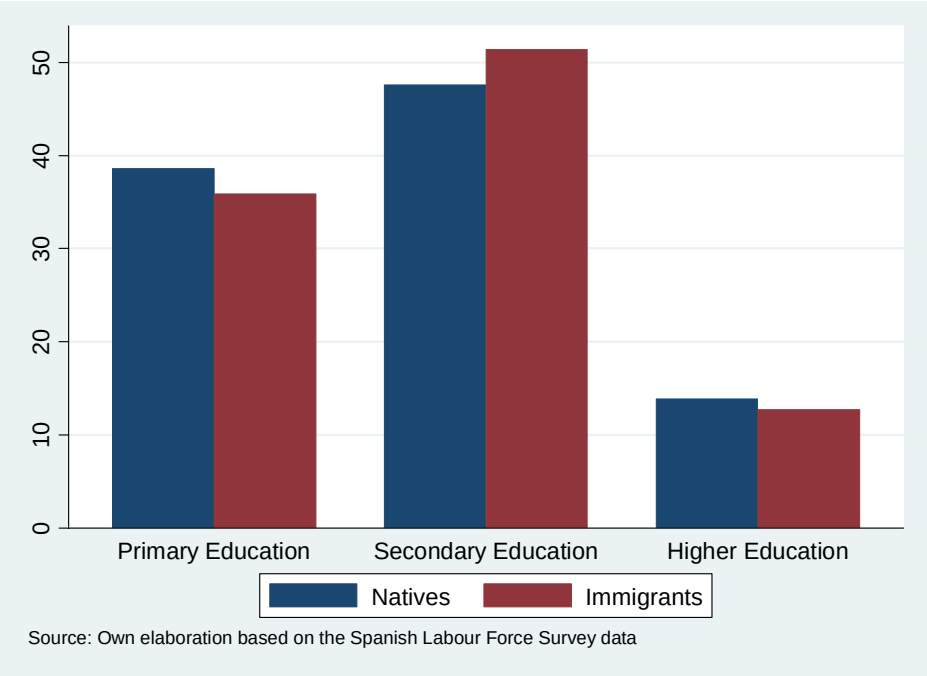
[7] To obtain the Total Added Value for a CCAA (while maintaining the accounting identity) we have assigned the Production Tax (*impuestos sobre la producción*) to each regional sector using the same sectorial distribution rule applied the whole economy in the year 2001 (last available data).

[8] As there are no data in relation to wages in the agricultural sector, we have used the median wage of natives and immigrants respectively and estimated for the economy as a whole.

To calculate the wage difference between natives and immigrants, we will use the Wage Structure Survey for the year 2002, which contains information about the wages for the native and immigrant population in each sector and for each region. Since this is the only wage data available at the moment, we have to assume it as invariable throughout the period under analysis. What we are going to presume here, in other words, is that the ratio between the wages of natives and immigrants appropriately reflects their differences in relation to productivity. In this respect, and using the same survey, Simón, Ramos and Sanromá (2007) have demonstrated that there is no wage discrimination between natives and immigrants[9].

To have sufficient data[10] for each sector and for each CCAA to calculate the differences in wages, we are going to aggregate the twenty five sectors of the market economy into five sectors (*s*= agriculture, energy, industry, construction and services). Finally, it is worth discussing briefly the human capital of the new immigrant workers. As can be seen in Graph 9, the human capital of immigrants (from outside the EU) is not significantly higher than the human capital of natives. While we are convinced that the distribution of human capital by nationalities would be a relevant factor to take into account in any comprehensive analysis of the productivity, the data available at the moment makes the inclusion of such variable next to impossible[11].

Graph 9. Educative structure of natives and non EU-25 immigrants



Source: Own elaboration based on the Spanish Labour Force Survey data

[9] However, if the reader considers that immigrants are discriminated and are receiving lower wages in relation to their marginal productivity, we will be in this case underestimating the impact of immigration on productivity. The analysis will give us the inferior threshold of the impact of immigration on the per capita income.

[10] The Wage Structure Survey (EES) does not provide enough data to estimate the wage differences between natives and immigrants in the 25 sectors for each CCAA. Regional Accounting provide information neither about Gross Added Value (VAB) nor the sectorial productivity at such detailed regional level.

[11] See appendix for the educational structure by CCAA.

Consequently, the productivity growth rate can be expressed as follows:

$$tv(pr^{CCAA}) = \frac{pr_t^{CCAA} - pr_{t-1}^{CCAA}}{pr_{t-1}^{CCAA}} =$$

Aportación Productividad Sectorial (a)

$$\frac{1}{pr_{t-1}^{CCAA}} \sum_s \lambda_t^{CCAA,s} \left(pr_t^{N,CCAA,s} - pr_{t-1}^{N,CCAA,s} \right) \left(1 - \alpha_{t-1}^{CCAA,s} \delta^{CCAA,s} \right) +$$

Aportación Composición Sectorial (b)

$$+ \frac{1}{pr_{t-1}^{CCAA}} \sum_s \left(\lambda_t^{CCAA,s} - \lambda_{t-1}^{CCAA,s} \right) pr_{t-1}^{N,CCAA,s} \left(1 - \alpha_{t-1}^{CCAA,s} \delta^{CCAA,s} \right) +$$

Aportación Inmigración (c)

$$\frac{1}{pr_{t-1}^{CCAA}} \sum_s \lambda_t^{CCAA,s} pr_t^{N,CCAA,s} \left(\alpha_{t-1}^{CCAA,s} - \alpha_t^{CCAA,s} \right) \delta^{CCAA,s}$$

With the methodology employed in this analysis, as we can see from the previous equation, it is possible to detect variations in productivity. This is the case, even when there are no changes in the individual productivity of each different group of workers, and the only variations taken place are in terms of employment, sectorial composition, or nationalities. As a result we can now identify the three factors which determine the productivity growth in each CCAA:

The first factor is the *Sectorial Productivity Contribution* (a) and measures the impact of the changes in the sectorial productivity of natives - $pr^{N,s,CCAA}$ - (i.e. what would have been the productivity growth rate if there had not been any changes in the job composition by sector - $\lambda^{CCAA,s}$- and the weight of immigrants in each sector - $\alpha^{CCAA,s}$- and only the native job composition by sector would have experienced any change);

The second factor is the *Sectorial Composition Contribution* (b) and measures the effect of changes in the weight of each different sector or the sectorial composition of the employment (i.e. what would have been the productivity growth rate if the sectorial composition of the employment had remained unchanged and only the weight of immigrants in each sector would have been experienced any change);

The third factor we have called the *immigrant contribution* (c) and measures the effect of the variations in the employment composition by nationalities (i.e. what would have been the productivity growth rate if the sectorial composition of the employment and the productivity of natives in each sector had remained the same and only the relevance of immigrants in each sector would have experienced any change).

Here it is important to note that, because we presume that only the third factor measures the impact of immigration on productivity, we also have to presume that any variations in productivity resulting from changes in the productive pattern or the development of productivity by natives would have taken place independently without the arrival of immigrants.

In all the CCAA, as Table 4 shows, there has been an increase in the sectorial productivity of natives[12] (except La Rioja and Islas Baleares), although there are still

[12] See Appendix for details by sector and by CCAA.

important differences between them. The productivity increase has been greater in the following regions: Aragon, Castilla y León, Extremadura, Navarra and País Vasco. Much lower increases on the native sectorial productivity are found in the following regions: Canarias, Cantabria, Castilla la Mancha, Valencia and Murcia.

Table 4. Productivity Breakdown: Native Sectorial Productivity, Sectorial Composition and Employment Composition

	tv(Pr)	Sectorial Productivity Changes	Sectorial Composition Changes	Employment Composition Changes
Andalucía	-0,21	0,34	-0,24	-0,25
Aragón	1,60	2,38	0,29	-0,99
Asturias	0,97	1,25	-0,07	-0,17
Islas Baleares	-0,85	-0,01	-0,06	-0,52
Canarias	0,17	0,37	0,36	-0,32
Cantabria	0,25	0,70	-0,15	-0,26
Castilla y León	1,64	2,24	-0,20	-0,38
Castilla La Mancha	0,40	0,75	-0,16	-0,39
Cataluña	0,91	1,79	-0,11	-0,67
C. Valenciana	-0,08	0,37	0,23	-0,57
Extremadura	1,91	2,38	-0,31	-0,20
Galicia	1,99	1,32	0,87	-0,07
Madrid	-0,22	1,63	-0,34	-1,32
Región de Murcia	0,13	0,69	0,03	-0,57
Navarra	1,73	2,02	0,44	-0,63
País Vasco	1,80	2,24	-0,02	-0,20
La Rioja	-0,69	-0,28	-0,03	-0,48
Total	0,52	1,22	-0,09	-0,51

Source: Spanish Labour Force Survey (INE)

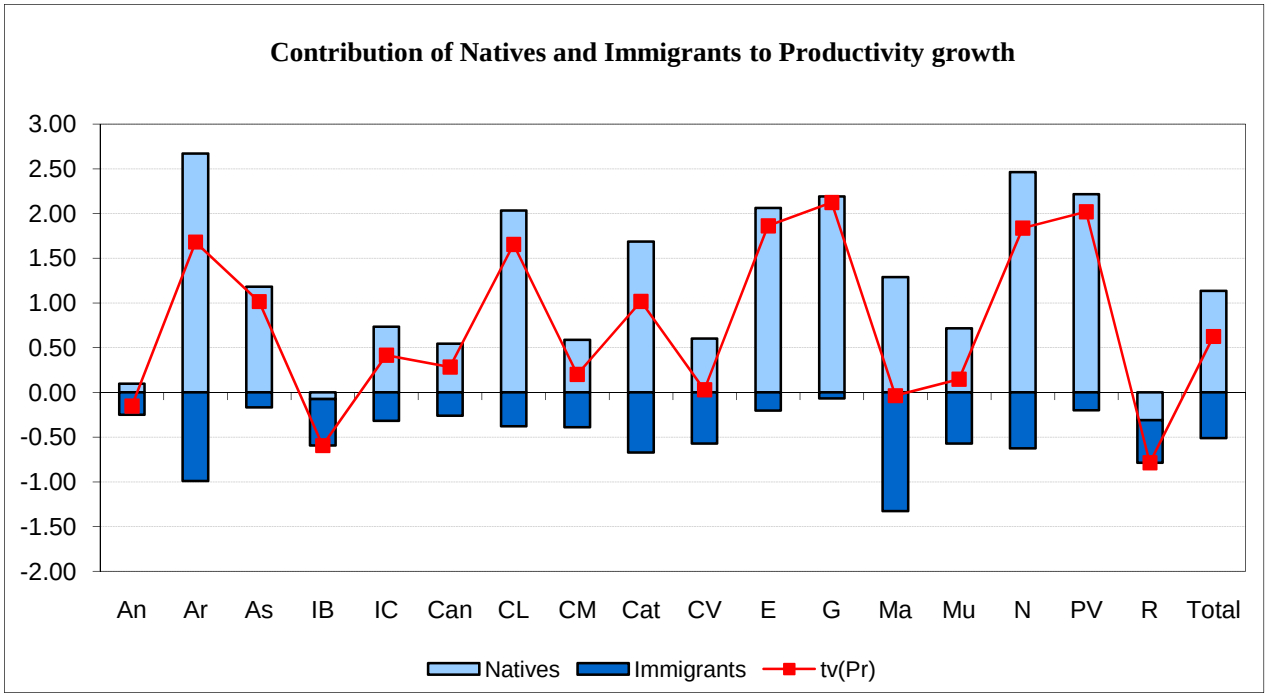
The impact of the sectorial composition on the productivity growth is not particularly significant, although it differs from one region to another. It is interesting to note that in Aragon, Canarias, Valencia, Galicia and Navarra, the more productive sectors have increased their share in the regional economies. By contrast, the productive pattern in regions like Madrid, Extremadura, Cantabria, Valencia, Castilla la Mancha, and Castilla y Leon have shifted towards less productive sectors.

Finally, when we examine the effects of the variations in the employment composition by nationalities, we can see that it has a negative impact on productivity in all CCAA. The greater number of immigrants in a region, the greater the negative impact they have on the productivity of that particular region.

Figure 4 shows the productivity growth breakdown between natives and immigrants.

Figure 4. Productivity growth breakdown

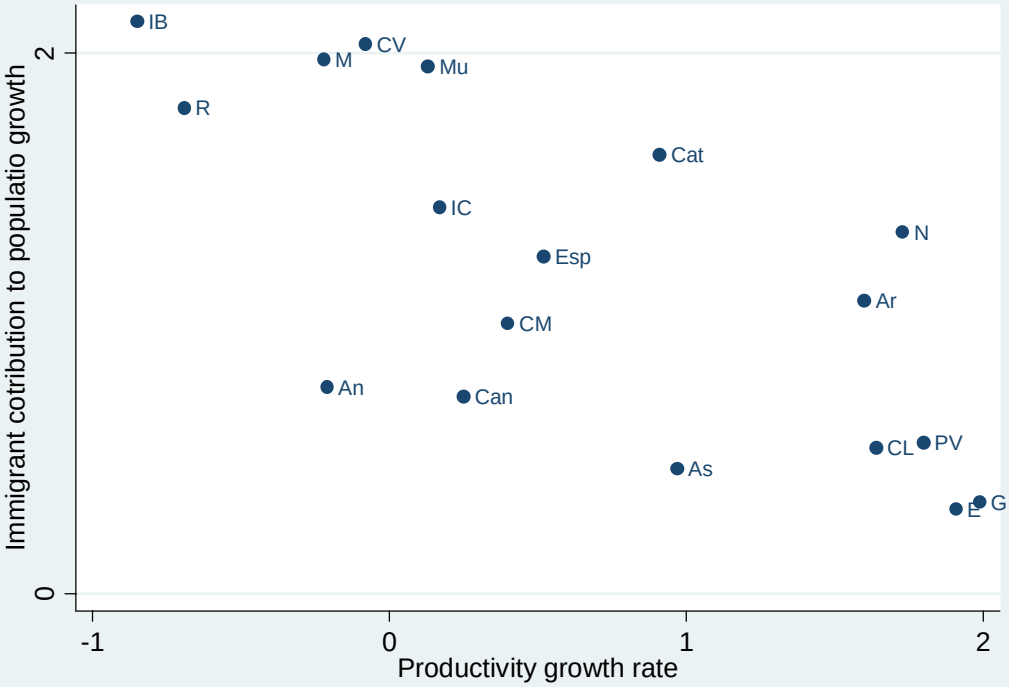
	Total	Natives	Immigrants
Andalucía	-0.15	0.10	-0.25
Aragón	1.68	2.67	-0.99
Asturias	1.02	1.18	-0.17
Islas Baleares	-0.59	-0.07	-0.52
Canarias	0.42	0.73	-0.32
Cantabria	0.29	0.55	-0.26
Castilla y León	1.66	2.03	-0.38
Castilla La Mancha	0.20	0.59	-0.39
Cataluña	1.02	1.69	-0.67
C. Valenciana	0.03	0.60	-0.57
Extremadura	1.86	2.06	-0.20
Galicia	2.12	2.19	-0.07
Madrid	-0.04	1.29	-1.32
Región de Murcia	0.15	0.72	-0.57
Navarra	1.84	2.46	-0.63
País Vasco	2.02	2.22	-0.20
La Rioja	-0.79	-0.31	-0.48
Total	0.63	1.14	-0.51



Source: Own elaboration

Ceteris paribus, had there been no influx of immigrants, the per capita income would have increased 0.51 at a national level for the period 2000-2006 due to their negative impact on productivity. Finally as we can see in the graph below, the greater influx of immigrants in a region, the lower the productivity growth in that particular region

Graph 10. Relationship between the immigrant contribution to population growth and the productivity growth rate



Source: Own elaboration based on the Regional Accounting and Spanish Labour Force Survey data

3. Main Results

3.1. Direct effect of immigration on per capita income

Here we examine the co-ordinated effect of the three factors determining per capita income analysed in the previous section. If we aggregate their effects, we see that immigration for the whole country has a positive net impact on the per capita income of 0.05 points measured as an annual average for the period 2000-2006. There are, however, significant differences at regional level as we can see below in Table 5.

Table 5. Immigrant contribution to the per capita income growth by CCAA

	GDP_{pc}	Immigration			
		Total	Demographic	Employment	Productivity
Andalucía	2,40	0,30	0,25	0,30	-0,25
Aragón	2,36	-0,56	0,37	0,06	-0,99
Asturias	2,92	0,08	0,13	0,12	-0,17
Islas Baleares	-0,71	-0,23	0,40	-0,11	-0,52
Canarias	0,93	0,45	0,40	0,37	-0,32
Cantabria	2,53	0,06	0,22	0,10	-0,26
Castilla y León	3,03	-0,06	0,18	0,14	-0,38
Castilla La Mancha	1,87	0,18	0,40	0,17	-0,39
Cataluña	1,26	-0,17	0,49	0,01	-0,67
C. Valenciana	0,78	-0,02	0,40	0,15	-0,57
Extremadura	3,28	-0,06	0,11	0,03	-0,20
Galicia	2,90	0,07	0,12	0,02	-0,07
Madrid	1,17	-0,40	0,52	0,40	-1,32
Región de Murcia	1,25	0,15	0,46	0,26	-0,57
Navarra	1,91	-0,18	0,38	0,07	-0,63
País Vasco	2,71	-0,05	0,12	0,03	-0,20
La Rioja	0,83	0,20	0,49	0,19	-0,48
Total	1,78	0,05	0,35	0,21	-0,51

Source: Own elaboration

On the one hand, we have regions like La Rioja (0.2), Murcia (0.15), Castilla la Mancha (0.18), Canarias (0.45) and Andalucía (0.3) where the overall impact of immigration in the per capita income growth rate has been very positive. On the other hand, this impact has been negative in other regions like Madrid (-0.4), Navarra (-0.18), Cataluña (-0.17), Baleares (-0.23) or Aragon (-0.56). The impact for the rest of CCAA can be considered to have been neutral.

As we can see in Table 6, the results for the country as a whole are slightly lower than the ones obtained by the Economic Bureau of the President (OEP) and the Spanish Central Bank: both institutions found in their respective analysis a positive impact of +0.4 decimal points per year.

Table 6. The impact of immigration on the per capita income: different studies

	GDP_{pc}	Immigration			
		Total	Demographic	Employment	Productivity
OEP (2006): 2001-2005	1,6	0,40	0,4	0,2	-0,2
Banco de España (2006): 2000-2005	1,70	0,40	0,31	0,27	-0,18
Conde-Ruiz *et al* (2008): 2000-2006	1,78	0,05	0,35	0,21	-0,51

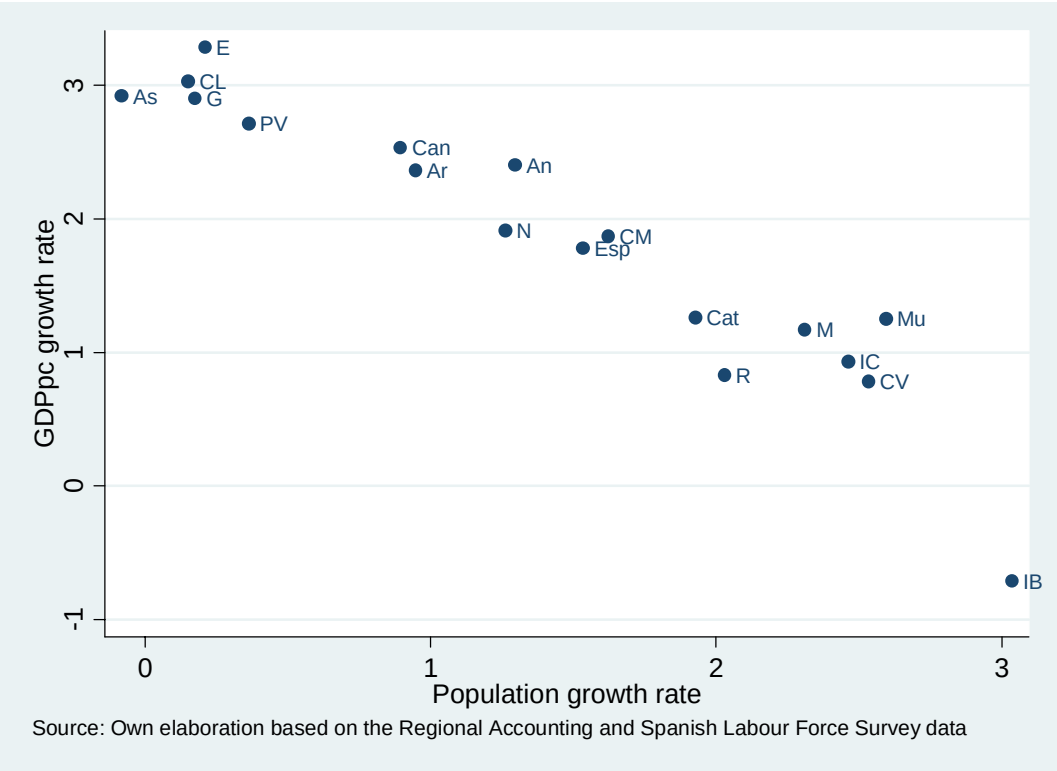
Source: Own elaboration

The differing results between these studies can be attributed to differences in the period under examination (our analysis includes a longer period) and the methodology employed to calculate the impact on productivity. The estimation of the OEP study (2006) is based on a production function; consequently, it is not an accounting exercise of the type presented here. While the study from the Spanish Central Bank (2006) employs a similar methodology than the one used here, when it comes calculate productivity it only uses the aggregated value of the market economy, which is then

extrapolated to the economy as a whole in a lineal form. Even if it is possible to distinguish the aggregated values of the market and the non-market (i.e. public services, taxes and transfers) economies, this methodology does not allow to do the same regarding workers (i.e. the statistical information available only distinguishes between public servants and non-public servants, but not between workers in the non market economy (which includes a public-funded services) and workers in the market economy. In our study, as we have mentioned before, we have used the total added value (VA) in order to assess impact on productivity in each region.

The Graph 11 shows the relationship between the GDPpc and population growth rates. As we can see, in the regions were the population growth has been greater, there has been corresponding decrease in the per capita income. More specifically, the elasticity between the population and the per capita GDP growth rates is –0.81. What this means is that, if the population growth rate increases one point, then the per capita income growth rate decreases 0.81 points.

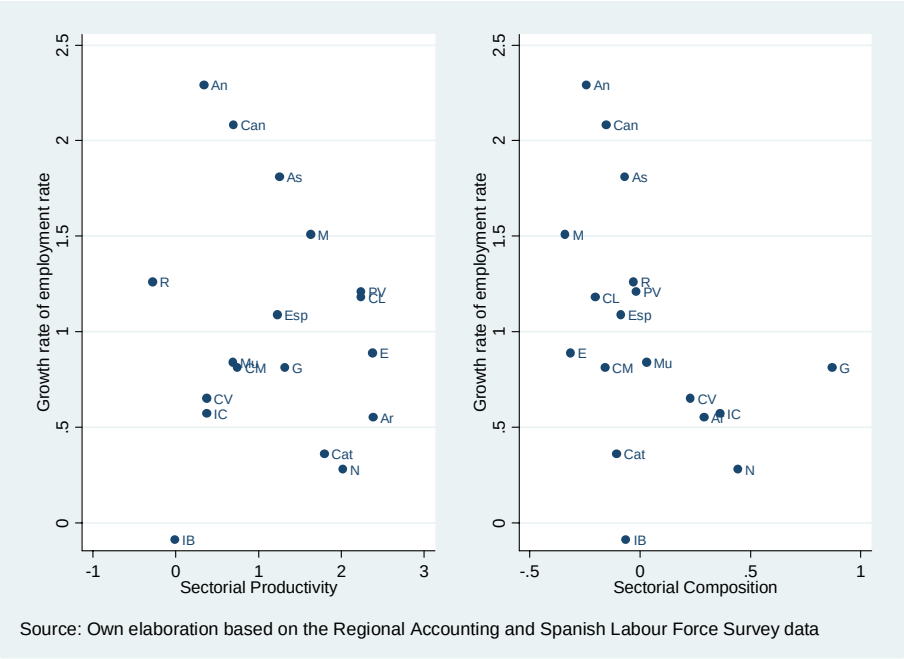
Graph 11. Relationship between the per capita income and population growth rates (in average rate for the period 2000-2006)



Source: Own elaboration based on the Regional Accounting and Spanish Labour Force Survey data

The accounting explanation for this relationship is as follows: where the increase in the employment rate (specially among immigrants and women) has been greater, the productivity growth has been lower. Furthermore, as we can see in Graph 12, where there is a significant rise in employment, there is a lower growth in the productivity components which have been assigned to natives in our accounting breakdown (the sectorial composition and the sectorial productivity of natives effects are both more negative).

Graph 12. Relationship between growth rate of the employment rate and the productivity growth rate: sectorial composition effect and sectorial productivity effect (annual average rate for the period)



Source: Own elaboration based on the Regional Accounting and Spanish Labour Force Survey data

The economic explanation (or causal explanation for this relationship) is more difficult to determine. We have two plausible hypothesis here: *i*) with the influx of immigrants in an area, the labour costs are reduced, the economy turns to be more intensive in its labour factor and, as a result, there is fall on productivity; or *ii*) in regions where there is technological innovation to increase productivity, there is less demand for immigrants as they do not usually have the appropriate human capital.

3.2. The direct impact of immigration on the GDP.

Table 7 shows the contribution of immigration to the regional GDP growth. This contribution was positive in all CCAA. To estimate such contribution, we have to add to the relatively modest impact of immigration on the per capita income the effect of immigration on the population growth in each region.

For the period 2000-2006 and at a national level, we can attribute to immigrants an average annual GDP growth of 38%. By CCAA, the greatest impact on the regional GDP is found in Baleares (82.08%), La Rioja (69.61%), Comunidad Valenciana (60.41%), Canarias (55.21%), Murcia (54.18) Cataluña (45,24%) and Madrid (44.80%).

In relation to these figures, it is interesting to note that, in those regions where the increase in productivity has been greater, the employment has increased at a lower rate. This relationship is shown below in Graph 13. More specifically, we have estimated that the replacement elasticity between the employment and the productivity growth rates is –0.68.

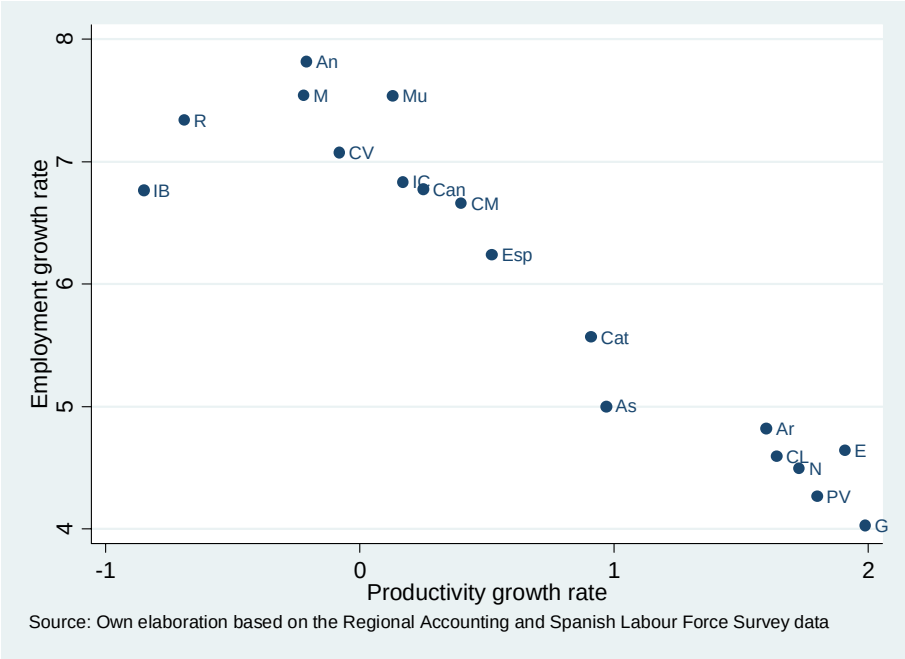
Table 7. Contribution of immigrant influx to the growth of Spanish economy (GDP)

2000-2006	GDP	Immigration		
		Total	Per capita Income	Population
Andalucía	3,72	1,07 (28,68%)	0,30	0,77
Aragón	3,33	0,52 (15,71%)	-0,56	1,08
Asturias	2,83	0,54 (19,23%)	0,08	0,46
Islas Baleares	2,30	1,89 (82,08%)	-0,23	2,12
Canarias	3,41	1,88 (55,21%)	0,45	1,43
Cantabria	3,44	0,79 (22,91%)	0,06	0,73
Castilla y León	3,18	0,48 (15,14%)	-0,06	0,54
Castilla La Mancha	3,52	1,18 (33,55%)	0,18	1,00
Cataluña	3,21	1,45 (45,24%)	-0,17	1,62
C. Valenciana	3,33	2,01(60,41%)	-0,02	2,03
Extremadura	3,50	0,25 (7,17%)	-0,06	0,31
Galicia	3,08	0,41 (13,39%)	0,07	0,34
Madrid	3,51	1,57 (44,80%)	-0,40	1,98
Región de Murcia	3,88	2,10 (54,18%)	0,15	1,95
Navarra	3,20	1,16 (36,30%)	-0,18	1,34
País Vasco	3,08	0,51 (16,54%)	-0,05	0,56
La Rioja	2,87	2,00 (69,61%)	0,20	1,80
Total	3,34	1,30 (38,87%)	0,05	1,25

Source: Own elaboration

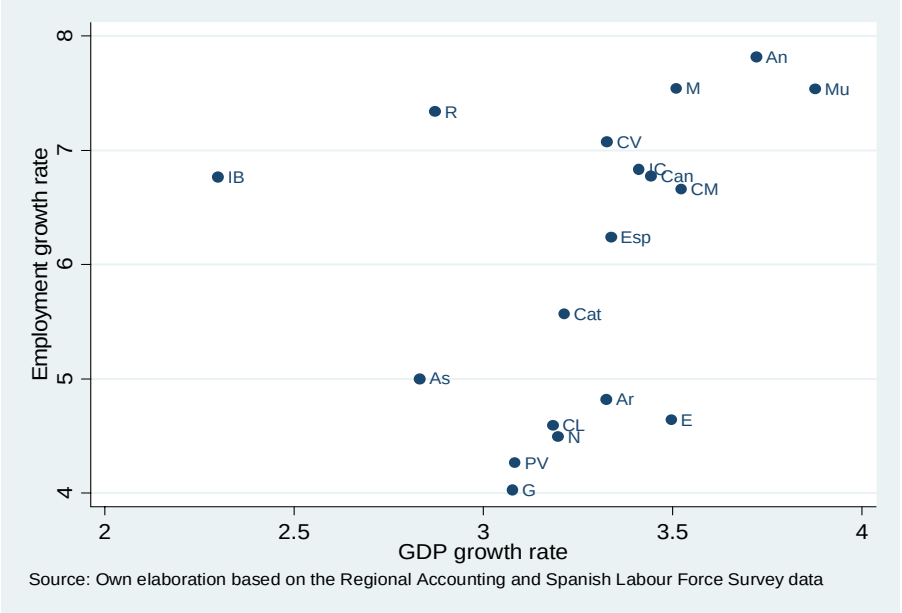
What we find here is that, although there are several regions with relatively similar average GDP growth rates, their growth composition is quite different between each other (see Graph 14). As a result, we have, on the one hand, regions like Murcia, Andalucía, Comunidad Valenciana, Canarias, Madrid where growth can largely be attributed to employment growth and, on the other, regions like País Vasco, Galicia, Extremadura, Navarra or Castilla la Mancha where increases on productivity are the main growth factor.

Graph 13. Relationship between the productivity and the employment growth rates (annual average for the period)



Source: Own elaboration based on the Regional Accounting and Spanish Labour Force Survey data

Graph 14. Relationship between the employment and GDP growth rates (annual average for the period)



Source: Own elaboration based on the Regional Accounting and Spanish Labour Force Survey data

4. Conclusions

In this paper we have examined the direct (i.e. no causal) impact of immigration on regional growth during the period 2000-2006. This period has been characterised by large influx of immigrants arriving to Spain. To assess the impact of immigration, we have done an exercise of accounting nature consisting on the breakdown of the per capita income in its three determining factors, namely, demographic factor, employment rate, and productivity.

The fact that immigration has not been uniformly distributed throughout the national territory has made possible to obtain the following results.

In the first place, the impact of immigration on the demographic factor (percentage of working age population) has been largely positive as most immigrants arriving at the country are of working age. Secondly, the impact of immigration on the employment rate is also positive because the immigration has been mainly labour-oriented. In fact, almost half of all the employment generated in the period has been occupied by immigrants. Regionally, we see how the greater influx of immigrants in a region has resulted in an increase in the employment rates for natives, especially in relation to women participation in the labour market. Thirdly, the impact of immigration on productivity has been negative. By regions it is clear that an increase in the number of immigrants has resulted in a lower productivity growth.

Finally, in quantitative terms, the net impact of immigration on the per capita income for the country as a whole has been neutral, with 0.05 points of annual average. At a regional, however, the differences are more significant. On the one hand, we have regions like La Rioja, Murcia, Castilla la Mancha, Canarias and Andalucía where the overall impact of immigration on the per capita income growth rate has been quite positive. On the other, in regions like Madrid, Navarra, Cataluña, Baleares and Aragon, the balance has been negative. The impact of immigration on the GDP has been more positive. At a national level, we can attribute more than a 38% of the average annual GDP growth directly to immigrants. The impact of immigration at regional level has been similarly positive in all CCAA.

In summary, then, we have found in this study that in the regions where there has been a greater increase in the employment rate (due mainly to the influx of immigrants and the incorporation of women into the labour market) are precisely those in which there has been a lower increase in productivity. The aim of this analysis, however, was not to give an economic explanation for this phenomenon. It may well be the case that those regions where immigrants are arriving in greater numbers the cost of labour is falling, so the economy becomes more labour intensive and therefore productivity declines. Alternatively, it can be that the regions where technological changes to increase productivity have taken place do not have such demand for immigrants due to their lack of appropriate human capital.

We are convinced, however, that the results of this paper offer a good starting point for a more detailed discussion about the impact of immigration on the Spanish economy. To do so, we will have to leave aside the accounting methodology and create an economic model coherent with the empirical evidence presented here to allow us to detect the key causal effects through which immigration interacts with the economy. If we take as starting point, for example, the classic model presented by Borjas (1996), the influx of immigrants would stimulate medium term investment. The observed decrease in productivity is only a short term effect resulting from the diminution of the labour capital ratio. In the medium term, however, the increase in capital profitability would result in more investment in productive capital, with its long-term positive effect on productivity. Alternatively, there are other growth models, like the one developed by Boldrin and Levine (2007), which shows how the influx of immigrants slows down medium term capital investment. The argument here is that the steady influx of immigrants reduces the low skilled labour costs and, therefore, reduces the incentives for investment in technology. Although both models are consistent with the empirical

evidence of this work, there is no doubt that the political implication of either model are quite different. We hope that in the near future new academic works would be able to clarify which one of these alternative models more accurately reflects the socio-economic realities of Spain.

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A1. Technical Appendix.

The aim of this section is to describe in detail the methodology employed to estimate the immigrant contribution to the per capita GDP growth in each CCAA for the last six years.[13]

Per capita GDP breakdown

The following accounting identity allows us to break down the per capita GDP (both at regional and national level) as the product of three factors: *i)* productivity –*Pr*- (i.e. production per employment unit); *ii)* employment rate –*ER*-(i.e. the ratio between employed population and the working age population from 16 to 64 years old); *iii)* the demographic factor -*DF*- (i.e. the ratio between the working age and the total population):

$$\underbrace{\frac{GDP}{Pop}}_{\text{Per capita GDP}} = \underbrace{\frac{GDP}{L}}_{\text{Productivity (Pr)}} \quad \underbrace{\frac{L}{Pop^{16-64}}}_{\text{Employment Rate (ER)}} \quad \underbrace{\frac{Pop^{16-64}}{Pop}}_{\text{Demographic Factor (DF)}}$$

We have used the following data: *i)* for the GDP of each CCAA we use the Regional Accounting (*Indice de volumen encadenado*) data information and the total population for each CCAA as it appears in the Labour Force Survey (EPA); *ii)* for demographic and labour data we have mainly used the Labour Force Survey (EPA).

GDPpc growth breakdown by CCAA

Likewise, the growth rate of the per capita GDP in each CCAA can be broken down as:

$$tv(GDPpc) = (1 + tv(DF))(1 + tv(ER))(1 + tv(\text{Pr})) - 1$$

where *tv* is the growth rate for the period. For the case of *n* periods, we will use the average growth rate defined as:

$$\overline{tv}(GDPpc) = \frac{(GDPpc_{t+n} / GDPpc_t) - 1}{n}$$

Each growth rate (either for the GDPpc per CCAA, the DF, the ER, or the productivity) can accordingly be broken down as the contribution of natives and the contribution of immigrants.

Demographic factor. We know that $tv(DF) = tv(Pop_{16-64} / Pop)$: variation of working age population *versus* variation of total population (both natives and immigrants). That is:

$$tv(DF) = \frac{DF_t - DF_{t-1}}{DF_{t-1}} = \frac{\frac{Pop_t^{16-64}}{Pop_t} - \frac{Pop_{t-1}^{16-64}}{Pop_{t-1}}}{\frac{Pop_{t-1}^{16-64}}{Pop_{t-1}}} = \frac{Pop_{t-1}}{Pop_t}\frac{Pop_t^{16-64}}{Pop_{t-1}^{16-64}} - 1 = \frac{tv(Pop^{16-64}) - tv(Pop)}{1 + tv(Pop)}$$

[13] The National Accounting changed its methodology few years ago. Although the GDP series has been reconstructed at a national level for the years prior to 1995, that has not been the case with the regional GDP. We only have data for regional GDP for the year 2000 onwards.

Furthermore, we also know that each variable is the addition of immigrants and natives, $Pop = Pop^I + Pop^N$ and $Pop^{16-64} = Pop^{16-64,I} + Pop^{16-64,N}$, and for this we will accordingly have:

$$tv(Pop^I + Pop^N) = \frac{Pop_t^I + Pop_t^N - Pop_{t-1}^I - Pop_{t-1}^N}{Pop_{t-1}} =$$

$$\frac{(Pop_t^I - Pop_{t-1}^I)}{Pop_{t-1}^I}\frac{Pop_{t-1}^I}{Pop_{t-1}} + \frac{(Pop_t^N - Pop_{t-1}^N)}{Pop_{t-1}^N}\frac{Pop_{t-1}^N}{Pop_{t-1}} = tv(Pop^I)\frac{Pop_{t-1}^I}{Pop_{t-1}} + tv(Pop^N)\frac{Pop_{t-1}^N}{Pop_{t-1}}$$

likewise, $tv(Pop^{16-64,I} + Pop^{16-64,N}) = tv(Pop^{16-64,I})\frac{Pop_{t-1}^{16-64,I}}{Pop_{t-1}^{16-64}} + tv(Pop^{16-64,N})\frac{Pop_{t-1}^{16-64,N}}{Pop_{t-1}^{16-64}}$

Finally, we are already in a position to estimate the contribution of immigrants and natives:

$$tv(DF) = \frac{tv(Pop^{16-64}) - tv(Pop)}{1 + tv(Pop)} =$$

$$= \frac{tv(Pop^{16-64,I})\frac{Pop_{t-1}^{16-64,I}}{Pop_{t-1}^{16-64}} + tv(Pop^{16-64,N})\frac{Pop_{t-1}^{16-64,N}}{Pop_{t-1}^{16-64}}}{1 + tv(Pop)} - \frac{tv(Pop^I)\frac{Pop_{t-1}^I}{Pop_{t-1}} + tv(Pop^N)\frac{Pop_{t-1}^N}{Pop_{t-1}}}{1 + tv(Pop)} =$$

$$= \underbrace{\frac{tv(Pop^{16-64,I})\frac{Pop_{t-1}^{16-64,I}}{Pop_{t-1}^{16-64}} - tv(Pop^I)\frac{Pop_{t-1}^I}{Pop_{t-1}}}{1 + tv(Pop)}}_{\text{Contribution of Immigrants to the DF, ContrI(DF)}} + \underbrace{\frac{tv(Pop^{16-64,N})\frac{Pop_{t-1}^{16-64,N}}{Pop_{t-1}^{16-64}} - tv(Pop^N)\frac{Pop_{t-1}^N}{Pop_{t-1}}}{1 + tv(Pop)}}_{\text{Contribution of Natives to the DF, ContrN(DF)}}$$

Employment rate. Following identical procedures we can also do the employment rate breakdown. The contribution of the native and immigrant population to the employment growth rate is:

$$tv(ER) = \frac{tv(L) - tv(Pop^{16-64})}{1 + tv(Pop^{16-64})} =$$

$$= \underbrace{\frac{tv(L^I)\frac{L_{t-1}^I}{L_{t-1}} - tv(Pop^{16-64,I})\frac{Pop_{t-1}^{16-64,I}}{Pop_{t-1}^{16-64}}}{1 + tv(Pop^{16-64})}}_{\text{Contribution of Immigrants to the ER, ContrI(ER)}} + \underbrace{\frac{tv(L^N)\frac{L_{t-1}^N}{L_{t-1}} - tv(Pop^{16-64,N})\frac{Pop_{t-1}^{16-64,N}}{Pop_{t-1}^{16-64}}}{1 + tv(Pop^{16-64})}}_{\text{Contribution of Natives to the ER, ContrN(ER)}}$$

Productivity. The relevant variables to estimate the impact of immigration on productivity are the following ones:

Development of sectorial weight on the employment in each CCAA, $\lambda^{CCAA,s}$. As we can see in the table below, employment in Agriculture and Industry has lost weight in all CCAA. Construction and Services, by contrast, have gained importance in all CCAA in terms of employment.

Table A1. Changes in the sectorial weight on the employment by CCAA ($\lambda^{CCAA,s}$) Accumulated for the period 2000-2006

2000-2006	Agriculture	Energy	Industry	Construction	Services
Andalucía	-25.51	-22.58	-18.74	24.32	3.45
Aragón	-11.22	24.29	-23.42	6.80	10.64
Asturias	-38.57	-34.93	-7.74	3.81	10.05
Islas Baleares	-14.03	-18.87	-19.18	-2.61	3.69
Canarias	-45.73	9.63	-8.96	4.87	3.63
Cantabria	-43.93	-30.61	-17.84	13.36	9.55
Castilla y León	-19.27	-11.36	-8.97	8.75	4.59
Castilla La Mancha	-32.64	10.36	-2.76	11.30	4.17
Cataluña	-2.91	-2.00	-17.25	23.00	4.17
C. Valenciana	-41.99	20.51	-13.19	24.14	3.93
Extremadura	-14.96	-47.15	16.30	-2.19	3.67
Galicia	-44.60	-0.52	3.31	0.95	13.21
Madrid	43.88	-20.30	-29.65	17.99	3.72
Región de Murcia	-24.26	9.05	-11.93	43.33	-0.06
Navarra	-30.75	43.61	-18.20	14.78	11.07
País Vasco	-4.83	6.00	-15.85	-4.56	8.14
La Rioja	-29.90	-13.92	-15.24	-3.55	17.21
Total	-27.97	-10.93	-16.48	15.80	5.32

Source: Own elaboration

Development of sectorial productivity in each CCAA, $pr_t^{CCAA,s}$. As we can see in the table below, the sector which has experienced the lowest increase in productivity is agriculture, while the energy sector shows the higher increase.

Table A2. Productivity Growth for each sector by CCAA

2000-2006	Agriculture	Energy	Industry	Construction	Services
Andalucía	-13.89	46.73	11.89	-9.98	0.50
Aragón	-18.93	19.69	41.73	20.88	6.48
Asturias	14.02	53.53	9.34	9.48	1.14
Islas Baleares	-36.34	49.64	17.51	2.57	-4.20
Canarias	8.01	10.64	7.33	2.39	0.92
Cantabria	5.05	50.95	17.71	-6.04	-0.95
Castilla y León	-6.22	35.16	15.35	10.90	13.02
Castilla La Mancha	5.95	-15.35	7.12	3.40	7.36
Cataluña	-28.64	29.28	17.34	-3.71	9.92
C. Valenciana	14.02	-6.09	2.30	-12.95	5.46
Extremadura	-11.20	133.96	-8.00	25.79	14.44
Galicia	41.17	13.43	3.97	12.42	5.15
Madrid	190.15	42.34	33.37	-0.21	5.70
Región de Murcia	-9.56	2.51	11.66	-23.64	9.52
Navarra	8.11	-12.28	32.33	6.19	7.35
País Vasco	-32.26	15.36	26.79	24.66	7.51
La Rioja	-9.42	31.40	7.39	14.20	-8.85
Total	-7.68	22.25	13.19	-4.24	2.20

Source: Own elaboration

Variation in the percentage of immigrants in each sector by CCAA, $\alpha_t^{CCAA,s}$. Apart from the energy sector, immigrants have gained weight in all other productive sectors as can be seen in the table below.

Table A3. Variation in the immigrant weight in each sector by CCAA. $(\alpha_t^{CCAA,S})$ **Accumulated for the period 2000-2006**

2000-2006	Agriculture	Energy	Industry	Construction	Services
Andalucía	8.60	0	6.98	14.98	1.78
Aragón	1.63	0	2.95	5.06	2.25
Asturias	14.84	0	8.42	26.42	12.27
Islas Baleares	0.13	0	1.15	2.64	1.21
Canarias	3.82	0	5.8	2.29	2.21
Cantabria	0	0	6.29	0	0
Castilla y León	4.08	1.17	8.03	6.57	3.72
Castilla La Mancha	8.43	0	8.56	6.57	4.26
Cataluña	2.45	0	2.62	3.96	2.16
C. Valenciana	2.87	0	11.86	7.09	3.43
Extremadura	42.58	0	2.32	2.19	12.3
Galicia	4.76	-1.00	1.07	9.61	2.44
Madrid	0	2.13	3.62	5.66	2.9
Región de Murcia	1.14	0	4.37	8.1	4.42
Navarra	0	0	9.49	16.31	10.02
País Vasco	7.19	0	1.75	7.46	4.24
La Rioja	2.73	0	4.06	3.35	7.89
Total	3.35	6.98	3.76	5.61	2.62

Source: Own elaboration

Analysis of the wage differential between the median wages for natives and immigrants in each sector of the same CCAA ($\delta^{CCAA,s}$).

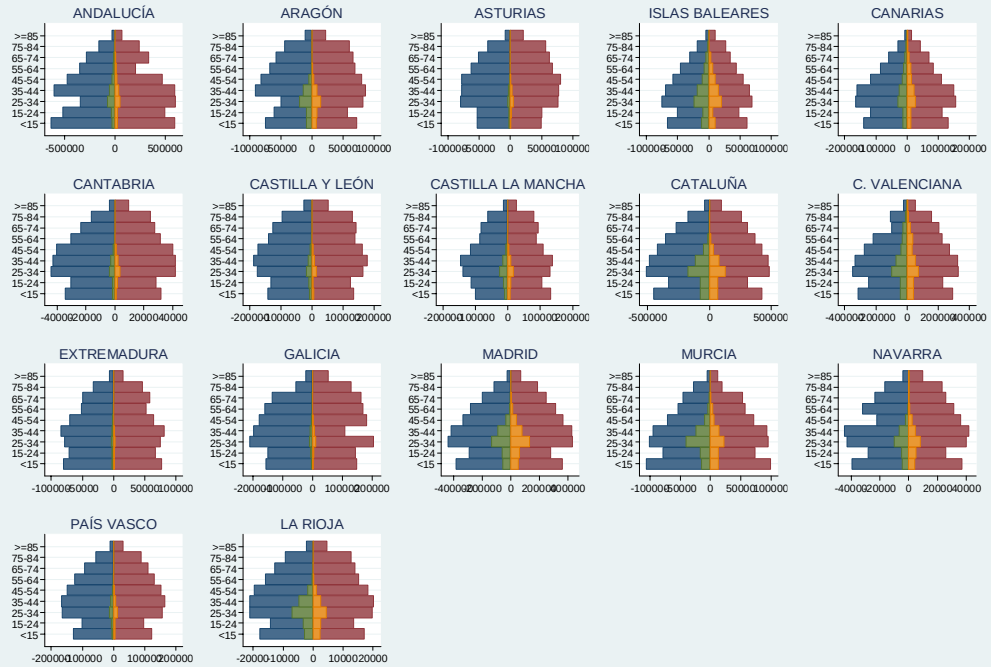
Table A4. Wage differences between median wages for natives and immigrants in each sector of the same CCAA ($\omega_{Natives}^{CCAA,s} / \omega_{\mathrm{Im}migrants}^{CCAA,s} - 1$ **)**

	Agriculture	Energy	Industry	Construction	Services
Andalucía	17.20	108.47	15.11	7.78	26.77
Aragón	32.31	178.53	37.16	24.32	40.67
Asturias	11.09	61.53	6.34	8.33	24.46
Islas Baleares	26.92	164.16	16.03	21.58	24.71
Canarias	9.15	123.39	13.19	5.48	11.39
Cantabria	24.38	87.87	20.98	3.54	39.92
Castilla y León	19.20	161.00	19.30	4.91	44.00
Castilla La Mancha	29.47	115.72	51.90	15.50	20.17
Cataluña	30.37	89.15	36.92	15.98	29.92
C. Valenciana	23.75	54.20	15.97	13.12	31.37
Extremadura	25.38	63.55	2.52	2.01	43.03
Galicia	18.36	32.63	19.55	11.95	18.09
Madrid	54.06	112.70	61.58	29.97	59.52
Región de Murcia	15.88	115.48	26.25	4.64	33.42
Navarra	35.93	72.70	44.40	21.54	36.41
País Vasco	29.70	130.76	22.13	16.19	33.91
La Rioja	18.99	117.91	26.37	5.03	32.23
Total	30.25	98.53	32.44	12.12	33.59

Source: Wage Structure Survey EES 2002 and own elaboration

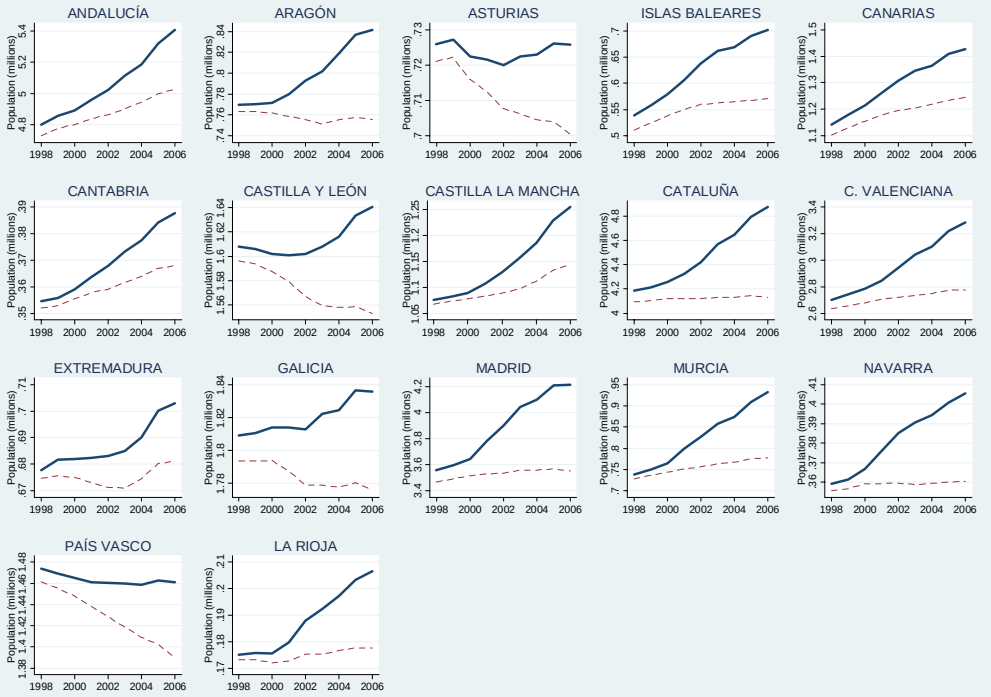
A2. Graphs Appendix

Graph A1. Population pyramids for each CCAA



Source: INE

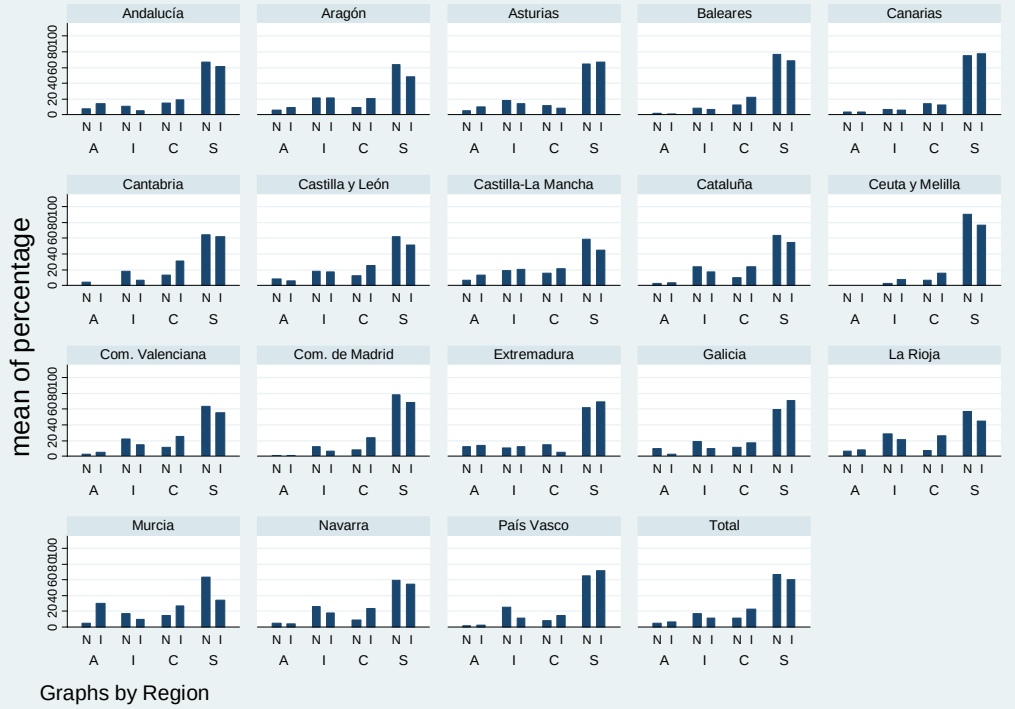
Graph A2. Development of working age population by CCAA (natives *vs* immigrants)



Graph A3. Educational structure of natives and non EU-25 immigrants by CCAA

Source: Own elaboration based on the Spanish Labour Force Survey data

Graph A4. Sectorial distribution by CCAA (natives *vs* immigrants)



Graphs by Region

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