An inter-regional migration model applied to Portuguese data

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Abstract

There are a significant number of NUTS III regions of Portugal undergoing a human desertification process. In order to provide support to policy makers, the Demospin project is developing a joint demographic-economic model to describe the trends and to allow the evaluation of policy impacts.

The estimation of the number of migrants in these regions proved to be one of the main difficulties to be surmounted. From the census information of 1991 and 2001, a specific model was developed to estimate migration based on socioeconomic factors: the creation or destruction of employment, the relative GDP *per capita* and the relative demographic potential of the region.

A highly significant dependence of migration on the variation of employment opportunities is observed for the age groups between 20 and 40 year olds. Gender is not relevant in this analysis of patterns of employment dependence, even if for some regions the migration by gender is clearly different.

The proposed model is statistically significant in explaining the migration of working age groups, mainly dependent on the creation or destruction of jobs. The weaker relation between the economic and demographic dynamics, in elderly age groups, makes the development of a complementary methodology necessary.

Keywords: ageing population, estimation models, migrants return, migration dynamics, peripheral regions

1. Introduction

This paper presents a model to estimate inter-regional migrations. This analytical tool is integrated in the project Economically Sustainable DEMOgraphy ReverSing Decline in Peripheral RegIoNs/ DEMOSPIN, funded by the Portuguese Foundation for Science and Technology. The project is developing a tool to support the definition of policy strategies concerning the development of demographically depressed regions. The methodology will combine demographic projection techniques with regional growth models relating the net creation of new jobs to the expected net migration.

The outputs are estimates of economic growth and population evolution in peripheral Portuguese regions up to 2030, according to different socio-economic scenarios. The estimates will support policies to revert the demographic decline of these peripheral areas. Low fertility rates and the shortage of people in fertile age, make this reversal only possible by attracting young population moving in response to job opportunities.

In short, the model explains net migration in each region as a function of net creation of employment, GDP per capita and demographic potential. The obtained results confirm our expectations: the model has a high capacity to predict net migrations for the groups corresponding to working age. As it was also expected, the model gives very poor predictions for net migration of elderly people, whose motivations to migrate are in general not related to job opportunities. A different model to deal with elderly people migrations is presented in this paper though the empirical results are not yet available. In which concerns net migrations for groups under working age, they are assumed to occur inside household's movements and thus they are estimated as a function of net migrations for working age people.

This paper is divided into five sections: (i) a brief characterization of the demographic evolution; (ii) the main migration trends; (iii) the presentation of the migration model; (iv) main results and (v) conclusions.

2. Demographic evolution of the Portuguese Population

The Portuguese demographic evolution is characterized by a process of population concentration along the coast, through a process of continuous and simultaneous urban and industrial agglomeration. From this process arises a significant decrease in the volume and ageing of population in most peripheral NUTS III, in spite of the increase in the total Portuguese population.

Table 1 and figure 1 show the evolution in the last three decades and separate peripheral from coastal Portuguese regions. The Autonomous Regions (Islands of Azores and Madeira), in spite of their social and economic specificities are included in the coastal group. From 1981 to 1991, all the peripheral NUTS III lost population as well as four coastal NUTS III. From 1991 to 2001, ten NUTS III lost population, and from 2001 to 2011 this number increased to eighteen. Making the comparison for the global evolution 1981-2011, the cost-periphery divide is clear, to the extent that population in all the peripheral NUTS III decreased while in the others, with the exception of Médio Tejo, there was an increase.

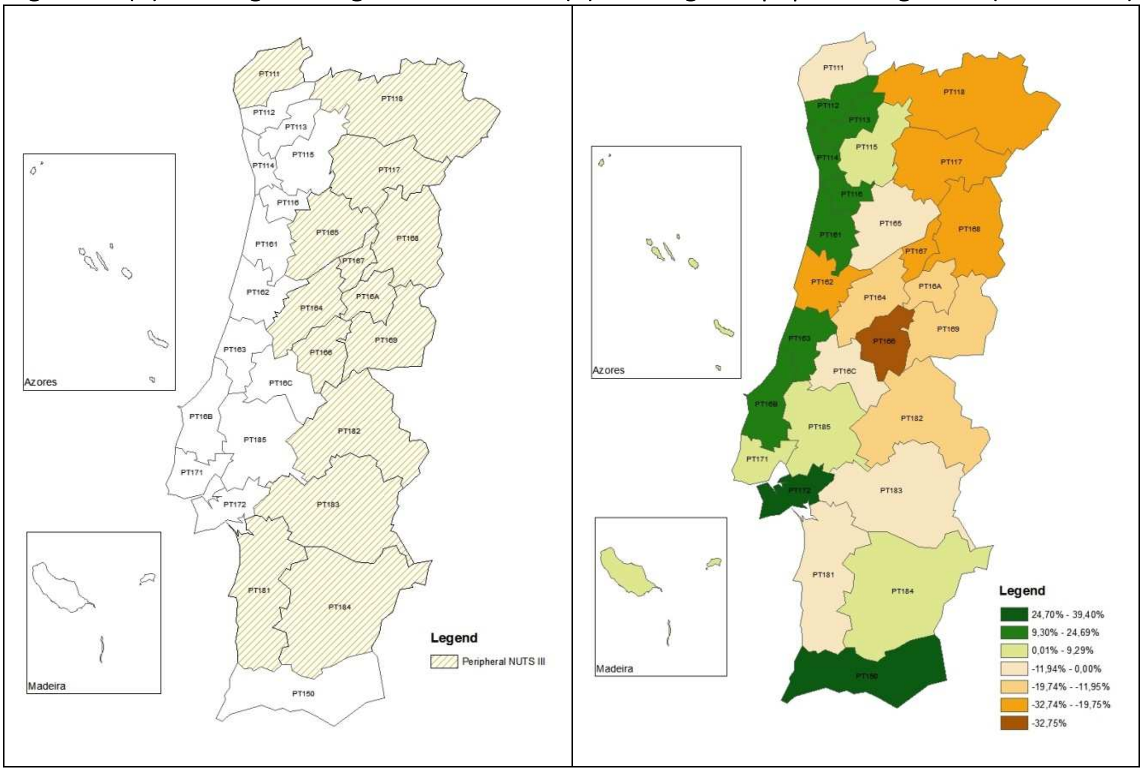
Table 1 - Portuguese population evolution (1981-2011)

	Regions NUTS III	Region Code	2011	Evolution 1981-91 (%)	Evolution 1991-01 (%)	Evolution 2001-11 (%)	Evolution 1981-2011 (%)
Peripheral NUTS III	Minho – Lima	PT111	244836	-2,58	0,08	-2,22	**-4,66**
	Douro	PT117	205902	-8,72	-7,03	-7,24	**-21,28**
	Alto Trás Montes	PT118	204381	-13,60	-5,04	-8,58	**-24,99**
	Pinhal Interior Norte	PT164	131371	-8,16	-0,68	-5,28	**-13,60**
	Dão – Lafões	PT165	277216	-4,24	1,36	-3,21	**-6,06**
	Pinhal Interior Sul	PT166	40705	-15,85	-11,84	-9,35	**-32,75**
	Serra da Estrela	PT167	43737	-5,04	-7,66	-12,48	**-23,26**
	Beira Interior Norte	PT168	104403	-8,79	-2,71	-9,58	**-19,75**
	Beira Interior Sul	PT169	75026	-5,77	-3,61	-4,11	**-12,90**
	Cova da Beira	PT16A	87869	-6,65	0,52	-6,17	**-11,95**
	Alentejo Litoral	PT181	97895	-4,37	1,46	-2,17	**-5,09**
	Alto Alentejo	PT182	118352	-5,52	-5,64	-6,97	**-17,06**
	Alentejo Central	PT183	166802	-3,94	0,23	-4,01	**-7,58**
	Baixo Alentejo	PT184	126692	-9,87	-5,57	-6,35	**-20,30**
	Total peripheral regions		**1925187**	**-7,18**	**-2,63**	**-5,61**	**-14,60**
Coastal NUTS III	Cávado	PT112	410149	7,19	11,36	4,46	**24,69**
	Ave	PT113	511737	7,72	9,54	0,44	**18,51**
	Grande Porto	PT114	1287276	4,34	8,02	2,17	**15,15**
	Tâmega	PT115	550469	0,89	8,39	-0,05	**9,29**
	Entre Douro e Vouga	PT116	274859	6,34	9,80	-0,64	**16,02**
	Baixo Vouga	PT161	390840	4,03	10,11	1,35	**16,10**
	Baixo Mondego	PT162	332306	-0,31	3,49	-2,38	**0,71**
	Pinhal Litoral	PT163	260924	3,30	12,55	4,00	**20,90**
	Oeste	PT16B	362523	1,60	7,29	7,00	**16,64**
	Grande Lisboa	PT171	2042326	-0,95	3,55	4,92	**7,63**
	Península Setúbal	PT172	779373	9,50	11,57	9,12	**33,31**
	Médio Tejo	PT16C	220660	-2,63	2,08	-2,46	**-3,05**
	Lezíria Tejo	PT185	247449	-0,38	3,34	2,70	**5,72**
	Algarve	PT150	451005	5,56	15,75	14,09	**39,40**
	R A Açores	PT200	246746	-2,31	1,67	2,06	**1,37**
	R A Madeira	PT300	267785	0,23	-3,32	9,30	**5,91**
	Total coastal regions		**8636427**	**2,56**	**7,02**	**3,86**	**13,97**
	Portugal		**10561614**	**0,35**	**4,96**	**1,93**	**7,41**

Source: Statistics Portugal Census 1981, 1991, 2001 and Provisional data from the 2011 Census

Figure 1 (A) identifies the Portuguese NUTS III and what is considered the peripheral and the coastal areas; figure 1 (B) presents a synthesis of population demographic changes, by NUTS III. It is evident the displacement of population from the periphery to the coast, associated with the decrease of the natural dynamics.

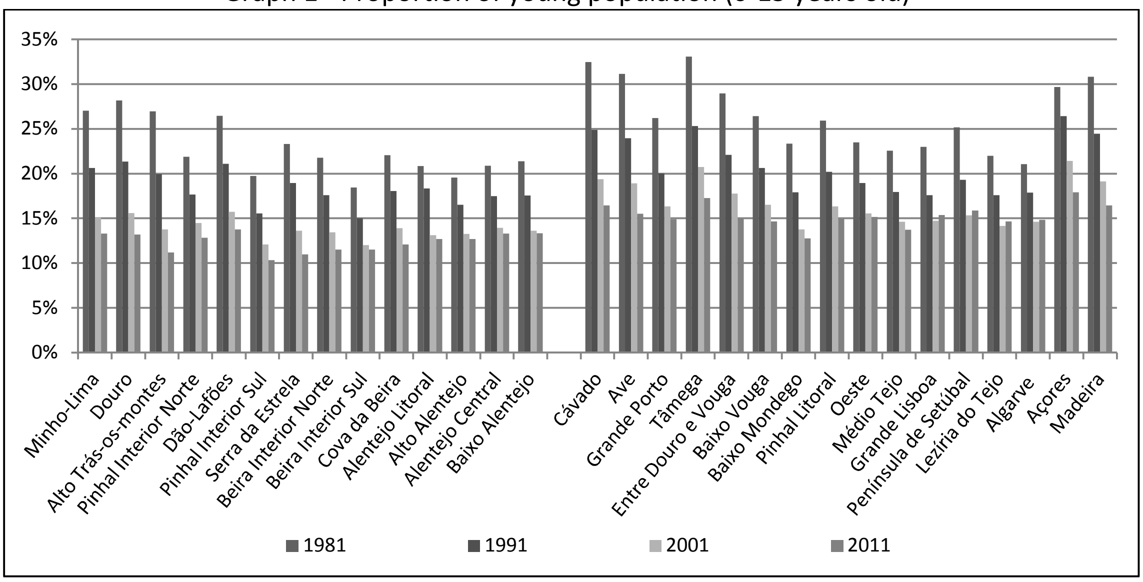
Figure 1 - (A) - Portuguese regions codes (B) - Portuguese population growth (1981-2011)



Source: Statistics Portugal Census 1981, 1991, 2001 and Provisional data from the 2011 Census

Along with population change, the ageing process took place quickly and intensively. Since 1981 the proportion of young population, (0-14 years old) decreased in all regions, though less markedly in the coastal NUTS.

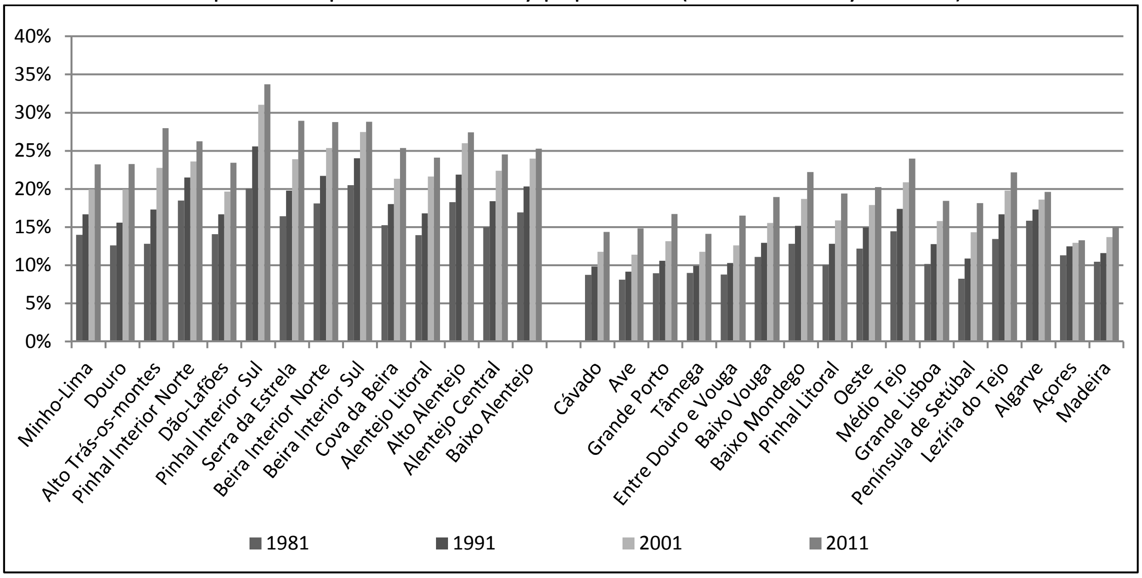
Graph 1 - Proportion of young population (0-15 years old)



Source: Statistics Portugal Census 1981, 1991, 2001 and Provisional data from the 2011 Census

The opposite occurred in the evolution of elderly population (65 years old and more), whose proportion increased all over the period, with a stronger incidence in the peripheral regions.

Graph 2 - Proportion of elderly population (65 and more years old)

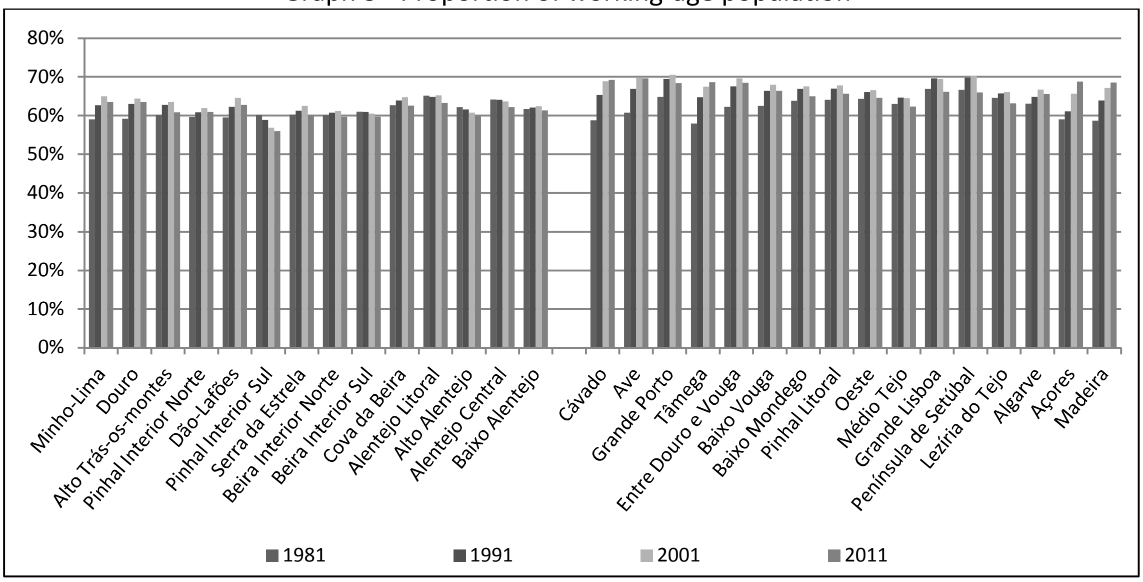


Source: Statistics Portugal Census 1981, 1991, 2001 and Provisional data from the 2011 Census

The demographic dynamics is also reflected in the evolution of working-age population. Because the decrease of the youngest was stronger than the increase of eldest people, the percentage of working-age population increased generally, but with a marked regional contrast: while there was a clear growth in the coastal areas and in the islands, the percentage remained stable or even decreased in the periphery, as a consequence of a more mature ageing process.

This short presentation showed the contrast between a coastal zone which, in spite of the ageing process which is occurring in almost all Western Countries, has still a positive demographic dynamics, and a periphery where ageing is coupled with a sharp demographic decline. A deeper analysis, necessary to uncover the drivers of the demographic process which can sustain a reversal of the situation, is made in the next section.

Graph 3 - Proportion of working-age population



Source: Statistics Portugal Census 1981, 1991, 2001 and Provisional data from the 2011 Census

3. Migration trends

Migrations are the main driver of Portuguese population evolution. The natural growth of population is still positive but it is decreasing and was marginal in the last decade; furthermore, it is expected to become negative in the near future. In the last two decades population growth was mainly the outcome of a positive net migration and the continuation of growth is only possible if this population inflow is maintained, something that the present crisis makes much unexpected. The contrast between the coast and the periphery is marked: though decreasing, the growth of coastal regions was maintained in both the natural and migration components, while in the periphery a sharp natural decline was only partially compensated by migrations which are now averaging zero. The present crisis will turn the situation significantly worse than what is depicted in this paper.

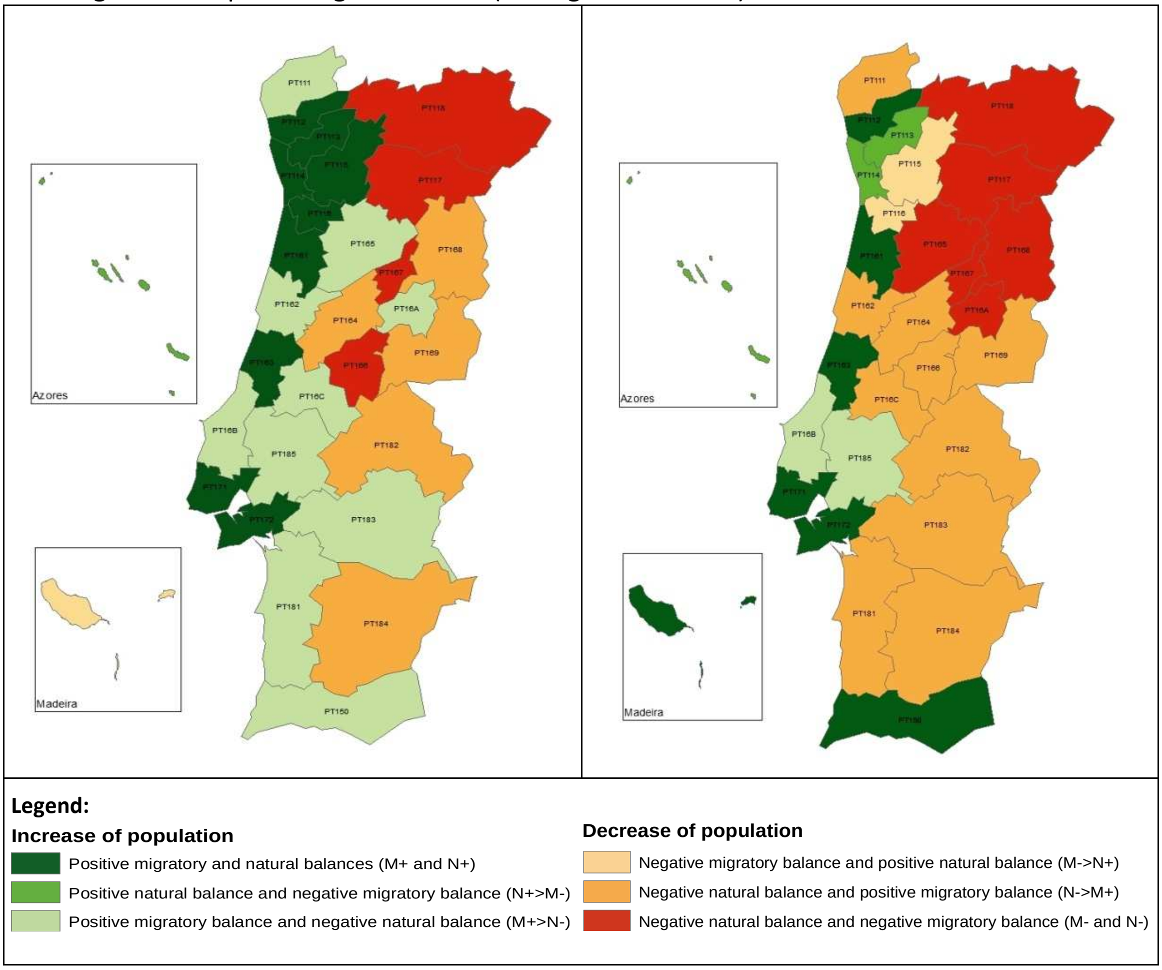
Table 2 – Portuguese population growth rates

	Regions NUTS III	Region code	1991-2001			2001-2011		
			Rate of total increase	Rate of natural increase	Rate of net migration	Rate of total increase	Rate of natural increase	Rate of net migration
Peripheral NUTS III	Minho-Lima	PT111	0,1%	-2,2%	2,3%	-2,1%	-3,3%	1,2%
	Douro	PT117	-7,0%	-1,8%	-5,3%	-7,2%	-4,1%	-3,0%
	Alto Trás Montes	PT118	-5,0%	-4,3%	-0,8%	-8,3%	-6,2%	-2,0%
	Pinhal Interior Norte	PT164	-0,7%	-5,9%	5,2%	-5,3%	-6,4%	1,1%
	Dão Lafões	PT165	1,4%	-1,5%	2,9%	-2,9%	-2,8%	-0,1%
	Pinhal Interior Sul	PT166	-11,8%	-9,4%	-2,5%	-9,1%	-11,7%	2,6%
	Serra Estrela	PT167	-7,7%	-5,9%	-1,8%	-12,4%	-8,8%	-3,6%
	Beira Interior Norte	PT168	-2,7%	-5,8%	3,1%	-9,5%	-7,6%	-1,9%
	Beira Interior Sul	PT169	-3,6%	-7,5%	3,9%	-4,2%	-8,4%	4,2%
	Cova Beira	PT16A	0,5%	-4,0%	4,5%	-6,2%	-4,4%	-1,9%
	Alentejo Litoral	PT181	1,5%	-4,8%	6,2%	-2,1%	-4,9%	2,8%
	Alto Alentejo	PT182	-5,6%	-6,1%	0,5%	-6,4%	-7,8%	1,3%
	Alentejo Central	PT183	0,2%	-3,6%	3,9%	-3,5%	-4,3%	0,8%
	Baixo Alentejo	PT184	-5,6%	-7,0%	1,4%	-6,3%	-7,1%	0,8%
	Total peripheral Regions		**-2,63%**	**-4,11%**	**1,48%**	**-5,42%**	**-5,36%**	**-0,06%**
Coastal NUTS III	Cávado	PT112	11,4%	6,6%	4,8%	4,5%	3,9%	0,6%
	Ave	PT113	9,5%	6,2%	3,3%	0,3%	2,6%	-2,4%
	Grande Porto	PT114	8,0%	3,5%	4,5%	2,0%	2,1%	-0,1%
	Tâmega	PT115	8,4%	7,2%	1,2%	-0,1%	3,4%	-3,5%
	Entre Douro e Vouga	PT116	9,8%	4,9%	4,9%	-0,6%	2,0%	-2,6%
	Baixo Vouga	PT161	10,1%	1,8%	8,3%	1,3%	0,3%	1,0%
	Baixo Mondego	PT162	3,5%	-1,3%	4,8%	-2,4%	-2,4%	0,0%
	Pinhal Litoral	PT163	12,5%	1,8%	10,8%	4,1%	0,8%	3,3%
	Oeste	PT16B	7,3%	-1,2%	8,5%	6,6%	-1,1%	7,7%
	Médio Tejo	PT16C	2,1%	-3,3%	5,4%	-2,2%	-3,5%	1,3%
	Grande Lisboa	PT171	3,6%	1,2%	2,4%	4,7%	2,4%	2,3%
	Península Setúbal	PT172	11,6%	1,8%	9,8%	8,9%	2,5%	6,4%
	Lezíria Tejo	PT185	3,3%	-3,3%	6,6%	2,9%	-2,8%	5,7%
	Algarve	PT150	15,7%	-1,9%	17,6%	14,0%	0,1%	13,8%
	R A Açores	PT200	1,8%	3,7%	-1,9%	1,8%	2,0%	-0,2%
	R A Madeira	PT300	-3,3%	2,5%	-5,8%	9,4%	0,8%	8,5%
	Total coastal Regions		**7,03%**	**2,21%**	**4,82%**	**3,73%**	**1,53%**	**2,20%**
	Portugal		**4,98%**	**0,87%**	**4,11%**	**1,93%**	**0,17%**	**1,76%**

Source: Statistics Portugal Census 1981, 1991, 2001 and Provisional data from the 2011 Census

The figures below summarize the dynamics shown in the table above. The number of NUTS III with positive natural and migration growth rates decreases as well as the number of NUTS III with positive natural growth rate. It is important to stress that in 2001-2011 there are 2 NUTS III (Tâmega e Entre Douro e Vouga) with positive natural growth and negative migratory growth rates, making clear the transformations that are going on even in the coastal regions. Comparing with the evolution from 1991 to 2001, the north coastal regions show a more intense change in demographic dynamics. The peripheral regions face a pervasive pattern of natural decrease of population while there is a north south divide between negative and positive migration rates.

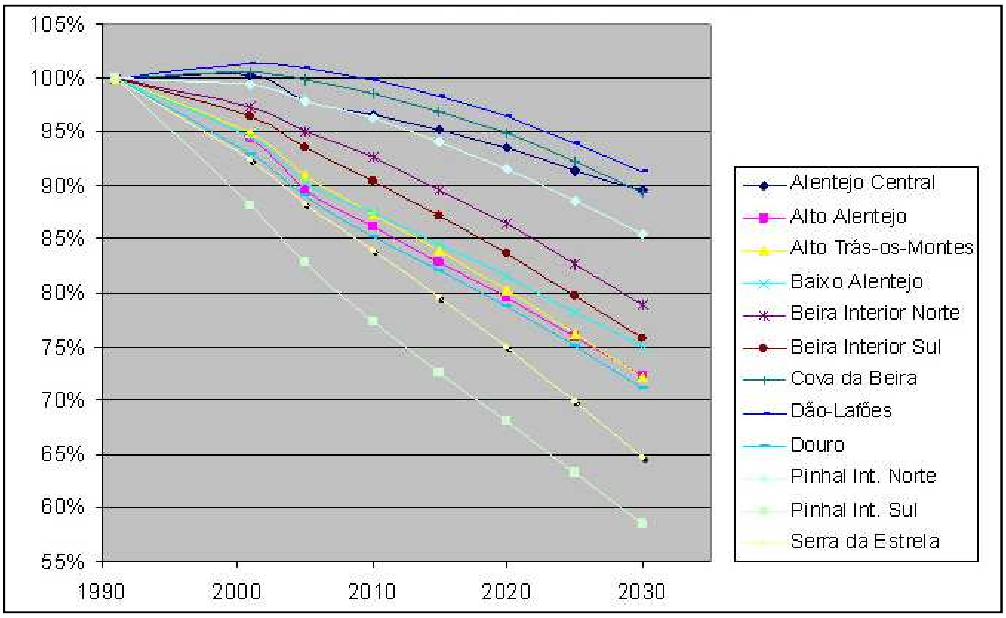
Figure 2 – Population growth rates (Portuguese NUTS III) – 1991-2001 and 2001-2011



Source: Statistics Portugal Census 1991, 2001 and Provisional data from the 2011 Census

Our population forecasts, developed by the DEMOSPIN project, by applying a cohort component method to data collected from Statistics Portugal show how depressive is the demographic dynamics of the peripheral NUTS III. In the extreme case of Pinhal Interior Sul - a mountain sparsely populated area - population in 2030 will be less than 60% of the 1991 census value.

Graph 4 – Population Projections by peripheral Portuguese NUTS III



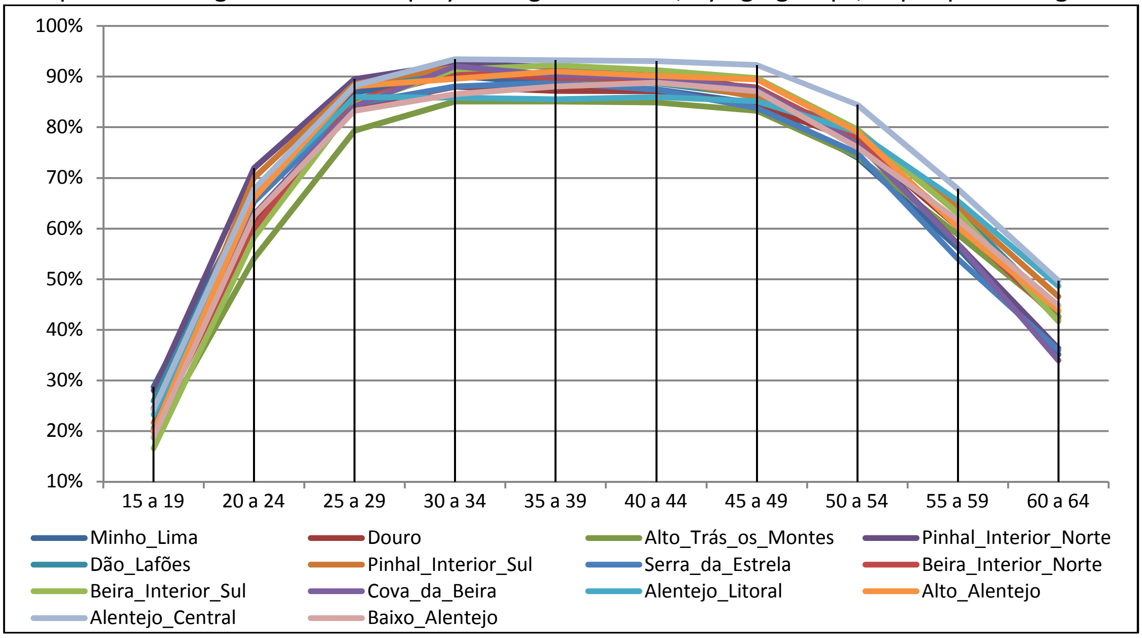
Our results are in line with the main conclusions of specialised literature, which stresses that population movements are gaining in importance, given the diminishing impact of natural change on population dynamics (Bijak, 2006, pp.3). Indeed, the impact of the natural balance on population growth has decreased due to population ageing and diminishing fertility. This downward trend can only be reversed by immigration of younger working population. In fact, as mentioned by Park and Hewings (2007), attempting to change population fertility would take several years to have an impact on the economy (through labour force expansion), [while] an increase in immigration of say people aged 20-35 would have an immediate effect on the economy. Moreover, given the ageing levels that Portuguese peripheral regions have reached, any encouraging policy of births wouldn´t be effective, due to the lack of women in childbearing age. So, the alternative is to attract young people, which move in response to job applications, what means that immigration policies became the most effective way of intervention. However, a reasonable ex ante evaluation of any police to attract migrants through job opportunities depends on the analysis of the relationship between the stimulus and the migration outcome. This is the main objective of the following model.

4. Migrations model

As the literature demonstrates, migration is stimulated by economic and social factors (Zlotnik, 2003). Lee (1966) points out the drivers of migrations, mentioned by Ravenstein, in *The Laws of Migration* (1885): i) the propensity to migrate decreases with distance between origin and destination; ii) migration drives population upwards in the hierarchy of urban centres; iii) each migration flow tends to produce a time lagged inverse flow; iv) urban inhabitants have a lower propensity to migrate than rural people (this principle is more obvious for the ninetieth and most of the twentieth century, when the massive rural-urban exodus occurred, then for the present urban societies); v) women have a higher propensity to migrate to close destinations; vi) the improvement of transport technologies increases migrations, though there is a debate on the potential of information and communication technologies to reverse this trend (O'Brien, 1992; Castro et al 2003); vii) economic motivations are the main driver of migrations. If we accept the last Ravenstein Law, economic theories are particularly important to explain migration flows as a response to regional differences in job opportunities and wages; however, economy cannot explain migrations in the two extremes of the pyramid: dependent young people and retired elderly people. As Lee (1960) noted, the selection of the migrants and their propensity to migrate also depend on the stages of the life cycle, like the entry in the labour force, marriage, divorce or widowhood. This stresses the importance of interdisciplinary studies, encompassing various theoretical perspectives: economic, sociological, mobility transition, political and systemic (Zlotnik, 2003).

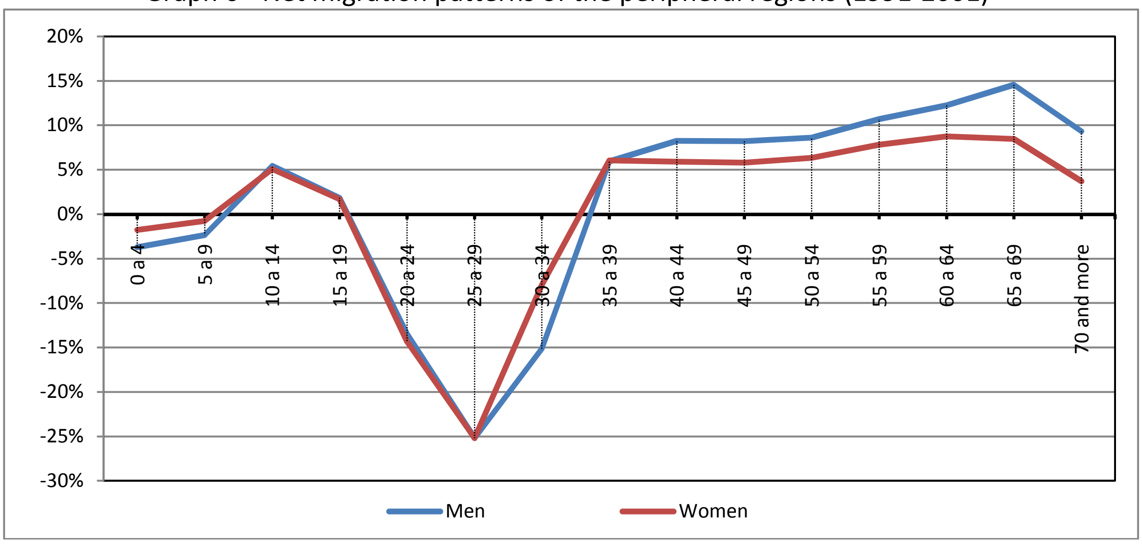
For the Portuguese case, the following graph illustrates the close relationship between migrations and employment opportunities, expressed by the ratio between net increase in migration and employment growth, occurred between 1991 and 2001; results are presented for all peripheral regions and age groups for male population (the equivalent results for female population are very similar). For the working age groups between 25 and 49 years old, the correspondence is almost perfect, being much weaker both for younger people - who responds more to educational opportunities - and to older people leaving the labour market.

Graph 5 - Net migrations and employment growth ratio, by age groups, in peripheral regions



The disaggregation of net migrations (1991-2001) by age and sex, sets the pattern of net migration distribution in the peripheral regions.

Graph 6 - Net migration patterns of the peripheral regions (1991-2001)



The observation of Portuguese data, the analysis of relevant literature and the assumption that employment and economic performance are the main drivers of migration are the basis for our model to forecast net migrations in all NUTS III regions, represented by equation 1. There is an independent equation for each age group (from 15 to 64 years old) and sex, which estimates simultaneously net migration rates for all regions – a *multiregional perspective* (Rogers, 1990). The model was applied for the decade 1991-2001 and will be improved with the use of data for the 2001-2011 decade, as soon as the required census results will be available. The obtained outcomes will then be extrapolated to the future making migration and population forecasts conditional to different scenarios of economic evolution. The model is as follows:

$$Mig = a + b\Delta E + c\Delta GDP + d\Delta Pot \qquad \text{eq. 1,}$$

where:

Mig is the net migration by age group and by sex for the decade 1991-2001;

ΔE is the variation of employment opportunities in the region, given by the difference between economic and demographic employment; economic employment is given by Census data, while for future forecasts it is obtained by applying regional input-output models, one for each NUTS III, where exogenous growth stimulus are made conditional to different evolution scenarios (Ramos et al 2011); demographic employment is obtained by multiplying, for each age group (from 15 to 64 years old) and NUTS III, by a similar process, the population which would exist in 2001 in the absence of migrations by the rate of activity in 2001; for forecasting, demographic employment is calculated; thus, the model consider the age structure changes of the population over time as a migration determinant factor (Rogers, 1990);

ΔGDP is the ratio between GDP per capita in the region and the national GDP per capita – an indicator that relates the economic performance in the origin and destination regions – being an explanatory variable which responds to the economic approach theories of migrations (Zlotnik, 2003) and to the migration modelling theoretical framework (Termote, 2003);

ΔPot is the ratio between the demographic potential in the region and the weighted average of the demographic potential of all the regions, corresponding the weights to the population of each region; demographic potential is included in order to model the effect corresponding to the second and third Ravenstein laws: the attrition of distance will induce a positive value in the coefficient d, while the trend to move upwards the urban hierarchy will have an inverse effect and thus the final value of d will represent the balance between these two opposite effects; in short, this explanatory variable represents a *gravitational approach*[1] of the distance factor (Termote, 2003) and may reflect *the influences of spatial population distribution* along the territory (Rogers, 1990);

b, c, d are regression coefficients;

Finally, the constant a represents the propensity to migrate, independently of the economic and demographic situation of the region (see the sociological and political approach theories of migration, referred in Zlotnik, 2003);

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[1] The demographic potential in a region is estimated by the equation $Pot_j = \sum_i \frac{P_j}{d_{ij}}$, where Pot_j (the demographic potential in the region *j*) is the sum of the ratios between P_j (population of the region *j*) and d_{ij} (the distance from the region *j* to each region i).

Because *GDP* and *Pot* ratios are a-dimensional values, the same must happen to the demographic variables; therefore, both migrations and variation of employment opportunities, rather than being absolute numbers, are divided by the total amount of population in each age group (Rogers, 1990, and Termote, 2003).

5. Main results

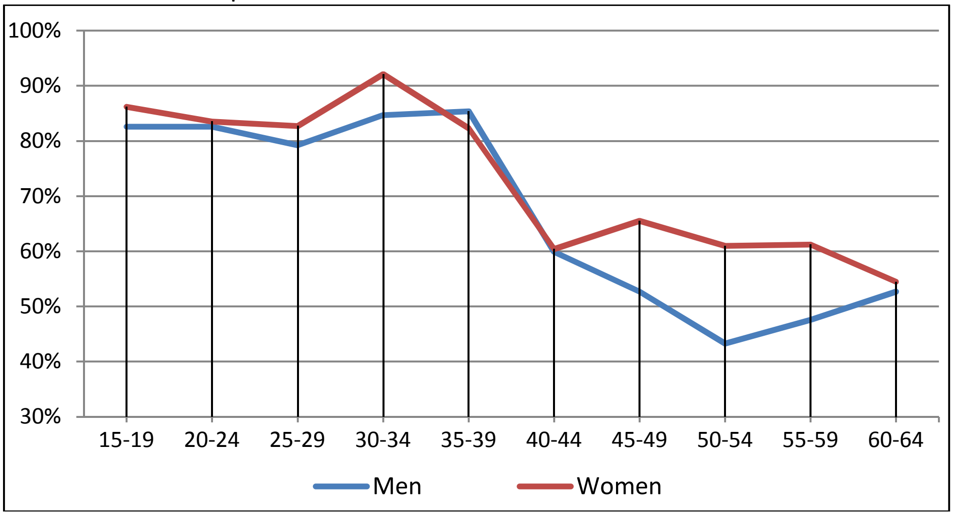
The next table summarizes the main results obtained. The coefficient of determination shows a high explanatory capacity of the model, which varies according to age group and sex, following a pattern when values grow up to the 30-39 years old groups and then decline more or less regularly. This pattern corresponds to the varying responsiveness to economic stimulus of the different age groups and becomes more evident if we look to the different regression coefficients (table 3 and graph 7).

Table 3 – The SPSS correlations output (significance: XX<0.01 - very high; 0.01>X>0.05 - high)

Age groups	Sex	Higher signific.	Explanatory variables	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Adjusted R Square	Std. Error of the Estimate
				B	Std. Error	Beta				
15_19	M		(Constant)	.027	.006		4.899	.000	.826	.0178704
		XX	ΔE	.956	.093	.929	10.327	.000		
			ΔGDP	-.020	.017	-.109	-1.205	.239		
			ΔPot	.011	.009	.101	1.197	.242		
	W		(Constant)	.031	.005		5.844	.000	.862	.0171793
		XX	ΔE	.993	.089	.894	11.151	.000		
			ΔGDP	-.014	.016	-.071	-.881	.386		
		X	ΔPot	.022	.009	.182	2.425	.023		
20_24	M		(Constant)	-.039	.015		-2.516	.018	.826	.0495006
		XX	ΔE	2.024	.256	.712	7.893	.000		
		X	ΔGDP	.122	.046	.240	2.658	.013		
			ΔPot	.046	.026	.149	1.765	.089		
	W		(Constant)	-.047	.016		-2.879	.008	.835	.0531110
		XX	ΔE	2.306	.275	.735	8.379	.000		
			ΔGDP	.074	.049	.131	1.488	.149		
		XX	ΔPot	.083	.028	.246	3.001	.006		
25_29	M		(Constant)	-.115	.025		-4.578	.000	.792	.0810785
		XX	ΔE	3.035	.420	.711	7.224	.000		
		X	ΔGDP	.179	.075	.234	2.372	.025		
			ΔPot	.057	.042	.125	1.357	.187		
	W		(Constant)	-.119	.022		-5.294	.000	.827	.0723687
		XX	ΔE	3.149	.375	.755	8.399	.000		
			ΔGDP	.103	.067	.138	1.533	.137		
		X	ΔPot	.088	.038	.196	2.334	.028		
30_34	M		(Constant)	-.070	.017		-4.026	.000	.847	.0559131
		XX	ΔE	2.816	.290	.822	9.721	.000		
		X	ΔGDP	.118	.052	.191	2.260	.032		
			ΔPot	.001	.029	.002	.025	.980		
	W		(Constant)	-.038	.008		-4.602	.000	.921	.0268047
		XX	ΔE	2.122	.139	.925	15.282	.000		
			ΔGDP	.015	.025	.037	.617	.542		
			ΔPot	.014	.014	.056	.987	.333		

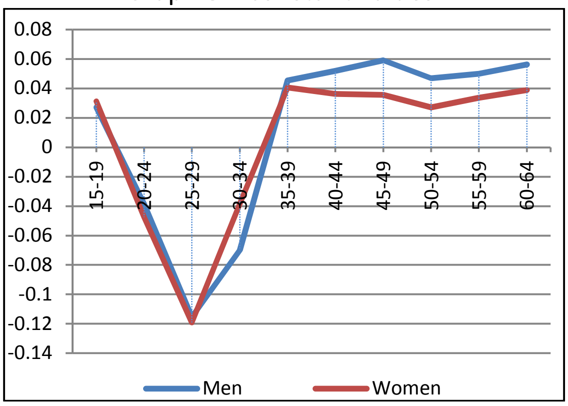
Age groups	Sex	Higher signific.	Explanatory variables	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Adjusted R Square	Std. Error of the Estimate
				B	Std. Error	Beta				
35_39	M		(Constant)	.045	.008		5.753	.000	.854	.0254313
		XX	ΔE	1.588	.132	.995	12.052	.000		
			ΔGDP	-.009	.024	-.033	-.401	.692		
		X	ΔPot	-.036	.013	-.209	-2.707	.012		
	W		(Constant)	.041	.008		5.154	.000	.823	.0253662
		XX	ΔE	1.479	.131	1.023	11.251	.000		
		X	ΔGDP	-.051	.024	-.196	-2.155	.041		
			ΔPot	-.020	.013	-.125	-1.476	.152		
40_44	M		(Constant)	.052	.011		4.858	.000	.599	.0343373
		XX	ΔE	1.209	.178	.929	6.798	.000		
		X	ΔGDP	-.076	.032	-.327	-2.393	.024		
			ΔPot	-.026	.018	-.185	-1.451	.159		
	W		(Constant)	.036	.009		4.113	.000	.604	.0284505
		XX	ΔE	1.002	.147	.924	6.799	.000		
		X	ΔGDP	-.065	.026	-.334	-2.455	.021		
			ΔPot	-.010	.015	-.089	-.700	.490		
45_49	M		(Constant)	.059	.009		6.349	.000	.527	.0299823
		XX	ΔE	.918	.155	.877	5.907	.000		
		X	ΔGDP	-.069	.028	-.366	-2.459	.021		
			ΔPot	-.029	.016	-.257	-1.852	.075		
	W		(Constant)	.036	.008		4.660	.000	.655	.0245810
		XX	ΔE	.943	.127	.939	7.407	.000		
		XX	ΔGDP	-.092	.023	-.509	-4.009	.000		
			ΔPot	.002	.013	.016	.134	.894		
50_54	M		(Constant)	.047	.009		5.203	.000	.433	.0290587
		XX	ΔE	.684	.151	.739	4.544	.000		
		XX	ΔGDP	-.097	.027	-.581	-3.571	.001		
			ΔPot	-.019	.015	-.189	-1.243	.225		
	W		(Constant)	.027	.007		4.136	.000	.610	.0211807
		XX	ΔE	.748	.110	.919	6.819	.000		
		XX	ΔGDP	-.079	.020	-.539	-3.992	.000		
			ΔPot	-.015	.011	-.173	-1.375	.181		
55_59	M		(Constant)	.050	.008		6.158	.000	.476	.0261137
		XX	ΔE	.603	.135	.696	4.455	.000		
		XX	ΔGDP	-.080	.024	-.515	-3.289	.003		
		XX	ΔPot	-.038	.014	-.413	-2.825	.009		
	W		(Constant)	.034	.006		5.613	.000	.612	.0192741
		XX	ΔE	.632	.100	.851	6.327	.000		
		XX	ΔGDP	-.084	.018	-.630	-4.680	.000		
		X	ΔPot	-.023	.010	-.289	-2.297	.030		
60_64	M		(Constant)	.056	.010		5.921	.000	.527	.0306432
		XX	ΔE	.737	.159	.690	4.644	.000		
		XX	ΔGDP	-.125	.029	-.652	-4.383	.000		
		X	ΔPot	-.038	.016	-.331	-2.381	.025		
	W		(Constant)	.039	.007		5.456	.000	.545	.0228719
		XX	ΔE	.592	.118	.727	4.993	.000		
		XX	ΔGDP	-.087	.021	-.595	-4.084	.000		
		XX	ΔPot	-.034	.012	-.392	-2.884	.008		

Graph 7 - The SPSS coefficients of determination

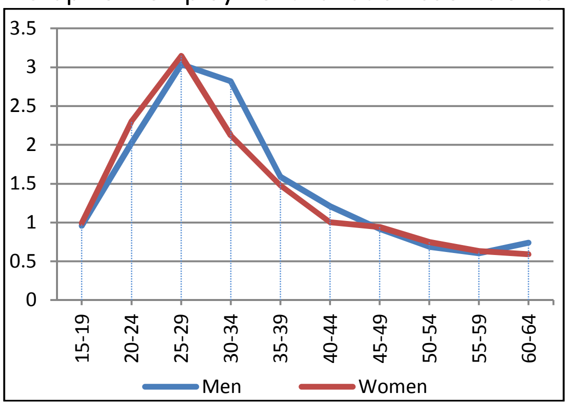


The constant a is negative for the age groups between 20 and 34 years old and positive for all the other groups - this means that, when all the drivers analysed in equation 1 are controlled, younger working age people tends to leave, while the other ones tend to come, in most cases returning to the land they left years ago. The variable employment opportunities is by far the more relevant for the model and the corresponding coefficient b has a very clear inverse U-shape pattern: increases up to the age 25-29 and then decreases regularly, showing how the response to job opportunities vary with age.

Graph 8 – constant values

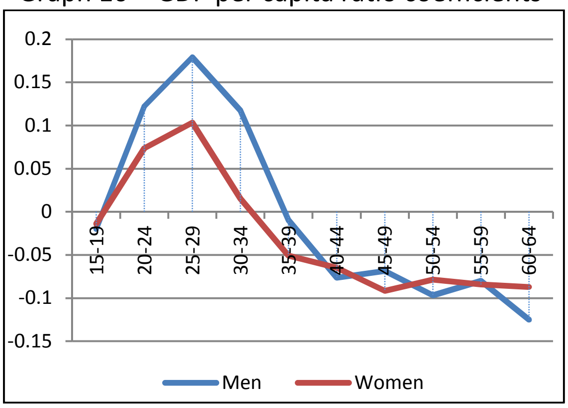


Graph 9 – employment variation coefficients

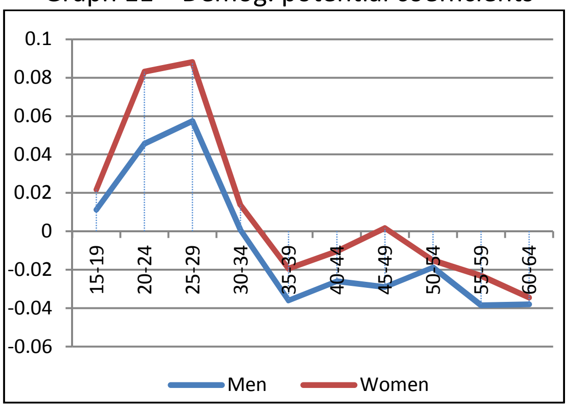


The same inverse U-shaped pattern applies to the remaining variables, showing that younger workers tend to move to richer and more central regions, whilst elderly people do the opposite, returning to the poorer and more peripheral regions which they left in the past.

Graph 10 – GDP per capita ratio coefficients



Graph 11 – Demog. potential coefficients



These results suggest that a more accurate model is necessary to estimate migration patterns, both to people in the end of their working life and to retired people. This work is being developed by DEMOSPIN research team, and consists of adding to equation 1, for each age group, variables describing the rate of migration lagged by 20, 25, 30, 35 years (equation 2):

$$_5M_y = a + b_5(\Delta E)_y + c(\Delta GDP)_y + d(\Delta Pot)_y + e\ _5\left[_5(_nM_{x-20})_{y-20}\right]_y +$$
$$+ f\ _5\left[_5(_nM_{x-25})_{y-25}\right]_y + \ \ldots$$

where, for the general age group (X, X+5 years) and for the period Y to Y+5 years:

$_nM_{x-20}$ is the net migration by the present age group which is x to x+5 years old, for the period lagged by 20 years and when they were 20 years younger.

Because migration data for Portugal is scarce, it is necessary to make a fastidious work of estimating net migrations in a given time period, as the difference between the population which would occur if net migrations in that period were zero and the actual population. This requires the collecting and organization of a huge amount of data, which will be finished soon.

It is important to stress that return of elderly people is a key element for the economic input-output model, due to the significant impact on peripheral regions of demand generated by elderly population.

6. Conclusions

The work developed by DEMOSPIN project revealed how serious is the problem of desertification in almost all Portuguese peripheral regions and how difficult will be to reverse the trend. It showed also that only the attraction of younger people, through job opportunities can reverse the situation. This paper presents a model which analyses the relation, by age group, between job opportunities and migration. The model was only applied for population between 15 and 64 years old; the results were excellent for younger people and the quality declined with the age of analysed groups. This means that the model must be improved with the analysis of the effect of past migrations on present movements of people moving back to their place of origin; furthermore, this effect will be the main element of the model when applied to people over 65 years. Further work has been developed on that direction.

Finally it is necessary to give a note concerning the migration of people younger than 15 years old. Though they are not directly affected by employment opportunities, younger people are an important element of the input-output model, to the extent that they generate demand and consequently affect positively the regional employment dynamics; in addition, they are a fundamental element when we forecast future population. However, younger people do not respond autonomously to migration drivers, being rather dependent upon the movements of their parents. As such, younger people migrations were estimated as a function of older people migration, assuming that migrating parents have the same fertility behaviour as the host regions. This is a rough assumption which can only be substituted by more sophisticated analysis based on a sound sociological approach and fed by the required data.

Acknowledgements

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