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**Multiregional Stable Population as a Tool  
for Short-Term Demographic Analysis**

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## 1 - Introduction

The demographic behaviour of the Italian population has been changing markedly over the last decades. In a period of ten years (from 1970-1972 to 1980-82), female life expectancy at birth increased by almost three years and male life expectancy by two years. Between 1972 and 1982, both the total fertility rate and the rate of interprovincial migration dropped by one third, and regions which in the beginning of the seventies experienced important gains from these migrations found themselves with considerable losses ten years later.

These profound changes in demographic behaviour have obviously had a marked impact on growth rates. At the national level, thus excluding the impact of modifications in internal migration behaviour, the annual growth rate observed at the beginning of the eighties was one fourth the rate observed ten years earlier. Of course, some provinces and regions have experienced even higher changes in their growth rate.

Yet, as long as we consider observed growth rates (be it the natural growth rate or the growth rate due to migration), we do not fully catch the significance of these changes. Observed growth rates are indeed not only the result of present behaviour, but contain also all the "weight of the past", because they depend also on the level and the age structure inherited from the previous behaviour. Moreover, all changes in demographic behaviour have not the same impact at each age. Changes in mortality usually affect immediately the growth rate at all (or almost all) ages, while changes in fertility are immediately registered only in the growth rate of the population at age zero. Changes in migration, much like mortality, may affect all ages, but actually have a stronger impact at some specific ages.

A useful way to consider the implications of present demographic behaviour, and of the changes of this behaviour over time, is to make use of stable population analysis. By definition, the stable population is a function only of the present demographic behaviour, so that any change in this stable population is only the result of changes in the present behaviour. In this paper, we will make use of multiregional stable populations, that is, we will consider simultaneously fertility, migration and mortality, taking into account all interrelations between the three basic components of demographic behaviour. Our analysis has been carried out for Italy's 20-region system. In order to catch the impact of short-term variations in demographic behaviour, two successive three-year periods were considered: 1977-1979 and 1980-1982, the latter period being the last one for which all data required for the use of multiregional analysis were available.

After a brief presentation of the approach (section 2), and a rapid look to the evolution of the observed rates (section 3), we will discuss more in depth the main characteristics of the multiregional stable population, its intrinsic rates and "spatial" reproductive value (section 4).

## 2 . The Multiregional Stable Model <sup>1</sup>

Let  $\{P^{(0)}\}$  = the distribution of the total (national) population according to age, sex and region of residence at moment 0 (in our analysis, the distribution according to sex will not be considered, in order to avoid the problem of small numbers, leading to insignificant rates);

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<sup>1</sup> For a more detailed presentation, see Rogers (1975), and Willekens and Rogers (1978).

$\underline{G}$  = the growth (Leslie) matrix, which expresses the fertility, mortality and migration behaviour of the population

$$= \begin{bmatrix} 0 & 0 & \underline{B}(\alpha-5) & \dots & \underline{B}(\beta-5) & \dots & 0 & 0 \\ \underline{S}(0) & 0 & \dots & \dots & \dots & \dots & \dots & \dots \\ 0 & \underline{S}(5) & \dots & \dots & \dots & \dots & \dots & \dots \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ 0 & 0 & \dots & \dots & \dots & \dots & \dots & \dots \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ 0 & 0 & \dots & \dots & \dots & \dots & \underline{S}(z-5) & 0 \end{bmatrix}$$

where  $\alpha, \beta$  = the beginning and the end of reproductive years, respectively;  
 $z$  = the last age group;

$$\underline{S}(x) = \begin{bmatrix} s_{11}(x) & \cdot & \cdot & \cdot & \cdot & s_{1n}(x) \\ s_{21}(x) & \cdot & \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\ s_{n1}(x) & \cdot & \cdot & \cdot & \cdot & s_{nn}(x) \end{bmatrix}$$

$s_{ij}(x)$  representing the proportion of those who, being  $x$  years old, had their residence in region  $i$  at moment  $t$ , and who survived until age  $x+5$ , residing at moment  $t+5$  in region  $j$ .

and where the sign  $\sim$  indicates matrix notation (and not a scalar, as in the traditional, non-spatial approach).

Then the stable population is defined as:

$$\{ \underline{P}^{(\infty)} \} = \lim_{t \rightarrow \infty} \underline{G}^t \{ \underline{P}^{(0)} \} \quad [1]$$

$$= \lambda^{t \rightarrow \infty} \{ \underline{Y} \} \quad [2]$$

where  $\lambda$  = a scalar, representing the dominant "eigenvalue" of  $\underline{G}$ .

$\underline{Y}$  = the stable equivalent of the observed population, that is, the population which, if distributed as the stable population, would have the same growth rate and lead to the same population as the one that would be obtained if the observed population was growing according to equation [1].

As far as we are concerned, the main property of this stable population lies in the fact that it is a function only of the growth matrix  $\underline{G}$ , and does not depend on the present distribution of the population,  $\{ \underline{P}^{(0)} \}$ . In other words, the stable population fully reflects the present demographic behaviour of the population, and this is precisely what we need if we want to analyze short-term changes in the behaviour. If we only look to the observed rates, such changes may be "lost" because of the "weight", the "inertia" of the past. The best analogy that may be used to understand the significance of stable analysis in our case, is probably the speedometer. When reading a speedometer on our car, we do not forecast how many kilometers we will do in the next hour. We actually measure the present behaviour of the car we are driving. Stable multiregional population analysis represents then a way to measure the "demographic speed" of each unit of our

multiregional system, as it is the result of the fertility, mortality and migration behaviour of the population.

A particularly interesting development of stable population analysis may be found in what has been called the "theory of reproductive value". Initiated by Fisher, in 1929, this theory was further developed by Goodman (1967 and 1971), Keyfitz (1975), Rogers (1975) and Willekens (1977).

According to this approach, life is considered as a debt we have inherited when were born, and the birth of a son or a daughter is viewed as the way to pay this debt. When this debt is put equal to one, then, in the stable population, the present value of this payment is necessarily equal to the debt:

$$1 = \int_0^{\infty} e^{-ra} m(a) \hat{l}(a) da = \Psi(r) \quad [3]$$

where  $m(a)\hat{l}(a)da$  = the number of children (daughters) expected (between age  $a$  and age  $a+da$ ), from a new-born person (woman) of the life-table population, subject to the observed fertility regime;

$r$  = the stable growth rate, or discount rate.

Rogers and Willekens have "spatialized", "regionalized", this approach, by taking into account not only fertility and mortality, but also migration. The important question we may then ask is: what would be the regional distribution of births, in such a stable population? This implies that, instead of computing net (multiregional) reproduction rates, by combining the population of the (multiregional) life-table with the observed fertility regime, we substitute to the life-table population the stable population.

In other words, we discount the number of births, the discount rate being the stable growth rate (also called intrinsic growth rate). In this way, we do not obtain, as with the net reproduction rate, the expected number of babies to be born (in a particular region, from a person born in any given region), but the number of babies discounted at the moment this parent was born.

The multiregional equivalent to [3] is

$$\{ \underline{Q}^s \} = \underline{\Psi}(r) \{ \underline{Q}^s \} \quad [4]$$

where  $\{ \underline{Q}^s \}$  = the right "eigenvector" associated with the dominant "eigenvalue" of  $\underline{\Psi}(r)$ .

We may also write

$$\{ \underline{v}(0) \}' = \{ \underline{v}(0) \}' \underline{\Psi}(r) \quad [5]$$

where  $\{ \underline{v}(0) \}'$  = the left "eigenvector" of  $\underline{\Psi}(r)$ , with the sign ' indicating that the matrix has been transposed.

The demographic meaning of [4] and [5] is the following.  $\{ \underline{Q}^s \}$  represents the regional distribution of births in the stable population, that is, the regional distribution of the investments (births) which allow the intrinsic rate of return to be equal to  $r$ , the stable

growth rate. While  $Q$  thus represent a number of births,  $v$  expresses the marginal value of a birth (more precisely, of a new-born baby), that is, its contribution to the stable population. Note that the growth model being linear, this marginal value is equal to the mean value.

As far as we are concerned, the important point is that the regional distribution of births, as expressed by  $\{Q^s\}$ , is fully consistent with the observed fertility, mortality and migration behaviour, and with the stable growth rate (or discount rate). Because this behaviour varies from one region to another, which the stable growth rate is unique, a birth occurring in a low-fertility region will contribute less to sustaining the stable rate of growth of the total (national) population, than a birth occurring in a region where fertility is higher.

In other words, the value of a birth for sustaining the stable growth rate will depend on the capacity of this new-born baby to produce new lives. The capacity will be a function of the fertility (and mortality) level in the region of birth, but also of the propensity to out-migrate from this region. If this new-born baby migrates to a low-fertility region, and adopts - as is assumed in the model [1] which leads to the stable population - the fertility behaviour of the region of immigration, then his capacity to produce new lives will be reduced. We have therefore to take into account the whole migration path expected for this new-born baby. The capacity of a new-born baby (member of the stable population) to produce new lives, when all interactions between fertility, mortality and migration are taken into account, is called the spatial (regional) reproductive value.

### 3 . Observed Rates, 1977-1979 and 1980-1982.

Table 1 shows how much demographic conditions have changed in Italy's region over a three-year period around the turn of the seventies to the eighties. As far as Italy's natural growth is concerned, the 1980-1982 yearly rate is half the rate observed three years earlier, with the decline being more pronounced in the Center-North regions, that is, in those regions which already had the lowest rates of natural growth. The drop was particularly important in the North-West regions and in the regions of the Center, except Lazio. As a result, all regions of the North and the Center had a negative natural growth rate at the beginning of the eighties, except Trentino and Lazio (and Veneto, which had a rate only slightly above zero), while all regions of the South, including the Islands, had still a positive rate, always above the national average ( except for Molise).

This relatively more favourable (or, more exactly, less defavourable) natural evolution of the Southern regions was reinforced by a relatively more favourable evolution of net interregional migration (international migration has been excluded from our analysis, not only because of the unreliability of the data, and also because of the fact that international immigration does not make part of the demographic behaviour of the Italian population). On the whole, those regions which showed the smallest decline in natural growth also experienced the largest increase in growth from interregional migration. Actually, all regions of the South including the Islands, except Campania, ameliorated their migration balance, while all regions of the North and the Center, except Friuli V.G., Umbria and Lazio had lower net migration rates. The drop was particularly pronounced in Piemonte and Marche, while the improvement was particularly impressive in Basilicata and Calabria. The trend which had started in the beginning of the seventies (see Termote, 1985), towards a more balanced system of migration flows, with gainers gaining less and losers losing less, has thus persisted.

Table 1- Rates (in ‰) of natural growth and of net regional migration, per region, 1977-1979 and 1980-1982.

	<i>Natural growth</i>		<i>Net interregional migration</i>	
	1977-1979	1980-1982	1977-1979	1980-1982
Piemonte	-1.4	-2.9	0.3	-1.0
Valle d'Aosta	-0.5	-2.1	1.7	1.0
Lombardia	1.3	-0.1	0.9	0.5
Liguria	-4.9	-6.6	0.7	0.4
Trentino A.A.	2.3	1.6	-0.2	-0.3
Veneto	2.0	0.2	1.2	1.0
Friuli V.G.	-3.4	-4.6	1.5	1.8
Emilia R.	-1.7	-3.5	2.7	2.7
Toscana	-1.3	-2.9	2.6	2.4
Umbria	0.6	-0.6	2.1	2.3
Marche	1.6	-0.1	2.8	1.5
Lazio	4.2	2.6	0.9	1.4
Abruzzi	2.7	1.6	-0.3	0.9
Molise	2.0	1.0	-1.7	-1.7
Campania	9.3	7.7	-2.5	-2.8
Puglia	9.3	7.3	-1.9	-1.1
Basilicata	6.2	5.4	-6.2	-4.9
Calabria	7.5	6.1	-4.7	-3.5
Sicilia	6.5	5.3	-1.9	-1.4
Sardegna	7.1	5.7	-1.4	-0.7
ITALIA	2.9	1.4	--	--

Table 2 - Net reproduction rates, with and without migration, per region, 1977-1979 and 1980-1982

	<i>With migration (multiregional)</i>		<i>In region of birth of parents</i>		<i>Without migration (uniregional)</i>	
	1977-1979	1980-1982	1977-1979	1980-1982	1977-1979	1980-1982
Piemonte	0.81	0.68	0.54	0.43	0.76	0.61
Valle d'Aosta	0.77	0.64	0.52	0.40	0.73	0.59
Lombardia	0.80	0.68	0.63	0.53	0.77	0.65
Liguria	0.69	0.58	0.45	0.35	0.63	0.52
Trentino A.A.	0.81	0.74	0.68	0.63	0.81	0.76
Veneto	0.79	0.67	0.69	0.59	0.78	0.67
Friuli V.G.	0.73	0.61	0.55	0.45	0.69	0.57
Emilia R.	0.70	0.56	0.57	0.43	0.67	0.52
Toscana	0.75	0.64	0.62	0.51	0.73	0.61
Umbria	0.80	0.71	0.65	0.57	0.79	0.72
Marche	0.82	0.70	0.70	0.58	0.82	0.69
Lazio	0.85	0.75	0.69	0.60	0.84	0.74
Abruzzi	0.85	0.79	0.66	0.62	0.85	0.80
Molise	0.85	0.81	0.56	0.53	0.83	0.81
Campania	1.07	0.97	0.89	0.81	1.15	1.06
Puglia	1.04	0.94	0.85	0.78	1.12	1.01
Basilicata	0.94	0.87	0.60	0.58	1.01	0.96
Calabria	0.95	0.88	0.67	0.65	1.03	0.95
Sicilia	0.97	0.92	0.79	0.76	1.03	0.98
Sardegna	0.94	0.86	0.77	0.70	1.00	0.91
ITALIA	0.87	0.77	--	--	0.87	0.77

Table 3 - Life expectancies at birth with and without migration, per region, 1977-1979 and 1980-1982.

	<i>With migration (multiregional)</i>		<i>Percentage spent in region of birth</i>		<i>Without migration (uniregional)</i>	
	1977-1979	1980-1982	1977-1979	1980-1982	1977-1979	1980-1982
Piemonte	73.9	74.5	68	67	73.5	74.3
Valle d'Aosta	72.9	73.7	65	63	71.9	73.0
Lombardia	73.7	74.3	77	77	73.3	74.0
Liguria	74.5	74.9	68	66	74.5	75.0
Trentino A.A.	73.6	74.3	81	81	73.4	74.2
Veneto	73.7	74.3	85	85	73.6	74.2
Friuli V.G.	73.5	74.2	76	76	73.2	73.8
Emilia R.	74.7	75.4	82	81	74.8	75.7
Toscana	75.2	75.6	82	81	75.5	75.8
Umbria	75.4	75.7	78	77	75.7	76.0
Marche	75.3	75.9	82	80	75.6	76.2
Lazio	74.8	75.1	78	77	74.9	75.1
Abruzzi	75.0	75.5	73	73	75.3	75.9
Molise	74.6	75.0	63	61	75.0	75.3
Campania	73.3	73.6	74	74	73.0	73.2
Puglia	74.3	74.8	74	74	74.7	75.1
Basilicata	74.5	74.9	58	59	75.3	75.5
Calabria	74.4	74.9	63	65	75.1	75.4
Sicilia	74.3	74.5	75	75	74.6	74.6
Sardegna	74.4	75.1	75	76	74.6	75.3
ITALIA	74.3	74.8	--	--	74.2	74.7



Tables 2 and 3 present the evolution of the two components of "natural behaviour". Fertility behaviour has been measured through the net reproduction rate, and mortality behaviour through life expectancy at birth. In both cases, results are shown as well for the uniregional approach (that is, without taking into account the possibility to out-migrate), and for the multiregional approach (with migration).

It does not come as a surprise that the single-region net reproduction rate declined in all regions. The drop was however much more pronounced in the regions of the North and the Center, that is, in those regions which already showed the lowest fertility levels. While, at the national level, the decline represented, in absolute terms, 0.10 points (from 0.87 to 0.77, that is, 12% over a three-year period), the drop was, still in absolute terms, and a fortiori in relative terms, more important in all regions of the North and the Center (except in Trentino A.A., Umbria and Lazio), and, in most cases, markedly lower than the national average in all regions of the South and the Islands (except Puglia).

If we disregard migration, there were, at the beginning of the 1980's, only two regions where the net reproduction rate was above replacement level (Campania and Puglia). Once we take into account the possibility to migrate, there is not anymore one single region where the rate is higher than one. This is due to the fact that most out-migrants from high-fertility regions usually settle in low-fertility regions, therefore lowering their net reproduction rate. Simultaneously, the multiregional rate of low fertility regions is in most cases markedly higher than their uniregional rate, because some out-migrants from those regions settle in high-fertility regions, thus leading to an increase in their reproduction rate.

A second consequence of taking migration into consideration (beside, the reduction in regional fertility disparities and the fact that all regions have now a rate which is below replacement level) concerns the capacity of a region to replace itself with its own native population. If indeed we look to the net reproduction rate in the region of birth of parents, that is, the expected number of children to be born in a given region from a person now born in the same region, then we observe that not one single region is able to replace itself with the help of its own native population. This was already so at the end of the 1970's. It was even more so at the beginning of the 1980's.

The drop in the "local" net reproduction rate was relatively marginal in most cases of the South, including the Islands (the only exceptions are Campania and Puglia). This is due to the fact, as we have seen, in these regions a relatively small decline in the fertility level was partially compensated by an improving migration balance. In most regions of the North and the Center, there was instead a cumulative process going on: a relatively larger drop in the fertility rate was reinforced by a deterioration of the migration situation, so that the local reproduction rate dropped markedly in these regions. As a result, the local rate observed in 1980-1982 was only 0.35 in Liguria (only one third the replacement level!), and only slightly above 0.40 in Piemonte, Valle d'Aosta and Emilia Romagna. The highest local rates are observed in Campania and Puglia; yet, with a local rate around 0.80, the population of these regions is far from able to replace itself with the help of its own native population.

A brief look to the life expectancies of table 3 reveals that, on the whole, life expectancies at birth increased the most in those regions where life expectancy was the lowest, that is, in the regions of the North. Correlatively, regions of the Center and the South (including the Islands), which had all (except Campania) above average life expectancies, experienced only small increases. The mortality performance of Campania is particularly poor : this region had the second lowest life expectancy in 1977-1979 and the second lowest increase. Only for regions had above average increases while having already above average life expectancies : Emilia R., Marche, Abruzzi and Sardegna. On the

whole, the results just discussed are valid as well for single region life expectancy as when migration is taken into account.

A significant way to evaluate the impact of migration is to consider the percentage of life expectancy spent in the region of birth. Some regions (Veneto, Trentino A.A., Emilia R., Toscana, Marche) are able to retain their natives during most of their life, while other regions see their natives spending as much as 40% of their life in another region (this is the case for Basilicata and Molise). Natives of Piemonte, Liguria and Calabria also spend a considerable part (about one third) of their life out of their region of birth.

These percentages have remained relatively constant during the period considered. This reflects the fact that between 1977-1979 and 1980-1982, the level of out-migration did not vary much. If we look to the figures presented in Table 4, where the net interregional migration rate of Table 1 are decomposed into their two components, outmigration and immigration, one may indeed observe a remarkable stability of the propensity to outmigrate. The national propensity to migrate between regions remained constant. In most regions, the rate of outmigration remained either constant, or changed only marginally. The only case where a significant change may be noticed are Liguria, which experienced a non negligible increase, and Basilicata and Calabria, where a relatively important drop (about 1% in points of percentage) took place. Of course, these outmigration rates are "crude" rates, that is, they are affected by the age structure of the population. In order to eliminate the impact of the age structure, one may compute gross migraproduction rates, obtained in the same way as the total fertility rate. If we thus eliminate the impact of changes in the age structure, then it appears that the level of interregional migration actually (slightly) increased at the national level, as well as in most regions. Only six regions showed a decrease: one in the North (a very small, non significant decline in Friuli V.G.) and the others in the South (Puglia, Basilicata and Calabria) and the two Islands.

More considerable changes took place as far as immigration is concerned. First, one may observe that almost all regions of the South and the Islands experienced an increase in their rate of immigration (the only exception is Campania); while many of the regions located in the North and the Center showed a decrease in their capacity to attract people from other regions. The decline in the immigration rate was particularly pronounced in the case of Piemonte and Lombardia. Three regions experienced a remarkable increase of their rate of immigration : Umbria, Lazio and Abruzzi. One should note that, except for the latter region, the increase observed in most of the other regions of the South, including the Islands, has been relatively marginal.

The question now is : to what extent are these (on the whole, relatively small) changes in migration behaviour, when combined with the continuing decline in fertility and mortality, reflected in the stable population ? In other words, to go back to the analogy with the speedometer, to what extent did these changes in demographic behaviour affect the "demographic speed" of the various Italian regions, and what do their changes in velocity imply in the long run ? The next section is devoted to this question.

Table 4 - Annual interregional migration rates (‰), 1977-1979 and 1980-1982.

	<i>Outmigration</i>		<i>Inmigration</i>		<i>Grossmigraproduction</i>	
	77-79	80-82	77-79	80-82	77-79	80-82
Piemonte	9.2	9.2	9.5	8.2	0.74	0.76
Valle d'Aosta	9.9	10.6	11.6	11.6	0.79	0.87
Lombardia	6.5	6.3	7.4	6.8	0.52	0.52
Liguria	8.7	9.5	9.4	9.9	0.75	0.85
Trentino A.A.	5.1	5.1	4.9	4.8	0.39	0.41
Veneto	3.9	3.8	5.0	4.7	0.31	0.31
Friuli V.G.	5.9	5.7	7.4	7.5	0.49	0.48
Emilia R.	4.4	4.7	7.1	7.4	0.36	0.40
Toscana	4.4	4.7	7.0	7.1	0.37	0.40
Umbria	5.6	6.1	7.6	8.3	0.45	0.51
Marche	4.6	5.0	6.4	6.6	0.37	0.42
Lazio	6.4	6.8	7.3	8.1	0.53	0.58
Abruzzi	7.5	7.6	7.3	8.5	0.58	0.61
Molise	11.2	11.7	9.6	10.0	0.86	0.93
Campania	7.6	7.6	5.1	4.8	0.56	0.58
Puglia	7.8	7.4	5.9	6.3	0.57	0.55
Basilicata	14.5	13.6	8.3	8.7	1.08	1.06
Calabria	12.1	10.9	7.4	7.5	0.86	0.81
Sicilia	7.3	6.8	5.4	5.4	0.53	0.52
Sardegna	7.3	7.0	6.0	6.2	0.51	0.50
ITALIA	6.8	6.8	6.8	6.8	0.53	0.55

#### 4 - Stable Population Analysis, 1977-1979 and 1980-1982.

4.1 Before analyzing the evolution of the intrinsic rate and of the spatial reproductive value, we will briefly discuss the main characteristics of the stable populations corresponding to the demographic behaviour as observed in 1977-1979 and 1980-1982. Table 5 produces the share of each region in the total stable population of Italy, as well as three indicators of the age structure of this population (mean age, percentage aged less than 20 year, percentage aged 65 years and over). In order to help the interpretation of the results, we also present in this table the 1981 corresponding figures.

The *share of a region* in the total stable population of Italy may be considered as a measure of the relative "demographic speed" of that region. An increase in this share does indeed imply that the region is "running faster", demographically speaking, than other regions. The larger a region's share in the total stable population, the larger its present "demographic speed" relatively to the one shown by the other regions. As a result of demographic speed shown in the past, Lombardia was, in 1981, far ahead of all other regions, followed by Campania, Lazio, Sicilia and Piemonte. However, if we consider only the demographic speed shown in 1977-79, then Campania appears to be "running" the fastest, followed by Lombardia, Puglia, Lazio, Sicilia and Piemonte. Except for the emergence of Puglia, the ranking does not change much, at least among the "leaders". However, "distance" between these leaders and the rest of the runners has increased considerably.

Indeed, one of the most dramatic difference between the regional distribution observed in 1981, and the one implied by the demographic speed of each region as measured in 1977-1979, lies in the growing concentration of Italy's population in a few regions. According to the 1981 census, Italy's population was relatively dispersed among regions, with only one region having more than 10% (Lombardia, with 15.7%), and the four most populous regions containing 43% of the total population. If we eliminate the weight of the past, that is, "the acquired speed" and consider only the speed shown in 1977-1979, then those four regions represent almost 57% of the total population. This increasing concentration of the population, as implied by the demographic behaviour of the end of the seventies, is accompanied by a radical shift of Italy's demographic weight in favour the four southernmost regions of continental Italy and the two Islands. Indeed, these six regions contained one third of the total population in 1981, but, according to the demographic speed shown by Italy's various regions in 1977-1979, they would represent almost half the population of the country.

Between 1977-1979 and 1980-1982, all six regions of the South (except Campania, which kept a relatively constant speed), including the two Islands, showed an increase in their relative speed, that is, their speed with respect to the other regions, as we will see later on, between 1977-1979 and 1980-1982, all regions of Italy, including those of the South, actually experienced a decline in this demographic speed. During the same period, all regions of the North and the Center (except Trentino A.A. and Lazio) showed a decline in their relative speed (or, at the least, a constant speed). In some cases, like Piemonte and Lombardia, the drop is particularly impressive (from a share of 6.3% to a share 4.8% in the first case, from 13.2% to 11.4% in the second case and this over a three-year period). The trend towards greater regional concentration and the shift towards the South are thus continuing, if not accelerating.

These changes in demographic behaviour, as reflected in the stable population, imply changes in the *age structure* of these populations. All regional populations are aging very fast, but some are going faster than others. In 1981, as a result of past demographic behaviour, the four Southern continental regions and the two Islands clearly had the youngest populations: they all had a below-average mean age, an above-average share of

Table 5 - Main characteristics of Italy's stable population, 1977-1979 and 1980-1982.

Region	Share (in %)			Mean age			% 0 - 19			% 65 +		
	Obs	Stable		Obs	Stable		Obs	Stable		Obs	Stable	
	'81	'77-79	'80-82	'81	'77-79	'80-82	'81	'77-79	'80-82	'81	'77-79	'80-82
Piemonte	7.9	6.3	4.8	38.9	41.9	45.2	25	21	17	16	19	23
Valle d'Aosta	0.2	0.1	0.1	38.0	41.9	45.0	26	20	16	14	18	22
Lombardia	15.7	13.2	11.4	36.6	41.4	44.1	28	21	18	13	18	21
Liguria	3.2	1.7	1.6	41.6	45.1	47.3	22	17	15	19	23	26
Trentino A.A.	1.5	0.8	1.0	35.7	41.5	42.9	31	22	21	13	19	21
Veneto	7.7	4.3	3.9	36.3	42.5	44.8	29	21	18	13	20	23
Friuli V.G.	2.2	1.2	1.2	39.7	43.7	45.8	25	19	16	17	21	24
Emilia R.	7.0	4.7	4.5	39.8	44.2	47.0	24	18	15	16	22	25
Toscana	6.3	4.9	4.7	39.9	43.9	46.1	24	19	17	17	22	25
Umbria	1.4	1.0	1.0	39.3	43.9	45.8	25	20	18	16	22	25
Marche	2.5	1.8	1.6	38.4	43.0	45.8	27	21	18	15	21	25
Lazio	8.8	8.7	9.2	35.8	41.7	43.7	30	22	20	12	19	22
Abruzzi	2.2	1.5	1.9	37.2	42.6	44.1	29	22	20	15	21	23
Molise	0.6	0.5	0.6	37.5	42.7	43.6	29	22	21	16	21	23
Campania	9.7	22.9	22.8	32.3	36.8	38.5	37	30	28	10	15	17
Puglia	6.8	11.9	12.4	32.9	38.2	40.2	36	29	26	11	17	19
Basilicata	1.1	0.9	1.0	34.7	40.2	41.7	33	26	24	13	19	21
Calabria	3.7	2.7	3.0	33.6	40.2	41.7	35	26	24	12	19	21
Sicilia	8.7	8.2	10.5	34.5	39.5	40.6	34	27	25	12	18	19
Sardegna	2.8	2.7	2.8	33.5	40.0	42.0	35	26	23	11	19	21
ITALIA	100.0	100.0	100.0	36.4	40.3	42.2	30	25	22	13	18	20

Note : the 1981 figures refer to the population enumerated at the Census.

the population aged less than 20 years and a below-average share of those aged 65 and over. In the rest of the country, only Trentino A.A., Veneto and Lazio had also a mean age below the national average. According to the demographic behaviour shown in 1977-1979 and 1980-1982, the latter three regions join the group of the "rest of the country" as far as aging is concerned, and among the six youngest regions, only Campania, Puglia and Sicilia still show a below-average share of people aged 65 and over.

If we concentrate on the changes between 1977-1979 and 1980-1982, then one may observe that, on the whole, the aging process, as implied by the demographic behaviour shown during these two sub-periods, is pursuing at a much faster rate in the regions where the population is already the oldest. The mean age (in years) of the stable population and the share of the stable population aged 65 and over is increasing faster (in points of percentage) in the North and the Center than in the South, including the Islands, while the share of those aged less than 20 years declined at a slower pace in the latter regions. In Molise and Sicilia, changes in demographic behaviour did have only a small impact on the aging process, but in Piemonte and Valle d'Aosta, the impact was dramatic, with an increase of more than three years in the mean age of the stable population.

As a result, regional disparities in the age structure of the stable population are increasing. For example, extreme values for the mean age were 36.8 years (Campania) and 45.1 years (Liguria) according to the 1977-1979 behaviour, a 8.3 years difference; for 1980-1982, the respective values were 38.5 years (still for Campania) and 47.3 years (still for Liguria), a 8.8 years difference. This implies a share of 17% for the 0-19 age group in the 1977-1979 stable population of Liguria, and 30% for Campania, a difference of 13 points of percentage; the 1980-1982 corresponding figures are respectively 15% and 28%, with therefore a constant difference between the extreme values. As far as the stable population aged 65 and over is concerned, the extreme were 15% and 23% for 1977-1979, and 17% and 26% for 1980-1982, a small increase in the difference.

4.2 The annual *stable growth rate* - also called *intrinsic growth rate* - is, by definition, the same for all regions. The 1977-1979 demographic behaviour implies a rate equal to -2.4‰, while the 1980-1982 rate is equal to -5.7‰: the decrease has more than doubled over a three-year period. This illustrates once more how sensitive the stable population may be to short-term changes in demographic behaviour.

Of course, the fact that all regions have the same stable growth rate does not mean that they have the same rate for each component of growth. Table 6 presents, for each region, the intrinsic birth and death rates, and the resulting intrinsic rate of natural increase, and Table 7 presents the intrinsic rates of out- and in-migration, with the corresponding intrinsic rate of net migration.

The North-South dichotomy is an obvious feature of Italy's natural increase: all four Southern most regions, plus the two Islands, have in both sub-periods an *intrinsic birth rate* above the national average and an *intrinsic death rate* below the national average, and the reverse is true for all regions of the North and the Center, plus Abruzzi and Molise, which, as far as natural increase is concerned, are thus not part of "the South". Between 1977-1979 and 1980-1982, all regions have experienced a decline in their intrinsic birth rate and a increase in their intrinsic death rate, leading to a considerable drop in the intrinsic rate of natural growth. While in 1977-1979, there were still two regions with a positive intrinsic rate of natural growth (Campania and Puglia), by 1980-1982 all regions had a negative rate, the four southern-most regions, plus the Islands, having still rates significantly above the national net rate and all other regions having rates significantly below the national average.

Table 6 - Intrinsic birth and death rates, and intrinsic rates of natural increase (in %), 1977-1979 and 1980-1982.

	<i>Births</i>		<i>Deaths</i>		<i>Natural increase</i>	
	1977-79	1980-82	1977-79	1980-82	1977-79	1980-82
Piemonte	1.01	0.75	1.58	1.84	-0.57	-1.09
Valle d'Aosta	0.97	0.73	1.65	2.85	-0.68	-1.12
Lombardia	1.03	0.81	1.56	1.76	-0.53	-0.95
Liguria	0.77	0.62	1.83	2.06	-1.06	-1.44
Trentino A.A.	1.07	0.98	1.59	1.70	-0.52	-0.72
Veneto	0.99	0.82	1.66	1.85	-0.67	-1.03
Friuli V.G.	0.87	0.71	1.75	1.95	-0.88	-1.24
Emilia R.	0.82	0.62	1.68	1.90	-0.86	-1.28
Toscana	0.89	0.73	1.64	1.85	-0.75	-1.12
Umbria	0.93	0.82	1.68	1.89	-0.75	-1.07
Marche	1.00	0.79	1.60	1.85	-0.60	-1.06
Lazio	1.08	0.90	1.51	1.68	-0.43	-0.78
Abruzzi	1.04	0.93	1.58	1.74	-0.54	-0.81
Molise	1.03	0.97	1.60	1.73	-0.57	-0.76
Campania	1.58	1.41	1.29	1.43	0.29	-0.02
Puglia	1.48	1.28	1.31	1.48	0.17	-0.20
Basilicata	1.29	1.17	1.43	1.55	-0.14	-0.38
Calabria	1.31	1.17	1.43	1.57	-0.12	-0.40
Sicilia	1.34	1.24	1.40	1.53	-0.06	-0.29
Sardegna	1.30	1.12	1.43	1.58	-0.13	-0.46
ITALIA	1.23	1.07	1.47	1.64	-0.24	-0.57

Table 7 - Intrinsic in -, out -, and net migration rates (in %) , 1977-1979 and 1980-1982.

	<i>Immigration</i>		<i>Outmigration</i>		<i>Net migration</i>	
	1977-79	1980-82	1977-79	1980-82	1977-79	1980-82
Piemonte	1.21	1.35	0.88	0.83	0.33	0.52
Valle d'Aosta	1.36	1.49	0.92	0.94	0.44	0.55
Lombardia	0.90	0.96	0.61	0.58	0.29	0.38
Liguria	1.64	1.75	0.82	0.88	0.82	0.86
Trentino A.A.	0.75	0.61	0.47	0.46	0.28	0.15
Veneto	0.78	0.80	0.35	0.34	0.43	0.51
Friuli V.G.	1.20	1.18	0.56	0.51	0.64	0.67
Emilia R.	1.03	1.12	0.41	0.41	0.62	0.71
Toscana	0.92	0.97	0.41	0.42	0.51	0.55
Umbria	1.02	1.04	0.51	0.54	0.51	0.50
Marche	0.78	0.94	0.42	0.45	0.36	0.49
Lazio	0.79	0.84	0.60	0.63	0.19	0.21
Abruzzi	0.97	0.91	0.67	0.67	0.30	0.24
Molise	1.33	1.24	1.00	1.05	0.33	0.19
Campania	0.17	0.15	0.70	0.70	-0.53	-0.55
Puglia	0.29	0.28	0.70	0.65	-0.41	-0.37
Basilicata	1.19	1.01	1.29	1.20	-0.10	-0.19
Calabria	0.92	0.77	1.04	0.93	-0.12	-0.16
Sicilia	0.47	0.33	0.65	0.61	-0.18	-0.28
Sardegna	0.51	0.47	0.62	0.58	-0.11	-0.11
ITALIA	0.65	0.63	0.65	0.63	--	--



The gap between "North" and "South" is much less evident when we consider outmigration. Of course, the six regions of the South have above-average *intrinsic rates of outmigration*, but they share this situation with Piemonte, Valle d'Aosta and Liguria, while the two Islands are not member of this group. However, once we look to net migration, then we find again exactly the same North-South dichotomy as observed for natural increase, with the four southern-most regions of continental Italy, plus the Islands, have negative net rates and all other regions positive net rates.

Migration behaviour represents a particularly clear illustration of the importance of distinguishing observed rates and intrinsic rates. Indeed, if we compare the evolution of observed in- and outmigration rates (Table 4), and of observed net migration rates (Table 1), with the evolution of the corresponding intrinsic rates (Table 7), then marked differences come to light. The case of Piemonte provides a good example. Between 1977-1979 and 1980-1982, this region experienced a constant rate of outmigration, a significant drop in the rate of immigration, and consequently a pronounced decline in the observed rate of net migration (the net rate actually becoming negative). But if we look to intrinsic rates, the feature is totally different: the intrinsic rate of outmigration decreases, the intrinsic rate of immigration significantly increases, and as a result the rate of net migration shows a marked increase and remains positive.

As we have seen before (Table 1), the observed rate of net migration declined in all four regions of the North-West; yet, the intrinsic net rate increased. Opposite evolution of the net rates may also be found for Veneto, Toscana, Umbria, Marche, Abruzzi, Basilicata, Calabria and Sicilia. These examples show how important may be the "weight of the past"; more precisely, the age structure of the population and the regional disparities in the differences between observed and intrinsic rates of natural increase play a crucial role. As shown by Preston (1986), these differences between observed and intrinsic rates have a precise demographic significance, in terms of the age pattern of the various demographic events and, therefore, of demographic growth (on this subject, see also Preston and Coale, 1982).

By definition, all regions have the same stable growth rate, equal to the national rate of natural increase. If we sum the intrinsic rate of natural increase (Table 6) with the corresponding intrinsic rate of net migration (Table 7), we indeed observe that (except for rounding) the 1977-1979 total is, for each region, equal to -0.24, and the 1980-1982 total to -0.57, that is, the national intrinsic rates of natural increase for the two sub-periods.

Changes in fertility, mortality, and migration behaviour are not the same for each region, and the impact of these changes on the stable growth rate are not the same either. In other words, the evolution in the stable growth rate is the same for each region, but the role of each component of growth in this change may vary. Table 8 decomposes the -0.33% change (from -0.24% to -0.57%) of the stable growth rate into its four components.

It is clear from the result presented in this table, that, in most cases, changes in migration behaviour between 1977-1979 and 1980-1982, did have only a minor impact on the evolution of the stable growth rate. The intrinsic rate of outmigration did not vary much, except for Basilicata and Calabria. Intrinsic rates of immigration varied more widely, so that in a few regions (Piemonte, Liguria, Marche, Molise, Basilicata, Calabria and Sicilia), changes in migration behaviour had a relatively large contribution to the evolution of the stable growth rate.

As seen before (Table 5), the changes in demographic behaviour between 1977-1979 and 1980-1982 imply a rapid aging of the population. As a result, one may observe that, on the whole, the change in the intrinsic death rate is of the same magnitude as the change in the birth rate. Because aging is proceeding much faster in the regions of the North and the Center, the changes in the intrinsic death rate are much more pronounced in these regions

Table 8 - Variation of intrinsic rates between 1977-1979 and 1980-1982

	<i>Birth</i>	<i>Death</i>	<i>Immigration</i>	<i>Outmigration</i>
Piemonte	-0.26	-0.26	0.14	0.05
Valle d'Aosta	-0.26	-0.20	0.13	-0.02
Lombardia	-0.22	-0.70	0.06	0.03
Liguria	-0.15	-0.23	0.11	-0.06
Trentino A.A.	-0.09	-0.11	-0.14	0.01
Veneto	-0.17	-0.19	0.02	0.01
Friuli V.G.	-0.16	-0.20	-0.02	0.05
Emilia R.	-0.20	-0.22	0.09	0.00
Toscana	-0.16	-0.21	0.05	-0.01
Umbria	-0.11	-0.21	0.02	-0.03
Marche	-0.21	-0.25	0.16	-0.03
Lazio	-0.18	-0.17	0.05	-0.03
Abruzzi	-0.11	-0.16	-0.06	0.00
Molise	-0.06	-0.13	-0.09	-0.05
Campania	-0.17	-0.14	-0.02	0.00
Puglia	-0.20	-0.17	-0.01	0.05
Basilicata	-0.12	-0.12	-0.18	0.09
Calabria	-0.14	-0.14	-0.15	0.11
Sicilia	-0.10	-0.13	-0.14	0.04
Sardegna	-0.18	-0.15	-0.04	0.04
ITALIA	-0.16	-0.17	-0.02	0.02

Note : the minus sign indicates an evolution leading to a decrease in the stable growth rate. For instance, a decline in the intrinsic rate of immigration implies a negative sign while a decline in the intrinsic rate of outmigration implies a positive sign.

than in the Southern regions (the only exception in this respect is Trentino A.A.). The high "intrinsic rate of aging", combined with the marked drop in fertility, led to a considerable decline in the intrinsic birth rate. This decline was the highest in Piemonte, Valle d'Aosta and Lombardia, followed by Marche, Emilia R., and Puglia. The decline in the intrinsic birth rate was the lowest (about one fourth to one half the decline in Piemonte) in Molise, Trentino A.A., Sicilia, Umbria, Abruzzi and Basilicata. As far as the evolution of the intrinsic birth rate is concerned, we thus do not find the same clear North-South dichotomy as in the case of the intrinsic death rate.

4.3 We now turn to the question of the *regional distribution of births* within the stable population. Answering the question implies that, instead of computing net reproduction rates by combining the multiregional life-table population with the observed fertility regime, one replaces the life-table population by the stable population. One thus do not obtain anymore a net reproduction rate representing the expected number of children, but a rate expressing the number of children discounted at the moment of birth of the parent, with the stable (intrinsic) growth rate being the discount rate. Results are presented in the first part of Table 9.

As we have seen, Italy's stable growth rate is now negative. This implies that the regional *net reproduction rates* for the stable population (also called "*characteristic matrix*") will necessarily be larger than the rates obtained for the life-table population. In the case of Italy, the difference is about 6% to 7% in 1977-1979, and 17% to 19% in 1980-1982 (compare the figures on the left part of Table 9 with the corresponding figures of the first two columns of Table 2). The fact that the difference more than doubled is of course related to the fact that the stable growth rate dropped by more than 100 % (from -0.24% to -0.57 %).

Because the discount rate is the same for all regions (by definition, in a stable population, all regions have the same growth rate), the regional pattern of net reproduction rates and migraproduction rates obtained for the stable population is very similar to the regional pattern previously obtained for the life-table population (see Tables 2 and 4). This is why we will not discuss these rates any further, and proceed instead to the analysis of the reproductive value, that is, the marginal value (in terms of contribution to the stable growth of the whole population) of a new-born baby, as obtained from equation [5]. Results are shown in the second half of Table 9.

In order to facilitate interregional comparison, the reproductive value of a baby born in Piemonte has been put equal to 1.00. We need indeed a "numeraire", and the value obtained for Piemonte has been arbitrarily chosen to fulfill this function.

The results presented in Table 9 show a remarkable and increasing regional disparity in the reproductive value of a new-born baby. In 1977-1979, a baby born in Campania had a capacity to produce new lives which was 8 times larger than a baby born in Veneto, and in 1980-1982, it was ten times larger. Among all regions of the North and the Center, Piemonte shows the highest reproductive value for its new-borns. Only babies born in Lazio have a reproductive value close to it. All regions of the South (except Abruzzi), including the two Islands, have a reproductive value which is significantly above the one observed for Piemonte and Lazio. It is thus quite clear that Italy's stable growth is supported for the largest part by "the South", and this is increasingly so: except for Puglia and Sardegna, all southern regions show a marked increase, in the reproductive value of their new-borns, relatively to the value obtained for Piemonte, used as "numeraire".

However, a new-born baby may have a large reproductive value in a given region, and yet, if this region is small, if only a small number of births is expected in this region, then, not much will be added to the total number of births in the country. The per capite

Table 9 - Discounted number children and reproduction value of a person at age zero (exact age), 1977-1979 and 1980-1982.

	<i>Discounted number</i>		<i>Reproduction value</i>	
	1977-79	1980-82	1977-79	1980-82
Piemonte	0.86	0.79	1.00	1.00
Valle d'Aosta	0.82	0.75	0.71	0.71
Lombardia	0.85	0.80	0.81	0.80
Liguria	0.74	0.69	0.60	0.66
Trentino A.A.	0.86	0.88	0.49	0.59
Veneto	0.84	0.79	0.43	0.41
Friuli V.G.	0.77	0.72	0.51	0.51
Emilia R.	0.75	0.66	0.48	0.52
Toscana	0.80	0.75	0.59	0.64
Umbria	0.85	0.84	0.57	0.61
Marche	0.88	0.82	0.54	0.53
Lazio	0.91	0.88	0.97	1.00
Abruzzi	0.91	0.93	0.79	0.95
Molise	0.90	0.94	1.11	1.42
Campania	1.14	1.14	3.59	4.02
Puglia	1.11	1.10	2.38	2.50
Basilicata	1.01	1.03	1.48	1.78
Calabria	1.01	1.02	1.20	1.38
Sicilia	1.04	1.07	1.31	1.83
Sardegna	1.01	1.01	1.12	1.19

reproductive values have thus to be weighted by the level and the age structure of the regional population. Table 10 presents the share of each region in the total (national) number of "discounted" children, and compares with the share of each region in the 1981 census population.

Once the reproductive value has been "weighted" (by region and by age), the reproductive "force" of the South becomes even more impressive: half the country's reproductive value is produced by Campania and Puglia, and the six regions of the South, plus the two Islands, contain 73% of Italy's reproductive value as derived from the 1980-1982 demographic behaviour (70% according to the 1977-1979 regime). In 1980-1982, the South (including the Islands) contained 36% of the total population and 47% of the total number of births. The Center represents only 9% of the total reproductive value, while its share in the total 1980-1982 population was 19% (17% of the total number of births). The North, with 45% of the total population registered in 1980-1982, had 36% of the total number of births: its share in the total reproductive value of the country is however only 18%, according to the 1980-1982 demographic regime, while it was 20% for 1977-1979. Between 1977-1979 and 1980-1982, the shift of Italy's reproductive value from North to South has thus been far from negligible, and this despite the short period considered. Losses were mainly concentrated in Piemonte and Lombardia, which together contained almost 24% of Italy's 1981 population, but only 17% of the 1977-1979 reproductive value and 12% of the 1980-1982 value. In the South, where Puglia experienced a slight drop in its remarkable high reproductive value, Campania and Sicilia (together representing 18% of the 1981 population) had their reproductive value increasing from 44% to 48%.

## 5. Conclusion

The marked difference between the level and the evolution of the observed rates and of the "stable" rates (particularly as far as migration is concerned), the considerable discrepancy between the observed regional distribution of the population and of births, and the regional distribution of the reproductive value of this population, the pronounced acceleration of the aging process when we look to the evolution of the age structure of the stable population, represent only a few examples of the importance of eliminating the "weight of the past" when analyzing changes in demographic behaviour. The inertia due to the heritage of the past does not always allow us to fully perceive the importance of these changes are considered. These discrepancies between the observed situation and the "intrinsic" situation have a clear demographic meaning, which in this short report could however not be fully discussed. This paper should be viewed only as a first step towards building a flexible and yet comprehensive tool of multiregional short-term demographic analysis.

Table 10 - Reproductive value of the total population 1977-1979 and 1980-1982. Share (in %) of each region in the total discounted number of children and in the 1981 population.

Region	<i>Share in total reproductive value</i>		<i>Share in 1981 population</i>
	1977-79	1980-82	
Piemonte	4.9	4.2	7.9
Valle d'Aosta	0.2	0.1	0.2
Lombardia	8.6	7.5	15.7
Liguria	1.0	1.0	3.2
Trentino A.A.	0.6	0.7	1.5
Veneto	2.4	2.1	7.7
Friuli V.G.	0.6	0.6	2.2
Emilia R.	1.9	1.8	7.0
Toscana	2.2	2.2	6.3
Umbria	0.5	0.5	1.4
Marche	0.9	0.8	2.5
Lazio	6.4	5.9	8.8
Abruzzi	1.2	1.3	2.2
Molise	0.5	0.5	0.6
Campania	34.1	35.2	9.7
Puglia	15.7	14.7	6.8
Basilicata	1.4	1.5	1.1
Calabria	4.0	4.2	3.7
Sicilia	10.0	12.7	8.7
Sardegna	3.0	2.8	2.8
ITALIA	100.0	100.0	100.0

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