TEMPORAL AND SPATIAL VARIATIONS OF OBSERVED AND PROJECTED AGE STRUCTURES IN POLAND IN THE NINETEEN EIGHTIES

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1. Introduction

In the late seventies and in the eighties we witnessed substantial changes in demographic patterns in Poland. These were: a rapid decrease in mobility after the bulge in late seventies, an increase in mortality and a bulge in fertility in early eighties followed by a substantial decrease in the late eighties. Due to the fact that these changes had an obvious spatial dimension their influence on dynamics and the structural characteristics of the regional populations were different.

Recently much attention has been paid to the question of changes of age structures, in particular to the question of ageing and young cohorts. In Europe ageing of population is in the focus of these research efforts. In Poland, where the process of ageing is neither advanced nor rapid in comparison to other European countries, not too much attention has been paid to this question up to now. A short review of literature can be found in Korcelli and Potrykowska (1988). In this paper an attempt is made to show how the fluctuating patterns of mortality, fertility and migration observed in the late seventies and the eighties have influenced the process of changes of population age structures. The point of departure for this analysis is a set of multiregional population projections based on alternative data sets referring to various points in time. The data for 1977, 1978, 1981, 1983, 1984, 1985, 1986, 1987 and 1988 are projected. A comparison of age structures obtained as results of alternative projections seems to be a very attractive way of investigating demographic characteristics of observed population. A number of empirical studies are based on this approach, namely Kawashima (1984), Korcelli (1985, 1987, 1988), Korcelli and Kupiszewski (1989) and Kupiszewski (1988). Korcelli and Kupiszewski (1989:1) pointed out that the comparison of the results of various population projections gives deeper insight into observed demographic behaviour of the population, because it "... enlarges all discrepancies and differences and allows to evaluate hypothetical consequences of the observed demographic patterns." Korcelli (1989) argues that multiple-point-based projections could be used as a set of projections with "real", instead of a set of projections with arbitrary

adopted scenarios and therefore a forecast could be placed somewhere between the highest and the lowest projection of observed population. Most papers based on the multiple-point approach concentrate on the spatial dynamics of population. In this paper the focus is on structural changes.

There are three spatial systems adopted in this study. The first one encompassing five main agglomerations and eight demo-economic macroregions (Fig.1), was designed by Dziewonski and Korcelli (1981). The main shortcoming of this regional system is that it does not take into account important rural-urban differentiation (Paradysz 1987). On the other hand it allows the results obtained to be compared with the results of earlier studies. To reveal the important dimension of the population dynamics supplementary projections of the rural-urban population based on the data of 1978, 1983 and 1988 have been done. Some results of computation obtained by Kupiszewski (1988) have been used in the present study. Neither 13-regional nor rural-urban divisions of the population present processes undergoing in the urban agglomeration and the core surrounding it. This is why an analysis of another supplementary 5-regional projections has been necessary. The first region has been created from the capital city of Warsaw, the second and third from urban and rural parts of Warsaw's outer ring respectively and the remaining two regions consist of urban and rural parts of the rest of Poland. This is a continuation of the investigations carried out by Korcelli (1987).

2. Ageing of Polish population

The problem of population ageing will be approached by first an analysis of the patterns observed in the period 1977-1988 and then the projected patterns. In each case the attention will be drawn to the temporal and spatial changes in three indices: the mean age of population, dependency ratio and percentage of very old old.

No.	Region	Constituent voivodships
1	Warsaw	Warsaw - capital city
2	Lódz	Lódz–city, Lódz
3	Gdansk	Gdansk
4	Katowice	Katowice
5	Cracow	Cracow–city, Cracow
6	East–Central	Ciechanów, Piotrków, Plock, Radom, Sieradz, Skierniewice
7	Northeast	Bialystok, Lomza, Olsztyn, Ostroleka, Suwalki
8	Nothwest	Elblag, Koszalin, Slupsk, Szczecin,
9	South	Bielsko–Biala, Czestochowa, Opole
10	Southeast	Kielce, Krosno, Nowy Sacz, Przemysl, Rzeszów, Tarnobrzeg, Tarnów
11	East	Biala, Podlaska, Chelm, Lublin, Siedlce, Zamosc
12	West–Central	Bydgoszcz, Kalisz, Konin, Pila, Poznan, Torun, Wloclawek
13	West	Gorzów, Jelenia Góra, Legnica, Leszna, Walbrzych, Wroclaw, Zielona, Góra

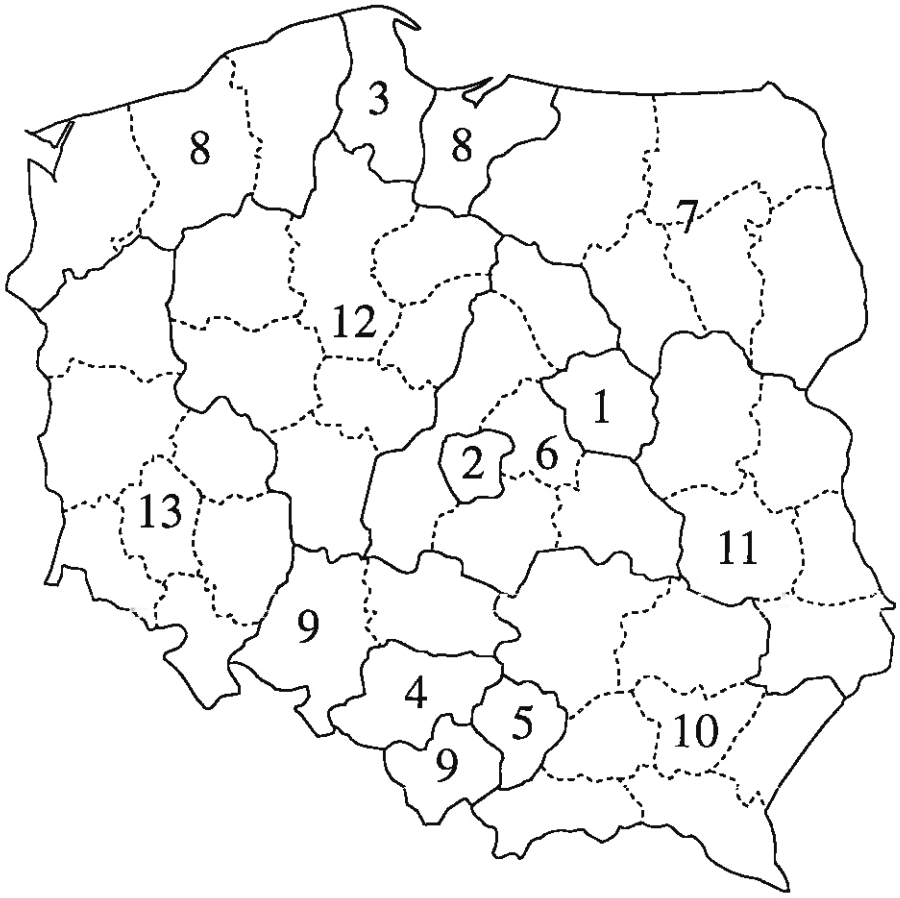

Figure 1. The 13–region division of Poland used in present study

Source: Dziewoński and Korcelli. 1981a, p. 36–37.

2.1. Observed patterns

2.1.1. Mean age of population

Changes in the mean age of the total population in Poland over the period under consideration were moderate: the yearly increase around .08 years over the period of 11 years was observed. This process was strongly differentiated from spatial point of view (Fig.2).

The difference between the mean age of urban and rural population is not very high (in 1978 the respective values equal to 32.7 and 33.2, in 1988 - 33.5 and 33.9).The fact that rural population is older than urban is due to a long lasting outflow of young people from rural to urban locations, which has distorted the age structures of both populations (Kupiszewski 1992). High fertility in rural places certainly reduced substantially the difference. The oldest population in Poland (both in 1977 and 1988, the first and the last years of the analysis) lived in urban regions Lódz and Warsaw. The data collected for the capital city of Warsaw, the remaining towns of Warsaw voievodship, the rural communes of Warsaw voievodship and two regions covering the rest of Poland allow for deeper insight into the age structure of Warsaw agglomeration. Population of the capital city of Warsaw that could be identified with the core of the functional urban region (FUR), has the population much older (by around three years) than population in the outer ring of the FUR. As the outer ring has been decomposed into rural and urban part it is possible to ascertain, that the age structure of these two "regions" is very similar.

A slightly younger, but still relatively old population lived in the Cracov and East-Central regions as well as in the East region. In the latter case it is an evident consequence of depopulation processes (Kupiszewski 1992). The youngest population lived in South-West, North-West, Gdansk and North-East regions, constituting the territories regained after the World War II. This phenomena is well known (Kosinski 1963) and originated from the post-war massive shifts of young population resettled from the Eastern pre-war territories as well as from Central Poland to the territories regained after the World War II. The only region in which the mean age of population has not changed (33.2 in 1977 and 33.3 in 1988) is Katowice. This could be attributed mainly to the

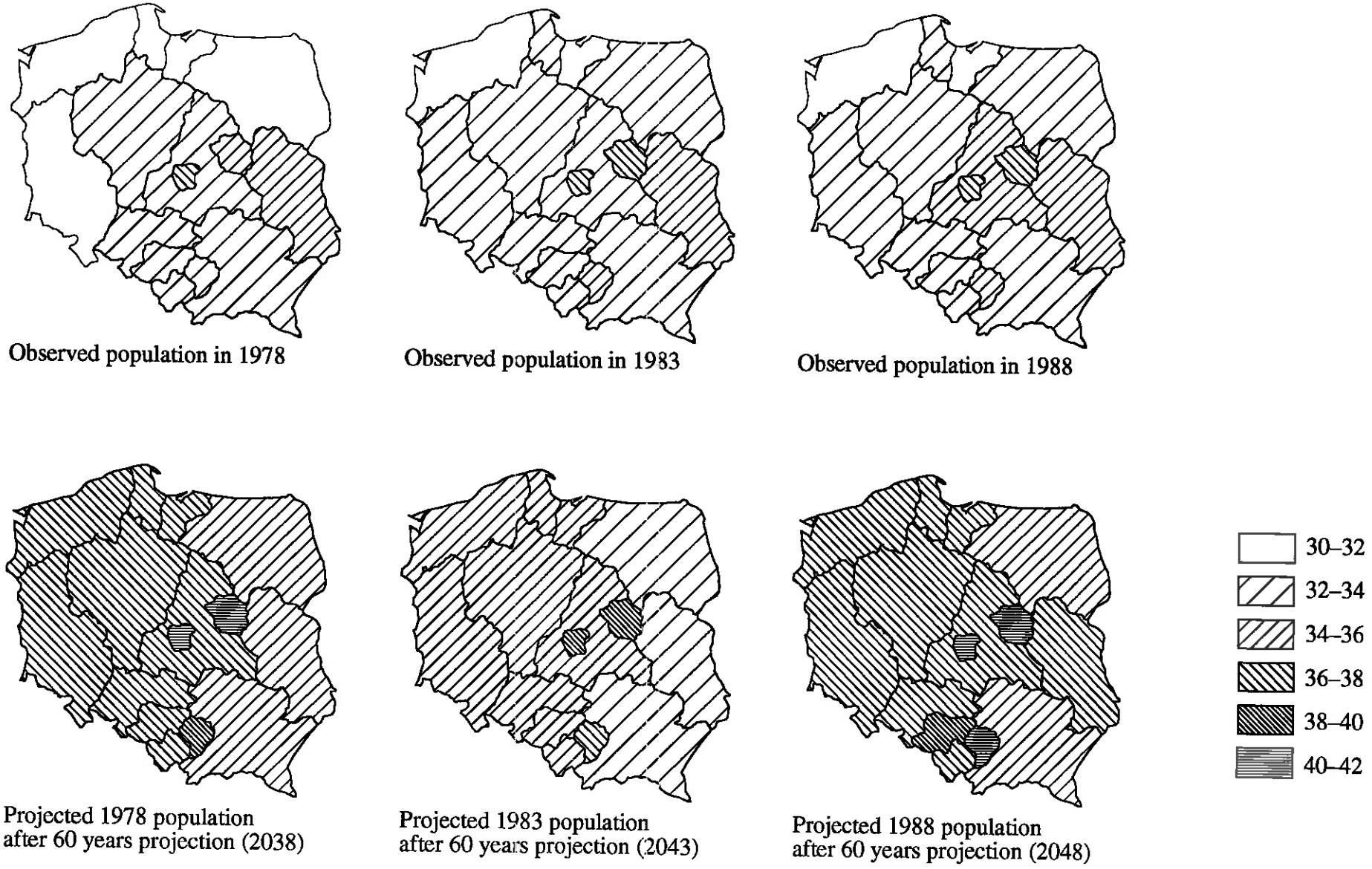

Figure 2. Mean age of observed (1978–1988) and projected (2038–2048) regional population. Migration included.

Source: Own computations based on CSO data.

difference in the age structure of migrants. Population immigrating to this region is slightly younger, whereas population outmigrating is much older than residing population. In addition, in the eighties Katowice had the highest net migration gains. In three other regions, namely South-East, East and West-Central the increase in the mean age of population was very limited (0.5 years over 11 years of observation). In West-Central region, which has relatively balanced, but negative net migration, especially in the eighties, with relations of the age structure of in- and outmigrants unfavourable from the point of view of ageing of resident population, the moderate rather than rapid growth of observed mean age was achieved only due to the above average fertility. Similar explanation of a very moderate ageing of observed population could be offered with respect to the remaining two regions (South-East and East), however it should be noted, that the two processes: high fertility (respectively the highest and second or third highest) and unfavourable structure of age of migrants are much more in contradiction than in the West-central region. To be more exact it should be said, that the difference between mean age of in- and outmigrants converge over time. in the case of the East region it decreases from 8.0 years in 1977 to 1.6 in 1988. Simultaneously migration loses decreased from -3.0 to -1.6 in the same region and over the same time span. Respective values for South-East region were -2.8 and -1.6. On the other hand there are two regions, namely North-West and South-West, which suffered from the most substantial increase of the mean age of population (1.8 and 1.7 years respectively).Both regions are characterised by moderate negative net migration (in the case of South-West region diminishing over time), with the age structure of in- and outmigrants unfavourable from the point of view of ageing of resident population. Lower than national fertility level supports the ageing process.

2.1.2. Dependency ratios

One should bear in mind that mean age does not characterise the age structure of population in a unique way. A high mean age could be achieved either due to very small cohort of very young or due to very big cohort of very old. Also, from social and economic point of view mean age of population has unclear interpretation. For better understanding of the age structures of population two dependency ratios were calculated: the first general dependency ratio (referred to as DR), where the population at the age up to 14 years plus the population

at the age over 60 is divided by the population at the age between 15 and 59 years; the second old age dependency ratio (referred to as ODR) is obtained by dividing of the population at the age over 60 by the population at the age between 15 and 59 years. DR shows how many children and the aged must be supported by one employed person, whereas ODR shows how many old people must be support by one employed.

Figures 3 and 4 present a cartographic picture of both ratios. The lowest values of DR are observed first of all in large agglomerations (Warsaw, Lódz, Katowice, Cracov) and in the Western and Northern parts of Poland (North-Western, South-Western, and Gdansk regions). Large agglomerations profit from massive migration gains and age structure of immigrants, substantial part of whom is at the age 20-29 years (in 1988 34.2% of immigrants to Warsaw region fall into this category). The highest values of DR are in South-East and East regions. Minor variations of distribution of the phenomena over time are insignificant and refer to the level of the phenomena rather than ranks of the regions. More striking is spatial division between Eastern part of Poland (South-East, East, North-East and Central-East regions) with high DR values and Western part of Poland (with Gdansk, North-Western, Central-West, South-West, South, Katowice and Cracov regions) with lower values. This pattern is persistent over projection time. It should be noted, that the values of DR increase over the time of observation.

2.1.3 Very very old

Another aspect of ageing, one of the most important from social and social policy point of view is the distribution of very old old. Usually people of the age of 85 and over are considered to be very old old. This group requires usually special attention from social services and health services. Percentage of those requiring constant supervision is the highest, what in combination with the highest percentage of one-person household imposes special requirements on the society to take care of these people.

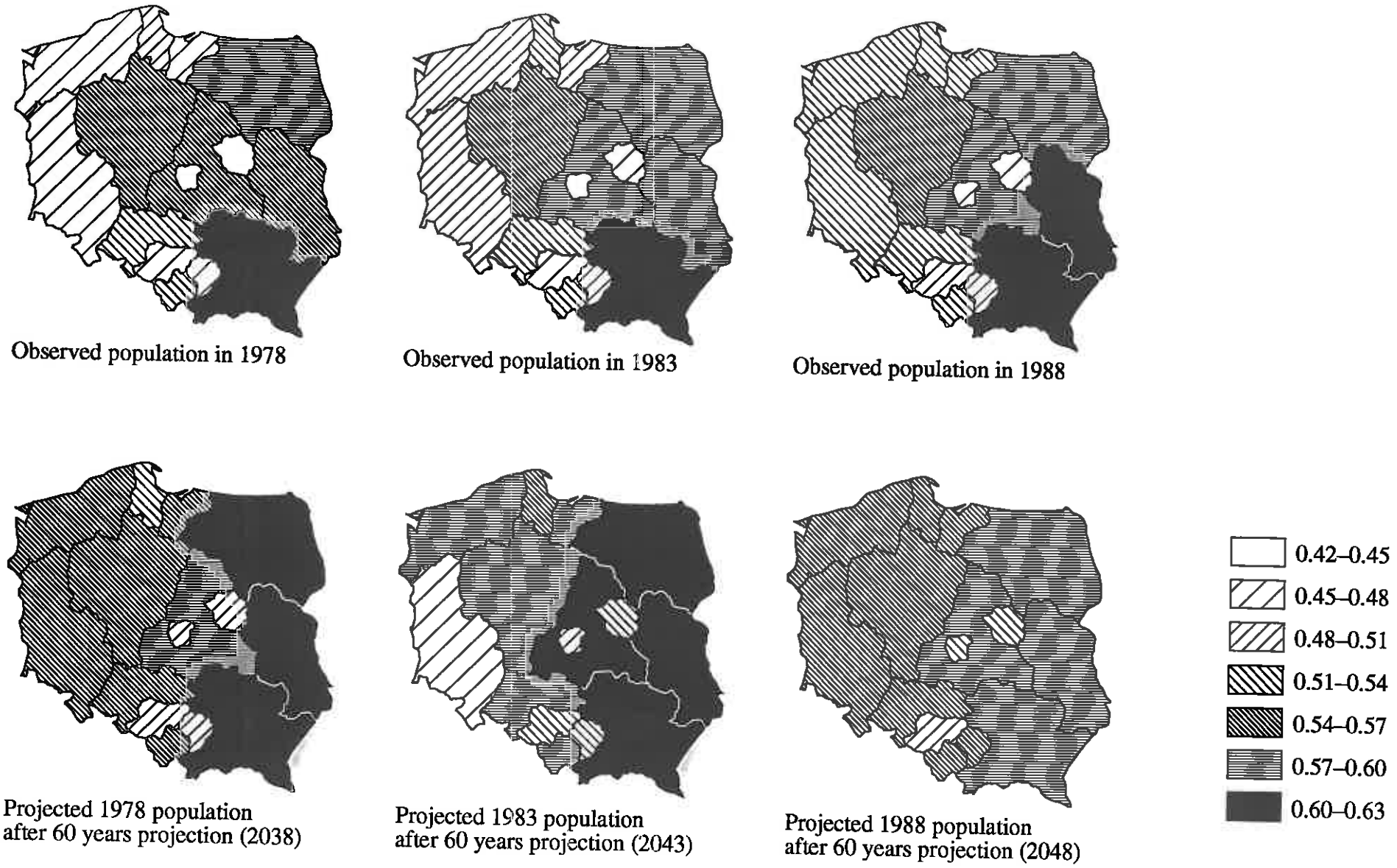

Figure 3. Dependency ratio of observed (1978–1988) and projected (2038–2048) regional population. Migration included.

Source: Own computations based on CSO data.

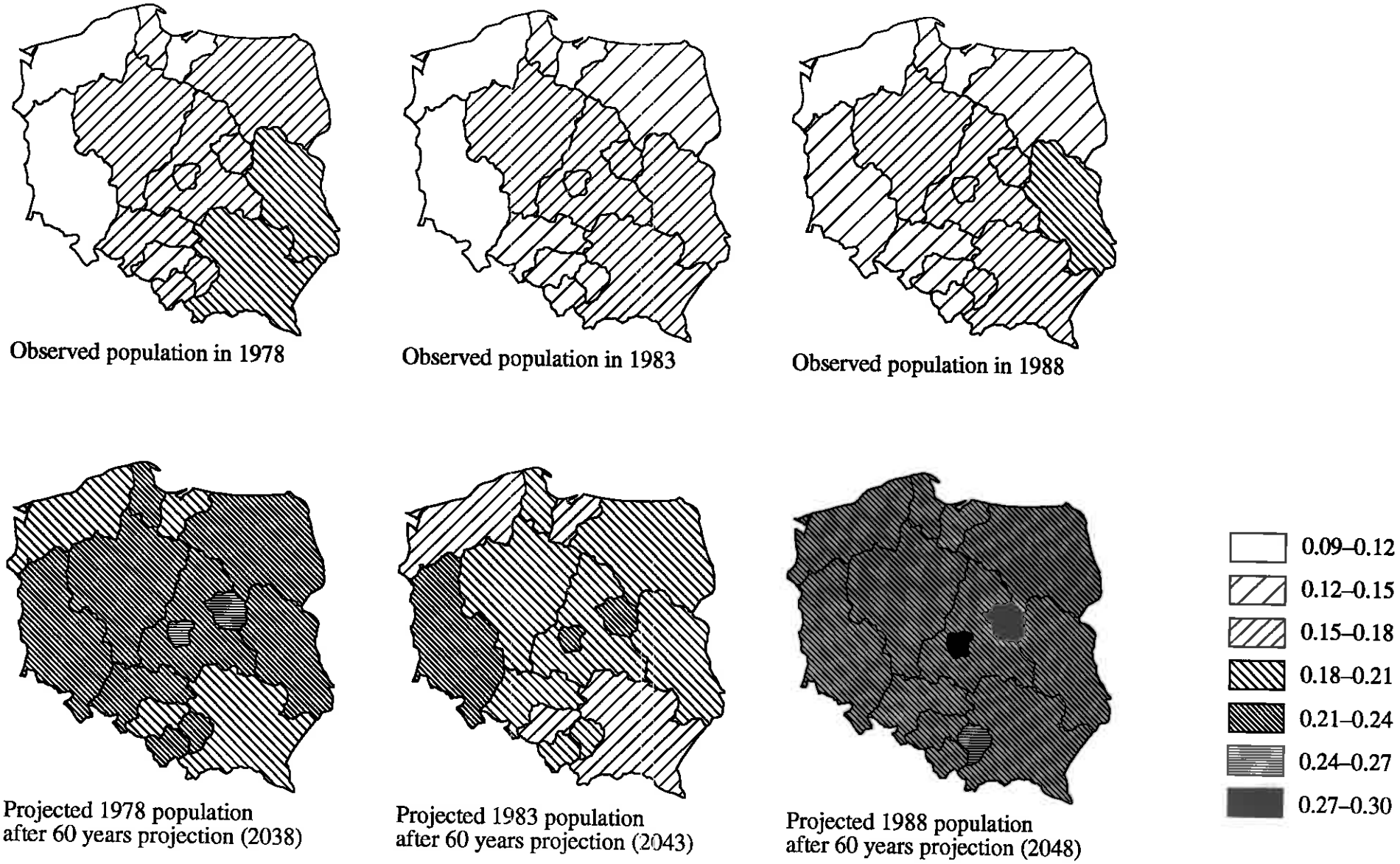

Figure 4. Old people dependency ratio of observed (1978–1988) and projected (2038–2048) regional population. Migration included.

Source: Own computations based on CSO data.

On the national scale the percent of very old old equalled 0.44 in 1978 and grew up to 0.64 in 1988. This growth must be considered as substantial. The biggest shares of population at the age of 85 and more were observed in Warsaw region (0.7% in 1983 and even more 5 years later), next went Lódz and West-Central regions (Fig.5). As one could expect from former comments on the mean age of population in the capital city of Warsaw the share of very old old was very high here and exceeded 0.8% in 1983 and even 1.0% in 1988.

The smallest shares were observed in North-West, South-West, Gdansk (constituting regained territories) and Katowice regions. After exclusion of large agglomerations one could say that as we move towards North-West of Poland the shares grow. In all cases the share of the region first in the ranking was at least twice as high as the share of the region last in the ranking.

2.2. Projected patterns

2.2.1. Mean age

Even a brief inspection of changes of mean age of population over the time of all projections shows that there are two different types of trajectories of growth of mean age of population. The first observed as a result of projections of the data for the period 1977-1981 and 1986-1988 with relatively fast and steady increase of mean age of population with maxima reached after 55 or 60 years of projection (the analysis covered only 60-years long span of time), higher for 1978 and 1985 than for 1977 and 1986 respectively and for 1981 and 1988 than for 1978 and 1987 respectively. Mean age of the stable population (which is independent on observed age structures of populations and depends only from observed age-specific rates of fertility, mortality and mobility) are in most cases lower than values after 60 years of projection. In other words the isolation of the effect of observed age structure of population at the outset of projections on ageing gives younger population than these observed in long term projections.

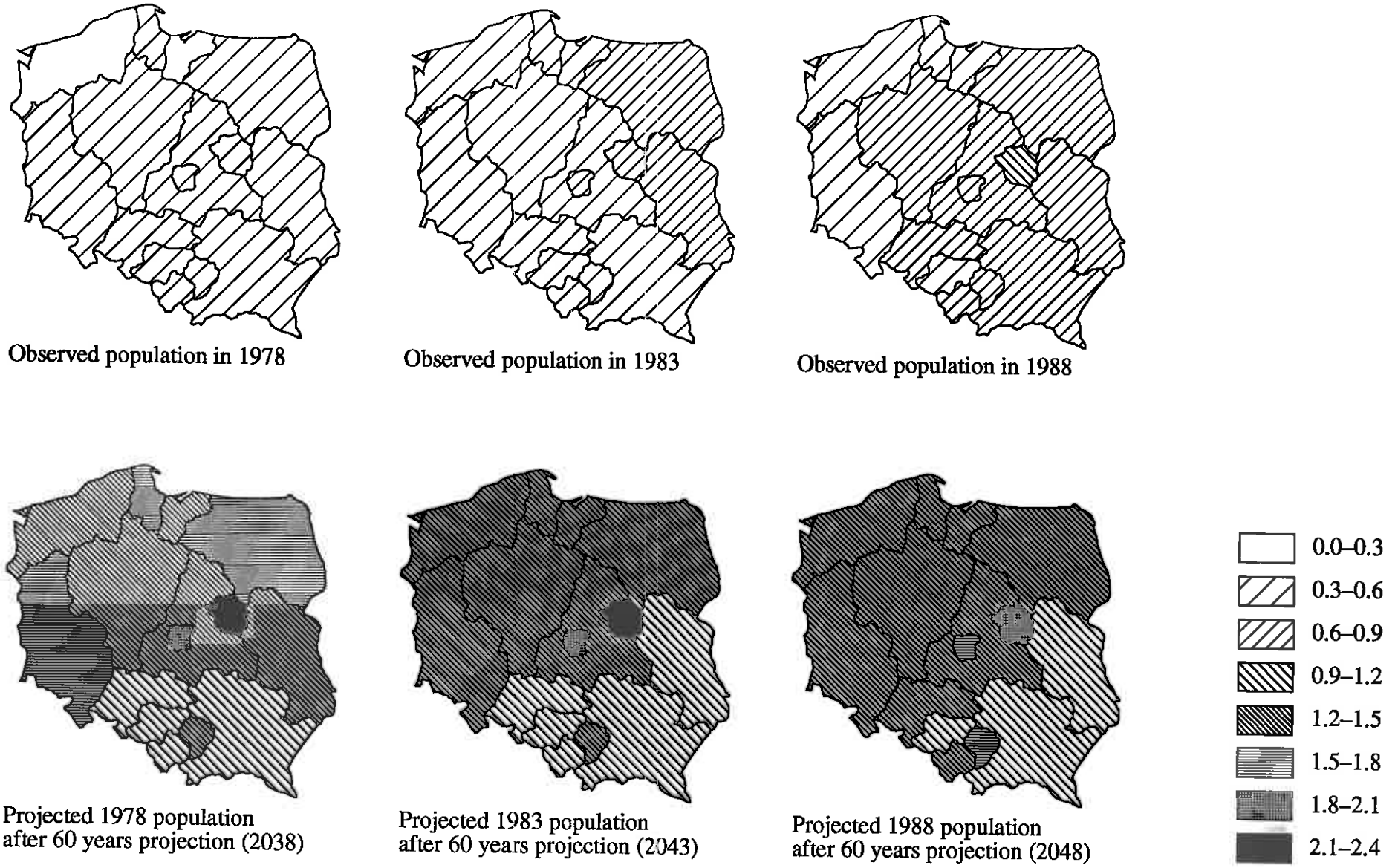

Figure 5. The shares of very old (85+) of observed (1978–1988) and projected (2038–2048) regional population. Migration included.

Source: Own computations based on CSO data.

Projection of rural-urban population shows quite fast reversal of the observed age structures. Projected rural population is younger than projected urban population. Projection of 1988 data gives the oldest urban population (38.7 years in 2048) and the largest gap between rural and urban population (3.14 years). Definitely fertility patterns observed in rural areas could "revitalise" its demographic structure whereas migration to urban areas, reduced over the time of observation, can not help much in keeping the age structure of urban areas comparable to the observed ones.

Now we proceed to the analysis of 13-regional population system. A map of mean age of projected population is presented in Figure 2. To be more exact, a very simple procedure of classification of projected patterns of changes of mean age of population has been applied. Namely for each region percentage growth of mean age over 60-years long projection based on 1983 data (approximately the middle of the period of observation under consideration) has been computed. Then an average value x and standard deviation σ has been calculated and on this basis four categories of regions has been constructed. These values could be interpreted as parameters of speed of ageing in each region. For the sake of comparison, an identical classification for 1978 and 1988 projections has been made. Table 1 shows the categories applied and distribution of regions among them.

To the first category, where the process of ageing of population in the course of projection was the slowest (values after 60 years of projection are in the interval $(x-2\sigma, x-\sigma>$ belong: the East and South-East regions.

The East region, traditionally with one of the highest fertility, high life expectancy, nearly constant mean age of observed population, high but decreasing observed migratory loses and closing gap between mean age of out- and immigrants shows substantial diversification in the patterns of changes of mean age of population over the time of projection. In the first run (1977) mean age increases at a medium pace and in the second (1978) and third (1981) runs at a low pace. In the other projections (where data for 1983, 1984 and 1985 were projected) decrease in mean age of population after 60 years of projection and of stable population was observed. The trajectories for the projections of the data of 1986, 1987 and 1988 demonstrated features very similar to those observed in the trajectories for 1977, 1978 and 1981. In all cases only during first 15 years of projection population get older. This

phenomena could be attributed mainly to high fertility increasing over time. In 1977 Net Reproduction Rate equals to 1.1587 and 1.2898 (maximum) in 1983. Slightly lower values were observed in 1984 and 1985.

A region which has similar observed and projected patterns of population is the South-East. Due to the high fertility which was able to overcome unfavourable mobility patterns (negative net migration combined with unfavourable age structure of migrants) and low mortality in all projections in this region only medium and moderate increase in the mean age of population was observed. As in the case of East region the curves discussed here could be grouped into two categories: the first for projections of the data for 1977, 1978, 1981, 1986, 1987 and 1988, with steeper growth of mean age of population and the second for projections of data of 1983, 1984 and 1985 with flatter increase of the mean age of population over projection time. This pattern is persistent over space. Values in the first set of curves are higher than values in the respective curves from the second set.

To the second category, comprising regions where moderate speed of ageing was observed (values after 60 years of projection are in the interval $(x-\sigma,x>$), belong Central-East, North-East, West-Central and Lódz regions. The Central-East region suffered from high migration losses (highest among all regions between 1977 and 1983 and in 1988) and high fertility (in most cases the fourth highest fertility after South-East, East and North-East regions). In this region the most steep trajectories of growth of mean age we re observed for projections based on the data from the most recent years.

The North-East region, with high migration losses, very similar age composition of in- and outmigrants (with exception of 1977, what has immediate response in the shape of the trajectory of growth of mean age), long life expectation and very high fertility, has characteristics of population quite similar to those described above.

In all the above regions fertility evidently counterbalanced the unfavourable or even very unfavourable effects of migration.

Geographically, regions discussed up to now create Eastern and partially Central Poland. Historically the Northern part of this territory more or less covers the area of Polish Kingdom created after the Vienna Congress in 1815,

united by the person of sovereign and actually belonged to the Russian Empire, whereas the Southern part belonged at that time to Western Galizia - part of the Austrian Empire. In the independent Poland Eastern part of former Polish Kingdom formed a western edge of so-called Poland B - the notion still having negative connotation. The whole territory was in the past underdeveloped economically, with a worse educated population, a worse infrastructure and generally speaking a worse level of life. This pattern is extremely persistent over time. (Chojnicki, Czyz 1989).

The West-Central region characterised by moderate migration losses and unfavourable age structure of migrating population with a tendency of convergence of the mean age of in- and out migrants over the time of observation and with close to the average fertility could serve as an example of a well balanced population system.

In the Lódz region a different mechanism of ageing of population is observed: this is a region with the lowest fertility (much below replacement level), and one of the highest infant mortality acting towards increase of mean age. This is to some extend counterbalanced by high overall mortality and high migration gains (with exception of mid-eighties), which are able to keep the reasonable size of ageing process. Interplay of these factors was of this kind that the differences between "steep" and "flat" trajectories are relatively small.

The third category encompasses regions in which ageing process is relatively strong (values after 60 years of projection are in the interval $(x,x+\sigma>$ i.e. South-West, Warsaw, Katowice and South regions.

Although losing population, the South-West region is characterised by an interplay of mean age of migrants typical for urban agglomerations: more younger people move in than out. As a result the ageing of population is being slowed down by migration. Due to the fact that migration losses are neglectable, fertility, being low (NRR's are very close to those observed in Cracov), plays the most important role in ageing process.

The South region, surrounding the Katowice region, differs much in demographic patterns. With the above average fertility and limited migration losses it is very close to the borderline between regions with moderate and strong ageing process. Economic changes undergoing currently in Poland

could eventually direct a stream of outmigrans from Katowice to this region, which could be a major factor influencing dynamic of population as well as ageing process in this region.

Warsaw and Katowice having similar demographic patterns could be discussed together. Characterised by low fertility (second and third lowest respectively), they do not fit into the last category only due to high migration gains (second and first respectively) and in the case of Katowice a very large difference between age structure of in- and outmigrants, never being smaller than 6 years, but in 1977 exceeding even 12 years! The last phenomena could be attributed to the high attraction of heavy and coal mining industry as well as vocational training offered on very favourable financial conditions. This has already finished, because the state had stopped enormous subsidies pumped into these two branches, that are not competitive on the free market.

A more detailed projection performed for the city of Warsaw and surrounding it rural and urban parts of outer ring shows that the ageing process in the capital city itself will be much faster than in any other region analysed in this paper. After 60 years of projection based on 1978 data the mean age of population in Warsaw reaches as much as 42.3 years, being more than 4 years higher than in the urban part of the outer ring (38.2) and over 5 years higher than in the rural part of the outer ring (36.9).Obviously a finer disaggregation of the population inhabiting Warsaw would demonstrate much more dramatic differentiation of its parts i.e. between Ursynów, a "bedroom" of Warsaw agglomeration, with relatively young demographic structure and Śródmiescie (the city centre) with a high percentage of aged and retired. Although the social consequences of this process are beyond the scope of this paper one should keep in mind that such demographic situation requires special and expensive steps on the policy makers side.

The fourth category, grouping regions with the highest speed of ageing (values after 60 years of projection are in the interval $(x+\sigma,x+2\sigma>$ consists of Cracov, North-West and Gdansk regions. Population inhabiting North-West region is the youngest and the fastest ageing among all regions This region is characterised by fertility close to the national value and moderately negative migration balance. Patterns of ageing of Cracov and Gdansk regions is shaped by low fertility which can not be outweigh by migration gains, not to mention that in the former case age structure of migrants changes between 1981 and

1983 from typical for urban agglomeration (outmigrants are older than immigrants, therefor migration process slows down ageing process of population) to typical for regions with substantial part of rural population.

Now we can proceed to the question asked at the outset of this paragraph. How stable are the patterns described above? The classification described above has not only been done for the 1983 projection, but for the 1978 and 1988 projections too. Table 1 if in any of classifications a given region has changed its position it is marked with "+" or "-" sign and a four digit number. "+" means, that in the year identified by the number in parentheses region was classified in upper (lower speed of ageing) class. Sign "-" means, that in the year given in parentheses the region was classified in lower class (higher speed of ageing).Such notation is acceptable, because none of regions was classified in more than two different classes and none of them moved in different classifications more than one class up or down. It turned out that in projection based on 1988 data classes obtained are almost identical with those obtained in classification based on projection of 1983 data. The only difference is, that in 1988 Central-East region moved to the category of regions in which ageing was the slowest. Classification based on the 1978 projection reveal bigger differences. Two highly urbanised and industrialised regions has shown faster ageing patterns in 1983 than in 1978, whereas two others: Central-West and South-East shifted in opposite direction.

An important question asked frequently in the recent investigations was, to what degree the process of ageing is influenced by migration. Rogers and Woodward (1988) introduced a concept of "ageing in place" as one of sources of growth of ageing population. In this paper a very simple method of assessing the influence of migration on ageing has been applied. Results of projections of the data for 1978, 1983 and 1988, 13 regions, with all migration set to 0 (Fig. 6) are compared with the results described earlier. It is not necessary to say, that regions gaining population will usually profit from these gains on the other way: they will "juvenilized" its population. The reasons for it are quite obvious and were discussed earlier in this paper. So we shall concentrate on quantitative side of the problem. Mean age of regional populations has been compared after 60 years of projection. The biggest gainers from the migration are, in

Table 1. Categorisation of regions according to speed of ageing in the course of projection (based on the data of 1983)

The interval in which the changes of mean age fit	Regions belonging to a given interval
$(x-2\sigma,x-\sigma>$	South-East, East
$(x-\sigma,x>$	Lódz, North-East, Central-West (-1978), Central-East (+1988)
$(x,x+\sigma>$	Warsaw, Katowice, South (+1978), South-West (-1978)
$(x+\sigma,x+2\sigma>$	Cracov (+1978), North-West, Gdansk

Source: own computations based on CSO data.

Explanations:
x - average value of the change of mean age of population
σ - standard deviation of the above

+ and - sign and the year means that in the classification for this year the region was classified in the immediately upper (+) or lower (-) category than in 1983.

terms of ageing, the biggest urban agglomerations (except Gdansk).In Warsaw region these differences are amazingly big: migration could reduce the mean age of population even by 6.31 years (1978 projections). Katowice and Cracow are the second and the third on the list of winners with the differences basically above two years. The age structure of East-Central region suffered the most from migration and this process is more and more profound (the difference for 1978 projections equals after 60 years of projection 2.1 years, whereas the same difference for 1988 projections equals 4.1 years).Also in South-East and North-East regions these differences were quite high. Gdansk is probably the most interesting: Projections based on 1978 data demonstrate that migration patterns reduced slightly the mean age of population. But in the two others projections this tendency change dramatically: projection in which migration were taken into account give for the data of 1983 the population older by 2.2 years and for the data of 1988 even 3.4 years! This simple comparison clearly demonstrate how important role in the shaping age structures of population is played by mobility.

2.2.2. Dependency ratios

Projections of population show a very clear pattern of changes of DR (Fig.3). The division between the West of Poland with low DR (as measured after 60 years of projection) and the East of Poland with high DR is evident. The highest DR are obtained in the projection based on 1983 data. The lowest values are obtained in the projection based on 1988 data. In all cases urban agglomerations are characterised by lower DR than other regions. This reverses when ODR (Fig.4) is analysed. Urban regions in all projections have the highest ODR values. High ODR linked with low or medium DR suggests very small shares of children and large shares of the oldest. This is basically corroborated by the analysis of the distribution of very old old (see paragraph 2.2.3.).

2.2.3. Very old old

The projected population (after 60 years of projection) (Fig. 5) shows some similarities in the spatial distribution of the observed phenomena, but its tension or size is bigger. To demonstrate it let us say that the share of very old

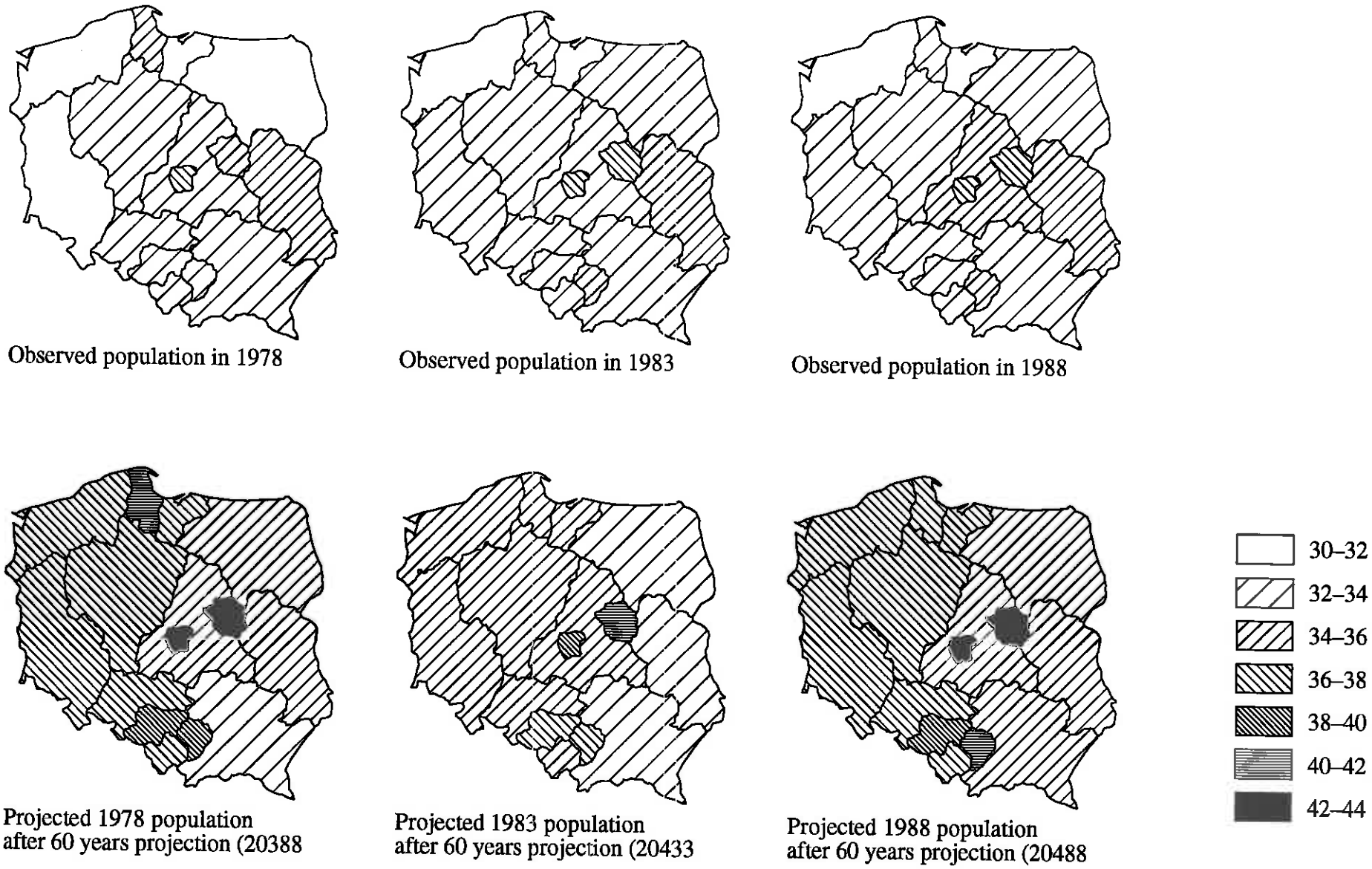

Figure 6. Mean age of observed (1978–1988) and projected (2038–2048) regional population. Migration excluded.

Source: Own computations based on CSO data.

population exceeds 2% in Warsaw region and even 2.5% for Warsaw itself. The projection process informs us about the slowest increase of the share of very old old in East region (in particular for the projection of the data of 1988). South and South-East regions will also have one of the lowest share of very old old. Katowice is the region with the lowest level of this category of population. This result does not to seem very realistic due to expected changes of migration patterns in this region (Kupiszewski 1991).

3. Conclusions

It is clear that population of Poland is growing older and that this process will continue in the future. *Status quo* projections analysed in this paper show the potential level of advancement of the phenomena over time and space. It is quite clear, that spatial division of Poland could be twofold: The biggest cities (with exception of Gdansk and Katowice) have the oldest populations. Over the time of projection situation of these cities is worsening. This, to a certain degree, concerns also Katowice and Gdansk.

Another, equally important division exists between Western and Eastern Poland, with the former with younger and the latter - older age structure of population. Some measures (mean age of population, relation between DR and ODR) suggest that this could change in the future, if the observed demographic patterns last long enough.

The oldest projected population is obtained as a result of projection of the 1988 data. This is not an accident. The trend of the ageing of population could also be observed in the projection of the 1986, and 1987 data. From the perspective of mid ninety nineties it is clear that the trend has been very persistent (Drzewieniecka, Dzienio, 1994) and very dangerous from demographic and in consequence social point of view. Weak Polish economy has problems coping with complex problems of ageing society, which could result with unsatisfactory social measures to take care and support the oldest.

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