

Czech Republic Population Prospects in the Mirror of Replacement Migration Concept¹

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Abstract

The Czech Republic population development regardless of recently improving natural development balance and its present moderate surplus does not look optimistic in perspectives posterior to the year 2010. It is only international migration which can ensure population replacement in the medium and long term perspectives. In the following text, the Replacement Migration Concept is introduced and the question “How many net immigrants would the country likely need to eliminate changes to the Czech Republic’s population number and age structure caused by expected negative natural growth?” is answered using this concept. Relying on “political” terms we are investigating to what extent is migration a solution for expected changes – population decline and ageing inducing labor force decrease, worsening relation between economically active and inactive population, etc. The overall character of the obtained findings allows us to assume that they will result in the revision of many practical thoughts on possible migration impact especially on the ageing process.

Key words: population development, international migration, replacement, projection, Czech Republic

Unquestionably, hazard is naturally rooted in many population issues. Population development of the Czech Republic, howsoever it is viewed with some optimism nowadays, does not look so optimistic in perspectives posterior to the year 2010. Currently observed slight surplus of natural growth is an ephemeral phenomenon which will be soon replaced by negative balance again. This time, the deficit is going to be permanent and deepening. It will be an unavoidable result of currently starting decrease of the number of potential mothers which will be more influential regarding the number of live births than the expected long-term rise of fertility. Analogically, decrease of mortality should seemingly paradoxically induce higher numbers of deaths due to rapidly growing population in the post-productive age. Under these conditions only international migration can ensure replacement or even growth of our population in a sixty-year time span. In the following text, after introducing the Replacement Migration Concept (RMC – including an attempt to

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pinpoint its main weaknesses), just via this concept we will try to shed light on the needed volume of migration to eliminate changes to the Czech Republic's population number and age structure caused by expected negative natural growth.

Replacement Migration Concept

Within the executive summary of the United Nations Replacement Migration Reports² (Replacement 2000, Replacement 2001) it is stipulated that: “focusing on these two striking and critical trends... (population decline and population ageing...), the present study addresses the question of whether replacement migration is a solution to declining and ageing populations. Replacement migration refers to international migration that would be needed to offset declines in the size of population and declines in the population of working age, as well as to offset the overall ageing of a population” (Replacement 2000, Replacement 2001). In this line of thought, the Report developed some hypothetical scenarios up to the year 2100 asking the following questions.

How many net immigrants would be required in selected countries³:

- to prevent a decline in total population size;
- to hold constant the number of working-age population (15 to 64 years);
- to keep the ratio of the size of the population aged 15–64 to the size of the population aged 65 or over (“potential support ratio” – PSR) from declining below the value of 3.0;
- to hold constant the “old-age (elderly) dependency ratio” frequently also labeled as “dependency ratio I” (see more in Replacement (2000) and Replacement (2001)).

Obviously according to the UN and its Report “striking and critical trends” (Replacement 2001) declining and ageing populations in many developed countries of the world were the trigger to the laying out of this study.

The report came to several significant conclusions, for instance:

- (a) During the first half of the 21st century, the populations of most developed countries are projected to become smaller and older as a result of below-replacement fertility and increased longevity.

² One can trace a “philosophy” of the RMC in studies back to Cole (1972), Romaniuc (1984), Ryder (1997) – according to Beaujot (2003) and Lesthaeghe (2000). As for other RMC studies – see e.g. Lulle (2003), Rauhut (2004).

³ France, Germany, Italy, Japan, Republic of Korea, Russian Federation, the United Kingdom, the USA but also Europe and the European Union.

- (b) In the absence of migration, the declines in population size will be even greater than those projected and population ageing will be more rapid.
- (c) For France, the United Kingdom, the United States and the European Union, the numbers of migrants needed to offset population decline are less than or comparable to recent past experience... For Italy, Japan, the Republic of Korea and Europe, a level of immigration much higher than experience in the recent past would be needed to offset population decline.
- (d) The numbers of migrants needed to offset declines in the working-age population are significantly larger than those needed to offset total population decline.
- (e) The levels of migration needed to offset population ageing (i.e. maintain potential support ratios) are extremely large, and in all cases entail significantly more immigration than occurred in the past.
- (f) Maintaining potential support ratios at current levels through replacement migration alone seems out of reach, because of the extraordinarily large numbers of migrants that would be required.
- (g) The new challenges brought about by declining and ageing populations will require objective, thorough and comprehensive reassessments of many established economic, social and political policies and programs.

Once published (in fact, during the press release conference where results of the so far not available official Report had been introduced – Coleman (2000)) it drew massive publicity and widespread media attention all over Europe⁴ (widely publicized, read, quoted and the like – Coleman (2000)). While on one hand, the Report was appreciated for the “... imaginative and adventurous systematic exploration of one aspect of a fundamental problem which affects, to varying degrees, all developed societies...” (Coleman 2000) and, indeed, a useful study (Tietelbaum 2004), on the other hand, the same authors and many others pointed out its controversial character (e.g. Martin 2004).

First of all, before depicting main arguments of those who criticize the Report, the whole concept or some of its aspects, let us confirm via latest data on the example of the EU countries that declining and ageing populations do exist (see Table 1 but also e.g. Bijak et al. (2005)).

There are also many comments and analyses as to what the demographic situation in Europe looks like. Grant et al. (2004) clearly stipulate: “Nearly all European nations are experiencing long-term downtrends in fertility, and consequently, ageing of their populations. Fertility rates are now below replacement level in nearly all

⁴ Then head of the UN Population Division, the respective Department responsible for the Report, Mr. Chamie writes: “This report ... has been the most contentious report in our fifty-five-year history at the UN. It has generated more news articles, more complaints, more discussion, and more interest than any other single report since 1946. I think we hit a nerve in Europe, maybe even the entire nervous system of Europe, with this report ...” (Chamie 2001).

Tab. 1 Declining and ageing populations (EU by countries, 2004–2050, estimated change of numbers, zero migration variant).

Total population change		Population aged 65+ change	
Country/Area	(Jan. 1, 2004 = 100)	Country/Area	(Jan. 1, 2004 = 100)
Bulgaria	71	Ireland	280
Germany	77	Cyprus	241
Italy	78	Slovakia	224
Latvia	79	Malta	206
Slovenia	79	Poland	203
Czech Republic	80	Luxembourg	200
Hungary	80	Spain	191
Greece	80	Austria	191
Estonia	81	Czech Republic	187
Romania	82	Slovenia	180
Lithuania	82	France	178
Austria	84	Netherlands	177
Spain	84	United Kingdom	172
Slovakia	86	EU-25	170
Poland	87	Portugal	170
Portugal	87	EU-15	167
EU-25	87	Finland	167
EU-15	88	Romania	166
Belgium	91	Belgium	166
Denmark	92	Denmark	158
Malta	93	Italy	157
Netherlands	93	Greece	155
Finland	93	Hungary	153
United Kingdom	96	Lithuania	152
Sweden	96	Sweden	152
Luxembourg	97	Germany	150
Cyprus	97	Estonia	135
France	103	Bulgaria	133
Ireland	117	Latvia	132

Source of data: Lanzieri (2006).

countries. As a result, natural population growth rates are entering periods of declining growth or outright decrease. At the same time, the proportion of old-age dependants continues to grow while the working-age population declines as a share of the overall population. Moreover, net immigration, which potentially could offset declines in working-age population, remains generally low in most European countries”. Tietelbaum (2001), while commenting upon a global scale adds that what is striking about the present period in the industrialized world is that “... fertility, mortality and migration ... are undergoing substantial shifts, and all in directions that

maximize their cumulative effects on important rates of demographic change ... the convergence of low fertility rates, rising life expectancy among the elderly, and high immigration lead to rates of demographic transformation in most countries that are essentially unprecedented...”. Constituting such post-industrial demographic structures reflects new life style and behavioral patterns (more individualism, more hedonism, greater efforts to find a working place of the new kind and loosening bonds with partners and relatives) (Schmid 2001). Furthermore, one has to take into account a broader structural context when behind low fertility rates are also unfavorable immediate economic circumstances for young people (McDonald 2002). All these new behavioral models, expressed mainly as the destandardization of patterns of home-leaving and household formation have found its materialization in the so-called Europe’s second demographic transition (see more in van de Kaa (1997), Lesthaeghe⁵ (2000) and Schmid (2001)).

What will the consequences of such demographic development be? There are at least two different sets of opinions. As Grant et al. (2004) argue “... taken as a whole, these demographic trends could have potentially damaging consequences for European economies. They state that, for example, it can lead to experiencing declines in human capital, which potentially reduces productivity; pensions and social insurance systems can become heavily burdened, the ability to care for the growing old-age population declines as household sizes decrease, the elderly face sharply increased health care needs and costs ... significant barriers for fulfilling the EU Social Agenda (full employment, economic growth, and social cohesion) are built ...”.

By contrast, Coleman (2000) along with others (see Feld (2000) in Coleman (2000), other authors – see below) belittle, to some extent, the whole issue and conclude that, for example, based on the EUROSTAT projections workforce in most western countries (except Italy) will either remain constant or grow substantially at least until 2020 (Coleman (2000), see also below).

Two basic questions

In the very beginning, there are two basic issues questioning the whole RMC. First, whether we should contravene the existing developments (especially low fertility rates and consequent population decline and ageing) and second, whether it is a good strategy to tackle the international migration issue at all, in other words, to try to reverse the given situation via massive inflows of international migrants.

⁵ As Lesthaeghe (2000) clearly characterizes some 1) more general transition’s features: the prolongation of education and the “democratization” of access to higher education, the emergence of a more libertarian culture with greater tolerance for alternative life styles, the expansion of the welfare state, the intergenerational transmission of family instability, growing labor market flexibility, and 2) more specific settings: cycles characterized by weakened economic opportunities for new cohorts, unfavorable housing conditions, rising consumerism, mechanisms of social diffusion, more idiosyncratic or culture specific factors.

As for the first issue, some demographers (including very distinguished ones) point out that it is a question whether both population decline and ageing are to be perceived negatively as authors of the Report implicitly do (e.g. Coleman (2000), Saczuk (2003) and Vishnevsky (2000)) and give various reasons why a rather positive perception of this issue should be preferred. Coleman (2000) informs us about the same ideas within the state administrations⁶. “Allowing population to lower itself and level off naturally is not suicidal as some have charged. But economic policy that leads to population growth that erodes the environment that sustains both economy and society is suicidal (A Ponzi Problem 2000). Now is the time not to scheme how to generate endless population growth, but rather to adapt to a stable population” (A Ponzi Problem 2000). By itself, population stabilization, or even mild reduction, is probably to be welcomed in the UK, claims Coleman (2001). The demographic problem in the developed countries may very well be exaggerated (A Ponzi Problem 2000). “It is true that over the next fifty years, the population in many European countries will begin to drop off to a lower level. But the assumption that this shift will necessarily lead to severe disruption may be unwarranted ... the transition to an older population will be gradual enough to allow time to plan, shift in the so-called ‘dependency ratio’ is exaggerated because ‘dependency’ is unsatisfactorily defined, ... nor is there clear evidence that as more people live to be older, health and social service costs will rise accordingly, people remaining fit to later ages and there is strong evidence that they can continue to make a positive contribution to the economy as workers and as consumers until relatively late ages. Social services can also be redesigned to maximize the independence of the elderly while minimizing costs” (A Ponzi Problem (2000), similarly Vishnevsky (2000)).

Among experts, comments on a stationary population as a sort of an “ideal population structure” seem to be quite popular. As Coleman (2001) mentions “...government should not lose sight of reaching, in due time, a more or less stationary population situation which could imply that in the longer term government should promote fertility stabilizing on a level guaranteeing the replacement of successive”. Clearly, in the longer run a stationary population is viewed as desirable (Government of the Netherlands (1998) – according to Coleman (2001), Romaniuc (2005), Tapinos (2000) and Lesthaeghe (2000)).

As for the second issue, many demographers agree that by words of Lutz and Scherbov (2003) migration is the most volatile of the three demographic components. There is a common agreement on immigration having a rather small impact on the age structure of a host, majority population (Beaujot (2003), similarly

⁶ “While the possibility is strongly opposed by the majority of French opinion (Chesnais 1995), official reports in the UK (1973) have welcomed the prospect of the end to growth. Official responses in Germany (Höhn 1990) have discussed the management of population decline and the Netherlands has in the past defined it as a policy aim in the long run, for example, in the 1983 government response to the Dutch Royal Commission on Population 1977” (Coleman 2000).

Saczuk (2003), Tapinos (2000), Coleman (2000 and 2001), McDonald and Kippen (1999) according to Saczuk (2003), Vishnevsky (2000), Tietelbaum (2004), A Ponzi Problem (2000), Mitra (1990) and Le Bras according to Grant et al. (2004)) and immigration as an unrealistic solution to demographic ageing (e.g. Grant et al. (2004), Coleman (2003), Lutz and Scherbov (2002 and 2003), Lesthaeghe (2000), Beaujot (2003), Tapinos (2000), Martin (2004)). More specifically let us quote Coleman (2003): "... immigrants themselves age and then require more immigrants, as it were, to replace their number. Also, there is a tendency for immigrant birth rates to converge to those of the host population although by no means a complete one. Population ageing is a consequence of low birth and death rates, not of a failure of migration; birth rates are a much more effective way of changing age-structure". The same author adds "... large scale migration is an undesirable alternative not just because it is an inefficient means to reduce population ageing but because it is also likely to present the host society with serious cultural, social and political difficulties and economic costs" (Coleman (1994) according to Coleman (2000)). Anyway, Coleman (2000) noting that today's age structure, inherited from the 20th century, is unstable and non-sustainable and that the "only way in which it could be preserved into the future is either by cutting back expectation of life to about fifty years or by persuading the average family to have at least three and a half children, or by importing rather large numbers of immigrants". Coleman (2003) indirectly calls for RMC. If one refuses the first Coleman possibility as impossible-unimaginable, the second as impossible-unrealistic, only the third one is left. Then, it is perhaps reasonable to find out: How many immigrants and under what conditions one might bring into a country while trying to offset losses of local population!

Turning back to the original UN Report, let us now pinpoint and, to some extent, also systematize, main comments that have been raised by critics of this concept.

RMC and its criticism

Publicity and related misunderstandings

- There were some unfortunate and doubtless unintended consequences of massive publicity: "The strategy and some of the phrasing of the Report and of its press release may have contributed to misunderstanding on this politically sensitive issue ..." (Coleman 2000).
- "The results of the EU preliminary estimates were widely (sometimes wildly) misinterpreted, especially, by the European press, politicians and advocacy group" (Tietelbaum 2004 and 2001).
- Terms "needed/required" were understood as "a must": "... the targets, parameters in a hypothetical scenario, have been widely interpreted by the media as policy prescriptions" (Coleman 2000). Similarly, public perception is

- that inevitably people take the (hypothetically) set target as a real target (Lutz and Scherbov 2002). Hypotheses were understood as recommendation to survive in the future; it brought about – questions, doubts and confusion concerning possible future direction of the world’s development (Saczuk 2003).
- The media zoomed in on the results of only one simulation, i.e. the one maintaining a constant potential support ratio at all times till 2050 (Lesthaeghe 2000).

Conceptual/approach matters

- The Report in various aspects seems to be incomplete. On the other hand, if there are some recommendations, they are too general (Saczuk 2003).
- There are no answers to important questions like: “Why is population decline so dangerous? Why is it considered as a problem?” (Saczuk 2003).
- Missing is a clearly formulated purpose of the study and justification of the suggestions (Saczuk 2003).
- The authors ignored the past development: “... real populations do not evolve ‘back from the future’. Demographic trends tend to be determined by past and current contexts and evolve as these contexts change ...” (Lutz and Scherbov 2002).
- There is no reference to and consideration of preceding analyses (Feld 2000).
- The authors assume that “population decline is *ipso facto* undesirable and that declines in the potential support ratio are not only undesirable but avoidable” (Coleman 2001). In a similar vein, there is no discussion whether, e.g. a constant labor force is a meaningful political goal (Lutz and Scherbov 2002), or, “... impression given was that substantial increases in immigration, some of them astronomical, were the only option in many cases to prevent declining population, declining work force and declining potential support ratio” (Coleman 2001). Similarly, there are many statements implying that the scenarios might be a realistic solution to demographic problems.
- Its concentration on immigration as the solution, one already known to be impractical at least in respect of the support ratio, gave the impression that other approaches, possibly more promising and practical, were of little consequence. Alternatives (pensions, retirement and workforce reform, productivity, more substantial changes in fertility) were noted but not evaluated in any detail. The political, social and economic costs of the large-scale immigration discussed by the Report received no special attention⁷ (Coleman (2000), similarly Saczuk (2003), Beaujot (2003), Espenshade (2002) and McDonald and Kippen (1999), according to Saczuk (2003)).

⁷ Nevertheless, one must say that the UN experts do urge governments to undertake “objective, thorough and comprehensive reassessments” of labor force participation, appropriate retirement ages, the nature and types of retirement and health care benefits available for ageing citizens, policies and programs pertaining to international migration, and the integration of immigrants and their descendants into society ... However, there is no further elaboration on these issues.

- There are problematic statements, e.g. decreasing of the labor force doesn't settle the matter, as the decrease in the labor force has not been proven to be obviously unequivocal with the disaster in the economy, ... they do not take into consideration any solutions other than demographic⁸ (Saczuk (2003), see Coleman's "demographism" in Coleman (2000)).
- One can notice neglecting of distinguishing native and immigrant population both in the basis population and in the assumption of their respective demographic behavior (Höhn (2000) and see also Coleman (2001)). Accordingly, "there is a problematic hypothesis that migrants instantaneously adopt the low fertility of the host population" (Lesthaeghe 2000).
- Strong opposition to immigration that is typical of many countries is ignored and not discussed. Negative public opinion may well restrict any options that require substantial increases in admission of immigrants (Martin 2004).
- It is unrealistic to assume continuous inward migration with no outflows (e.g. there is no possibility to influence return migrations, thus, consequently also a net-ratio – Tapinos (2000)).
- Ignoring social dynamics in a host society that predetermine as to how immigrants are accepted by a majority population (Tapinos 2000, Saczuk 2003). For example, "the history of immigration in France, as elsewhere shows that immigrants have a better chance of integrating into the host society if the native population is experiencing a natural increase" (Tapinos 2000). As also Tapinos states, "fertility and immigration are, to large extent, complementary, not substitutable" (Tapinos 2000).
- The problem of the whole RMC vis-à-vis temporary migrants, non-permanent residents – these albeit numerous are not at all taken into account (see Beaujot (2003) and Grant et al. (2004)).
- Educational profiles of the migration streams, or, more generally, quality of the labor force is ignored (Saczuk 2003).
- Illegal/irregular migrants are not discussed and their role is not commented upon – e.g. Saczuk (2003).

Technical issues

- There is a criticism targeting both the concept and the way the projection was performed (Coleman 2000).
- Sometimes rather very different "entering parameters" were used by the UN as compared to those that are used by national statistical offices (e.g. the UN versus the UK net immigration levels – Coleman 2000).

⁸ The Report "discards the fertility solution because it cannot positively affect the PSR problem in the short run ... the only other solution to the issue of aging population is to increase the mortality of the elderly, a policy which the UN recognizes as socially unacceptable. Thus, the UN and the EU turn to immigration as the only way to solve the demographic crisis..." (Ghodsee 2002).

- Working with the following age categories: 0–14, 15–64, 65 and older, does not correspond to reality in many countries (Tapinos 2000), it is more suitable for developing rather than developed ones. Also, for example, in France, there is clear shortening of the length of the working life (Tapinos 2000).
- There were no mentions of the well-known tendency of synthetic cohort measures such as the total fertility rate (TFR) to under-state contemporary fertility levels (Coleman 2000).
- There were no comments made on speculative character of projections done for a time span of 50 years (Coleman 2000).

Estimating replacement migration for the Czech Republic

One can only agree with what has been pinpointed. Nevertheless, setting aside all the above mentioned critical remarks, we evaluate the RMC as a good analytical exercise that still, must be understood as a sort of a “warning message” rather than anything else. Our contribution is a follow-up study done on the example of the Czech Republic. Our “added value” is: 1) we work on this issue in a region of Central/Eastern Europe where except Vishnevsky’s (2000) and Bijak’s et al. (2005) studies not so much has been done and 2) we elaborate on some modified categories and scenarios aiming at giving answers more relevant to the questions most frequently asked by the applied sphere.

Approach, methods and models

Replacement migration represents migration of the particular volume and structure needed to compensate the change of a given population parameter caused by natural growth as well as ageing of the concerned population, i.e. its natural developments. As such, the RMC operationalization requires first of all formulation of the assumptions on fertility and mortality future developments. The detail and format of these assumptions have to correspond to the initial sex and age structure of the studied population and the estimation methods employed.

Methodologically, there is no difference whether the assumptions are realistic or not. In practice, however, the most realistic or probable future is usually addressed. Since we also intended to remain as close as possible to the reality we have used the forecasted fertility and mortality parameters in the following application. These parameters have had to correspond with the formal requirements of the cohort component model of population growth which had been adopted for all prospective calculations in this study when estimating replacement migration.

The adopted cohort component model is a classical one in its modification incorporating migration through the annual sex and age specific numbers of the so called “net-migrants”. The population of net-migrants is a hypothetical construct

based on comparison of sex and age structures of immigrants and emigrants regardless of the fact that their numbers are empirical or merely model ones.

The principle of the cohort component projection model is that the males and females distributed according to age at the beginning of any projection step are transformed into the analogical structure in its end moving each cohort (age group) to the higher age under the exposition of all its members to the particular mortality force (here expressed in terms of survivorship ratio and its values) and to the force of migration represented by the above mentioned net-migrants. Parallel to this transformation, the missing numbers of surviving males and females in the first age group (age 0) at the end of the projection step are derived on the basis of potential mothers' numbers (females between age 15 and 49) divided by age and corresponding age-specific fertility rates, sex ratio at birth, and forces of mortality and migration during the first year of life.

In comparison with standard applications of the above mentioned projection model for analytical or forecasting purposes, when estimating replacement migration we faced one more problem. Neither the numbers of net-migrants nor any other characteristics of migration allowing their direct derivation are known in this case. Conversely, we are searching for these numbers. All we know is that the selected population parameter (reference parameter) has to be the same in the end of the projection step as it was in its beginning and that migration is an only "movable" or regulative projection parameter. Considering these conditions we were compelled to formulate a suitable estimation model and corresponding procedure first. Our research effort met with success and after several improvements we were finally able to formulate a general estimation model with the cohort component projection one in its core. Its principles can be summarized as follows:

- (1) One-step population projection based only on sex and detailed age specific fertility and mortality (survival) parameters is prepared and difference between the initial and final values of the given reference parameter or, in other words, the impact of natural reproduction is detected.
- (2) The sex and age structure of the net-migrants is fixed and the aggregated impact of the average net-migrant on a given parameter (including mortality and fertility effects) is estimated.
- (3) The total number of net-migrants in a given sex and age structure needed for elimination of the total observed change caused by natural development is estimated and tested using the cohort component model.
- (4) If there is a significant difference between the initial and final values of the reference parameter, the procedural steps (2) and (3) above have to be cyclically repeated until the value of the characteristic is zero or at least sufficiently small. Each new cycle is working with the residual difference of the preceding cycle only.
- (5) The total number of needed net-migrants is determined through those iterations and the final computations for the given projection step taking into

account all net-migrants in the particular sex and age structure are executed. The final population size and structure as well as the numbers of events and other population or reproduction characteristics are obtained.

The described iterative procedure creates a basic cycle of entire estimate and has to be repeated in all following projection steps until the entire projection period under the question is covered.

The model used for the estimation of the Czech Republic future replacement migration was built on the following preconditions:

A. Internal assumptions of the model:

- (1) All events are equally distributed in any unit time-bounded field of observation, so the mid stock numbers are equal to the arithmetic mean of the border ones and the flow numbers corresponding to any two equally extensive sub-areas of the observation field are identical.
- (2) The parameters of the model are changeable in a one-year step, the final population structure in each particular step represents the initial structure for the following one.
- (3) The net immigrants adopt demographic behavior of population in destination immediately and without reservations.
- (4) Replacement migration is estimated for both sexes together through the total number or adopted relative sex structure of the net-migrants. It means that its criteria in the case of males and females separately do not need to be necessarily reached.

B. External assumptions of the model:

- (1) Initial population size and the structure according to sex and age correspond with the Czech Republic population size and structure as on 1st January 2005 presented by the Czech Statistical Office.
- (2) The values of mortality and fertility parameters (Tab. 2) are identical with those used in the 2006 working revision of our last published Czech Republic population forecast (Burcin, Kučera and Drbohlav 2003) which covers the period 2005–2065.
- (3) Sex ratio at birth is a constant (485 females and 515 males per 1.000 live births).
- (4) The relative age structure of net-migrants by sex is represented by the adjusted recent empirical structure based on the international migration balance monitored by the official statistics during the period 2002–2004 and was taken as constant over the entire projection period. (Fig. 1)

Following the main aim of the study to fit our estimates to the most recent population forecast, we did not limit our model computations only on one scenario of expected natural development. Altogether three scenarios referring to medium, low and high

Tab. 2 Expected developments of fertility and mortality (low, medium and high variants).

Year	Fertility (Total Fertility Rate)			Mortality (Life Expectancy at Birth)					
				Males			Females		
	Low	Medium	High	Low	Medium	High	Low	Medium	High
2005*		1.29			72.9			79.1	
2010	1.36	1.42	1.45	73.4	74.1	74.9	79.7	80.3	81.0
2020	1.35	1.58	1.71	75.4	76.5	77.6	81.3	82.4	83.4
2030	1.41	1.66	1.79	77.0	78.7	80.0	82.6	84.0	85.2
2040	1.45	1.70	1.84	78.4	80.4	81.8	83.6	85.4	86.7
2050	1.47	1.73	1.87	79.7	82.0	83.4	84.6	86.7	88.0
2065	1.50	1.77	1.92	81.3	84.0	85.7	85.8	88.3	89.8

* Actual values

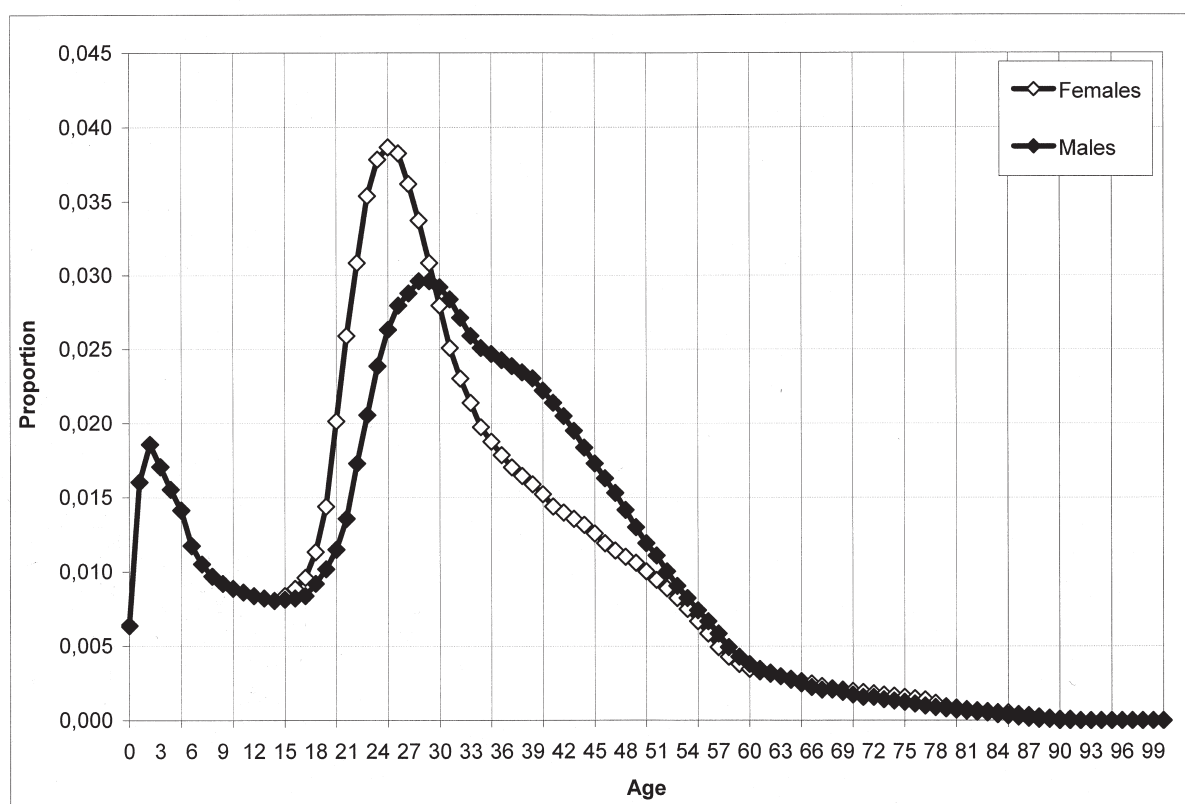


Fig. 1 Expected distribution of the net-migrants by age

variants of the forecast were employed. If the medium variant represents currently the most probable prospective development, the side variants bound the realistic futures.

In the described methodological frameworks we examined replacement conditions for four basic parameters:

- (a) Total population size
- (b) Average population age
- (c) Proportion of persons in productive age (P_{20-59}/P_{total})
- (d) (Old-age) dependency ratio I (P_{60+}/P_{20-59})

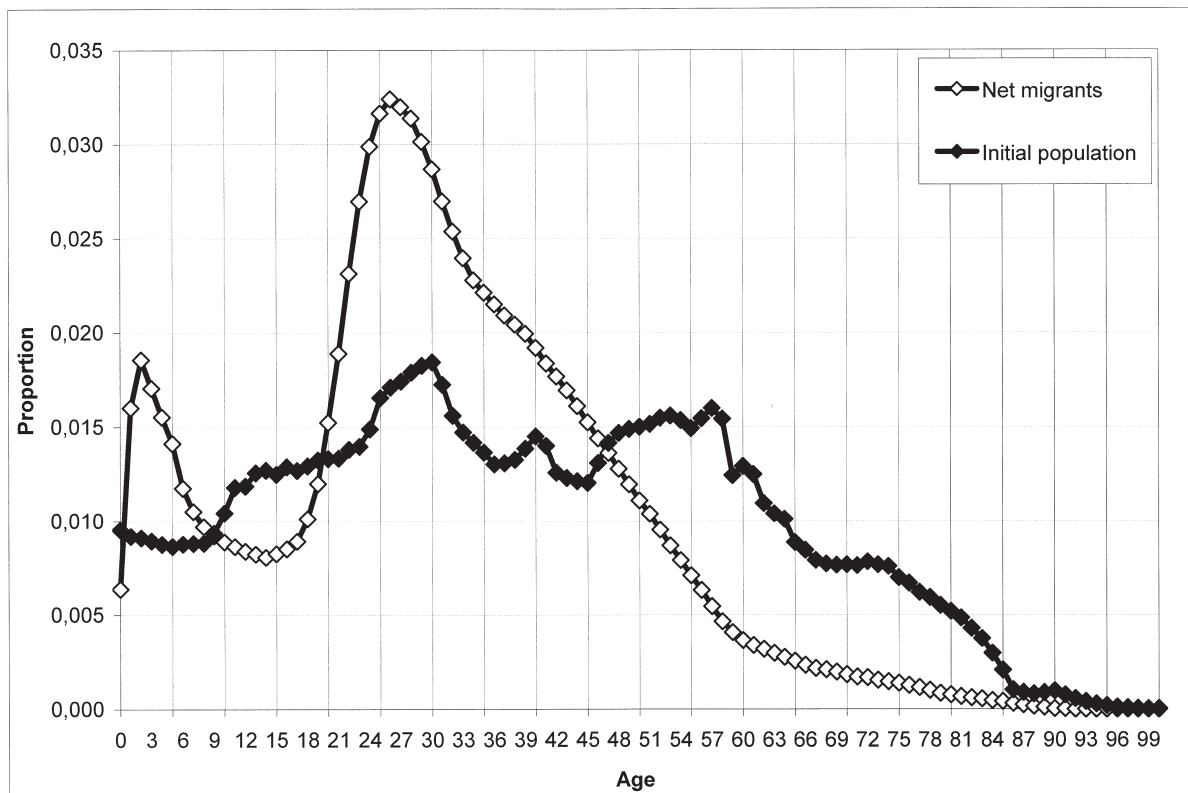


Fig. 2 Distribution of the initial population and net-migrants by age

Selection of these characteristics was conformal to current intensive discussions on population ageing and aiming at new relevant findings which could contribute to these discussions. Therefore the generally used demographic or socio-economic parameters of population structure can only be found on the list above. Driven with the same aims we also newly defined the age boundaries of the main age categories taken into consideration in our study. Our objective was to estimate numbers of economically active and non-active persons more precisely than the classical delimitation of those categories by the ages of 15 and 65 years allows. In the newly set limits we have reflected in particular the facts that (a) young people are entering the labor market later than ever before due to more frequent and longer studies and (b) the difference between *de jure* and *de facto* age at retirement is gaping open. Within these frameworks we drew and examined five future development scenarios: One serving as a standard for comparison based only on the effect of the population development natural components and four scenarios referring to “constancy” of the above listed indicators.

Basic results

The number of net-migrants needed to eliminate changes caused by natural developments is determined by two parameters in principle: by the expected size of change and by difference between the relative age structures of the population ob-

Tab. 3 Estimated natural developments of population size and structure.

Year	Total population (in thousands, as Jan. 1)			Average age (as Jan. 1)		
	Medium	High	Low	Medium	High	Low
2005*	10 221	10 221	10 221	39.77	39.77	39.77
2010	10 205	10 230	10 171	40.93	41.00	40.91
2020	10 105	10 236	9 908	43.37	43.43	43.56
2030	9 820	10 066	9 426	45.92	45.92	46.37
2040	9 392	9 753	8 791	47.76	47.69	48.40
2050	8 922	9 403	8 081	48.83	48.52	49.92
2065	8 104	8 782	6 894	49.90	49.34	51.48

* Actual values

served and population of net-migrants or more strictly saying by the difference in values of the given age structure parameter. General features of this initial dissimilarity are illustrated in the Figure 2.

The only exception from this rule is replacement migration offsetting the change of population size. In this case, solely the number of net-migrants plays an important role since the impact of the net-migrants successive reproduction on the total population size is relatively very marginal during the year of their migration.

Knowing the internal reproductive potential of the Czech Republic population which is determined by the historically constituted irregularities of the current age structure together with recent fertility and mortality developments and their prospects one can easily estimate the natural reproduction possible futures. It is highly probable that the prospective population development based only on natural exchange would be almost exclusively in the sign of population decline and rapid demographic ageing (Tab. 3).

The following presentation of basic findings is divided into three parts: the first part is devoted to the characteristic of total population, the second to the average age of population and the third covers parameters based on widely defined age categories. Illustrative overview of the obtained results allowing their comparison is presented in Table 4.

Constant total population size scenario

Replacement migration for total population size represents the simplest estimate in our gallery. As it was just mentioned, the numbers of net-migrants needed to replace the losses caused by the natural reproduction deficit are simple given by the size of this deficit. The annual deficit of natural growth is expected to increase permanently over the entire period under the observation except the forthcoming couple of years when we could theoretically expect stagnation or subtle growth of the Czech Republic population according to the medium and high variants respectively. As a result, the replacement volumes of migration represent maximally few thousands net-migrants inflow every year within next 10–15 years. In the most re-

Tab. 4 Expected needs and selected effects of replacement migration by scenarios.

Year	Total population			Average age			Productive age population (P_{20-59}/P_{total})			Dependency ratio I (P_{60+}/P_{20-59})		
	Medium	High	Low	Medium	High	Low	Medium	High	Low	Medium	High	Low
	Annual number of net-migrants (in thousands)											
2005	7	7	7	292	292	292	31	31	31	194	194	194
2010	3	-4	13	329	346	331	276	308	229	377	404	351
2020	16	5	34	548	531	634	479	603	296	364	407	318
2030	35	25	53	913	888	1 071	671	908	368	742	820	658
2040	37	27	58	1 357	1 277	1 699	1 530	1 948	1 032	1 477	1 611	1 330
2050	39	29	64	2 176	1 995	2 844	2 796	3 755	1 622	2 231	2 468	1 941
2065	44	30	72	4 208	3 790	5 854	5 340	8 043	2 494	4 439	5 002	3 775
	Cumulative number of net migrants (in thousands)											
2005	7	7	7	292	292	292	31	31	31	194	194	194
2010	18	-14	61	1 813	1 919	1 796	1 421	1 537	1 244	2 120	2 242	2 008
2020	124	-8	328	6 213	6 269	6 721	5 861	6 777	4 487	6 138	6 608	5 670
2030	399	171	781	13 696	13 568	15 401	11 562	14 325	7 653	11 796	12 877	10 662
2040	764	439	1 342	25 050	24 414	29 220	23 663	29 605	15 938	24 130	26 255	21 870
2050	1 146	721	1 961	42 785	40 828	52 054	45 584	58 340	29 594	42 835	46 851	38 375
2065	1 797	1 188	3 008	90 146	83 892	116 167	103 286	142 602	57 286	89 586	99 432	78 156
	Total population size (in thousands, as January 1)											
2005	10 221	10 221	10 221	10 221	10 221	10 221	10 221	10 221	10 221	10 221	10 221	10 221
2010	10 221	10 221	10 221	11 741	11 857	11 684	11 384	11 496	11 216	12 006	12 129	11 880
2020	10 221	10 221	10 221	16 265	16 526	16 431	15 930	16 950	14 405	16 422	17 065	15 690
2030	10 221	10 221	10 221	24 112	24 423	25 082	22 077	25 297	17 481	22 258	23 793	20 428
2040	10 221	10 221	10 221	36 474	36 651	39 271	34 525	41 610	25 208	35 109	38 168	31 432
2050	10 221	10 221	10 221	56 051	55 431	62 991	58 158	73 215	39 192	55 864	61 662	48 695
2065	10 221	10 221	10 221	109 318	105 563	130 699	123 061	169 375	68 628	108 271	122 385	90 391
	Average age (as January 1)											
2005	39.77	39.77	39.77	39.77	39.77	39.77	39.77	39.77	39.77	39.77	39.77	39.77
2010	40.92	41.01	40.87	39.77	39.77	39.77	40.00	40.00	40.08	39.59	39.59	39.64
2020	43.25	43.44	43.25	39.77	39.77	39.77	39.78	39.45	40.58	39.80	39.64	40.20
2030	45.47	45.70	45.52	39.77	39.77	39.77	40.25	39.50	41.98	40.49	40.17	41.22
2040	46.81	47.05	46.89	39.77	39.77	39.77	39.74	39.01	41.32	39.80	39.49	40.50
2050	47.49	47.56	47.76	39.77	39.77	39.77	39.04	38.37	40.47	39.46	39.11	40.23
2065	48.05	48.00	48.43	39.77	39.77	39.77	39.08	38.29	40.99	39.70	39.32	40.53

mote horizons of our observations however tens of thousands of net-migrants would very likely be annually required for offsetting the expected deficit of natural growth. These numbers are definitely not unrealistic since already today our migration balance corresponds with needs at about the year 2030.

To avoid depopulation, the Czech Republic should gain all together between 1.2 and 3.0 millions net-migrants within following 60 years, when in the most probable variant it would be about 1.8 million of them. It means that the proportion of the foreign born population in the end of the period would finally be around 15 percent in the medium variant. This number however could be substantially higher in reality and the effort to curb depopulation in our country could increase the proportion of foreign born population up to 25 per cent by the year 2065. Consequently, any volume of migration which is able to stop the decrease of the total population would not radically reduce the continual ageing of population expressed in terms of average age (please see and compare values in Tables 3 and 4).

Constant average age scenario

Dynamic increase of the Czech Republic inhabitants' average age within the past 15 years is caused by essential changes on the both sides of the age pyramid. These changes represent direct consequences of the deep fall of fertility and natality and intensive improvement of mortality, especially in higher ages, in coincidence with age structure of population and its irregularities. The observed intensive annual increase of the average age for about 0.20–0.25 year would very probably continue at least for 25 to 30 years before its successive reduction if only the natural reproduction of population is assumed. Without a rejuvenescent impact of migration it is practically certain that the average age of the Czech Republic population is going to grow for another ten or eleven years within the next 60 years. To offset existing growth potential of the average age value, about 300 thousand of net immigrants annually are needed immediately and even much more in the future. The expected progressive increase of demand for the net-migrants is implied by the frequently neglected fact that not only the initial population but also migrants are getting older as time goes by and that also an increase of their age has to be compensated by newly coming ones. Thus it is estimated that only for the year 2065 the “annual price” for a 60-year of average age constancy would be about 4.2 million new net immigrants according to the medium, most probable variant. The total price for stability during the entire period 2005–2065 would come to a difficultly imaginable 90 million net immigrants. These findings should be interpreted first of all as a sound signal of very limited manageability of the demographic ageing process in general and in the context of the Czech Republic in particular. Under the constant average age scenario, the total population of the country would reach almost 110 million by the year 2065 according to our estimate. Out of the total, about 80 million inhabitants would be born in the other countries of the world and more than 20 million would be the immigrants' descendants.

Population ageing is frequently discussed in the socio-economic context. At the same time, this context has influenced measurement and evaluation of population age structures. Among the most frequently used indicators one can find for instance proportions of widely defined age categories associated with boundaries of the so called productive age or aggregated indicators (indexes or ratios) examining relations among these categories. For the purpose of this study we selected among them two indicators: the proportion of population in productive age to the total population and partially related old-age dependency ratio I in the age delimitation specified in the methodological remarks above.

According to the size of replacement needs, these two scenarios seem to be very similar to the already discussed average age scenario. There is however a major difference between these groups of characteristics. The constancy of average age requires higher numbers of net immigrants in the case of the low variant, where lower intensity of surviving to higher ages and most especially lower natality are expected, than in the context with the high variant. It is because of the strong anti-ageing effect of a newly born child having completed age 0 at the end of the projection step. Its offset power regarding the increase of average age is more than four times higher than the power of an average net-migrant who is slightly above 31 years of age in the case of the Czech Republic. So therefore, higher natality mirrors a lower need in net-migrants.

Considering constancy of the dependency ratio, the situation is reverse. Here a higher number of children and elderly persons related to the high variant of natural growth than those related to the low one require higher numbers of inhabitants in the productive age to keep the ratio value constant over time. Since the growth of population in productive age can be in our conditions and their prospects achieved almost solely through net-immigration, the higher numbers of net immigrants are associated with the high variant of natural growth.

To keep unchanged the existing proportion of population in productive age, the annual numbers of net-immigrants needed will be lower during the first half of the observed period (before the year 2035) and substantially higher in the second one in comparison to the “average age” scenario referring in both cases to the medium variant of natural growth. Since this proportion is sensitive to the population change in all age groups, including the number of children, the required total numbers of net immigrants are higher than in the case of the dependency ratio I, where the children component is neglected. Moreover, the dispersion of the needed volume of net immigrants related to the border variants is much bigger in the case of the productive age population proportion than by the dependency ratio I since the number of children is in positive correlation with the number of elderly persons in particular variants.

More specifically, the total number of net immigrants needed within the next 60 years is approximately equal to 103 million if the proportion of population in productive age is kept constant and “only” to 90 million when keeping constant the

proportion of the numbers of inhabitants in post-productive age to those in the productive age. The range between values corresponding to the border variants is determined by approximately 143 million and 57 million net immigrants for high and low variants respectively in the case of the given proportion and 99 million and 78 million in the case of the dependency ratio I (Tab. 4).

Conclusions

Focusing on introduction of the replacement migration concept and examination of the Czech Republic population and its natural development prospects through this concept we made an attempt to answer the question whether and in to what extent is migration a solution for expected changes – population decline and ageing. Referring to the obtained results we could formulate a long list of more or less important conclusions. The findings representing the answers on the core research question are nonetheless of principal importance for any further practical thoughts on possible impact of migration on the process of ageing.

Using the model designed especially for the given purpose, the volumes of net-migration with predefined sex and age structure needed for immediate stabilization of selected parameters were estimated and examined. Our results have shown that constancy of the population size can be relatively easily reached in reality since the volumes of net-migration needed correspond to the current migration balance of the country. However, to offset the assumed changes of any parameter characterizing the age structure and its ageing by migration is *de facto* impossible even in a short term perspective since the estimated needs in net-migration inflows stay fully outside any reality.

There is no doubt that migration in the Czech Republic context is not able to prevent or even cure population of demographic ageing. All that migration of realistic dimension can do is to offset expected population decline caused by the insufficient natural reproduction and slightly reduce the most radical demonstrations of the demographic ageing process. Any higher expectations are unrealistic and signalize missing awareness of the fact that also migrants are getting older in the course of time and that their contribution to population ageing must be compensated by new net immigrants to keep selected parameters unchanged. What might be more hazardous than not to publicize such results?

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Résumé

Populační perspektivy České republiky v zrcadle konceptu Replacement Migration

Vývoj populace České republiky i přes nedávné zlepšení bilance přirozené měny a její současný mírný přírůstek nepůsobí optimisticky v perspektivě roku 2010 a později. Pouze mezinárodní migrace zajišťuje nahrazování ve střednědobé a dlouhodobé perspektivě. V článku je stručně představen koncept Replacement Migration a hledána odpověď na otázku „Jak mnoho imigrantů by země potřebovala, aby nedošlo ke změnám počtu obyvatel České republiky a jejich věkové struktury v důsledku dlouhodobě negativního přirozeného přírůstku a posunu nepravidelností této struktury?“. S ohledem na otázky často diskutované v politické sféře zkoumáme do jaké míry je migrace řešením očekávaných demografických změn – depopulace a stárnutí, které vyvolá pokles počtu pracovních sil, zhoršující se vztah mezi ekonomicky aktivním a neaktivním obyvatelstvem apod. Celkový charakter získaných výsledků nám dovoluje předpokládat, že tyto výsledky povedou k revizi mnoha představ o možném vlivu migrace na proces stárnutí u nás.