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The Impact of Population Growth on the Standard of Living: Demo-Economic Scenarios for The Netherlands

Jan H. M. Nelissen and Ad P. Vossen
Tilburg University, 5000 LE Tilburg, The Netherlands

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Abstract. The core of the article can be comprised in the question: Will population ageing become a threat to our standard of living? Because the demographic and the economic system – linked together in this question – share significant determinants, the future state of both systems has been derived from the same mother scenarios. In order to explore a broad range of possibilities two strongly contrasting mother scenarios serve as the starting-points of the analyses. The economic-demographic relationship is mediated through a simple Cobb-Douglas production function. The question of whether the ageing process will jeopardize the standard of living, is, for each of the demographic projections, answered by comparing them with three economic targets, formulated in terms of GNP per capita growth and capital stock growth. The most important conclusion is that in the long run neither of the scenarios developed will generate an economic growth comparable with that of the 1960s and 1970s.

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Résumé. L'essentiel de cet article cherche à répondre à la question suivante: le vieillissement de la population risque-t-il d'être à l'avenir une menace pour notre niveau de vie? Du fait que les systèmes tant économique que démographique – intimement liés dans cette question – ont des causes communes importantes, l'état à venir des deux systèmes a été déduit de scénarios communs. En vue d'explorer un large éventail de possibilités le point de départ de nos analyses est basé sur deux scénarios fortement opposés. La relation entre économie et démographie est posée à l'aide d'une simple fonction de production du type Cobb-Douglas. Nous répondons à la question initiale posée pour chacune des projections démographiques en comparant trois objectifs économiques, formulés en termes de croissance du PNB par habitant et d'accumulation du capital. La conclusion la plus importante est que dans le long terme aucun divers scénarios ne génère une croissance économique comparable à celle des décennies 1960 à 1970.

Correspondence to: J. H. M. Nelissen, Tilburg University, P.O. Box 90153, 5000 LE, Tilburg, The Netherlands

1. Introduction

The aim of this article is to elaborate on the question of whether population ageing will become a serious threat to the standard of living. The issue is placed within the broader field of population studies in which the relationship between population development and economic growth has always been debated. Although there is a lot of empirical evidence convincingly showing a significant relationship, the question about the exact causal character, embodied in a comprehensive theory, has never been answered satisfactorily (Simon, 1989). Most studies in this field are restricted to selected aspects of the relationship and merely analyse the impact of future demographic development on, for example, social security costs, labour supply or consumption.[1] Moreover, these studies deal with only one (official) demographic standard projection, without explicitly wondering whether the basic assumptions underlying this projection are consistent with their economic assumptions. Besides, the fact is often neglected that the variability of the population system can be very substantial, especially in the long run. In this article we will pay special attention to precisely these points by adopting a more integrated approach. This approach will enable us to see which specific demographic scenarios might or might not jeopardize the future standard of living, the latter being operationalised in terms of the gross national product per capita (GNP).

Our analysis is based on a rather direct approach, see Carlsson (1990). An alternative can be found in the attempts by economists to incorporate demographic projections into general equilibrium models. With respect to the ageing of the population, see for instance Auerbach, Kotlikoff, Hagemann and Nicoletti (1989), Masson and Tryon (1990) and Cutler, Poterba, Sheiner and Summers (1990). This general equilibrium approach makes it possible to look at the effect of ageing on the optimal timing of tax collections, interest rates and the implications of integrated world capital markets. We opted for another approach because the results from such a general equilibrium approach only refer to the steady-state situation. We, do however, focus on the question of which growth paths are feasible and if not, when will these problems arise, so that the steady-state situation generally is not relevant to us. Because our emphasis is also not on distributional (such as intergen-

[1] See for The Netherlands in this respect e.g. Goudriaan et al. (1984), Nelissen and Vossen (1985), contributions in Koninklijke Vereniging voor de Staathuishoudkunde (1987), Nieuwenhuis (1989), Petersen (1989), Vossen (1991) and Aarts and De Jong (1991).

erational) issues and the possible effect via international capital markets, the general equilibrium approach is not necessarily appropriate here.[2]

To answer our previous question – whether population ageing threatens our standard of living – we use strongly diverging scenarios for the population system. These scenarios serve as a starting-point for the economic calculations. The demographic and economic system will be connected by (different) series of labour force participation. The analyses have been carried out for The Netherlands. Since the demographic, economic and political structure of The Netherlands can more or less be considered representative for most of the modern populations, the results can *grosso modo* be generalised.

In Section 2 a three-level scenario system will be presented, followed in Section 3 by the projection results. The next section gives the resulting standard of living, considering three possible economic growth scenarios. Finally, Section 5 reviews and concludes.

2. An outline of the scenarios

We start this section by making some general remarks on the limited scope and function of our analysis. Apart from the absence of a valid and specified theory integrating the demographic and economic system, our choice for the remote future as time dimension may give additional grounds for scepticism about the credibility of the following analyses. As far as the demographic system is concerned, Ryder recently expressed the ambiguity inherent to population forecasting as follows: "One of the most useful products social science has to offer is the population forecast . . . It remains an old-fashioned art form, somewhat embarrassing to the profession, like a disreputable relative" (Ryder, 1990: 433). It is obvious that the same kind of feelings live, may be even stronger, among economists. One should bear in mind, however, that the opinions stated here regard the purely predictive power of both disciplines. It is our conviction that looking into the future can be useful even when it has little or even no predictive potential at all. As a matter of fact it can be very fruitful to confront policy makers with uncertainty instead of certainty. The kind of future study which supplies

[2] Here, it is implicitly assumed that changes in international capital flows are absent. Of course, changes in these flows affect the results (Cutler, et al., 1990: 37), but the effect heavily depends upon the degree of capital market integration. The possible effect seems to be rather limited.

consistent and coherent patterns of uncertainty is generally called a scenario approach. According to Willekens "Its goal is not to predict the future, but to provide the user with alternative internally consistent futures against which decisions can be tested and actions planned." (Willekens, 1990: 12). In terms of a typology suggested by Romaniuc the type of projection that will be presented here could best be described as a 'prospective analysis'. Romaniuc characterizes the concept as follows: "The hallmarks of this type of projection are 'potentiality' rather than 'inevitability', and 'plausibility' rather than 'certainty' or 'probability'." (Romaniuc, 1990: 23).

The resulting demo-economic long term perspectives are based on a three-level scenario system. To begin with, the situation for the year 2015 will be pictured for each of the three levels, with differing levels of specification. Unless explicitly stated, the relevant systems are assumed to be relatively stable beyond this anchor year. In general, the trajectory between the point of departure, 1990, and the year 2015 will be generated by simple interpolation procedures.

The first level (a) contains assumptions about the main elements of the 'mother' scenario, viz. general socio-cultural characteristics, general characteristics of the economic system, general characteristics of the state of technological development and finally general characteristics of governmental policy. On the second level (b) these general characteristics are specified and transposed in terms of elements of the relevant 'context' scenarios, describing the state of systems which are supposed to contain direct determinants of both demographic and economic development. As such we distinguish the *primary relations/demographic reproduction* system, the *bio-medical* system, the *international mobility* system and the *labour supply* system. On the third level (c) the expected trends derived from level b are quantified into model parameters in such a way that calculations can be made, enabling us to answer the question of what standard of living consequences might be expected from foreseen demographic and economic developments.

Two key scenarios will be elaborated in more detail, whereas another couple of scenarios will be described only generally. Both these key scenarios can be considered as specific, fairly consistent and coherent combinations of the structural elements as distinguished above. However, given the absence of theoretical knowledge providing firm causal relations between a- and b- respectively b- and c-level variables, choices between equally plausible options were occasionally inevitable. Decisions in this respect were made in such a way that the resulting scenarios might be considered as strongly discriminating – without going beyond the boundaries of what is reason-

able. This does not imply that other combinations are less imaginable or less plausible than the ones worked out in the following. Once again, what we are trying to evoke is a range of uncertainties that are inherent in looking into a distant future.

Towards a 'hyper dynamic' society: HD

The first scenario is based on the general assumption that recent trends will continue in a highly progressive, accelerating way, thus resulting in a strongly individualized society, which is oriented towards material values, prosperous, and highly dynamic. In the following, this scenario will be labeled HD for short. Transposed into the main elements of the mother scenario we can sketch the following picture of the situation in the year 2015.

* In the *socio-cultural* sphere, society can be characterized as being strongly secularized and individualized. Human action, on different levels, is predominantly based upon the rational choice principle. People are, on the whole ego-oriented, or in Durkheim's terms, very *Gesellschaft* oriented. As a consequence, the social structure is highly atomized. There is an undeniable emphasis on production and consumption in a strongly competitive, hedonistic climate.
* The *economy* operates successfully within a highly industrialized and automated production system, which is oriented towards international markets and which, due to a lack of raw materials, emphasises the tertiary sector.
* A substantial part of the economic growth is invested in a *technology* directed towards material goals, based on permanent education and leading to highly sophisticated remunerative production systems.
* Responding to socio-cultural, economic and technological trends, *government policy* is characterized by a 'laissez faire' attitude. As a consequence the concept of the welfare state is strongly eroded, and goods and services of the former public sector have been taken over by the private market sector. As a result there will be a sharp contrast in welfare between subsections within society, the proportion of 'haves' however being considerably larger than the proportion of 'have-nots'.

The situation described above ('a' level) could lead to the following states of the relevant sectors ('b' level).

* In the sphere of *primary relations and demographic reproduction*, the institution of traditional marriage will be abolished and replaced by partnership-based, individualized forms of cohabitation. Parenthood is a free

and rationalized choice of partners, where there is strong competition with the attainment of material goals. Due to high separation levels a large number of people live alone. And, since many women strive for a professional career, opportunity costs are high, so fertility will be far below replacement level.

* *Bio-medical development* is favoured by general technological progress. Due to a positive correlation between welfare and life expectancy, the latter is increasing considerably, and high quality (privatized) health provisions enable people to be active in the economy up to higher ages. Birth control has been perfected: unwanted pregnancies and involuntary childlessness are rare.
* Being a relatively small country with only a limited domestic market, there is a strong international orientation aiming at a profitable export of high quality commodities and human capital. Consequently *international geographic mobility* will be intensive. As far as permanent settlement is concerned there will be a continuous demand for low-skilled labourers from less developed countries.
* *Labour participation rates* will be high for both males and females. Retirement takes place at high ages, thus permitting people to realize their material aspirations. To meet high quality standards a long basic education period as well as permanent education are obligatory. Unpaid, voluntary jobs will be exceptional since work, including social work, has been high professionalized.

Towards an ideational system oriented towards non-material values: IV

The second key scenario is based on the core assumption that, as a reaction to current trends dominantly stressing material goals, there will be a general orientation towards a more immaterial meaningful ideational system. This scenario will be abbreviated to IV (Immaterial Values oriented). Analogous to the description of HD, we will first present the main elements of the 'mother' scenario here.

* In the *socio-cultural sphere* there is a deeply rooted consciousness of emancipation in the broadest sense, and a strong responsibility for the socially weak, on both the national and the international level. In short, people are *Gemeinschaft* oriented. Competition is replaced by caring. The social structure is thus molecularized instead of atomized. Ideology is dominated by non-material goals. There is a strong orientation to the family as well as to the environment.

* The *economic system* reflects values and goals as described above. Work is divided fairly over sexes and ethnic groups. Industrialization respects nature and is ecologically friendly. Less developed countries are supported directly as well as indirectly.
* *Technological development* is certainly not neglected. But contrary to the HD scenario, the focus is now on non-material goals, such as the protection of the environment and the support of less developed countries.
* *Government policy* plays an important role in a fair distribution of welfare over different categories of the population. There is a well organized public sector with an emphasis on social justice. Against the background of a modest economic productivity, people are stimulated to contribute to unpaid social work on a voluntary basis.

Translating these trends, the following situation can be envisaged.

* In the sphere of *primary relations* martial unions will be more stable, due among others to an equal role division between partners inside and outside the family. The male partner takes over a fair share of the traditional family activities, enabling the female partner to realize aspirations outside the direct family sphere. A substantial amount of time is spent on childcare as well as on care for the aged. In short, family commitments are strengthened. With regard to *fertility* there will no longer be constraints on the realization of the desired number of about two children.
* *Life expectancy* will increase, although in a less progressive way than was assumed in HD, because of fewer investments in technological development. Increase in longevity results from a healthier and more relaxed lifestyle.
* The attitude towards both developing countries (the economic support of people in their own country) and nature (protecting environment by avoiding overpopulation), will lead to only a modest immigration surplus.
* The two main characteristics of *labour force participation* are: an almost equal sharing of paid jobs by males and females, predominantly on a part time basis, and a considerable amount of unpaid working hours, which are likewise proportionally divided over both sexes.

So much for the description of the pattern and consequences of the two key scenarios. We shall now briefly introduce two other scenarios, which differ in character in some respects.

Trend: continuation of current trends

In the first place we will include in our analysis a recent official population forecast produced by the Netherlands Central Bureau of Statistics (NCBS, 1990). This population forecast can be regarded as a high-quality representative of the classical cohort component approach, with its extrapolation of analytically refined historical demographic trends into the future. Every year it is accurately monitored and, if necessary, adjusted. It produces projections specifying population according to age, sex and civil status for the period of 1990–2050. Demographic parameters are extrapolated until 2010 and the values are kept constant for the remaining period.

Labour market participation rates are extrapolated, resulting in a slightly diminishing male participation and an almost doubled female participation.[3] For obvious reasons this projection will be named the Trend scenario.

Zero population growth: ZPG

Reaching a stationary or zero growth population has long been considered as a panacea for a wide range of societal problems, and under strongly varying conditions; see Höhn (1987) and Lesthaeghe (1989). When restricting to developed countries, some decades ago, an average of 2.1 children (being the completed family size in a stationary population with low mortality) was viewed as a prerequisite to prevent overpopulation. Nowadays, the same, but according to actual levels relatively high, average number of children is considered to be an adequate weapon against the threat of underpopulation and ageing. Whether or not an equilibrium state of the population system can contribute in solving some of the problems that go hand in hand with demographic ageing, can be checked by comparing the results of the ZPG and the Trend scenario.

It is assumed that the demographic zero growth parameters will be reached in the year 2000 and will stay constant afterwards. In order to evaluate the 'net' benefits of a stationary population, the labour market participation rates of Trend, as briefly characterized above, will be applied in this projection variant too. The resulting scenario will be called the ZPG scenario.

A further specification of the parameter values (level c) of the scenarios

[3] Since existing projections of labour market participation rates for The Netherlands are rather divergent we roughly averaged different perspectives.

described above can be found in Table 1, which also contains currently observed values.

Both fertility parameters (total fertility rate and the standardized average age at which women have their children) beyond the anchor year 2015 are held constant at the 2015 level. The trajectories between 1990 and 2015 (between 1990 and 2000 for ZPG) are simply calculated by interpolation, with the exception of Trend, however. In this scenario (being the official Dutch forecast) the course of fertility is based on longitudinally estimated parity progression rates. As far as mortality is concerned, life expectancy for the period 2015–2060 is based on the continuation of the trend assumed between 1990–2015, except for Trend and ZPG. In the latter scenarios the 2015 level is held constant. In all scenarios external migration surpluses are fixed after 2015. The 1990–2015 trajectories are calculated again by interpolation.

Labour force participation is expressed on the aggregate level in net person years, thus indicating the average net number of years during which men and women are active in paid jobs. The ultimate 'labour force participation age profiles' for the year 2015, derived from these quantities, can be found in Fig. 1.

It will be clear that the step from the b-level to the c-level is a very crucial one. In the present case it has been carried out by the authors themselves, one being an economist and the other a demographer. In fact this procedure, which includes the transposition of the a-level to the b-level,

Table 1. Parameter values 2015.

	Fertility		Mortality		External migration	Labour force participation	
Scenario	TRF	Mean matern. age	Life expect. males	Life expect. females	Migration surplus	pers. years males	pers. years females
HD	1.25	31.0	77.0	83.5	50,000	39.0	33.0
IV	2.00	28.0	75.4	82.1	5,000	24.0	20.0
Trend	1.65	30.0	75.0 (2010)	81.5 (2010)	25,000	31.5	26.5
ZPG	2.1	30.0	75.0 (2010)	81.5 (2010)	0	31.5	26.5
1990 Values observed	1.55	29.0	73.7	79.9	40,000	33.3	14.8

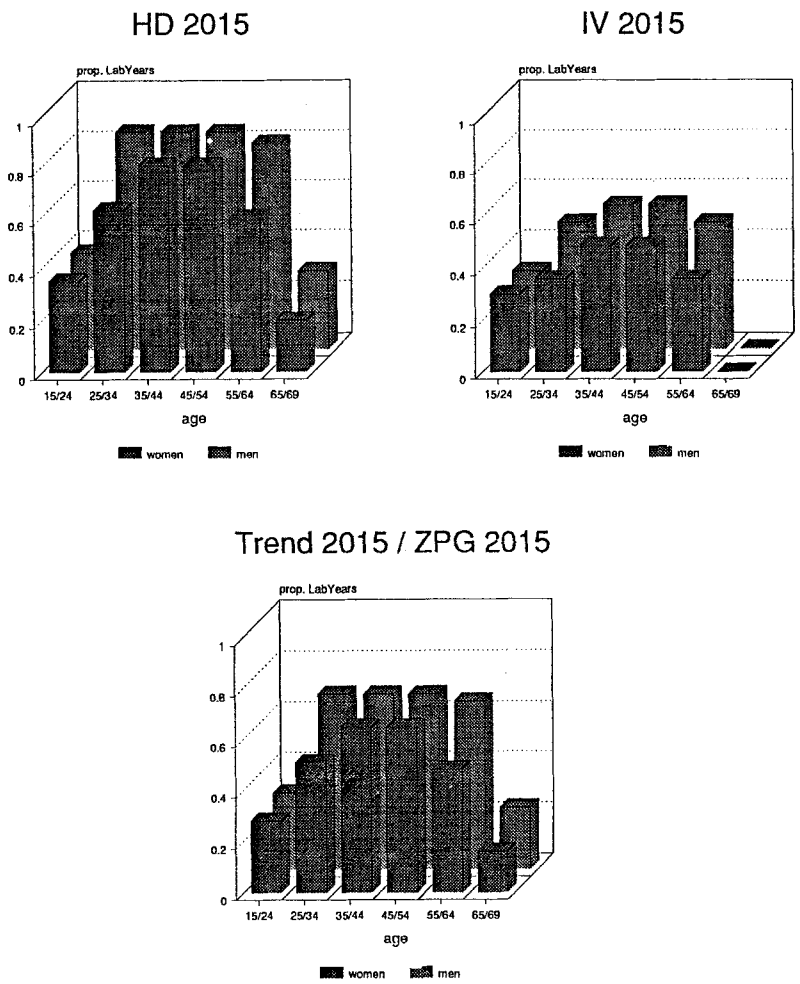

Fig. 1. Labour force participation age profiles.

should be a more formalized one. An appropriate way to proceed in this case is a Delphi approach in which a multidisciplinary team of experts tries to reach consensus in an 'iterative' process of negotiating; see Vossen (1988).

3. Projection results

Projections based on the scenarios stated above were carried out with the computer program INDEMPRO. Its results will be described briefly from graphical illustrations presenting consecutively population total, mean population age, the age structure, and finally the 'labour years/population total' ratio.

Population total

Figure 2 shows the development of population totals in the four scenarios for the period 1960–2060. The current number of inhabitants is a little over 15 million (4.3% aliens), i.e. a population density of 439 inhabitants per square kilometre, which makes The Netherlands one of the most densely national populations; see NCBS (1991). Due to the momentum of the age structure, population will continue to grow in the first coming three decades. In this period the momentum even overrules the subreplacement fertility levels in the scenarios HD and Trend. After the numerous baby boom generations have become extinct, two different trajectories gradually emerge, formed respectively by the couple IV and ZPG and the couple HD and Trend.

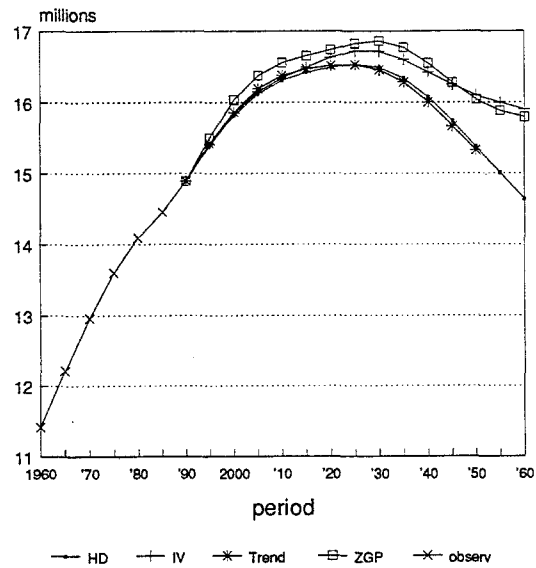

Fig. 2. Population total 1960–2060.

The former couple will, in the long run, show a rather stable population total (16 million), whereas the latter couple will show a constant decline.

Age structure

Mean population age (Fig. 3), being a first gross indicator of the population's age structure, is differing widely. Its ranking order is *grosso modo* the inverse of the population total order. All scenarios show a substantive rise, headed by HD which yields a 35% increase at the end. Both IV and Trend show a rather similar pattern. Its courses flatten or even go downwards around the year 2040, which is mainly due to the expiring of the 1945–1965 'birth plateau'.

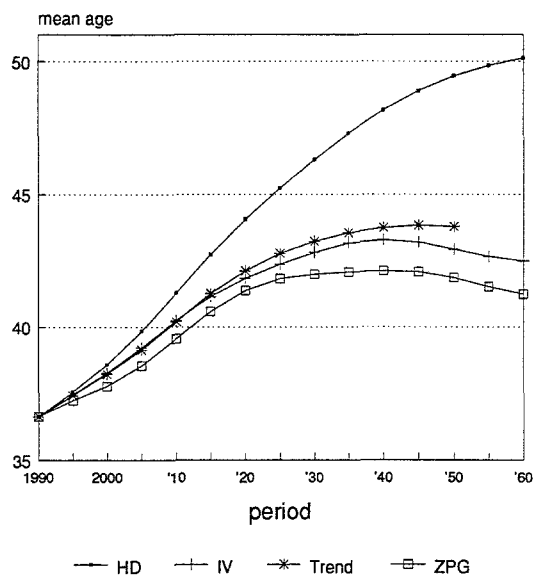

Fig. 3. Mean age 1960–2060.

A more differentiated picture of the age patterns can be obtained from Fig. 4, presenting the scenarios' age structure for 2015 and 2060 respectively.

For the year 2015 all scenarios feature the shifting of the birth plateau cohorts, through the age structure, who are at that time between 50 and 70 years old. At the end of the projection period, because parameter values have

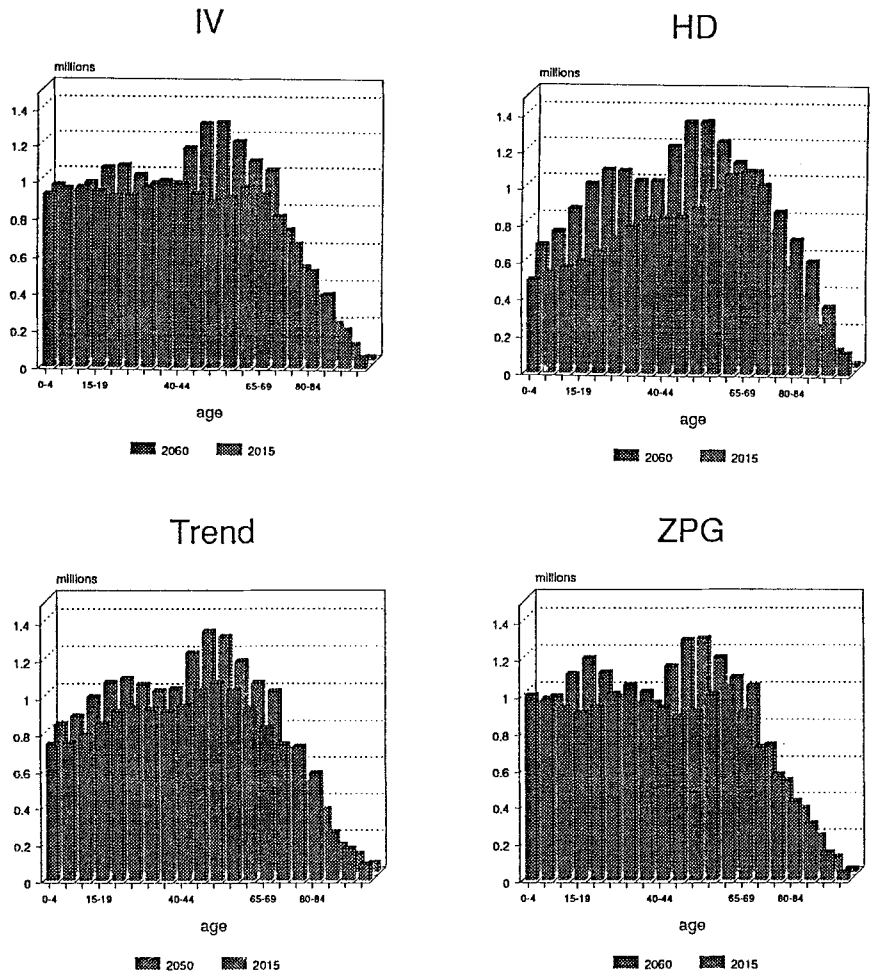

Fig. 4. Age structure.

remained constant, all scenarios are in a late phase of stabilization. It is clear that migration levels as such hardly influence the relatively stable age composition, which can be explained by the fact that at both migration surplus levels similar (actual) age patterns are applied.

Labour years

The key variable connecting the demographic with the economic system in our analysis is the annual volume of net labour years, which can be regarded

as a function of the population total, its demographic structure, and age and sex specific labour force participation rates.

Fig. 5 sketches the pattern of labour years (expressed in index figures) for the different scenarios. In the HD scenario especially the sharp increase in participation rates causes nearly 55% growth in labour-years in the 1990–2020 period. Afterwards, a combination of stabilized participation rates, decreasing population totals and the changing age structure, leads to a substantial fall. In the IV variant the future course of labour years is more regular. Participation rates are rather low, and in spite of favourable demographic conditions, the labour-years output goes steadily downwards until 2040, when it more or less stabilizes. The labour-years trajectory of both 'conservative' scenarios Trend and ZPG are very much alike and are something between the borderline scenarios HD and IV. Since labour force participation rates in Trend and ZPG are similar, the (only minor) difference in labour years is caused by differences in demographic parameters. Although at first sight the underlying demographic regimes seem to be very distinct (see Table 1) the compensating effects of fertility and migration result in almost equal labour-years trajectories.

Since the influence of total population numbers in this respect is obvious, a ratio expressing labour-years on a per capita basis might be even more

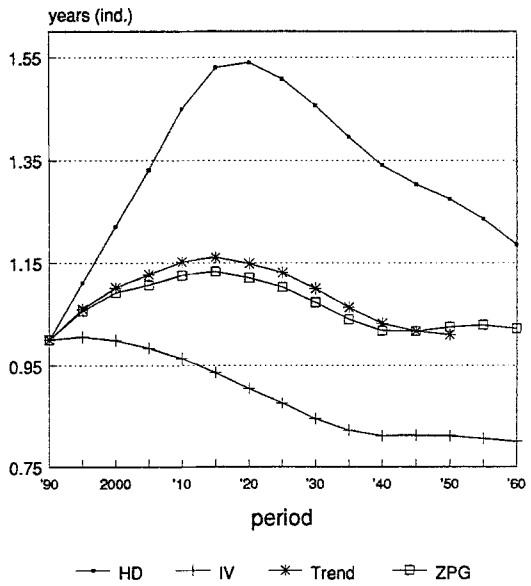

Fig. 5. Labour years.

illustrative. That is why, in addition, the quantity LabYears/PopTot Ratio will be introduced here. Fig. 6 presents the results, showing a picture which is not very different from Fig. 5. In 1990 1 out of 3 people (in terms of person years equivalents) is economically active. In the IV scenario this index gradually decreases to about 1 out of 4 in 2040, followed by somewhat higher constant levels afterwards (due to the expiration of the birth plateau cohorts). The HD scenario, embodying a strong sense of labour force participation, produces a strong growth in the LabYears/PopTot Ratio until 2015. By that time 1 out of 2 people contribute to the GNP. After this year labour force participation rates are fixed, and the ageing population structure means that many elderly people leave the labour market, whereas at the same time cohorts of decreasing size take over their places. This structural effect pushes the ratio significantly downwards until 2040 (the expiration of the birth plateau cohorts), followed by a trend towards an ultimate constant level of just over 0.40. Trend and ZPG once again show a strong similarity in their courses. Changes in the first three decades are hardly significant. Later on the trend goes down slightly and starts to oscillate around an average value of about 0.33. Although differences are small, in all instances the trajectory Trend shows more favourable ratio values. From this it can be tentatively

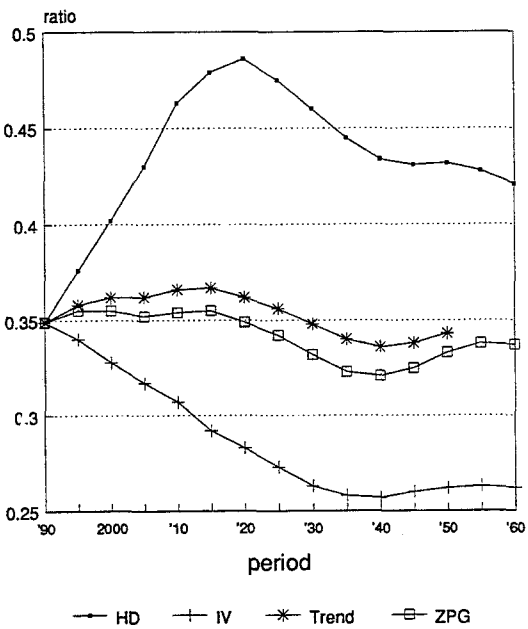

Fig. 6. Labour years/Population total ratio.

concluded that arguments in favour of ZPG population, arising from fears that ageing (as foreseen in Trend) will threaten economic welfare, are not well founded.

4. The effect on the standard of living[4]

To get an impression of the growth capacity under the different demographic scenarios, we distinguish three economic targets, formulated here in terms of questions. We investigate whether the concerning economic targets can be reached. For that goal we look at the GNP, the capital stock requirements, the investment ratio, the capital-labour ratio and the productivity. The three questions are:

* What requirements with reference to the capital stock, the investment ratio, the productivity of labour and the capital-labour ratio are needed to keep the economic growth at the average level of the last 25 years (in terms of real GNP per capita about 2.3% a year)?
* What are the implications for the indicators mentioned above when opting for zero economic growth (the real GNP per capita remaining constant at the 1990 level)?
* What will the development be in the real GNP per capita if we assume that the capital stock grows at the average rate observed during the period 1980–1989 (about 3% a year)?

The three economic objectives will be indicated by GNP2.3, GNP0 and CAP3, respectively. To answer these questions we need a production function with at least labour and capital as inputs.[5] We chose the Cobb-Douglas production function,[6] which was estimated for The Netherlands using data for the private sector for the period 1970–1989. The data have been derived from Central Planning Agency (several years). The estimation result for the (natural) logarithm specification – assuming an annual technological improvement of 0.5%[7] – is stated in the following equation.

[4] The choice of the subject and of the description heavily draws on Carlson (1990).

[5] If we had not been interested in capital needs, the approach of, for example, Okun (1970: 132–145) and McNees (1991) could have been chosen. See also Rasche and Tatom (1977).

[6] This type of production function is generally applied in this kind of applications; see e.g. Carlsson (1990), Cutler, et. al. (1990) and Auerbach, et al. (1989).

[7] This seems to be a reasonable percentage for the Netherlands. One could object that the technical progress depends – among other things – on the capital formation. However, literature is unambiguous to this point; see e.g. Simon (1981), Wattenberg (1987), Habakkuk (1962), Romer (1990) and Cutler et al. (1990).

$$\log (Y/K) - 0.5\, t = -4.241 - 0.036 \log(\mathrm{L24}/K) + 0.372 \log(\mathrm{L49}/K) + 0.309 \log(\mathrm{L64}/K)$$
$$(-5.15) \quad (-0.42) \qquad (1.41) \qquad (2.50)$$

mean $(\log(Y/K) - 0.5\, t) = -8.34$ $\quad R^2 = 0.986$ $\quad$ S.E. = 0.018

with Y = GNP in 1980 Dutch guilders
L24 = civilian employment persons < 25 years old
L49 = civilian employment persons 25–49 years old
L64 = civilian employment persons > 49 years old
K = fixed capital stock in 1980 Dutch guilders
t = time trend

The development in the real GNP per capita under the various targets and its historical development from 1950 on is presented in Fig. 7.

In the long run, target GNP2.3 and target GNP0 can be considered as extreme. Under the target CAP3, HD, Trend and ZPG have roughly the same development as target GNP2.3 until 2030. The real GNP per capita

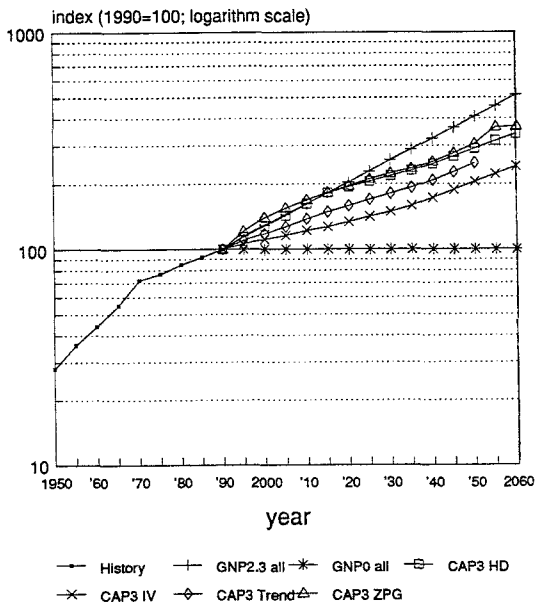

Fig. 7. Real GNP per capita.

is under HD even somewhat larger than the result for target GNP2.3 between 1990 and 2020. In 2060 GNP per capita is about four times the 1989-level under target GNP2.3. Target CAP3-HD lies almost exactly between target GNP2.3 and GNP0 (an average increase in the GNP per capita of about 1.25%). In the long run the development in CAP3-Trend is consistent with the developments during the years 1970–1989. The results under the economic target CAP3 diverge as the combined consequence of the differences in the development of the total population (see Fig. 2), the distribution between the three age groups (under 25, 25–49 and 50 and over) and the average number of labour years (see Fig. 5). The population totals do not differ much . Labour years and the distribution between the three age groups, however, differ greatly and the development in the GNP per capita obviously is the reaction to the course in the latter ones.

The consequences for the capital stock requirement for the whole period are given in Table 2 (HD), Table 3 (IV), Table 4 (Trend) and Table 5 (ZPG), and are pictured – also for the intervening years – in Fig. 8. Owing to the underlying assumption, target CAP3 shows a rise in the capital stock if the growth figures for the period 1980–1989 are maintained at 3% per year.

The average capital stock growth under target (GNP2.3-HD, GNP2.3-ZPG

Table 2. Decomposition of per capita GNP growth: HD (1990–2060)

Target	GNP2.3	GNP0	CAP3
Real GNP growth	2.311	–0.023	1.756
= Technical progress	0.500	0.500	0.500
+ Employment contr.	0.422	0.422	0.422
+ Capital st. contr.	1.389	–0.945	1.065
(= cap. st. growth	4.996	–3.399	3.000
* elasticity)	0.355	0.355	0.355
– Employment growth	–0.243	–0.243	–0.243
+ Change in employment-population ratio	0.266	0.266	0.266
(= employment growth	0.243	0.243	0.243
– population gr.)	0.023	0.023	0.023
= per capita GNP growth	2.334	0	1.779
+ Population growth	–0.023	–0.023	–0.023
= Real GNP growth	2.311	–0.023	1.756
– employment growth	–0.243	–0.243	–0.243
= Labour prod. growth	2.068	–0.266	1.513

Table 3. Decomposition of per capita GNP growth: IV (1990–2060)

Target	GNP2.3	GNP0	CAP3
Real GNP growth	2.424	0.090	1.275
= Technical progress	0.500	0.500	0.500
+ Employment contr.	–0.059	–0.059	–0.059
+ Capital st. contr.	1.983	–0.351	1.065
(= cap. st. growth	7.133	–1.263	3.000
* elasticity)	0.355	0.355	0.355
– Employment growth	0.319	0.319	0.319
+ Change in employment-population ratio	–0.409	–0.409	–0.409
(= employment growth	–0.319	–0.319	–0.319
– population gr.)	–0.090	–0.090	–0.090
= per capita GNP growth	2.334	0	1.185
+ Population growth	0.090	0.090	0.090
= Real GNP growth	2.424	0.090	1.275
– employment growth	0.319	0.319	0.319
= Labour prod. growth	2.743	0.409	1.594

Table 4. Decomposition of per capita GNP growth: Trend (1990–2050)

Target	GNP2.3	GNP0	CAP3
Real GNP growth	2.382	0.048	1.964
= Technical progress	0.500	0.500	0.500
+ Employment contr.	0.399	0.399	0.399
+ Capital st. contr.	1.483	–0.851	1.065
(= cap. st. growth	4.177	–2.397	3.000
* elasticity)	0.355	0.355	0.355
– Employment growth	–0.017	–0.017	–0.017
+ Change in employment-population ratio	–0.031	–0.031	–0.031
(= employment growth	0.017	0.017	0.017
– population gr.)	–0.048	–0.048	–0.048
= per capita GNP growth	2.334	0	1.916
+ Population growth	0.048	0.048	0.048
= Real GNP growth	2.382	0.048	1.964
– employment growth	–0.017	–0.017	–0.017
= Labour prod. growth	2.365	0.031	1.947

Table 5. Decomposition of per capita GNP growth: ZPG (1990–2060)

Target	GNP2.3	GNP0	CAP3
Real GNP growth	2.418	0.084	1.911
= Technical progress	0.500	0.500	0.500
+ Employment contr.	0.346	0.346	0.346
+ Capital st. contr.	1.572	–0.762	1.065
(= cap. st. growth	4.428	–2.146	3.000
* elasticity)	0.355	0.355	0.355
– Employment growth	0.031	0.031	0.031
+ Change in employment-population ratio	–0.053	–0.053	–0.053
(= employment growth	0.031	0.031	0.031
– population gr.)	–0.084	–0.084	–0.084
= per capita GNP growth	2.334	0	1.879
+ Population growth	0.084	0.084	0.084
= Real GNP growth	2.418	0.084	1.963
– employment growth	–0.031	–0.031	–0.031
= Labour prod. growth	2.387	0.053	1.932

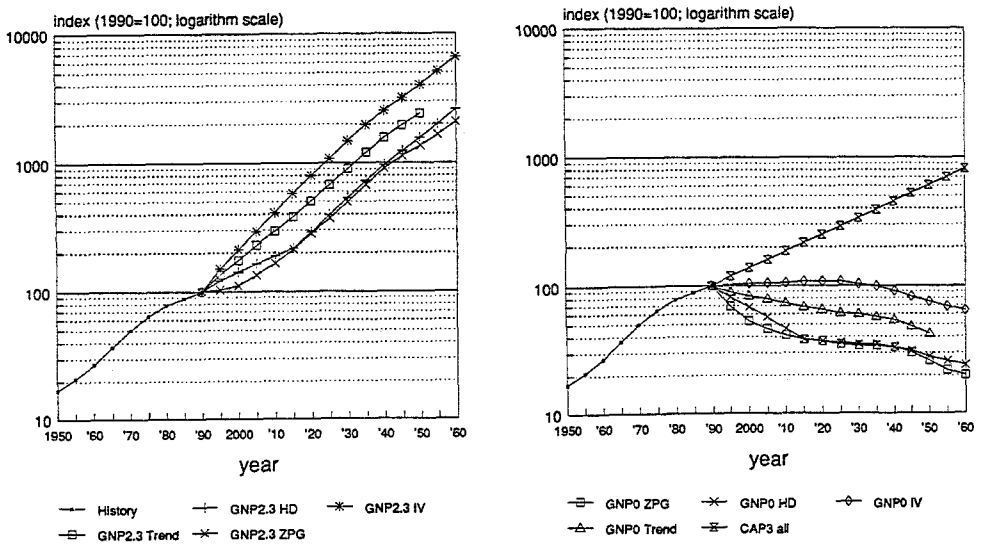

Fig. 8. Capital stock requirement.

and GNP2.3-Trend comes closest to the average development during the period 1950–1989, i.e. a steady and sharp increase. In 2060 the capital stock will be about twenty-five times that of the 1990-level (GNP2.3-HD). The other variant under target GNP2.3 (GNP2.3-NV) shows an even larger increase.

Under target GNP0 the capital stock need almost continually decreases. Its rate depends on the population size and the percentage of workers. All three demographic targets show a comparable rate of decrease in the long run. GNP0-NV stabilizes during a period of fifty years at the 1995-level. Since scenario NV generates some population growth, with a relatively low proportion of workers, a somewhat larger capital stock is needed, e.g. in comparison with GNP0-Trend. The opposite holds for GNP0-HD and GNP0-ZPG. In 2050 the capital stock requirement under GNP0-Trend is about 20% of the 1989-level. The ZPG and HD scenarios require a rapid decline in capital stock requirement during the first two decades (1990–2010), which will be difficult to reach. In both target GNP2.3 and GNP0 the capital stock requirement is inversely related to the development in the number of labour years, as sketched in Fig. 5. The lower the number of labour years, the more capital will be needed to get an equal per capita GNP.

In view of the historical development, we cannot consider any of the economic targets under discussion as unrealistic, although under target GNP 2.3 very high growth rates are required. To get an impression of the extent to which national income is taken up to meet the capital requirements we will look at the investment ratio.[8]

This investment ratio is shown in Fig. 9. From this picture it will be clear that it is impossible to maintain a rise in the GNP per capita at the level of the period 1965–1989 under all four demographic scenarios. The demand for capital investments exceeds the complete GNP. In the scenarios ZPG and HD, the investments required are within reach up to about 2050 and for Trend to 2025. Up to that time private consumption can also grow, but afterwards too much of the GNP has to be used for capital investment, so that consumption per capita will then decline.

The investment ratio derived from target CAP3 (an annual capital stock growth of 3%) seems to be within reach in all four demographic scenarios. The investment ratio – and the required savings – are such that consump-

[8] Because the projections are made using five-year intervals, the investment ratio in year t (IR_t) has been calculated as the quotient of the average annual change in the capital stock during the preceding five years (dK_t) and the GNP in the year t. So, $IR_t = dK_t/GNP_t$, with $dK_t = ((K_t/K_t^{-5})^{0.2} - 1)^* K_t$.

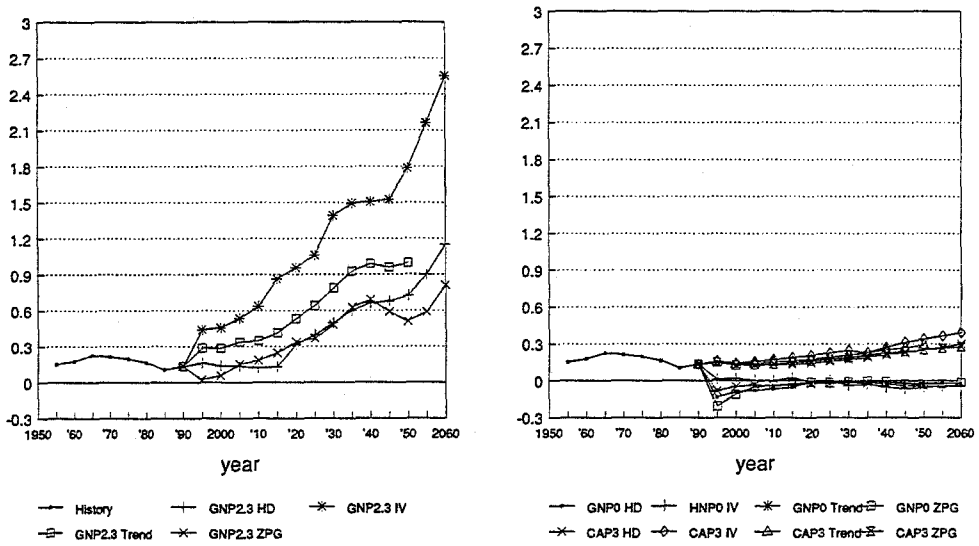

Fig. 9. Investment ratio.

tion per capita increases. The investment ratio will grow steadily to about 30% for HD, Trend and ZPG and to about 40% for IV. Under target CAP3, all demographic scenarios demand desinvestment, so that the investment ratio is generally negative.

Some additional ratios are shown in Fig. 10 and Fig. 11. Figure 10 gives the productivity, as measured by the real GNP per worker. Under target GNP2.3, Trend and ZPG follow the same growth path for productivity per worker as during the period 1965–1989. The course of GNP2.3-IV is somewhat above this path and the course of GNP2.3-HD develops somewhat beneath it until 2020, after which it has the same growth rate as during the latter period. Under the economic target CAP3, productivity per worker also grows, but the growth rate is slightly below the level of the last 25 years. If zero-growth is preferred (target GNP0) the productivity per worker under HD and IV is about constant from 2030 on. Under Trend and ZPG the productivity in the future hardly differs from the 1989-level. The IV trajectory runs somewhat above this level, whereas HD is below.

The productivity per worker is related to the capital stock requirement (see Fig. 8): if – under a similar development in population totals, which is the case here – a relatively high amount of capital is required to get a certain rate of growth for the per capita GNP (like in scenario IV), the productivity per worker will be high and vice versa.

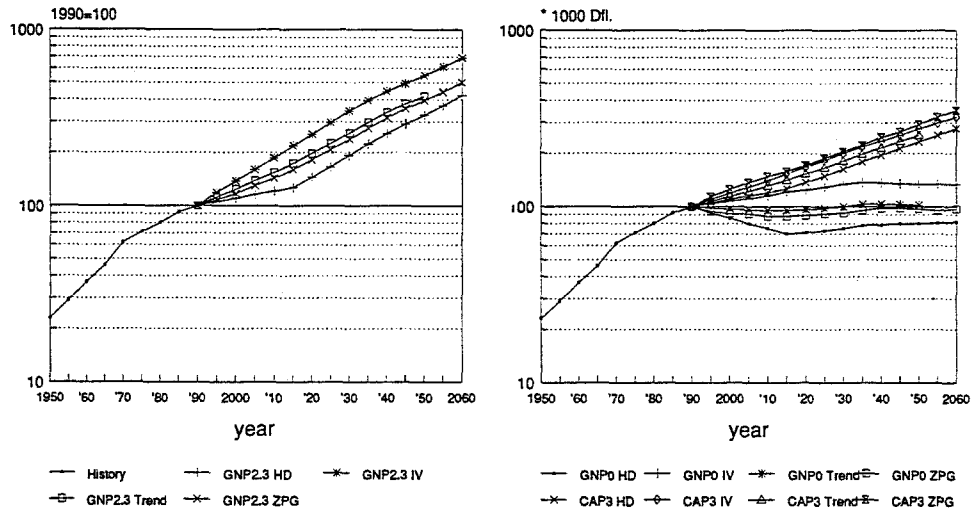

Fig. 10. Productivity: real GNP per worker.

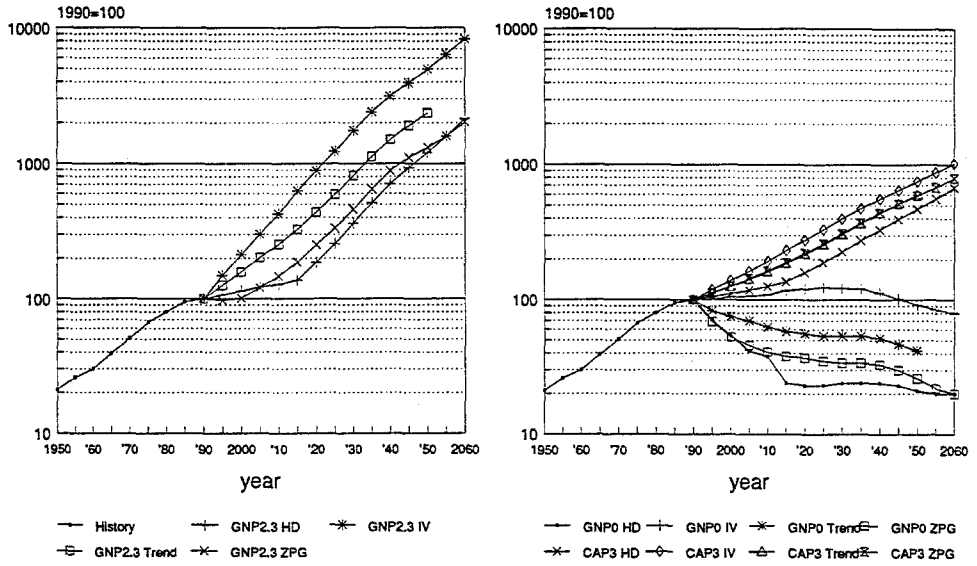

Fig. 11. Capital-labour ratio.

In Fig. 11, the capital-labour ratio is presented. In 1989 this ratio amounted to about five times its value of 1950. However, the rate of increase has strongly diminished in the course of time. Under target GNP2.3, the capital-labour ratio has to grow with at least the same rapidity as during the period 1950–1989. For GNP2.3-HD it holds that the growth has to be much stronger from 2015 on. The trend-growth-of-capital target (CAP3) demands a growth rate in the capital-labour ratio, corresponding with its development in recent history. The zero-growth target GNP0 shows a decline in the ratio for Trend and especially for HD.

It will be clear that an economic growth – in terms of real per capita GNP – at the average level of the last forty years, cannot be maintained if population development proceeds along the lines of one of the four demographic scenarios presented here. Under the scenarios Trend, ZPG and HD such a growth may be reached during a number of decades, but after some time (about thirty years), in these cases too, a great part of the national income will have to be used for capital stock investments. Economic growth can only be maintained if labour force participation rates keep increasing, which holds for HD and, to a less extent, for Trend and ZPG until the year 2015. From that year onwards, the required (net) investment ratio inclines and soon appears to be too high. Because IV presupposes a decreasing labour force participation rate from 1990 on, the investment ratio here increases immediately.

Economic growth rates which correspond with a trend-growth-of-capital target (CAP3) seem to be more realistic. Under Trend this implies a GNP per capita growth rate of 1.92% a year, under ZPG 1.88%, under HD 1.78% and under IV only 1.19%.

The zero-growth target requires desinvestment during about 20 years and it is debatable whether this will be attained.

The foregoing does not imply that no other scenarios are thinkable, in which a limited economic growth is possible. Our aim was just to give an indication of economic growth (im)possibilities starting from two rather extreme demographic scenarios, rather than to produce real forecasts. Such an impossibility has been found in the combination of economic growth and a society as sketched under scenario IV. This scenario is only within reach if society also opts for only very limited growth or chooses zero growth. This is quite in agreement with the a- and b-level of the scenario description.

Another important conclusion is that it will not be possible, under the scenarios studied, to maintain economic growth which is as great as that

of the last forty years in The Netherlands. In view of the rather strong differences in assumptions between these scenarios, it will be clear that this will also hold for other 'realistic' scenarios. Using the same method, but only the middle series population projections, Carlson (1990) arrives at the same conclusion for the United States.

5. Conclusions

The core of this article can be summarized in the question: will population ageing become a threat to our standard of living? Roughly speaking, the research design chosen simply compares different degrees of population ageing with respect to their long term effect on welfare. Because the demographic and the economic system, which are linked together in our research question, share a number of significant determinants, it has – for the sake of consistency – been considered necessary to derive the future state of both systems from the same, highly aggregated mother scenarios. In this context two strongly contrasting mother scenarios have been developed. Subsequently, from both scenarios the demographic ageing process has been assessed. The scenario, based on the perspective of a highly individualized and material goals oriented society, was designated HD, while the scenario outlining the opposite perspective was marked IV. The mother scenarios might be considered as a couple of borderline scenarios, in the sense that they represent – within the imagination of the authors – the boundaries of plausibility. In addition to the ageing trajectories directly derived from these mother scenarios, two less explicitly elaborated demographic projections have been included in the analyses, to wit Trend (the official Dutch population forecast) and ZPG (a zero population growth variant). In terms of the ageing process both Trend and ZPG represent positions between HD and IV.

The economic-demographic relationship is mediated through a simple Cobb-Douglas production function. The ultimate question as to whether the ageing process will jeopardize the standard of living, is answered for each of the demographic projections by matching them with three economic targets, to wit (1) a GNP per capita growth comparable to that during the last 25 years [called GNP2.3], (2) a zero-per-capita-growth [GNP0] and (3) a capital stock growth comparable to that during the last ten years [CAP3].

It appears that the GNP2.3 target is not feasible for all scenarios in the long run. The IV scenario results in problems even in the short run, whereas the HD scenario and to a less extent the ZPG scenario shows no problems

until about the year 2020. The CAP3 target seems to be attainable under all four demographic scenarios. Even under scenario IV the required capital stock growth can be financed without a decrease in per capita consumption.

The economic results presented are consistent with the assumed characteristics of the mother scenarios. The highly progressive and strongly individualized HD scenario, striving for high standards of living, shows the largest growth potential. The resulting high labour participation rates require the relatively lowest investment ratio, productivity and capital-labour ratio, so that an intended growth figure is relatively easy to attain. The orientation towards a more non-material society as assumed under the IV scenario, logically leads to a relatively low labour force participation. This requires extra capital investments to reach a certain GNP growth figure, and therefore problems in realizing the GNP2.3 target are a logical consequence of the underlying assumptions. In demographic and labour participation terms Trend and ZPG held positions between HD and ZPG. The same position is taken in terms of the economic analysis. Attention should be paid to the fact that the economic outcomes of Trend and ZPG are rather similar. As at the 'demographic' level differences were not very substantial, this observation as such is not very surprising. It shows however, that the widespread popular opinion, to the effect that reaching a stationary or ZPG population would be an adequate remedy against the negative effect of the current ageing process (as represented in Trend), can be seriously criticized.

The most important conclusion is that in the long run, economic growth comparable with that of the 1960s and 1970s is probably impossible. The HD scenario allows a postponement of the (investment) problems as a consequence of the increasing labour participation rates, but also under HD we find a decline in the LabYears/PopTot Ratio (see Fig. 6) from 2020 onwards. Also of importance is the fact that a capital stock growth of about 3% a year is attainable under all scenarios. It requires larger investment ratios (and consequently higher savings ratios), but given the associated rate of economic growth this does not result in decreasing consumption patterns.

Of course, our study contains several uncertainties. We have tried to look at the impact of two very diverging demographic scenarios, but alternative scenarios with respect of, for example, the migration surplus seem to become more and more plausible. For example, the consequence of higher immigration is that the GNP2.3 scenario is attainable for a longer time under a Trend-like scenario. However – as a result – it will only imply that problems

are temporarily delayed and not solved permanently. A second point of uncertainty is formed by the assumed constant technical progress imbedded in the Cobb-Douglas production function. Here, analogous remarks can be made. Higher technical progress probably results in lower investment ratios and higher productivity. In that case Trend, ZPG and HD can reach higher growth figures, although this is very debatable – and this is consistent with the underlying mother scenario – whether this solves the problems for the IV scenario. A third point of uncertainty can be found in the international economic context. How will international capital flows and interest rates react and how do these possible changes affect our results? Cutler et al. (1990) show a clear effect, but the magnitude appears to be too moderate in comparison with the requirements for a large economic growth as under GNP2.3.

When evaluating the meaning of the foregoing analyses, the reader should keep in mind the main purpose of this contribution, which is to explore the uncertainty inherent in future studies, rather than to supply definite forecasts.

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