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# Demography and Growth in Denmark

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## INTRODUCTION

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Taking the latest population forecast from Statistics Denmark as the starting point, the focus is on population trends in Denmark in the next 40 years. Their implications for economic growth and for general-government finances are analysed. This topic has been considered in several fora in recent years, such as the Ministry of Finance, the Ministry of Economic Affairs and the Economic Council.

The conclusion drawn is that with regard to the supply of labour Denmark is at a crossroads. During the last 50 years the proportion of the population in active age classes has increased by 0.5 per cent p.a., equivalent to 800,000 people on an accumulated basis. In the next 40 years there will be no growth whatsoever. Apart from a rising population, recent decades have been characterised by a strong increase in the participation rate for women, which is now close to that for men, apart from the older age classes. Even if a further increase from an internationally already high level were to be achieved in the age-related participation rates, via such measures as later retirement from the labour market, light jobs and similar, in realistic terms the potential is far below the previous level.

The aforementioned factors imply an end to the underlying increase in the supply of labour during the last 50 years. A reduction of working hours and an earlier retirement age will therefore have a direct impact on labour supply in the economy. If material affluence and the level of public service are to be maintained, there is no basis for a continued reduction of working hours at the same pace as seen in recent decades. In this connection it is important to acknowledge that the supply of labour in the longer term determines the level of employment, output and income, and thereby material affluence.

The stagnating influx to the labour force coincides with a strong displacement in the age breakdown of the population towards a greater number of elderly people and thereby a growing provider burden. In 1950 5 people were employed for each person over 60 years of age, while the equivalent figure today is 3, and is expected to decline further

to 2 in 2040. Especially the group of very old people, i.e. aged 80 and above, will rise significantly. Since these age classes are relatively cost-intensive, general-government budgets will be subject to pressure.

These conclusions are not altered by the results of an analysis which show that economic growth is predominantly driven by productivity increases arising from technological progress. Although a certain braking of increases in productivity may possibly be anticipated, real GDP will probably as a minimum increase twofold over the next 40 years. However, rising GDP in itself is not the solution to the general-government budget problems attributable to the increase in the provider burden arising from the demographic trend. The reason is that both transfer incomes and public-sector salaries in Denmark match the development in wages in the private sector, so that although higher productivity makes everybody richer, it does not necessarily increase the scope of central-government finances for manoeuvre. A further reduction of working hours will require a higher taxation level, if the level of public services is to be maintained.

## THE DEMOGRAPHICAL DEVELOPMENT

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Danmark's population has risen over the years, cf. Chart 1, although the rate of increase has diminished and was close to zero from the mid-1970s. The lowest growth rate was in 1983, with only 51,000 live births in the birth cohort. During the 1990s the fertility rate rose again to a degree, but the Danish population is still unable to reproduce itself. The so-called net reproduction rate<sup>1</sup>, which determines the long-term population trend, is only approximately 850, compared to the 1,000 required to stabilise the total population. Nevertheless, the total population figure is still expected to rise over the next 40 years, primarily due to expectations of positive net immigration in Statistics Denmark's forecast.

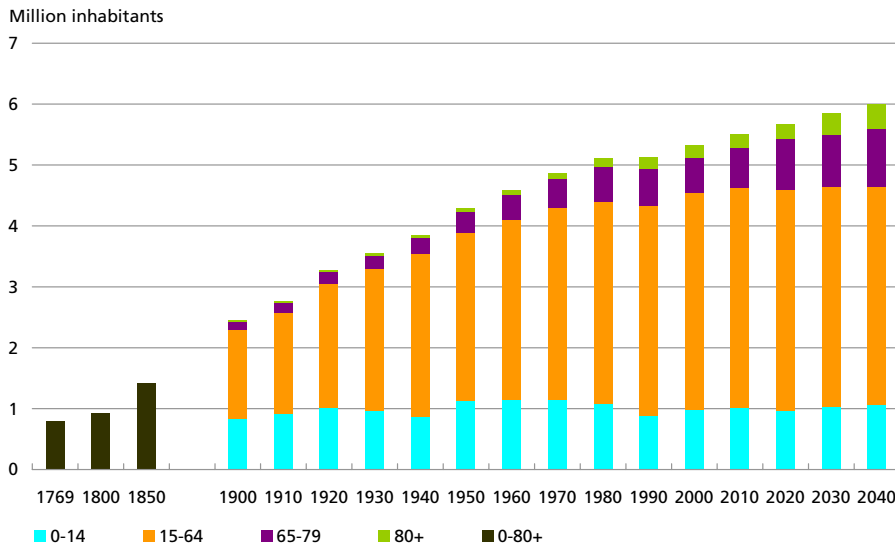
In addition to a rising population, the period after World War II has been characterised by a growing dependency ratio, cf. Chart 2. The proportion of the population aged over 60 has risen from 20 per cent of people in employment to 30 per cent today. The increase in the dependency ratio in the coming decades is thus not a new phenomenon, but represents the reinforcement of a known trend. In the last 50 years the increase in the dependency ratio has been offset by an equivalent drop in the proportion in the age class between 0 and 24 years, so that the proportion of 25-59 year-olds, which is the core of the labour force,

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<sup>1</sup> The net reproduction rate is the number of girls an assumed class of 1,000 new-born girls will give birth to, if they give birth in accordance with the age-related fertility coefficients and die according to a given survival table.

THE DANISH POPULATION

Chart 1



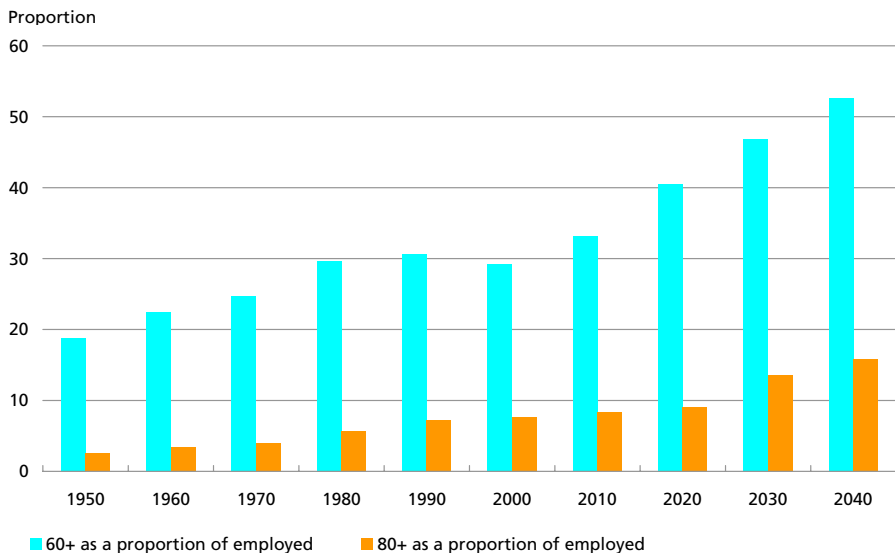
Note: The population figures for 1900 and 1910 exclude southern Jutland. This has no significant impact on the long-term profile.

has been unchanged at just under 50 per cent. In the future, this will change.

A rising dependency ratio is a phenomenon which to varying degrees will affect all industrialised countries during the next decades. Denmark and the UK appear to be among the countries where this trend is least

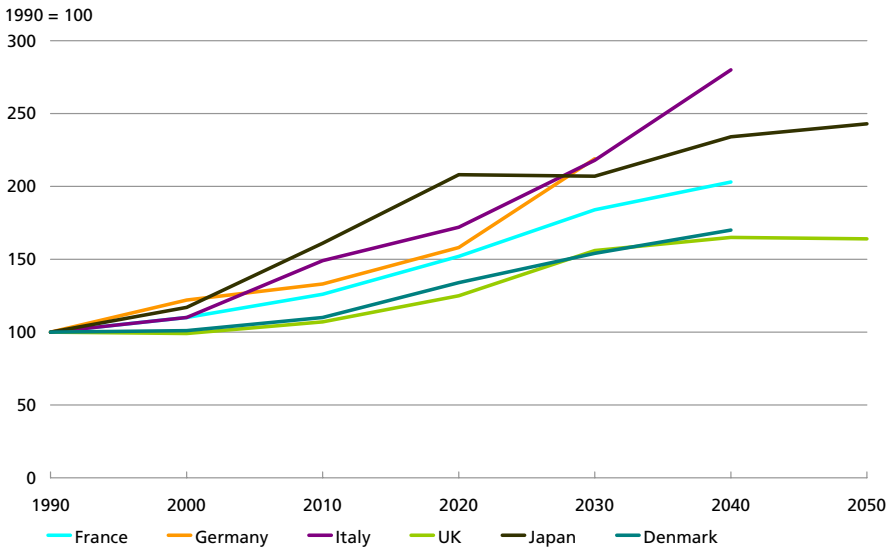
DEPENDENCY RATIO

Chart 2



DEVELOPMENT IN THE DEPENDENCY RATIO IN SELECTED COUNTRIES

Chart 3



Source: European Economy (1996) no. 3, "Aging and Pension Expenditure Prospects in the Western World".

pronounced, cf. Chart 3. The background is that while most industrialised countries have seen a drop in the fertility rate, not all have seen a revival as in Denmark's case.

Chart 3 shows only the relative development, and it must be borne in mind that the levels may differ.

The increase in the total population, together with the higher participation rate for women, has caused the labour force to increase from 2.0 million in 1950 to the current 2.8 million. However, this growth is more than offset by a strong reduction in working hours from typically 2,200 hours per year in 1950 to below 1,500 hours today, if part-time work is taken into account. The result has been a decrease by just over 10 per cent in the number of completed working hours in the economy during the last 50 years. Table 1 presents the breakdown by explanatory factors of the change in the number of completed working hours.

BREAKDOWN OF CHANGE IN NUMBER OF COMPLETED WORKING HOURS

Table 1

Per cent	1948-1999	2000-2040
Change in the number of completed working hours.....	-11	?
Of which contribution from:		
Average working hours .....	-40	?
Demography .....	22	-2
Participation rate .....	11	-2
Unemployment .....	-4	0

## PROJECTION OF HOURLY PERFORMANCE IN THE ECONOMY

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Statistics Denmark prepares an annual population trend forecast. The central assumptions for this forecast are the fertility rate, the mortality rate and net immigration.

The mortality rate is the most stable of these figures. However, in the most recent forecasts, apart from the latest one, expected lifetime has increased. This has aggravated the increase in the proportion of elderly people.

Only approximately half of the population 40 years from now has yet been born. The development in the fertility rate thus also plays a key role – and in the long term it is the decisive factor. The current problems of pressure on childcare institutions and numbers of pupils per class are to a certain extent temporary problems reflecting the demographic boom in the number of children born in the relatively high birthrate years in the first half of the 1960s.

The greatest factor of uncertainty is net immigration, which has been approximately 12,000 persons per year for a number of years, but is projected to 15,000 in Statistics Denmark's latest forecast. Viewed in relation to the number of live births in one year, i.e. currently approximately 65,000, the contribution from immigration is not insignificant. People of immigrant descent will thus account for an increasing proportion of the future basis for recruitment to the labour force.

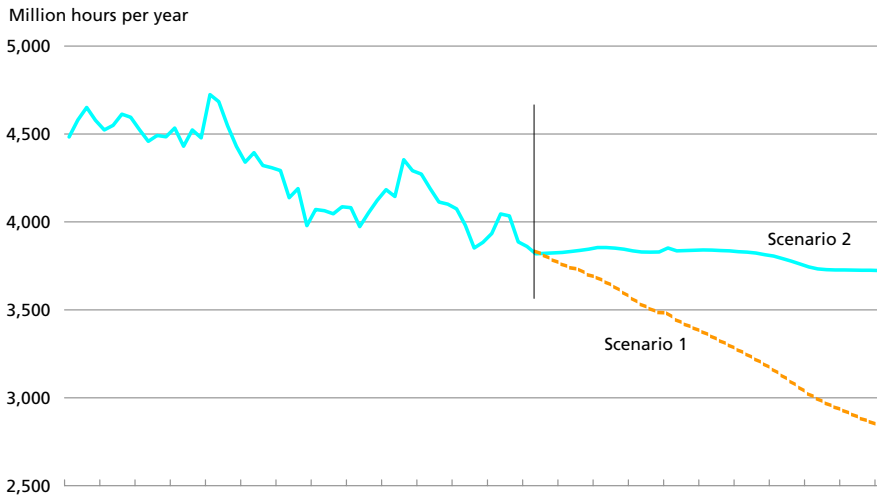
It must be emphasised that over a span of 40 years the sensitivity of the population forecast to the central assumptions is quite significant. This can be seen from e.g. comparing Statistics Denmark's forecasts for recent years. A case in point is the considerable variation in the proportion of senior citizens in the population shown in the various forecasts.

Against the background of the population forecast from December 1999 the potential future hourly performance in the economy has been projected. In addition to the total population figure this requires estimates of the participation rate, unemployment rate and number of working hours per year per employed person. The unemployment rate is set at 5 per cent for the entire period, and the age-related participation rates are assumed to be unchanged. This gives a decline in the average participation rate by approximately 2.5 to 76, due to the shift towards more elderly people with a lower participation rate than the younger classes of the population. Among other factors the amendment of the early retirement scheme and the abolition of the transitional allowance will undoubtedly contribute to increasing the participation rates of older people in the active age groups. A counterbal-

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**NUMBER OF COMPLETED WORKING HOURS PER YEAR IN THE ENTIRE ECONOMY** Chart 4
 

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ancing factor is that many of the future elderly can afford to retire earlier due to their private pension savings schemes.

The greatest factor of uncertainty is the number of working hours performed per year per employed person. Two scenarios are envisaged. In the first, the number of working hours is assumed to continue to fall at the same pace as the average for the last 50 years. Total working hours thereby decline to 1,100 hours in 2040. This corresponds to e.g. a 4-day working week of 7 hours per day and 10 weeks' annual holiday, in addition to the usual public holidays. This "leisure society" is hardly a realistic projection.

The alternative is a "work scenario" which solely assumes the introduction of a 6th week of holiday entitlement and otherwise unchanged working hours. The hourly performance thereby drops by a total of 7 per cent over the next 40 years. Chart 4 presents the two scenarios.

Should working hours be reduced further, it is possible that people will be more inclined than today to have two jobs, thereby dampening the decline in the supply of labour in hourly terms. This has not been taken into account in the projections.

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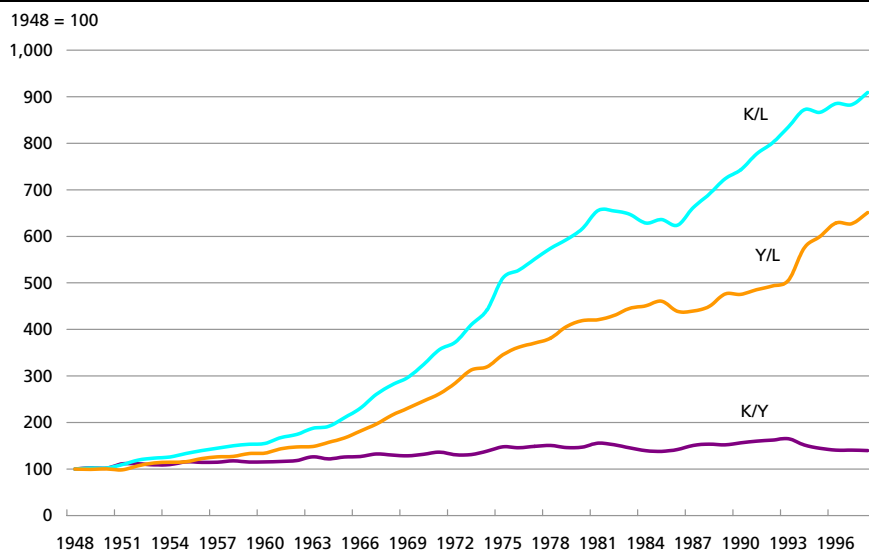
## LABOUR PERFORMANCE AND ECONOMIC GROWTH

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To gain an impression of the consequences of the population trend for economic growth, the course of the last 50 years is first considered. In an

## KEY RATIOS IN MANUFACTURING

Chart 5



Note: See the definitions in the Box.

analysis of economic growth applying a conventional neoclassical production function the perspective must be narrowed from the economy as a whole to e.g. the manufacturing industry, which comprises approximately 20 per cent of the economy<sup>1</sup>. This proportion has been almost constant throughout the period.

Chart 5 shows the key ratios for the manufacturing sector, where K is the value of the capital apparatus in constant prices, Y is real GNP and L is the number of hours supplied. A strong increase can be observed in K/L (the capital/labour ratio) and Y/L (hourly productivity), while K/Y (the capital/output ratio) shows only a weak increase. This pattern is reflected in all industrialised countries and all sectors.

Table 2 shows a breakdown of growth in GNP in the manufacturing sector in constant prices, cf. the Box. The breakdown gives an impression of the direct impact of the various production factors on growth in the manufacturing industry. The annual rate of growth in GNP in constant prices in the period from 1960 to the present time was 3.0 per cent. This growth rate can be explained fully by increasing productivity as a result of technological progress and increased human capital. Hourly labour

<sup>1</sup> The need to reduce the perspective from the entire economy to sectoral level on applying production functions is due to such factors as the method of compiling the value of general-government output in the national accounts, i.e. as the value of input. This makes productivity calculations based on the national accounts meaningless to this sector. The separate treatment of the manufacturing, service and agricultural sectors here can be attributed to the systematic differences in productivity development among these sectors.

## BREAKDOWN OF A NEOCLASSICAL PRODUCTION FUNCTION

Box

In a general production function such as  $Y = F(K,L,T)$  output in constant prices (Y) is the result of the performance of the two output factors, capital in constant prices (K) and number of completed working hours (L). T is the total factor productivity, i.e. the increase in output over time which is possible with an unchanged allocation of resources, i.e. unchanged K and L. Technological progress and an increase in human capital will thus have an impact on T and not on K or L.

By restricting the function to show constant return to scale, i.e. ensuring proportionality between K,L and Y, and by the fact that technological progress is "disembodied", i.e. does not require new investments, it is possible to break down growth by the Solow method to reveal each output factor's significance to growth. The breakdown is based on the following relation, with the further assumption of profit-maximising agents and perfect competition:

$$1) \quad dY/Y = p \cdot dK/K + (1-p) \cdot dL/L + dT/T$$

Y= Real GDP

K= Capital stock in constant prices

L= Work performance in total hours per year

T= Total factor productivity as a consequence of technological progress and increase in human capital

p= Capital elasticity of output. This will be equal to the profit ratio under perfect competition with profit-maximising agents. This value is set at 0.25 here. (1-p) is the wage ratio.

d in front of a variable signifies the differential coefficient with respect of time.

Normalising equation 1) with respect to L gives the following result:

$$2) \quad dy/y = p \cdot dk/k + dT/T$$

where

y = Y/L and

k = K/L

According to 2) hourly output growth (hourly productivity) can be broken down into two components, i.e. capital deepening and (Hick's) technical progress.

performance has declined, thereby making a negative contribution to growth, which is offset by an increasing contribution from capital, however.

The table must not be interpreted to mean that investments and labour supply are of minor importance to the growth process. New investments and upgrading of the qualifications of the labour force are the very manifestations of technological progress, i.e. they are not in practice "disembodied" as defined in the Box.

BREAKDOWN OF GROWTH IN DANISH MANUFACTURING INDUSTRY				Table 2
Rate of growth, per cent p.a.	dY/Y	0.25*dK/K	0.75*dL/L	dT/T
1950-1960 .....	3.0	1.1	0.0	1.9
1960-1970 .....	5.3	1.7	-0.7	4.3
1970-1980 .....	2.8	1.0	-1.9	3.7
1980-1990 .....	1.3	0.5	0.0	0.8
1990-1999 .....	2.6	0.3	-1.0	3.3
1960-1999 .....	3.0	0.9	-0.9	3.0

Note: See the Box for a definition of variables. The Table shows the annual growth from the first to the last year.

Table 3 shows the corresponding breakdown of growth in hourly productivity (Y/L). As the last column shows, technological progress explains approximately three quarters of the growth in hourly productivity by an average of 4.2 per cent p.a. over the last 40 years.

The appendix gives the equivalent breakdown of growth in the agricultural and service sectors respectively. The results are hardly surprising. The agricultural sector shows stronger productivity growth than the manufacturing sector, while the growth rate for services is lower. Perhaps a more surprising feature is that the proportion of the growth in labour productivity attributable to respectively technological progress and capital deepening is almost identical for all three sectors. There is no clear trend for growth in technological progress during the reference period with regard to services and agriculture, while for the manufacturing sector technological progress appears to have been slightly lower in the last part of the period.

The breakdowns assume a constant return to scale, i.e. proportionality between increases in K,L and Y. This is only an approximation. The last 50 years have seen rationalisation of the production process, resulting in considerable economies of scale. So some of the factors registered as technological progress are in fact rationalisation gains. These gains tend to be of a more one-off nature than actual technological progress. For example, dairies can only merge once.

BREAKDOWN OF HOURLY PRODUCTIVITY, MANUFACTURING				Table 3
Rate of growth, per cent p.a.	dy/y	0.25*dK/k	dT/T	Per cent
1950-1960 .....	3.2	1.3	1.9	59
1960-1970 .....	6.2	1.9	4.3	69
1970-1980 .....	5.3	1.6	3.7	70
1980-1990 .....	1.3	0.5	0.8	63
1990-1999 .....	3.9	0.6	3.3	85
1960-1999 .....	4.2	1.2	3.0	71

Note: The last column shows the share of growth in hourly productivity attributable to technological progress.

PROJECTION OF ECONOMIC GROWTH, ENTIRE ECONOMY				Table 4
Rate of growth, per cent p.a.	dY/Y	0.25*dK/K	0.75*dL/L	dT/T
1999-2040 I .....	1.6	0.5	-0.9	2.0
1999-2040 II .....	2.4	0.5	-0.1	2.0

The capital accumulation,  $K$  in the production function, depends on the actual savings in the economy if the balance of payments as a proportion of output is relatively unchanged. The tendency towards an ageing population will normally reduce the savings in the economy. Private savings will decline since the number in the 30-60 age class will decrease. This age class accounts for the predominant share of savings, while people over 60 typically draw on their savings, in accordance with the usual life-cycle hypothesis. At the same time, the elderly require more care than younger people. This imposes upward pressure on general-government expenditure, while all other things being equal general-government savings are depleted. Since all industrialised countries experience the same trend of an ageing population, and lower savings are thus an international phenomenon, this can push up real interest rates. The investment level will thereby be reduced, as will the accumulation of capital, with potential adverse consequences for the development in productivity and ultimately also for economic growth.

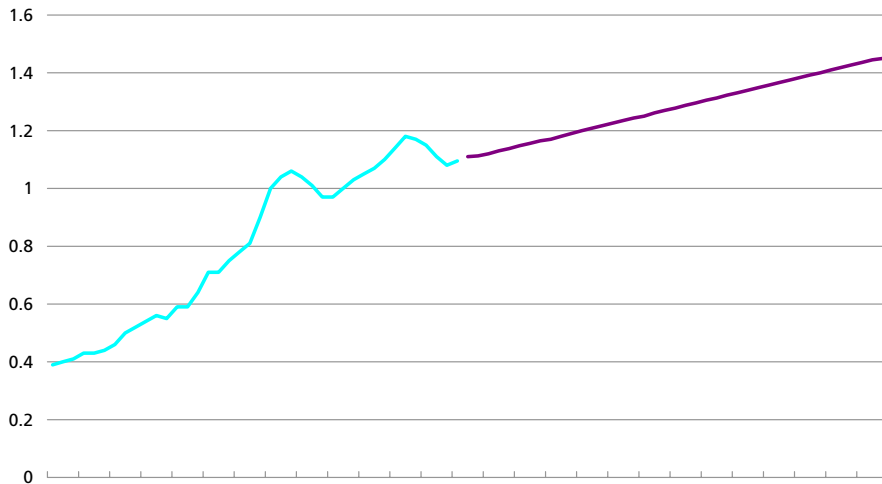
The above analysis can be used to gain a rough estimate of future growth in each of the two scenarios in Chart 4. Even with conservative assumptions of capital accumulation, labour supply and productivity it is realistic to expect at least a doubling of the real gross national product over the next 40 years. With an annual growth rate of 2.0 per cent it would double after 35 years. A number of new techniques which are still at the development stage in areas such as genetic engineering technology and IT have the potential to generate even stronger growth far beyond this estimate. The source of concern regarding the demographic development is thus not related to economic growth in general. The problem lies elsewhere.

## **GROWTH, DEMOGRAPHY AND GENERAL-GOVERNMENT FINANCES**

In Denmark the development in transfer incomes and salaries in the public sector mirrors the growth in wages in the private sector. As a result, productivity gains in the private sector benefit the entire population, and increasing inequalities between the various groups are avoided. However, a consequence is that economic growth in itself does

FINANCING RATIO

Chart 6



Note: The financing ratio is defined as the number of employees in the general-government sector plus the number of transfer-income recipients, divided by the number of employees in the private sector.

not solve the general-government sector's problem of financing the growing dependency ratio. The central issue in relation to the demographic development is thus a problem of redistribution, rather than a problem related to the general economic growth.

The Ministry of Finance defines the "financing ratio" as the number of employees in the general-government sector plus the number of recipients of transfer income as a ratio of the number of employees in the private sector. If the budget is in balance, this ratio will be in close correlation with the taxation burden for as long as user charges are negligible. The financing ratio, and thereby the proportion of GDP to be redistributed via taxes, has risen considerably since 1960, cf. Chart 6, and in all probability is likely to increase further in the coming decades. The chart shows the possible course in consideration of the demographic trend. This is far from a "worst case" scenario, but rather the opposite. If working hours are reduced further, and if the public sector is compensated fully or partly with additional employees, the increase in the financing ratio will be significantly higher.

A defect of this definition of the financing ratio is that interest payments on the government debt are disregarded. Today, government expenditure is subject to extraordinary pressure as a consequence of the fact that while the large birth cohorts were active in the labour market, the central government increased its debt instead of consolidating its

finances. The current government budget surplus should be maintained in order to reduce the future demography-related problems affecting government finances.

There are several alternatives to increasing the taxation burden in order to finance the increased dependency ratio: a reduction or complete repayment of the government debt will increase the scope for manoeuvre of government budgets at a given taxation burden, due to reduced interest and instalment payments. The same will be the case if the number of transfer-income recipients in the active age groups can be reduced, thereby increasing the age-related participation rates. For the older age groups this can also be achieved by raising the retirement age. Finally, productivity increases in the general-government sector will ease the pressure on sources of financing. In selected areas increased user charges can reduce people's demand for public services and thereby dampen the taxation burden.

A general reduction of working hours which, as stated, is not taken into account in Chart 6, will at most influence the financing ratio in one of two ways: either a corresponding reduction in the number of completed working hours in the general-government sector, leaving the expenditure and taxation burdens unchanged, but giving a lower service level; or the general-government sector is compensated by increasing the number of employees, so that the service level remains unchanged, but the expenditure and taxation burdens are increased. A further reduction of working hours thus exacerbates the dilemma between the level of public service and the taxation burden, and might also jeopardise the private sector's opportunities to recruit qualified labour, with wage inflation as a consequence.

In conclusion, a key challenge of the coming decades is to make the population understand that it is necessary to reduce expectations of a continued reduction of working hours if the levels of material affluence and of public service are to be maintained. The individual's choice between remaining in the labour market or retiring, and the more collective choice of working hours per year, have far-reaching consequences for the economy and for the taxation burden. It is not just a question of exchanging private consumption for more leisure, or providing a job for an unemployed person. In this perspective it is advisable that people be encouraged to remain in the labour market for longer. A declining supply of labour has vital socio-economic implications, particularly in the Danish system of predominantly taxation-financed public services, since the taxation base is hereby eroded.

## APPENDIX

Breakdown of growth and hourly productivity in the agricultural and service sectors.

**BREAKDOWN OF GROWTH IN THE AGRICULTURAL SECTOR** Table 5

Rate of growth, per cent p.a.	dY/Y	0.25*dK/K	0.75*dL/L	dT/T
1950-1960 .....	2.4	0.4	-1.6	3.6
1960-1970 .....	2.0	0.7	-4.0	5.3
1970-1980 .....	0.7	0.8	-3.5	3.4
1980-1990 .....	4.0	-0.1	-2.5	6.6
1990-1999 .....	2.4	-0.1	-2.4	4.9
1960-1999 .....	2.1	1.3	-4.4	5.2

**BREAKDOWN OF HOURLY PRODUCTIVITY, AGRICULTURE** Table 6

Rate of growth, per cent p.a.	dy/y	0.25*dk/k	dT/T	Per cent
1950-1960 .....	4.6	1.0	3.6	78
1960-1970 .....	7.4	2.1	5.3	72
1970-1980 .....	5.4	2.0	3.4	63
1980-1990 .....	7.3	0.7	6.6	90
1990-1999 .....	5.7	0.8	4.9	86
1960-1999 .....	6.7	1.5	5.2	78

**BREAKDOWN OF GROWTH IN THE SERVICE SECTOR** Table 7

Rate of growth, per cent p.a.	dY/Y	0.25*dK/K	0.75*dL/L	dT/T
1950-1960 .....	3.3	1.1	0.1	2.1
1960-1970 .....	3.6	1.1	0.0	2.5
1970-1980 .....	1.7	0.7	-0.7	1.7
1980-1990 .....	2.8	0.6	0.4	1.8
1990-1999 .....	2.9	0.5	0.3	2.1
1960-1999 .....	3.0	0.8	0.0	2.2

**BREAKDOWN OF HOURLY PRODUCTIVITY, SERVICE SECTOR** Table 8

Rate of growth, per cent p.a.	dy/y	0.25*dk/k	dT/T	Per cent
1950-1960 .....	3.1	1.0	2.1	68
1960-1970 .....	3.6	1.1	2.5	69
1970-1980 .....	2.6	0.9	1.7	65
1980-1990 .....	2.3	0.5	1.8	78
1990-1999 .....	2.5	0.4	2.1	84
1960-1999 .....	3.0	0.8	2.2	73