Ageing, Immigration, and Fiscal Sustainability

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Abstract
This paper evaluates the sustainability of Danish fiscal policy for a given demographic development. The total population forecast is the sum of individual forecasts for 5 different origin groups including immigrants and descendents of immigrants. Results are that the demographic dependency ratio increases and has a local maximum around 2040. However, the level of the dependency ratio remains permanently 25 percent higher than the current level. Correcting for shifts in the relative sizes of the different origin groups, and taken into account the differences in the labour market participation ratio of the different origin groups, indicates that the ageing problem is larger than suggested by the demographic dependency ratio and that there is no reduction in the problem after 2040.
The necessary fiscal adjustment – to fulfil the intertemporal budget constraint of the public sector – is fairly small, and involves a reduction in the level of public expenditures of 1.8 percent of GDP at factor prices.
The effects of a quantitative restriction on gross immigration are also analysed. We find that a quantitative restriction that is halving immigration has very significant effects on total population. At the end of the century the population is 27 percent lower than in the baseline forecast. Real GDP, employment, and the capital stock are reduced in the same magnitude and the aggregate private consumption is reduced a little less. The effect on the necessary fiscal adjustment is very small compared to the measures. The necessary reduction in the level of public expenditures is 1.4 percent of GDP at factor prices.

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1. Introduction

The economic consequences of the demographic development have become one of the major concerns in most welfare states. The ageing of the population that follows from increased expected lifetime and declining birth rates tend to set the fiscal policy in most welfare states under pressure, as public expenditures are increasing with the increased number of elderly citizens, whereas the potential reduction in the labour force tends to erode the tax bases. Therefore fiscal policy may be unsustainable and adjustments in the public expenditures are necessary to ensure that the intertemporal budget constraint is fulfilled.

Most developed countries would face a declining population if not for a positive annual immigration. Therefore the second element in the demographic development that has attracted focus is the size and the composition of the annual net immigration. Two very different concerns are central in the discussion of immigration to welfare states. The first is that immigrants from poorer countries arrive in increased numbers and strain the social welfare systems, which generates even larger necessary fiscal adjustments than what follows from the demographic ageing. This has led to fairly restrictive rules of immigration in the EU countries. On the other hand individual countries within Europe and other western economies compete for immigration of qualified labour to reduce the negative effect on the labour supply of the demographic ageing problem by introducing so-called green card arrangements.

The present paper presents a disaggregated forecast of the Danish population and evaluates the macroeconomic development and the sustainability of current Danish fiscal policy in the light of the projection. The demographic forecast suggests that demographic ageing is a permanent phenomenon in Denmark. In addition the forecast implies that the stock of immigrants and descendents of immigrants are increasing relative to remaining population. Given the relatively large differences in the labour market participation rates between the origin groups, this development tends to enhance the increase in the corrected dependency ratio, defined as the number of individuals outside the labour force divided by the number of individuals in the labour force.

The sustainability of current Danish fiscal policy given the demographic forecast is evaluated using the dynamic OLG-CGE model DREAM. Although the demographic development implies that the Danish economy faces a permanent ageing problem, the result of the analysis is that Danish fiscal policy is not very far from being sustainable. The necessary adjustment is a reduction in public expenditures of 1.8 percent of GDP at factor prises. One major reason why the adjustment may be reduced to this amount is that the Danish income tax base is automatically increasing in the next sixty years due to the present non-matured status of the funded occupational pension system and tax treatments of pension contributions and pension payments.

The effect of a reduction in the annual migration to Denmark on fiscal sustainability and the economic development is also analysed. The result is that the effect on population, production and employment is large, whereas there is only a minor reduction in the necessary reduction in public spending. Therefore increased immigration may put some strain on the Danish welfare state, but the effect is modest.

The remaining part of the paper has the following structure. In section 2 the demographic forecast is presented, section 3 discusses the modelling of the economic development, while the resulting macroeconomic development is described in section 4. Section 5 gives an account of the development in public expenditures and revenues. Finally, section 6 discusses the effect of the quantitative restriction on the immigration.

2. Demographic forecast

The demographic forecast of the population as a whole is constructed as a sum of individual demographic forecasts for 5 origin groups: Immigrants from less developed countries, immigrants from more developed countries, descendents of immigrants from less developed countries, descendents of immigrants from more developed countries and finally the remaining population. Two demographic effects may be studied given this approach: Demographic ageing and shifts in the composition of population across origin groups. Both effects are important from an economic point of view, since the behaviour of individuals differ both with the age and the origin group.[1]

2.1 Distribution across origin groups

Total population is forecasted to grow from 5.32 million in 2000 to 5.57 million in 2035. From 2035 to 2050 there is a small decline in the population. After 2050 population start growing at a fairly low rate and reaches 5.74 million in 2100.

The distribution of the total population across the 5 origin groups shows a significant change. The total stock of immigrants grows from a level of 5.4 percent of the population in 1999 to 16.0 percent in 2100. The growth rate is largest in the first phase of the forecast. The total stock of descendents grows even faster, from 1.4 percent in 1999 to 15.0 percent in 2100. The remaining part of the population declines both in a relative and in an absolute sense. The number of persons in this origin group falls from 5.0 million in 1999 to 4.0 million in 2100. The large shifts in the relative sizes of the origin groups reflect that positive net immigration to Denmark is a fairly new phenomenon, and therefore the present number of immigrants and their descendents is low. In addition total fertility of immigrant females from less developed countries is significantly higher than for other population groups.

Figure 1: Population distributed according to origin groups

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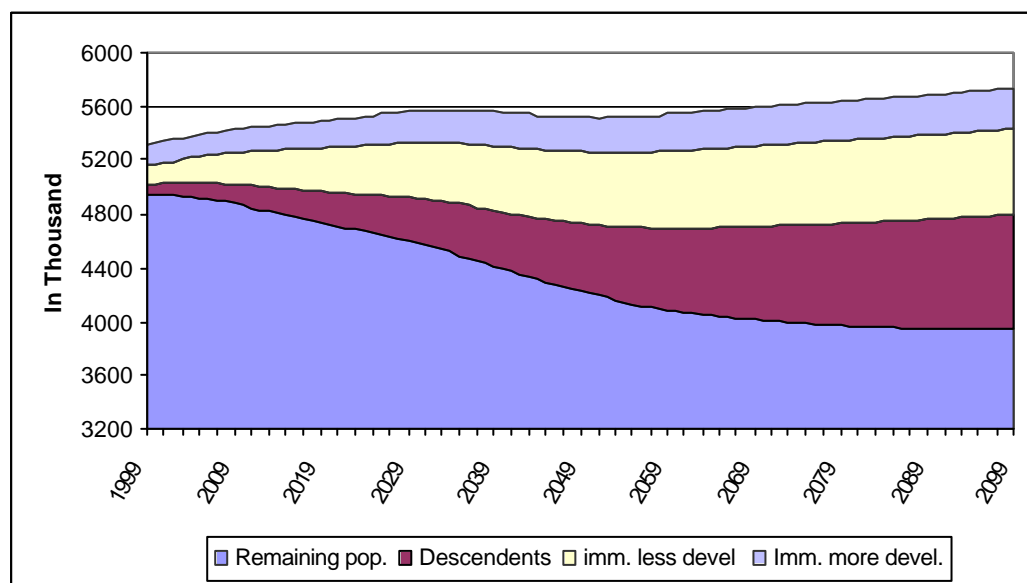
[1] Appendix describes the construction of the forecast and defines the concepts.

In 1999 the stock of immigrants from less and more developed countries were of similar size. The estimated development in gross immigration to the two groups is also similar. However, re-emigration is much higher from the group of immigrants from more developed countries and therefore, the increase in the stock of immigrants from less developed countries remains significantly larger than the increase in the stock of immigrants from more developed countries.

2.2 Dependency ratios

The moderate growth in the total population is in sharp contrast to the relatively large shifts in the proportions of different age groups. To measure these shifts we define some demographic dependency ratios: The old age demographic dependency ratio is defined as the number of individuals who are at least 65 years old divided by the number of individuals who are in the age groups from 17 to 64 years. This ratio increases by 54 percent from 1999 to the (local) maximum in 2042. From this point in time there is a minor decline in the old age demographic dependency ratio, which lasts until 2055 where the ratio starts increasing again. By 2100 the ratio is 47 percent higher than in 1999.

The demographic dependency ratio is defined as the sum of the number of individuals in the age group from 0 to 17 years and the number of individuals who are at least 65 years divided by the number of individuals who are in the age groups from 17 to 64 years. This ratio increases less than the old age dependency ratio. The demographic dependency ratio peaks in 2040 at a level that is 30 percent higher than in 1999. After a decline until 2050, the dependency ratio stabilizes at a level that is 25 percent above the level in 1999.

The conclusion is that demographic dependency ratios indicate that the ageing problem is permanent, but also that the immediate problem that appears from 2020 to 2040 is somewhat larger than the permanent increase in the dependency ratio.

However, the demographic dependency ratios by definition ignore the possible effects on labour supply from the shift in the composition of population between the origin groups. To introduce these effects a definition of the labour supply is necessary. In the present analysis labour supply is given as the following benchmark: Assume that the labour market participation rate of persons of a given age, gender, and origin group remains constant. Changes in the labour supply are therefore solely due to population changes, composition effects from the changing age structure and shifts in the relative sizes of the different origin groups. [2]

The labour supply is reduced by 300.000 persons (11 percent) from 2000 to a minimum in 2039. The permanent reduction amounts to 225.000 persons. This is a remarkable reduction given that the forecasted total population in the age groups from 17 to 64 years is approximately the same in 2100 as in 2000. The entire reduction in the labour force is therefore due to changes in the age composition and – most importantly – the origin composition of the population.

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[2] Two derivations from the principle of constant participation rates for persons of a given age, gender and origin group are made: The accession to the transitory benefits system for long term unemployed who are between 50 and 60 years old has been stopped. Therefore it is assumed that future labour market participation rates for these age groups are the sum of the present labour market participation rate and the participation rate of the transitory benefit system. The second exception is due to fact that old age social security pensions from 2005 starts at the age of 65 year instead of the present 67 years.

To measure the effect of the shift in the origin composition on the dependency ratios, we define the corrected dependency ratio as the number of individuals who are not in the labour force divided by the number of individuals in the labour force. This ratio increases faster than the demographic dependency ratio and peaks in 2037 at a level 35 percent higher than in 1999. The most important difference between this ratio and the demographic dependency ratio is, however, that the corrected dependency ratio remains fairly constant after having reached the local maximum in 2037. The level has increased by 33 percent in 2100 compared to 1999.

This implies that the combination of the ageing of the Danish population and the shifts in the origin composition of the population enforce each other. The resulting aging problem appears to be larger and of an even more permanent nature than the demographic dependency ratio suggests. No significant improvement in the corrected dependency ratio is measured after the original peak around 2040.

Figure 2: Dependency ratios.
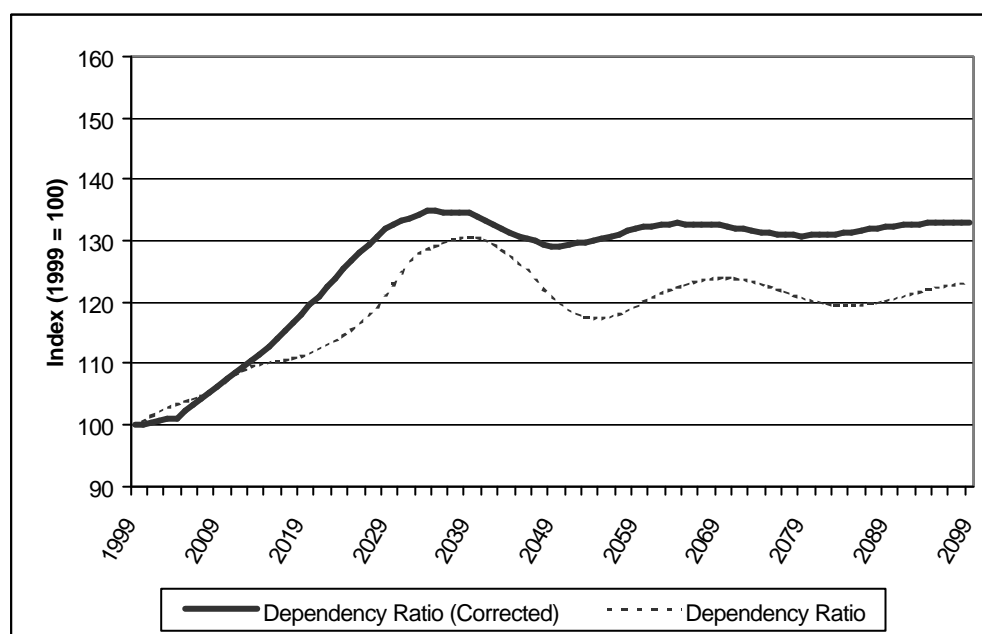
3. Modelling the economic development

The dynamic overlapping generations model DREAM is used to forecast the economic development given the forecasted demographic development.[3] To perform a forecast it is necessary to specify the information sets of the agents in the model. Furthermore, it is a necessary condition for existence of equilibrium that all agents – including the public sector – fulfil their intertemporal budget constraint. For the public sector a fiscal policy plan is specified, including a reaction function ensuring that the intertemporal budget constraint is fulfilled.

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[3] A documentation of DREAM may be found in Pedersen, Stephensen & Trier (1998), that may be downloaded from www.dreammodel.dk

3.1 The fiscal policy and the foreign sector

In the present analysis public consumption is divided into individual public consumption and collective public consumption, where the former consists of rival and semi-rival goods such as medication, hospitals, and education. The latter is standard non-rival public goods such as defence, justice etc.

Individual public consumption is distributed across gender and age groups based on an account of the use of the public services in 1998. It is assumed that the age and gender distributions are maintained and that the individual public consumption per individual grows at the same rate as the exogenous Harrod neutral technical progress. Figure 3 shows the age distribution of individual public consumption. Observe that the age groups older than 60 years receive the largest amount per individual, whereas younger age groups receive less. This implies that total individual public consumption grows at a higher rate than GDP in the period where the population is ageing.

Figure 3: The age distribution of individual public consumption
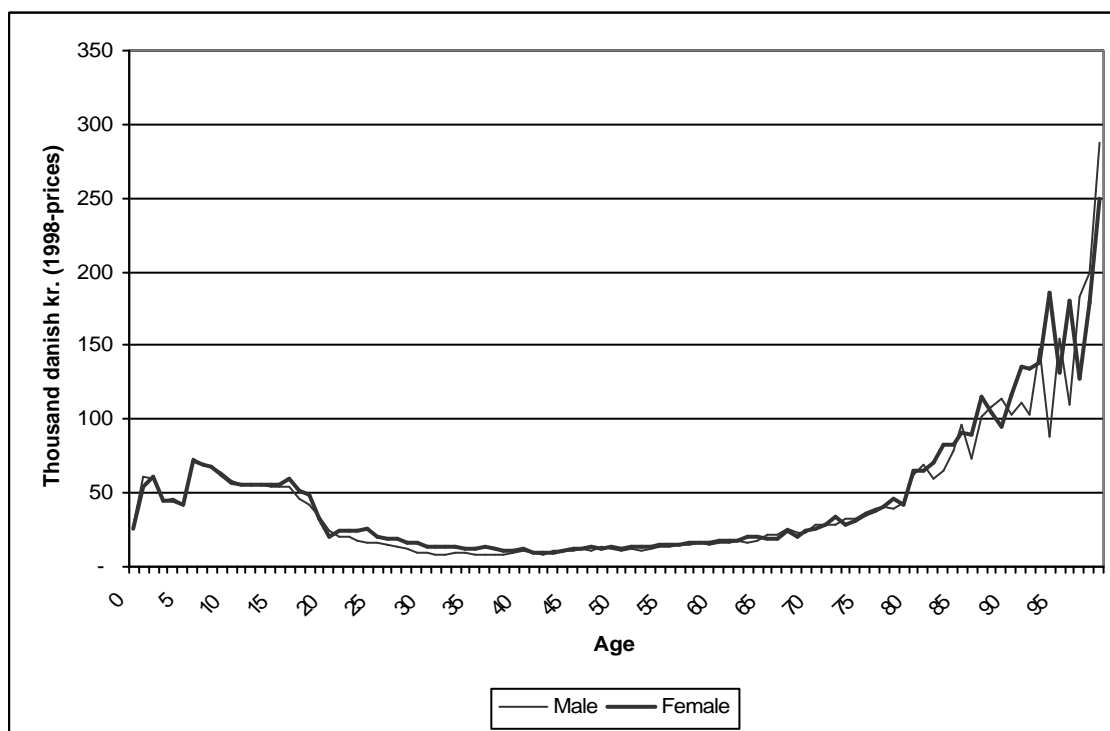
Real collective public consumption is assumed to grow at the same rate as real GDP. This implies that real collective public consumption per individual grows at a lower rate than the average growth rate in the economy in the period where the population is ageing.

Public transfers are divided into various types that are allocated to individuals according to different criteria. Since the unemployment rate is endogenous, the number of individuals who receive (publicly financed) unemployment benefits is endogenous. For most other types of public transfers the numbers of recipients are determined exogenously. The distribution of individuals receiving public transfers in 1999 is taken from a register of all individuals in Denmark, where individuals are classified according to type of income. From the register the

fraction of a given age, gender and origin group that receives a given public transfer is obtained for the year 1999. In the projection it is assumed that these fractions remain constant through time. Given the demographic forecast, this generates the number of recipients of each specified public transfer through time.

Each public transfer per individual is – according to Danish law – indexed to the wage rate and therefore the rate of growth is endogenously determined in the model.

The remaining part of public expenditure, most notably public investments and interest payment on public debt, is determined endogenously. The public investment is determined by the simple rule that the *Y-K* ratio in the public production is constant.

Public revenues are generally endogenous in DREAM, whereas tax rates are exogenous given the specified policy reaction function in the present analysis. Indirect taxes are converted to VAT equivalents and the rates are assumed to remain constant. Concerning the progressive income taxation it is assumed that the income brackets are indexed so that the progressivity remains constant as well as the level of the tax rates.

Finally, it is assumed that the level of collective public consumption is adjusted in 2005 to a level, which, given the indexation rule, ensures that the intertemporal budget constraint is fulfilled. This policy reaction function is chosen to reflect the policy announcement of the incumbent Danish government. According to this announcement taxes are to remain at the current level or lower.[4] Furthermore, government policy is to improve public service to elderly and to improve hospital services in general. In the present analysis this is interpreted as an announcement that individual public expenditures are not subject to budget reduction. Therefore the entire adjustment is taken by the collective public expenditures.

The foreign sector is modelled as "neutral" as possible. This implies that the rate of foreign inflation is constant at a 1.5 percent level. The rate of growth of foreign demand for domestic export grows – for given relative prices – at the rate of Harrod-neutral technological progress in the domestic country, which is also assumed to be 1.5 percent. The nominal foreign interest rate is kept constant through time at a level of 5.56 percent, amounting to a real interest rate of 4.0 percent. These assumptions are made to dampen the effects on the domestic economy in order to isolate the effects of the domestic demographic ageing. This implies that any effects of demographic ageing on the world economy are ignored.

3.2 The information set of the agents

The agents in the economy are assumed to have perfect foresight, to know the economic policy rules, the demographic development, and the exogenous development in the foreign economy. Firms choose the demand for labour, the level of investment, and the demand for materials. Monopolistic competition is assumed in all sectors and therefore each firm sets the price given the prices of its competitors. Households determine their optimal consumption plan and their labour supply, given this knowledge and perfect information on the demographic development, and therefore the development in the size of the households.

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[4] The announced "tax stop" implies that no tax rate is allowed to increase. Therefore nominal indirect taxes are to be kept at the current nominal level. Furthermore, the revenue from the residence tax is to remain constant in nominal terms. In sum, the "tax stop" implies a tighter revenue constraint than the policy analysed in the present paper.

4. Macroeconomic forecast

The assumption of perfect financial capital markets and the constant international rate of interest combined with the fixed tax rates in the corporate sector imply that the user cost of capital and therefore the (long run) K/L ratios in the production sectors and the wage rates are relatively fixed. Hence total production is closely linked to the development of the labour force. However, this fundamental supply side property of the model is modified by the presence of, first, endogenous terms of trade which generate (minor) changes in the user cost of capital and, second, installation costs of capital which imply that the K/L ratios only gradually approach their long run levels. These phenomena are reflected in the development of real GDP at factor prices, see table 1.[5]

In table 1 the real growth-corrected value of GDP is gradually reduced from the current level to 2044 where the level is 14 percent below the level in 1999. This reflects the drop in the labour force by 11.0 per cent from 1999 to 2044. The effect of the falling labour force is magnified by the fact that the new long run K/L ratio is lower than in the initial equilibrium.

	1999	1999	2004	2019	2044	2069	2099
	Level (bill. DKK)	Growth and inflation corrected index, 1998=100 except where noted					
Private consumption	493.5	100	95.0	94.1	89.5	89.0	90.5
Real GDP at factor prices	1046.7	100	98.9	92.1	86.1	86.5	88.7
Unemployment rate	5.9	100	97.1	93.8	92.6	93.3	93.5
Employment		100	99.8	93.2	88.0	88.4	90.8
in private production sector		100	100.2	90.9	82.5	83.1	85.1
in construction sector		100	100.5	106.0	99.9	100.1	102.6
in public sector		100	99.1	95.0	96.5	96.4	99.6
Capital							
in private production sector		100	98.9	91.3	83.1	83.7	85.5
in construction sector		100	100.0	106.2	101.0	101.3	103.7
in public sector		100	92.7	88.1	89.7	89.7	92.7
Foreign assets *	-175.0	-16.7	5.7	60.3	61.0	59.7	67.7

* Index is foreign assets to nominal GDP at factor prices

Table 1: Macroeconomic development in the baseline scenario

The reduced employment is unevenly distributed across sectors in the economy. The employment in the private non-construction sector is reduced by 17.5 percent from 1999 to 2044 and by approximately 15.0 percent in the last part of the century. Compared to this reduction the two remaining sectors – the construction sector and the public sector – have a fairly constant level of employment.

The main explanation is that the firms in the private non-construction sector are competing with foreign competitors and, due to a relatively high elasticity of substitution, the prices cannot deviate from the prices of the competitors.[6] The products of the non-construction sector

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[5] In all tables the levels of real values are measured in so-called growth-corrected units, meaning that actual real numbers are deflated by an annual growth rate of 1.5 per cent (equal to the Harrod-neutral technological change). Similarly, nominal values are measured in so-called inflation- and growth-corrected units, which means that the actual nominal numbers are deflated by an annual growth rate of approximately 3 percent, due to a 1.5 percent rate of inflation and a 1.5 percent rate of growth.

[6] Recall that the foreign economy is not subject to an ageing problem given the way that the forecast is constructed.

and the public sector are not faced with international competition and therefore the prices of these products may increase relatively to the prices in the non-construction sector.

The reduction in the competitive non-construction sector does not generate deficits on the current account of the balance of payments. On the contrary, there is a substantial improvement in the net foreign asset position. The effect is a combination of an increase in both public and private savings during the first 20 years of the forecast, and a simultaneous reduction in investments, redirecting savings to foreign financial asset accumulation.

The primary public budget surplus was 6.1 percent of GDP at factor costs in 1999. After interest payments this amounted to a total surplus of 4.1 percent of GDP at factor costs. This relatively high level of public surplus is expected to continue with almost the same strength in the next five-year period, given the announced fiscal policy. From 2005 a significant tightening of fiscal policy is introduced in the forecasted projection. This is due to the assumed policy reaction function, which adjusts the level of collective public expenditures from 2005 to obtain a fiscal policy that fulfils the intertemporal budget constraint of the public sector.

The necessary adjustment is a reduction of 1.8 percent of GDP at factor prices in the level of expenditures from 2005. However, since the impact of the demographic ageing does not gather speed until 2020, this reduction in collective public expenditures generates a relatively long period of large public surpluses. These surpluses – ceteris paribus – increase the foreign asset accumulation of the economy.

The increased private savings are generated partly by an expected reduction in lifetime income per adult in the younger generations, and partly by an assumed positive net savings effect from the occupational pension schemes that are currently being phased in for the manual part of the private labour market.

Lower average lifetime income per individual follows from the fact that the demographic composition of a given age group changes in such a way that the average labour market participation rate – and therefore also income – is reduced. The expected increase in household income over the life cycle is therefore lower.

Occupational pension schemes are funded pension schemes that are compulsory from the point of view of the individual employee. Contributions to schemes are negotiated between a confederation of employers and a union as part of the total wage bargaining. Savings in the occupational pension schemes are not perfect substitutes to individual savings, due to the collective life insurance aspect of the pension savings. This implies that pension payments from the occupational pension system are contingent on the individual being alive at the time where the pensions are to be paid from the pension fund. In this respect the system is similar to the insurance system in Blanchard (1985). The collective life insurance aspect implies that savings in the fund are not private property (but property of the fund) and thus the individual cannot borrow perfectly against this stock of savings. This fact along with general imperfections in the real world financial markets implies that a positive effect on net savings is to be expected from the extension of the occupational pension system.

The positive effect on the aggregate net savings implies that the stock of wealth in the private sector grows faster than the general growth rate in the economy and therefore the long run level of private consumption increases relative to production.

5. Public expenditures and revenues in the forecast

As expected from the significant increase in the corrected dependency ratio, see figure 2, there is a significant increase in public expenditures relative to GDP at factor prices. Table 2 indicates that public expenditures relative to GDP grow by 11.6 percentage points from 1999 to 2044. After 2044 it remains almost stable, which reflects the evolution in the corrected dependency ratio in figure 2. Observe that this increase in the public expenditures includes the endogenous reduction in the collective public consumption of 1.8 percent of GDP at factor prices, which follows from the policy reaction function ensuring that the intertemporal budget constraint of the public sector is fulfilled.

Table 2: Public expenditures and revenues in the baseline scenario

	1999	1999	2004	2019	2044	2069	2099
	Level (bill. DKK)	Pct. of nominal GDP at factor costs					
Expenditures	**543.8**	**52.0**	**52.5**	**58.9**	**63.6**	**62.9**	**63.2**
Social pensions *	104.3	10.0	9.9	11.8	12.0	11.5	11.6
Civil servants pension, ATP and LD	17.1	1.6	2.6	5.2	6.1	5.9	5.8
Age dependent public transfers	86.9	8.3	8.1	8.4	9.2	9.4	9.4
Age dependent public consumption	215.9	20.6	20.5	22.8	25.7	25.5	25.8
Total of age dependent	424.2	40.5	41.1	48.3	53.0	52.4	52.6
Non age dependent public consumption	97.6	9.3	9.3	7.5	7.5	7.5	7.5
Government investments	22.0	2.1	2.1	3.0	3.1	3.0	3.1
Total other expenditures	119.6	11.4	11.4	10.6	10.6	10.5	10.6
Tax revenues	**607.5**	**58.0**	**56.8**	**59.7**	**62.1**	**62.3**	**62.2**
Social pensions *	26.7	2.5	2.5	2.9	3.0	2.9	2.9
Civil servants pension, ATP and LD	7.6	0.7	1.1	2.2	2.5	2.4	2.3
Labour market pensions	9.0	0.9	0.9	1.7	3.2	3.8	3.8
Private pensions	8.3	0.8	0.6	0.9	1.4	1.4	1.3
Pension funds	1.1	0.1	0.5	1.5	2.1	2.3	2.3
Other taxes	554.8	53.0	51.2	50.5	50.0	49.6	49.5
Government primary budget	**63.6**	**6.1**	**4.3**	**0.9**	**-1.5**	**-0.6**	**-1.0**
Interest rate payment	**21.3**	**2.0**	**0.9**	**-1.9**	**-1.9**	**-1.7**	**-2.0**
Net debt	**194.4**	**18.6**	**2.1**	**-49.6**	**-38.6**	**-38.6**	**-44.0**

Early retirement benefits, early reitrements pensions, special early retirerement benefits and public age pensions

From table 2 one also observes that the individual public expenditures account for approximately half of the total growth of public expenditures relative to GDP at factor prices. Public income transfers, most notably social security pensions, account for most of the remaining growth.

The endogenous reduction in the level of collective public consumption necessary to fulfil the intertemporal budget constraint is, as mentioned, 1.8 percent of GDP at factor prices. By international comparison, this necessary budget adjustment is fairly small. Most other European countries face a significantly larger ageing problem and the associated budgetary problems are correspondingly larger (see Jägers & Raffelhüschen (1999)).

One major reason for this relatively small necessary adjustment in the fiscal policy is that tax bases in the Danish economy are increasing for institutional reasons. The current extension of the funded occupational pension system implies that the current tax base is relatively small, because contributions to occupational pensions system are deductible in the current income taxation, whereas pensions from the occupational pension system, which are subject to taxation, are only gradually increasing. It takes a full working life period before the steady state level of the tax base is reached. This means that the tax base of the income taxation is increasing until around 2060. A similar – but significantly smaller – effect appears in the tax base of

the capital income tax due to the positive net effect on aggregate savings from the increased contributions to occupational pension schemes.[7] In table 2, one observes that taxes from occupational pension payments (labour market pensions) increase by almost 3 percent of GDP at factor prices until 2069. Capital income taxation of pension funds increase by more than 2 percent of GDP at factor prices in the same period. This latter effect is, however, a gross effect as capital income tax revenue from non-occupational pension savings is reduced.

Even if the total necessary fiscal adjustment is fairly small, it may generate structural adjustment problems in the public sector. The policy announcements of the incumbent government that tax rates are to remain at the current level or lower, and that individual public expenditures focused at the elderly part of the population are not subject to budgetary reductions, imply that a fairly small part of the total public expenditures has to carry the total burden of adjustment. Given the interpretation of the policy in the present paper, the collective public consumption has to be reduced by more than 19 percent.

The necessary adjustment in public expenditures may be larger than these figures indicate. First, the reduction in the labour supply may be larger than the present forecast suggests. The historical trend indicates that the annual number of hours worked per individual is decreasing through time, which is consistent with a modelling of leisure as a normal good. This effect is ignored in the present analysis, and the annual number of working hours is kept at the current level throughout. Furthermore, the historical trend also indicates an earlier retirement from the labour force, which may be enforced by the additional savings that follow from the introduction of the occupational pension schemes. This is also ignored in the present analysis and for these reasons the evolution in the tax bases may be too optimistic. Second, the development in the tax revenues may also be too optimistic due to the fact that tax rates are kept constant. International tax competition may erode the tax bases for given tax rates or may generate a necessary reduction in the tax rates. In addition the interpretation of the incumbent government's announced ban on tax increases is relatively gentle in the present analysis.

6. Reduction in the number of immigrants

For the EU countries immigration policies have become a central issue in recent years. Two very different concerns affect the policy discussion. First, there is the concern that immigrants from poorer countries will come to Europe in increased numbers and strain the social welfare systems and thereby generate even larger necessary fiscal adjustments than what follows from the demographic development. This has led to fairly restrictive common rules of immigration. On the other hand individual countries within Europe compete for immigration of qualified labour to reduce the negative effect on the labour supply of the demographic ageing problem by introducing so-called green card arrangements.

The present analysis focuses on the first type of issue, and considers the effect of a general reduction in the number of immigrants to Denmark. The considered scenario reduces the annual immigration to 6,000 persons from less developed countries and 6,000 from more developed countries. This amounts to a 50 percent reduction in immigration from both groups

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[7] This effect is, however, modified by a significant tax subsidy to capital income in the occupational pension system.

compared to the level in 1999. It is therefore a substantial – and probably unrealistic large – reduction. [8]

6.1 The effect on the demographic development

The reduced immigration implies that total population is declining from 2007. Total population is reduced from 5.32 million persons in 1999 to 4.13 million in 2100. Compared to the population forecast in the baseline scenario population is 1.57 million lower in 2100, which is a reduction of 27 percent.

The distribution of the total population across the 5 origin groups of course also changes significantly. The share of immigrants in the total population grows from the current 5.4 percent to 9.0, compared to 16.0 percent in the baseline scenario. Descendents of immigrants grow from the current level of 1.4 percent of the population to a level of 8.6 percent compared to 15.0 percent in the baseline scenario.

The demographic dependency ratio increases by 34 percent from the present level to the peak in 2042, compared to an increase of 30 percent in the baseline scenario. After a temporary drop in the 2050s the demographic dependency ratio stabilises at a level around 30 percent higher than the current level. The similar figure for the baseline scenario is a permanent increase around 25 percent.

The conclusion is – not surprisingly – that reduced immigration increases the demographic ageing problem by reducing the number of individuals in the age group from 17 year to 64 year more than the remaining age groups.

Considering the corrected dependency ratio, which adjusts for the different labour market participation rates of the various origin groups, a different conclusion is reached. The level of the corrected dependency ratio in the alternative scenario is permanently lower than in the baseline scenario. The difference between the two is largest around 2015, where the level is 5 percent lower in the alternative scenario. From this point on the difference is gradually reduced and towards the end of the century the ratios in the two scenarios have almost converged.

The conclusion is therefore that the reduced immigration has a small positive effect on the ageing problem by slightly reducing the number of individuals outside the labour force relative to the number of individuals in the labour force. The explanation of the remarkable difference between the corrected and the demographic dependency ratio is that the stock of immigrants has a very low labour market participation rate compared to other origin groups.

6.2 Macroeconomic development and fiscal sustainability

The macroeconomic development – compared to the baseline scenario – is driven by the additional reduction in the labour force in the alternative scenario. Therefore employment and GDP are gradually reduced through time following the development in the labour force compared to the baseline scenario. During the century real GDP and total employment are reduced by approximately 33 percent in growth corrected units. Compared to the baseline scenario both figures are reduced by approximately 25 percent. From a macroeconomic perspective

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[8] It is beyond the scope of this analysis to consider the kind of legal restrictions that might generate such a change in the number of immigrants.

such a large reduction in the labour force is a huge challenge, and the cost of adjustment may well be underestimated in the current analysis.

Private consumption is reduced less than GPD in the long run. This is due to the modelling of household behaviour in DREAM. Given the modelling, the rate of consumption in a given young family is increasing with the number of children. In the alternative scenario the average number of children per family is reduced and therefore the young families reduce their spending, and thus savings are increased. This increases the long run stock of wealth and therefore long run consumption.

Measured in per capita terms the macroeconomic effects of the reduction in immigrants are relatively small. Real GDP per capita, employment per capita, and capital stock per capita are increased slightly. These effects are mainly due to the low labour market participation ratio of the immigrant groups and the increases in per capita terms simply reflect the reduction in the corrected dependency ratio. For private consumption there is a larger accumulated effect per capita. As explained above this is due to increased savings of younger households.

Table 3: Macroeconomic development in the alternative scenario

	1999	1999	2004	2019	2044	2069	2099
	Level (bill. DKK)	Indexes, 1988=100* and (baseline=100) except where noted					
Private consumption	493.5	100.0	95.0	91.9	82.9	76.8	70.8
		(100)	(100.0)	(97.7)	(92.6)	(86.3)	(78.3)
Real GDP at factor prices	1046.7	100.0	98.9	89.8	79.0	72.0	65.6
		(100)	(100.0)	(97.5)	(91.8)	(83.3)	(74.0)
Unemployment rate	5.9	100.0	97.1	93.6	92.2	92.7	92.4
		(100)	(100.0)	(99.8)	(99.6)	(99.3)	(98.8)
Employment		100.0	99.8	90.6	80.3	72.8	66.4
		(100)	(100.0)	(97.2)	(91.2)	(82.4)	(73.1)
in private production sector		100.0	100.2	88.6	75.9	68.7	62.0
		(100)	(100.0)	(97.5)	(91.9)	(82.6)	(72.9)
in construction sector		100.0	100.5	101.6	89.7	81.2	74.6
		(100)	(100.0)	(95.9)	(89.8)	(81.2)	(72.8)
in public sector		100.0	99.1	92.1	87.0	79.3	73.2
		(100)	(100.0)	(97.0)	(90.2)	(82.3)	(73.5)
Capital							
in private production sector		100.0	98.9	89.2	76.8	70.2	63.8
		(100)	(100.0)	(97.7)	(92.5)	(84.0)	(74.6)
in construction sector		100.0	100.0	102.0	91.3	83.7	77.5
		(100)	(100.0)	(96.1)	(90.4)	(82.5)	(74.8)
in public sector		100.0	92.7	85.6	81.1	74.1	68.4
		(100)	(100.0)	(97.1)	(90.4)	(82.6)	(73.8)
Foreign assets **	-175.0	-16.7	5.7	64.4	82.6	105.6	123.2
		(100)	(100.0)	(106.8)	(135.5)	(176.8)	(181.9)

* Index is growth and inflation corrected

** Index is foreign assets to nominal GDP at factor prices

The necessary adjustment in fiscal policy is lower in the alternative scenario. The reduction in the level of collective public consumption is 1.4 percent of GDP at factor prices compared 1.8 percent in the baseline scenario. Compared to the very large demographic and macroeconomic consequences of the reduction in immigration, the effect on sustainability is modest. The small positive effect is due to the fact that measured over the lifetime immigrants are – on average – net-recipients of payments from the public sector. Therefore a reduction in the number of immigrants has a positive effect on fiscal sustainability.

7. Conclusion

A demographic projection of the Danish population indicates that demographic aging peaks around 2040 with a 30 percent increase in the demographic dependency ratio. Demographic ageing is a permanent phenomenon, as the demographic dependency ratio remains 25 percent above current level throughout the century. Correcting for the shifts in the relative sizes of different origin groups and the average labour market participation rates of these groups indicates that the ageing problem is larger - the corrected dependency ratio increases by 34 percent and remains at this level throughout the century.

Danish fiscal policy is not sustainable, but the necessary adjustment is relatively small and amounts to 1.8 percent of GDP at factor prices. One reason for the relatively small adjustment is that the Danish income tax base is increasing through time. This is due to the non-matured status of Danish occupational pension schemes and the tax treatment of pension savings. The forecast points to the reduction of the labour force as the major macroeconomic adjustment problem. Employment in the private non-construction sector is reduced by more than 17 percent until 2040, while employment in the public and the construction sector remains at the current level.

A permanent reduction in the annual level of immigration to half of the 1999 level has large demographic effects. The total population is reduced by 1.2 million people through the century. Compared to the baseline scenario population is reduced by 27 percent at the end of the century.

The demographic ageing problem is increased by the reduction in immigration. However, the corrected dependency ratio – which accounts for the difference in labour market participation rate between origin groups – shows that the reduced immigration implies a minor reduction in the ratio of persons outside the labour force to persons in the labour force.

This reduction explains why the reduced immigration has a positive effect on fiscal sustainability. The necessary adjustment in fiscal expenditures reduces to 1.4 percent of GDP – a reduction of 0.4 percentage points compared to the baseline scenario. Compared to the very large macroeconomic and demographic effects this improvement of fiscal sustainability is almost negligible.

Real GDP, employment, and the capital stock are reduced by approximately 25 percent in the long run compared to the baseline level. Aggregate private consumption is reduced by more than 20 percent.

Measured in per capita terms there is a slight increase in all variables. Thus the major challenge that follows from a reduction in immigration is the significant reduction in production capacity in the domestic economy.

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Appendix: The construction of the demographic forecast

To perform the demographic forecast a database covering the period 1980-2000 is constructed.[9] In the database the Danish population is divided into five groups according to an origin criterion. The origin groups are: Immigrants from less developed countries[10], immigrants from more developed countries, descendents of immigrants from less developed countries, descendents of immigrants from more developed countries, and the remaining population. Each of the immigrant groups and the descendents of immigrants are further divided into to two groups according to whether or not they are Danish citizens.

The definition of an immigrant is a person born abroad by parents, who are both foreign citizens or born abroad. The definition of a descendent of an immigrant is a person born in Denmark by parents, who are not Danish citizens, born in Denmark. Finally, a person belonging to the remaining part of the population is defined as a person who has at least one parent that is a Danish citizen born in Denmark – regardless of the persons own birthplace and citizenship.

For each year the database contains the following variables for each population group: The number of men and women distributed according to age, the number of dead men and women distributed according to age, the number of newborn boys and girls distributed according to the age of their mother, the number of immigrants distributed according to gender and age, and finally the number of emigrants distributed according to gender and age. In addition, the database contains the following information on all newborns: The gender, citizenship and origin group (descendent of one of the immigrant groups or not) of the baby, and the mother's and the father's age, citizenship, and origin group.

From the data, the age and gender specific probability of shift of citizenship may be calculated for each immigrant and descendent group. Similarly, the information on the mothers and fathers of newborns may be used to calculate the origin group distribution of the father contingent of the origin group of the mother.

The age and gender specific mortality rate is estimated using the database. As the immigrants and descendents of immigrant groups contain relatively few elderly persons, the development in the age and gender specific mortality is estimated for the population as a whole. Contrary, the development in the age specific fertility is estimated individually for each of the nine population groups. The development in the annual number of gross immigration from less and more developed countries respectively is also estimated. The age distribution of immigrants is assumed to remain identical to the average age distribution in the last 5-year period. Similarly, the age and gender specific emigration probability is assumed to remain identical to the observed probability distribution in the last 5-year period. The probability of shift of citizenship is also assumed to remain identical to the latest 5-year average for all age, gender, and origin groups. Finally, the origin group distribution of the fathers' contingent of the origin group of the mothers' is assumed to remain equal to the latest 5-year average.

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[9] Danish population figures are register based. A unique number identifies each individual and information on the individual is registered according to this identification. These administrative registers are confidential, but legislation allows statistical use given that this does not violate a set of specified confidentiality requirements.

[10] The definition of a country as being more or less developed follows the UN definition (UN xxxx). According to this definition more developed countries are defined as: USA, Canada, Japan, Australia, New Zealand and all European countries except Turkey, Cyprus, Azerbaijan, Uzbekistan, Kazakhstan, Turkmenistan, Kirgisistan, Tadsjikistan, Georgia and Armenia. Countries not specified as more developed countries are by definition less developed countries.

Given these estimates and assumptions the demographic forecasting methodology is the following:

The initial stock of persons in a given population group and the age and gender distribution is taken as given. First, the number of dead persons is calculated using the estimated age and gender specific mortality. Then emigration is calculated using the age and gender specific emigration probability. Adding the estimated gross immigration implies that an age and gender distributed level of net immigrants may be calculated. The third step is to calculate the number of persons (and the distribution across age and gender) in the specific origin group who change citizenship. From these figures, the 1 year forecast of the number of persons in a given origin group, who are at least 1 year old, may be calculated.

The number of newborns is calculated using the age and origin group specific fertility. The newborns are distributed on boys and girls in a fixed proportion. To determine the origin group of the newborn the origin group distribution of the fathers' and the citizenship distribution of newborns are used.[11]

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[11] A documentation of the methodology and the estimation results are available (in Danish) in Stephensen (2001)