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Working Paper

Fiscal Federalism and Demography

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Fiscal Federalism and Demography

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Fiscal Federalism and Demography

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Abstract:

The paper examines the effects of demographic change on federal, state and local governments in Germany with a focus on the expenditure side to answer the question, whether demographic change will induce vertical fiscal expenditure imbalances. We present estimates of the impact of demographic change on public spending based on a decomposition of expenditures into almost 30 categories (functions). Our results suggest that demographic change will indeed result in significant vertical expenditure imbalances between the federal and the subnational government sector as well as within the subnational government sector. In addition, the estimates show that the structure of expenditures by function has to be adjusted considerably in order to avoid deficits as demographically induced increases in expenditures in some important functions, such as pension payments, have to be counterbalanced by exploiting potential savings that arise from demographic change in other functions.

1. Introduction

As most other industrialized countries, Germany faces rather dramatic demographic challenges in the next decades: An ageing society, a low reproduction rate, a declining population and workforce as well as a significant redistribution of population within and across regions. These demographic changes will have considerable effects on the economy and public budgets. The present paper is devoted to an examination of the fiscal consequences of demographic changes in federal systems, a subject that has been rarely touched in the literature. Notable exceptions are some studies for Canada, see for example Lazar, St-Hilaire and Tremblay (2003), Ruggeri (2001), Conference Board of Canada (2002) as well as for the US (see Lee and Edwards 2001) and the theoretical work of Echevarría (1995). Most studies that examine the interrelation between demographics and public finance take a look at the budget of the central government or the total government sector and concentrate on the financing of (publicly funded) social security systems.[1] In federal systems, repercussions of demographics on public expenditures and revenues can divert significantly across the different levels of governments and therefore a disaggregate analysis by level of government is important. Such an investigation will be presented in this study taking the Federal Republic of Germany as an example.

The focus of the paper is on the expenditure side of government budgets. Given that in Germany the bulk of tax revenues come out of joint taxes and a highly equalizing interjurisdictional transfer system contributes to a significant convergence of per capita revenues across the regions, demographic change will have only marginal effects on the distribution of tax revenues across the different levels of government in Germany. Therefore, the revenue side is not taken into account. In addition, contrary to many other studies the social security system is *not* included in our definition of the public sector, i.e., the public sector is confined to the federal, state and local government level. Only direct transfers out of public sector budgets - such as the tremendous subsidies of the federal government to the pension system - are taken into account. In section 2 we start with a brief discussion of the most important demographic facts in Germany. Section 3 sketches the fiscal federalism system in Germany. Methodical issues are discussed in section 4 with a focus on the derivation and forecast of age expenditure profiles which are the central element of our estimation procedure. In section 5 we construct simple age cost profiles by government functions and develop estimates of the impact of demographic change on expenditures at the three levels of government. These estimates are used to examine the question whether vertical fiscal expenditure imbalances will arise in Germany as a consequence of demographic change. A final section summarizes our results and outlines prospects for further research.

2. Demography in Germany

Figure 1 presents population forecasts for Germany up to 2030. There are marked differences between East and West Germany which are due to two main reasons: After the fall of the iron curtain in 1989 the birth rate in East Germany dropped to a dramatically low rate of about 0.75 children per woman in the early nineties and recovered only slowly in the following years but did not yet reach the West Germany average rate of about 1.4 children per woman. In addition, due to the poor economic performance of the East German economy there are rather strong east-west migration-flows. Hence, the East German population declined by about 7.5% in the period 1991 - 2003 whereas the population size in West Germany increased

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[1] See for example Börsch-Supan (1999), Dang et al. (2001) or Leibfritz et al. (1995).

by about 5.9%. In the next decades, a further dramatic loss of population is expected in East Germany, whereas for West Germany a slight increase is forecasted up to the year 2025, thereafter a decline in West Germany is expected, too.

Figure 1: Population size in Germany 2002 - 2030: Normalized series: 2002 = 100
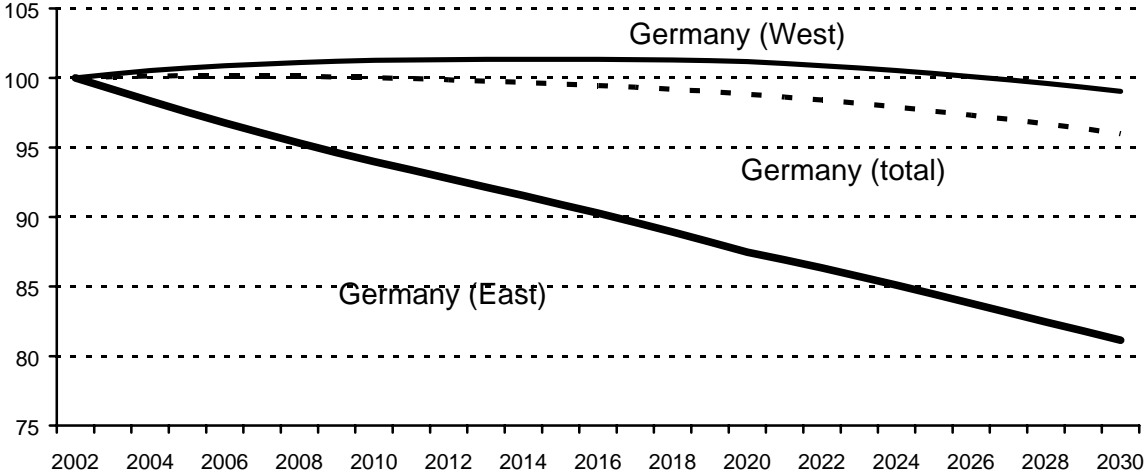
Source: Calculated from data supplied by the Federal Statistical Office of Germany.

The main reasons for the demographic developments in Germany are the low total fertility rate, defined as the average number of children per women, and the increase in life expectancy. The total fertility rate declined from about 2.3 in the 60ties to about 1.45 at the turn of the century. In the EU, only Spain, Greece and Italy have lower fertility rates. On the other hand, life expectancy (of new-borns) in Germany is forecasted to increase from 74.8/80.8 (male/female) in 2000 to about 80/85 (male/female) in 2030.[2] As a result, the average age of the German population increases strongly, from about 42 years in 2002 to about 47 years in 2030, and there are marked shifts between age groups.

Figure 2: Population aged 6 - 28 in East and West Germany as a share of total population
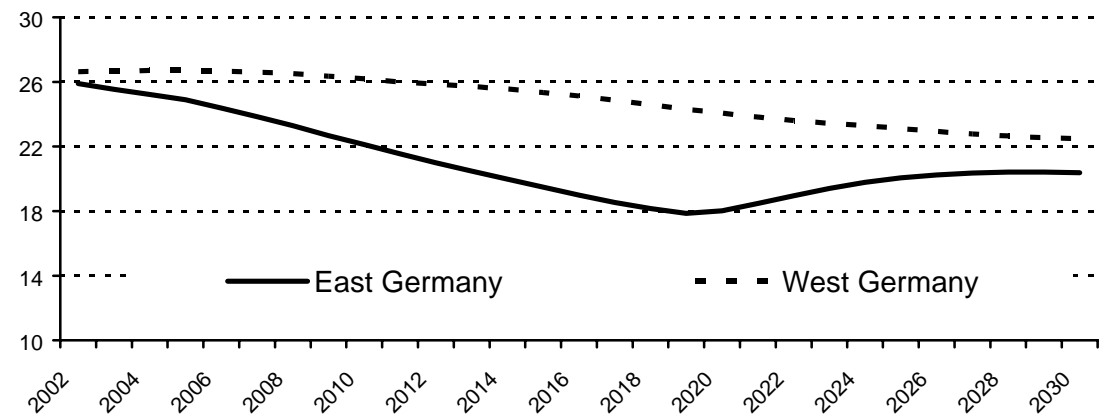
Source: Calculated from data supplied by the Federal Statistical Office of Germany.

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[2] For more details on population forecasts in Germany see: Federal Statistical Office of Germany (2003).

The share of the age cohort 6-28 which demands the services of the education system (schools and universities) will decrease from about 26% in 2002 to about 18% in East Germany and to about 24% in West Germany in 2020, see **figure 2**. However, in the years after 2020 there will be an east-west convergence process and the share of this age group will approach a level of about 21% in both parts of the country. The share of the elderly (65+) is currently about 17% in East and West Germany and will increase considerably. In 2030 about 33% of the East German and about 27% of the West German population will at least be 65 years old, see **figure 3**. The most dramatic changes will be observed for the very old (80+), the share of which will increase from about 3.9% in 2002 to 7.3% in 2030 and to about 12.1% in 2050.

Figure 3: Share of the elderly (65+) in East and West Germany as a share of total population
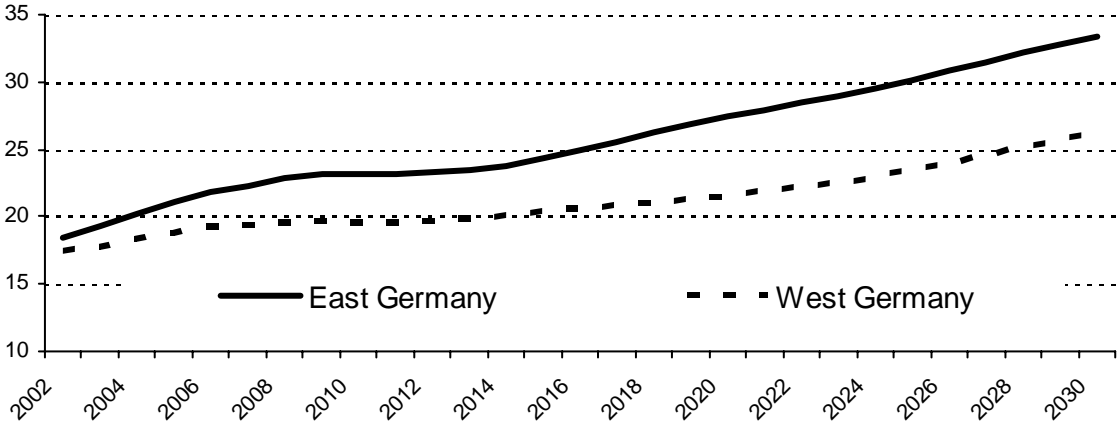
Source: Calculated from data supplied by the Federal Statistical Office of Germany.

Figure 4: Work force (15 - 65) in East and West Germany in % of the total population
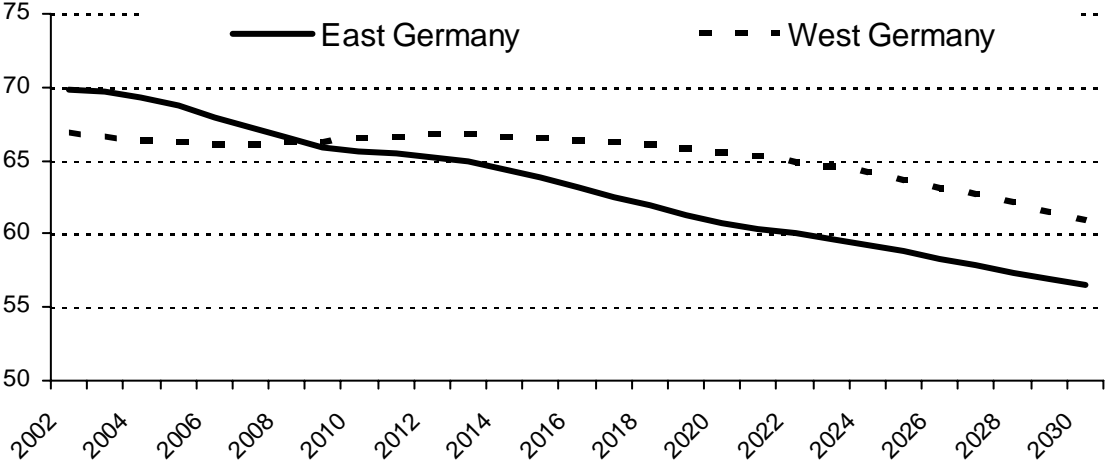
Source: Calculated from data supplied by the Federal Statistical Office of Germany.

There are also marked differences between East and West Germany with respect to the working age cohort, 15-65. Currently, in East Germany this age group accounts for about 70% of the total population whereas the corresponding share in West Germany is about 67%. Up to

the year 2030 this share will decline to about 56% in East Germany and to about 61% in West Germany, see **figure 4**.[3]

To summarize, Germany will live to see rather significant demographic changes: a strong ageing process, marked shifts of the age structure, a decline in the population size and a quite dramatic regional redistribution of population. Never in peace time an industrialized country experienced such fast and dramatic demographic changes as can be observed in East Germany. However, in some former socialist countries similar demographic earthquakes are observed. It should not be hard to imagine, that these changes will have marked effects on public budgets. We will examine these effects after discussing the fundamentals of the German fiscal federalism system.

3. The basic facts on fiscal federalism in Germany

For our subsequent investigation, some knowledge about fiscal federalism in Germany is necessary. The Federal Republic of Germany consists of three levels of government: federal (Bund), state (Laender) and local level (Gemeindeebene). The German constitution (Grundgesetz) defines the responsibilities of the different levels of government. Local governments are responsible in particular for local utilities and services such as water supply, sewage and waste disposal, the construction and maintenance of local roads, etc. With respect to education the local government sector is completely responsible for pre-primary education (kindergarten) and the construction as well as maintenance of school infrastructures (school buildings). In addition, local governments provide supplementary welfare benefits, especially social assistance benefits. These expenditures increased considerably in the past 25 years. However, in 2005 a labour market reform was implemented ("Hartz IV reform") which will contribute to a reduction of local social assistance expenditures because an increasing share of the burden will be shifted to the federal government level. The constitution guarantees communities the right to manage their own affairs independently. However, in practice this independence is quite restricted because the local governments rely heavily on grant financing from state governments and a considerable share of expenditures is mandatory and regulated by standards. The states are responsible for cultural affairs, school education (teachers), university education, the administration of justice as well as police. The federal government is responsible for foreign affairs, defence and supplementary benefits to unemployed persons. Moreover, the federal government provides considerable amounts of conditional as well as unconditional grants and transfers to the state level.

The main characteristics of the fiscal federalism structure in Germany can shortly be summarized as follows:
- There is a predominance of joint taxes. In 2003 about 68% of all tax revenues belonged to this type of taxes. Roughly 20% of tax revenues accrued to the federal government only, approximately 4% to state government and about 8% to the local government sector.
- Subnational governments have a rather low power to set taxes. State governments are even more restricted than local governments. However, the federal government has to pass a law if tax laws of joint taxes or taxes that are earmarked to the states are changed, and by voting in the Upper Chamber (Bundesrat) the states participate in the legislation process. Thus, the states can jointly influence tax policy but none of the

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[3] As a matter of course, the share of the labor force, depend on the working or retirement age. One should expect that in the next decades the retirement age will increase significantly.

- states can fix tax rates individually. In addition, the states and the federal government negotiate the distribution of tax revenues out of shared taxes - especially the value added tax - between levels of government.

- At the state level, there is a pronounced fiscal equalization system in which financially strong states make equalization payments to financially weak states and the federal government provides additional complementary federal grants (Bundesergänzungszuweisungen) to financially weak states. The strong equalization system brings about a rather weak correlation between state economic performance and per capita state revenues.

- Intergovernmental transfers are of considerable importance both between the federal and state government sector as well as between state governments and the local government sector.

- Finally, co-financing of tasks is quite common in Germany and consequently there is no clear division of (political and financial) responsibilities between the different layers of government.

Table 1 presents data on intergovernmental transfers in Germany in 2002. Contrary to our definition of the government sector - federal, state and local government sector - we also include the social security system in the table because of its significant dependence on federal transfers. At the state level, about 16% of all expenditures are financed by other levels of governments, the federal government being the most important donor. In East Germany this share is close to 40% and in West Germany about 12%. Local governments cover about 34% of their expenditures out of grants (from state governments) and here we also observe marked differences between East (almost 60%) and West (about 28%) Germany. About 17% of expenditures of the social security system are transfers out of the federal budget. **Table 1** also reports the share of expenditures at the various levels of government that are spent as transfers to other levels of government. The federal government's share is almost 50%, the bulk of which are transfers to the social security system (about 55%) and to the state governments (about 30%). In West Germany about 20% of state expenditures are intergovernmental transfers, in East Germany this share amounts to approximately 35%. Most of these transfers are targeted towards the local government sector. In part B of the table we show the most important sources of revenues: Taxes and social security contributions (B.1) and transfers from other levels of governments (B.2). At the federal government level, almost 90% of all revenues come out of taxes. At the state level, this ratio is about 76% in West Germany and less than 50% in East Germany. Local governments in West Germany collect about 38% of their revenues out of taxes, whereas in East Germany this share is well below 20%. Thus, the figures in **table 1** reveal the close fiscal interrelations between the different layers of governments at both the revenue and expenditure side of the budget. It is not difficult to imagine that these strong interdependencies make the political system in Germany rather sensitive to log-rolling and pork-barrel policies and creates inefficiencies and inflexibilities.

With respect to the impact of demographic change on revenues at the different levels of government, the properties of the fiscal federalism system in Germany have rather important implications:

- On the revenue side the predominance of shared taxes and the strong fiscal equalization system result in a "smoothing effect", i.e. differences in tax revenue capacity induced by demographics are smoothed away.

- The strong financial interrelations between the different levels of governments on the expenditure side also contribute to some "risk sharing" of the effects of demographic changes. However, the smoothing effect is considerably lower than on the revenue side.

Therefore, we refrain from examining the impact of demographic change on revenue distribution across the different levels of government because the institutional settings strongly suggest that these effects will not be that large, see Bach et al. (2002).

Table 1: Key-Data on intergovernmental fiscal relations in Germany in 2002

	Federal	state	local	social sec.
A.1 Share of expenditures financed by transfers from other levels of government				
total	1.3	15.9	33.6	18.1
West Germany		11.5	28.2	
East Germany		37.8	60.1	
A.2 Transfers to other levels of government as a share of total expenditures				
total	15.6[1] (45.6[2])	21.6	4.9	0
West Germany		19.3	5.5	
East Germany		35.3	2.1	
B.1 Share of revenues out of taxes, social security contributions etc.				
total	86.3	71.1	32.5	80.4
West Germany		76.1	36.0	
East Germany		47.1	16.0	
B.2 Share of revenues out of transfers from other levels of government				
total	1.5	17.9	34.5	18.4
West Germany		13.0	29.0	
East Germany		41.9	60.6	

1) Includes transfers to state and local governments only.
2) Includes transfers to state and local governments as well as the social security system.
Source: Calculated from data supplied by the Federal Statistical Office of Germany.

Next, we take a look at the distribution of expenditures across levels of governments. Because of the importance of intergovernmental transfers, the expenditures of the various government levels cannot simply be added. Therefore, we use *net expenditures ("Nettoausgaben")* defined as total expenditures less transfers received from other levels of governments. The federal government sector accounts for about 50% of total net government expenditures and this share has not changed systematically since 1975. Expenditures of state governments amount to about 35% of total expenditures. In the 1990s there has been an upward trend of this share whereas the share of local government expenditures slightly decreased. The main reason for this decline of local governments' expenditure share is the strong drop in infrastructure spending in recent years. The increase of the spending share at the state level is mainly due to the rise in pension payments for retired public servants and interest payments.

In **table 2** we report the importance of the different functions for public spending at the federal, state and local government sector. At the federal level, the most important spending category is welfare (41%). The next important government functions are interest payments (13,4%) and defence (9%).[4] Only about 4% of federal expenditures are spent on education. At the state level, spending on education has the highest share (about 31%). Public order (police), interest payments and pension payments for retired public services as well as social welfare account for about 10% of state expenditures respectively.[5] Public administration (esp. state ministries) consumes about 6% of total expenditures. All other government functions are of

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[4] The total sum of transfers of the federal government to lower government levels (state and local governments) cannot be calculated from table 2. Some federal transfers are unconditional grants which are included in line 13 of table 2. Conditional transfers, such as transfers to finance local public transport etc. are assigned as net expenditures of the federal government according to the specific government function.
[5] For the same reasons as mentioned above in footnote 7, transfers of state governments to local governments cannot be identified in table 2.

rather small importance. At the local level, spending on social welfare amounts to approximately 30% of expenditures. Most of these expenditures are means-tested social assistance benefits. Roughly 20% of local government resources are spent on community development and housing as well as education.

Table 2: Net expenditures by category as a share of total net expenditures at the federal, state and local government sector in Germany in fiscal year 2002

.	Function	Federal	State	Local
1	General public services and administration	4.4%	6.0%	15.2%
2	Defence	8.9%	0.0%	0.0%
3	Public order & safety	0.8%	5.9%	6.3%
4	Jurisdiction & prison	0.1%	4.8%	0.0%
5	Schools	0.0%	18.6%	10.1%
6	Kindergarten	0.0%	1.4%	7.1%
7	Universities	0.8%	8.6%	0.0%
8	Financial support to students	0.4%	0.7%	1.3%
9	All other education	0.1%	0.5%	0.5%
10	Research outside universities	2.4%	1.1%	0.2%
11	Culture	0.1%	1.7%	4.4%
12	Health and environmental protection	0.4%	2.6%	7.5%
13	Housing & community amenities	0.6%	2.4%	17.6%
14	Agriculture, forestry & fishing	0.4%	1.8%	0.2%
15	Fuel & energy & water	2.4%	2.9%	1.8%
16	Transportation & communication	3.6%	2.7%	7.1%
17	Other economic affairs and public property administration	8.7%	1.9%	7.9%
18	Pensions for retired public servants	2.2%	9.7%	4.2%
19	Interest payments	13.4%	9.5%	5.1%
20	Administration of social welfare	0.1%	0.6%	3.1%
21	Transfers to the pension system	26.9%	0.0%	0.0%
22	Other transfers to the social security system	3.4%	0.2%	0.0%
23	Social assistance	0.2%	4.0%	19.8%
24	Youth welfare	0.1%	1.1%	6.6%
25	Support for families and mothers	2.1%	1.6%	1.2%
26	Other social welfare	2.0%	0.9%	0.5%
27	Labour market policy and support for the unemployed	6.2%	1.1%	0.0%
28	unconditional transfers to other levels of government (transfers received minus transfers payed)	8.9%	6.1%	-29.7%
29	Other expenditures	0.2%	1.4%	0.7%
-	Total	100.0%	100.0%	100.0%

Source: Calculated from data provided by the Federal Statistical Office of Germany.

Table 3: Share of net expenditures by function of the federal, state and local government sector in Germany in fiscal year 2002

.	Function	Federal	State	Local
1	General public services and administration	30.3%	32.2%	37.5%
2	Defence	100.0%	0.0%	0.0%
3	Public order & safety	11.0%	59.8%	29.2%
4	Jurisdiction & prison	3.0%	97.0%	0.0%
5	Schools	0.1%	79.9%	20.0%
6	Kindergarten	0.0%	30.8%	69.2%
7	Universities	10.3%	89.7%	0.0%
8	Financial support to students	30.4%	38.6%	31.0%
9	All other education	19.9%	56.5%	23.6%
10	Research outside universities	71.7%	26.0%	2.4%
11	Culture	4.6%	43.4%	52.1%
12	Health and environmental protection	7.0%	40.2%	52.8%
13	Housing & community amenities	6.8%	21.6%	71.6%
14	Agriculture, forestry & fishing	22.3%	74.0%	3.7%
15	Fuel & energy & water	45.1%	42.9%	11.9%
16	Transportation & communication	43.6%	25.9%	30.5%
17	Other economic affairs and public property administration	66.8%	11.4%	21.7%
18	Pensions for retired public servants	19.5%	67.3%	13.2%
19	Interest payments	59.1%	32.8%	8.1%
20	Administration of social welfare	3.7%	29.3%	67.0%
21	Transfers to the pension system	100.0%	0.0%	0.0%
22	Other transfers to the social security system	95.5%	4.5%	0.0%
23	Social assistance	1.7%	29.9%	68.4%
24	Youth welfare	1.6%	27.0%	71.4%
25	Support for families and mothers	55.9%	32.5%	11.6%
26	Other social welfare	70.0%	23.9%	6.2%
27	Labour market policy and support for the unemployed	88.2%	11.8%	0.0%
28	unconditional transfers to other levels of government (transfers received minus transfers paid)	275.9%	148.0%	-323.9%
29	Other expenditures	13.2%	69.8%	16.9%
-	Total	46.8%	36.5%	16.7%

Source: Calculated from data provided by the Federal Statistical Office of Germany.

An item that deserves some special comment is the function "unconditional transfers to other levels of government" in **table 2** as well as **table 3** below. Recall that we use net expenditures, defined as total expenditures less transfers received from other government levels. *Conditional* transfers earmarked to a specific function (such as transfers from state governments to local governments to support local school financing) are taken into account in

the specific function (spending on schools at the local government level are defined net of transfers received from state government for school financing and state government spending on schools includes these transfers). *Unconditional* transfers that are not earmarked to a specific purpose are covered in the function "unconditional transfers to other levels of government". The federal government provides considerable transfers to state government, especially to the East German states, and state governments pay a significant amount of money as unconditional transfers to local governments. Because the local government sector makes only small transfer payments to the state government sector, net expenditures in this function at the local level are negative.

It should be noted that spending on health out of public budgets is of only minor importance at the federal, state and local public sector in Germany.[6] Public health expenditures are financed out of social security contributes. However, at the state and local government sector health related expenditures arise because the public sector provides investment grants for hospital buildings and homes for the elderly and the handicapped. In addition, there are means-tested social assistance benefits for handicapped and elderly persons.

Table 3 reports the distribution of net expenditures by function across the three layers of government in 2002. We will only comment on the most notable facts. In public order and safety, the bulk of expenditures falls on the states. In the education system, spending by the federal government is of only minor importance whereas the states account for about 70% of education expenditures. 2/3 of welfare spending are borne by the federal government which provides massive transfers to support the unemployed as well as the public pension system. Thus, from **table 3** we can conclude that subnational governments are in charge of public services targeted to the younger generation (education) whereas expenditures of the federal government are biased towards the elderly. Consequently, one should expect that the demographic changes will increase the fiscal burden of the federal government whereas the subnational government sector might profit from the declining share of the younger generation. However, as will be shown below, pension payments to retired public servants at the state level will increase dramatically in the near future and will counterbalance these expenditure savings.

4. Methodical issues and data handling

Before we turn to our empirical investigation we examine some methodical issues that arise when the effects of demographic change on public budgets are examined. Disregarding different government levels, we can write total public expenditures as:

$$(1) \qquad E_t = \sum_{j=1}^{J} E_{j,t} \ .$$

$E_{j,t}$ denotes expenditures in spending category j in period t. A decomposition of expenditures by age groups can be achieved by using the *age cost profile* concept and rewriting public expenditures as:

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[6] In 2001 total health expenditures in Germany amounted to about 227 bn Euro (about 11% of GDP). The bulk of these expenditures were covered out of social security contributions whereas only about 8.1% of total health expenditures were financed out of the budgets of federal, state and local governments.

$$(2) \qquad E_t = \sum_{j=1}^{J} \sum_{x=1}^{\bar{x}} N(x,t)e(x,j,t).$$

$N(x,t)$ denotes the population of the age x ($\bar{x}$ is the maximum age) in period t and $N_t = \Sigma_x N(x,t)$ total population. The variable $e(x,j,t)$ is the age cost profile which provides information on per capita spending on citizens aged x for the public good j (such as education, health, etc.) in period t:

$$(3) \qquad e(x,j,t) = \frac{E(x,j,t)}{N(x,t)}.$$

If the public good j is not age-specific (such as defence) the entries in $e(x,j,t)$ are identical across all age groups.[7]

The empirical determination of age cost profiles is not an easy exercise and in some cases it is not clear to which age groups public good provision has to be assigned to. Thus, for example the "demand" for kindergarten services does not only depend on the number and age structure of the kids but also on social norms in societies, the female labour market participation rate etc. This means that the cost of providing kindergarten services can increase despite a drop in birth rates if for example female labour market participation rates increase.[8] As a matter of course, age cost profiles differ considerably across various spending categories. Spending on education for example is primarily targeted towards the young whereas health expenditures are higher for the elderly than for the young. In some categories a clear differentiation according to age groups might be very difficult or even impossible, as for instance in general public service provision or in public order and safety. Age cost profiles are hard to compare across different countries because public and private service provision differ considerably. In Germany, private universities as well as private schools are still of minor importance whereas in other countries, such as the US, private institutions in the education system are of far greater importance. Even stronger distinctions can be observed with respect to the financing of health care and the pension systems across countries. In federal systems, additional problems arise out of the fact that different layers of government perform different tasks and therefore age cost profiles aggregated across all government functions can be quite distinct between the different layers of government.

If we had information about the age cost profiles of the various public sector spending categories as well as population forecasts - differentiated by age - we would be able to forecast the impact of demographic change on public expenditures. This is a simple exercise if we assume that age cost profiles are time-invariant, that is $e(x,j,t) = e(x,j,t+\tau) = e(x,j)$, for $\tau > 0$, in which case total spending in period $t+\tau$ is estimated by

$$(4) \qquad E_{t+\tau} = \sum_{j=1}^{J} \sum_{x=1}^{\bar{x}} N(x,t+\tau)e(x,j).$$

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[7] A corresponding *age revenue profile* can be constructed for taxes, user fees, social security contributions etc. However, as mentioned above, revenues are completely disregarded in the present study and therefore we completely disregard the impact of demographics on public sector revenues.
[8] In fact, the demand for kindergarten services should be considered a "derived" demand.

However, one should not expect that age cost profiles are time-invariant, see for example Franco and Munzi (1997) or Lee and Edwards (2001). A very simple procedure to make age cost profiles time-dependent is to specify a mechanical adjustment process:

(5) $\qquad e(x,j,t+\tau) = e(x,j,t)q(t+\tau)\pi(j,t+\tau).$

$e(x,j,t)$ is the age cost profile in the basic period t, $q(t+\tau)$ denotes the productivity growth factor in the period from t to t+τ and $\pi(j,t+\tau)$ the price increase in function j relative to the GDP deflator. Thus for example, Lee and Edwards (2001) assume an annual productivity growth rate of 2.5%, e.g. $q(t+1) = 1.025$, and assume that per capita expenditures keep pace with productivity growth. In addition, they assume the cost of service provision in the health sector exceeds the GDP-deflator by 1% each year, e.g. $\pi(health,t+1) = 1.01$. Apart from these productivity and inflation effects there are numerous other mechanisms that can bring about changes in age cost profiles across time, and we briefly examine the four most important ones: relative price effects, changes in political preferences, cohort-size effects and changes in participation rates.

Price effects can arise when, as the number of beneficiaries changes, the average cost of public service provision *per worker* changes, taking a specific benefit-level as given, see Lee and Edward (2001). Because the aging of the society increases the share of old-aged people, the cost of service provision to the elderly *per worker* increases if per capita spending on the elderly is left unchanged. This increase in the price of the care for the elderly per worker can result in a reduction of per capita services provided to the elderly. Gruber and Wise (2001) report evidence that an increase of the share of the elderly by 1% increases spending on the elderly - measured as a share of GDP - by 0.5 percent. *Cohort-size* effects are rather similar to these price effects. Poterba (1997) for the U.S. and Seitz and Baum (2003) for (West) Germany find that total spending on public schools does not change significantly if the number of school aged children changes. This suggests that the age cost profile for school education depends on cohort size and can be written as e(t,N(6-20,t)), with N(6-20,t) denoting the number of school-aged people in period t. This age cost profile has the property $\delta e(..)/\delta N(6-20) < 0$ and the elasticity of e with respect to N, $\eta_{e,N}$, is approximately -1. This means, that total education expenditures are left virtually unchanged if the size of the school-age cohort changes. However, whereas price effects are derived from neoclassical reasoning, the cohort size effects are due to the fact that (political) decisions on public school spending are arrived at by deciding on total school spending and not upon per capita benefit considerations. One should expect that rather strong changes in cohort sizes, see for example the evidence presented by Kempkes (2005) on public school spending in East Germany[9], should result in significant adjustments of total school expenditures and consequently in the long-run $\eta_{e,N} \rightarrow 0$ should hold, i.e. in the long run cohort size effects should be rather small. Contrary to that, one should expect that price effects are rather small in the short-run - benefit provision to the elderly cannot be cut immediately - and increase in size in the long-run. In our empirical investigation we disregard cohort-size effects because we examine a period of almost 30 years in which a complete adjustment of expenditures to changes in demographics is achieved.[10] The ageing of the society also changes the distribution of *voting power* at the ballot box and works in favour of political parties and policy makers that have more favourable preferences for goods provided to the elderly, see Edwards and Lee (2001). Consequently, one should expect that per capita benefits for the elderly increase whereas

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[9] In East Germany, in recent years the number of pupils in elementary schools dropped by about 50%!

[10] However, cohort effects might well force the government to incur debts during the adjustment periods. This in turn might affect public budget in the long run via interest and debt service payments.

younger generations will live to see cuts in public good provision.[11] An empirical investigation of this effect is quite demanding and cannot be achieved in this study. Therefore, these effects are also disregarded.

Another important source of changes in age cost profiles is the *participation effect*. As set out above, the usual procedure to estimate age cost profiles is to divide spending on a specific age group by the number of persons in this age group as stated in equation (3). Alternatively one can calculate the average cost of service provision per person that actually benefit from this service, $P(x,t)$:

$$(3a) \qquad c(x,t) = \frac{E(x,t)}{P(x,t)}.$$

The index j has been suppressed for the sake of convenience. $P(x,t) \leq N(x,t)$ is the number of persons that actually consume the public good and $c(.)$ is the average cost of providing the public service to a representative client. Thus, we can define a participation rate, $q(x,t)$:

$$(6) \qquad q(x,t) = \frac{P(x,t)}{N(x,t)}$$

which gives the share of people at the age of x that consume the public good. Given that

$$(7) \qquad q(x,t)c(x,t) = \frac{E(x,t)}{N(x,t)} = e(x,t),$$

we can examine which assumption on $c(.)$ and $q(.)$ a constant age cost profile implies by evaluating:

$$(8) \qquad de = qdc + cdq = qdc + \frac{cdP}{N} - \frac{cPdN}{N^2}.$$

The assumption of a constant $e(.)$ implies that $c(.)$ is unchanged and that P changes proportionally to N and thus, the participation rate is constant. However, if participation rates change over time and $c(.)$ is constant, $e(.)$ changes even if N is kept constant. Consequently, if there are strong a priory reasons to expect changes in participation rates, forecasts of future expenditures have to be made by applying the formula:

$$(9) \qquad E(x,t+\tau) = e(x,t) \cdot N(x,t+\tau) \cdot q(x,t+\tau)/q(x,t).$$

Note that the participation effect can be at work independently of the price effect, cohort size effect as well as the political power effect.

The most prominent example for secular trends in participation rates is student enrolment in universities. As **figure 5** shows, participation rates (enrolment rates) - especially those of women - in the university system in Germany increased rather strongly. Whereas only about 12% of people aged 20-28 attended a university in the mid 70ties, this ratio increased to about 26% in 2003 and differences between male and female enrolment rates are now quite small (~2.7%) as compared to about 8% in 1975. One might well expect that enrolment rates will

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[11] See, however, Gradstein and Kaganovich (2004) who argue the other way round.

further increase in the future, perhaps with a slower growth rate after achieving a convergence of male and female enrolment rates. Using a simple forecasting technique[12] we estimated that the total enrolment rate will increase to about 35% in 2030, which means that the participation factor, $q(x,t+\tau)/q(x,t)$, in the university system is about 1.35 in 2030.[13]

Figure 5: Number of university students per 100 inhabitants aged 20-28 in Germany 1975 - 2003 and forecast 2004 - 2030
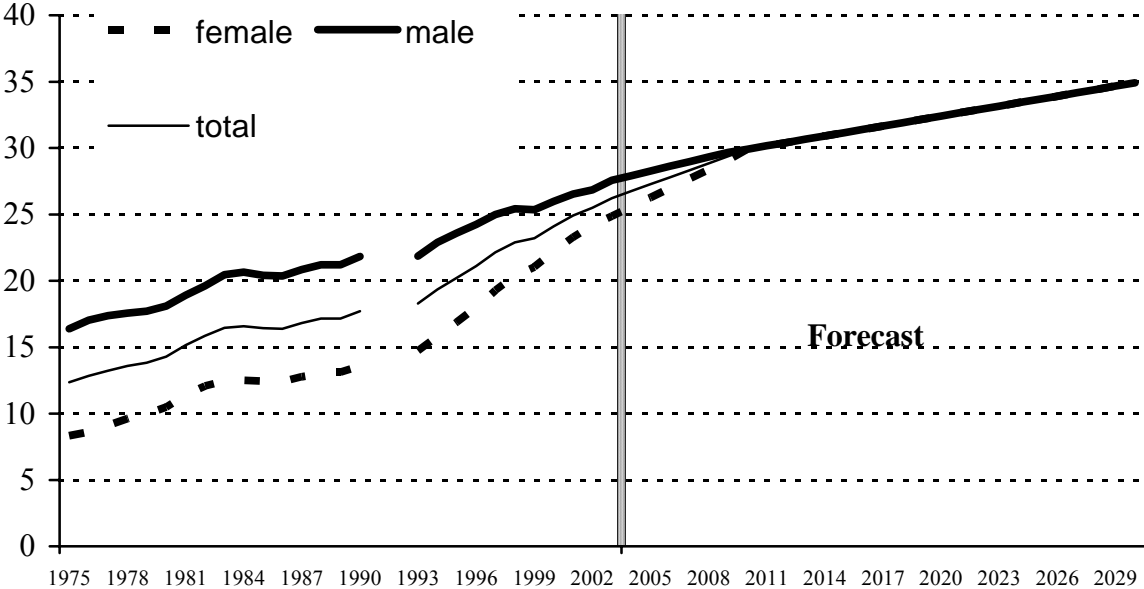
Source: Federal Statistical Office of Germany (Statistisches Bundesamt). Data up to 1990 refer to West Germany only, data 1993 - 2030 refer to Germany.

In our empirical examination we will disregard all effects discussed above with the exception of the participation effect. The inflation effect is usually taken into account in health service provision. However, public health expenditures are of only minor importance in Germany and we therefore neglect this effect in our empirical work. Productivity effects do not matter if these effects affect all government functions alike and we have no a priori assumptions to justify any differentiated effects across the various government functions.[14] This means that in our subsequent empirical investigation we completely abstract from real and nominal growth. *Thus, we conduct a comparative static experiment isolating the effects of demographic change by fictitiously transferring the demographic structure of 2030 to the year 2002.* With respect to interest payments, the neglect of productivity effects implies that the debt-GDP ratio as well as real interest rates in 2030 are identical to the 2003 figures. Participation effects are introduced in university education as well as in the provision of pensions to retired public servants. With respect to pension payments for retired public servants we have to take into account that the number of retired public servants relative to the number of old-aged persons (65+) changes in the period up to 2030. In 2003 there were a total of about 895.000 pensioners (including surviving dependants) and the majority, about 65%, are financed by state governments. 24% accrue to the federal government and 11% to the local government

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[12] We assume that the growth of enrolment rates of male and female students take on the average value in the period 1995-2003 in which case "convergence" of male and female enrolment rates is achieved in 2009. In the period 2010 - 2030 we assume an annual increase in the enrolment rate of both sexes of 0.4% which corresponds to the average annual growth rate of the male enrolment rate in the period 1995 - 2003.

[13] As a matter of course, this factor is also applied to the function "financial support for students".

[14] However, the cost of paying for public debt as well as some welfare related programs are exceptions.

sector. Recently, the Federal Ministry of the Interior (2005) published a report on public sector pension obligations up to the year 2050 differentiated by the federal, state and local government sector. From this report we can derive an estimate of the number of public pensioners[15] relative to the total number of the elderly (65+). This ratio is used as an estimate of the participation factor in forecasting public pension payments. At the federal government level this factor is 0.64, at the state government level 1.12 and 0.88 at the local government level.[16]

To summarize, spending - net of inflation and productivity growth - at government level f is estimated by applying the formula

$$(10) \qquad E_{t+\tau}^{f} = \sum_{j=1}^{J} \sum_{x=1}^{\bar{x}} N(x, t+\tau) e(x, j, t, f) \lambda(j, f)$$

with t denoting the base year (2002) and t+τ the year 2030. The parameter λ(j,f) serves to incorporate adjustments in age cost profiles due to changing participation rates (student enrolment at universities) as well as changes in the ratio of public sector pensioners relative to the number of the elderly. In addition, the parameter λ can be used to take into account policy changes on the provision of public services that have already been decided on. Thus, for example, recently several pension reforms were introduced in Germany that will lead to cuts in pension payments in the future. This in turn will reduce the growth of federal transfers to the social security system. According to the results of Werding and Kaltschütz (2005), if the pension system that will be valid in 2030 had been already introduced in 2002, pensions in 2002 would have been about 15% lower. Therefore, we set λ to 0.85 at the federal government level in function 21 (subsidies to the old age pension system) when we calculate federal expenditures in 2030. Finally, we make an adjustment in the function "research outside universities" by setting λ equal to 1.35, which is identical to the participation effect estimated in the university system. We justify this assumption for the reason that investment into research outside universities should at least keep pace with human capital accumulation, measured as the ratio of students at universities relative to the population 20 - 28. In all other government functions the parameter λ takes on the value 1.0.

Finally, another adjustment has to be made because a significant amount of unconditional transfers of the federal government are directed to the East German states and these transfers terminate in 2020.[17] Therefore, we adjust net expenditures of the three levels of government in 2030 as compared to 2002 in function 28 ("unconditional transfers to other levels of government") to take these effects into account. Because the East German states use these transfers to finance investment expenditures to reconstruct the infrastructure in East Germany and to pay capital subsidies to private companies that invest in East Germany, the East

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[15] In fact, we do not use the number of public sector pensioners but expenditures on pensions in the public sector derived on the assumption, that there will be no nominal adjustment of pensions in the period up to 2050. Therefore we take into account the changing structure of public sector pensions.

[16] Taking the state government level as an example, these factors are calculated as follows: The population 65+ increases by about 50% in 2002-2030 and the number of public sector pensioners at the state level by about 69%. From this we calculate 1.69/1.5 ~ 1.12. These means, that the number of state public sector pensioners increases about 12% faster than the total number of elderly, 65+, in the period 2002 - 2030. At the federal and local government level public sector pensioners increase by a slower rate as the total number of the elderly and therefore the participation factors are smaller than 1.0.

[17] For a detailed discussion of federal transfers to the East German States see Seitz (2004). Apart from federal transfers to the East German states we also take into account the termination of federal bailout transfers to Bremen and Saarland in the year 2004.

German states will be forced to reduce (investment) expenditures by at least the same amount in order to avoid excessive deficits. It is difficult to estimate which government functions are affected by these expenditure cuts. Therefore, we adjusted the function 29 "other expenditures" by these amounts downward.[18]

If we have an estimate of public expenditures by level of government in the year 2030 we can examine whether vertical fiscal expenditure imbalances arise by evaluating

$$(11) \qquad VFI(f, t+\tau) = \frac{E_{t+\tau}^f}{\sum\limits_{f=1}^{3} E_{t+\tau}^f} - \frac{E_t^f}{\sum\limits_{f=1}^{3} E_t^f}.$$

VFI(f,t+τ) is an indicator of vertical fiscal imbalance at government level f and corresponds to the difference of the 2002 and 2030 expenditure share of the government level f. If VFI is positive for government level f the expenditure share increases relative to that of the other levels of government.

5. Empirical results

Our estimates of the effects of demographic change on public expenditures at the various levels of government in Germany are subject to the following assumptions:
1. The population is divided into six age groups.
2. Age cost profiles are assumed not to change in the period 2002 to 2030. However, we take into account participation effects in university education, the changing intensity of public sector pensions as well as latest pension reforms and an upward adjustment of public research expenditures.
3. The public expenditure structure is perfectly adjusted to changes in the age composition as well as the size of the population in the period 2002 - 2030.
4. Price effects (wage and price inflation) as well as real growth are disregarded because these do not affect the estimate of vertical fiscal expenditure imbalances as long as these effects are identical across government functions and levels of government.
5. "Estimates" of age cost profiles are derived from data for the fiscal year 2002 as explained below.
6. We assume that the distribution of tasks between the different levels of governments as well as the legal and institutional settings do not change in the period 2002 to 2030.

All relevant assumptions about the "demand" for public services by the various age groups are reported in **table 4**. The entries in the table constitute a matrix of age-cost profile *indicators* which can be written as I(j,x). The index j = 1, ..J (J = 29) denotes the government function and the index x = 1, ..X (X = 6) is the age category.

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[18] In 2002 net expenditures in function 28 have been: federal government 24,789 bn Euro, state government sector: 13,292 bn Euro and local government sector -29,097 bn Euro. The figures for 2030 are: federal government: 13,259 bn Euro, state government sector: 22,522 bn Euro and local government sector -26,797 bn Euro. The corresponding figures for function 29 are in 2002: federal government 558 bn Euro, state government sector: 2.951 bn Euro and local government sector 716 bn Euro. The figures for 2030 are: federal government 558 bn Euro, state government sector -6.279 bn Euro and local government sector -1.584 bn Euro.

Table 4: Assumptions on age cost profile indicators by government function

| .	Function	Age group					
		0-6	6-20	20-28	28-65	65-80	>80
1	General public services and administration	1	1	1	1	1	1
2	Defence	1	1	1	1	1	1
3	Public order & safety	0	1	1	1	0.5	0.5
4	Jurisdiction & prison	0	0	1	1	0	0
5	Schools	0	1	0	0	0	0
6	Kindergarten	1	0	0	0	0	0
7	Universities	0	0	1	0	0	0
8	Financial support to students	0	1	1	0	0	0
9	All other education	0	1	1	0	0	0
10	Research outside universities	0	0	1	1	0	0
11	Culture	0.2	1	1	1	1	0.2
12	Health and environmental protection	0	1	1	1	0.5	0.5
13	Housing & community amenities	0.2	0.2	1	1	0.2	0.2
14	Agriculture, forestry & fishing	0	0	1	1	0	0
15	Fuel & energy & water	0.2	1	1	1	0.2	0.2
16	Transportation & communication	0.5	1	1	1	0.5	0.2
17	Other economic affairs and public property administration	1	1	1	1	1	1
18	Pensions for retired public servants	0	0	0	0	1	1
19	Interest payments	1	1	1	1	1	1
20	Administration of social welfare	1	1	1	1	1	1
21	Transfers to the pension system	0	0	0	0	1	1
22	Other transfers to the social security system	0	0	1	1	0.5	0.2
23	Social assistance	1	1	1	1	1	1
24	Youth welfare	0.2	1	0.5	0	0	0
25	Support for families and mothers	1	1	0	0	0	0
26	Other social welfare	1	1	1	1	1	1
27	Labour market policy and support for the unemployed	0	0	1	1	0	0
28	unconditional transfers to other levels of government (transfers received minus transfers payed)	1	1	1	1	1	1
29	Other expenditures	1	1	1	1	1	1

Source: See text.

Per capita expenditure on a representative member of age group x in function j at the government level f is calculated as:

$$(12) \qquad e(x,j,f) = \frac{E_j^f}{\sum_{x=1}^{6} I(j,x)N(x)} I(j,x).$$

E_j^f denotes expenditure of the government level f (f = federal, state, local) in government function j in fiscal year 2002. A "0" entry in **table 4** means that the specific age group does not consume the public good provided within the specific government function. The entries in **table 4** have been derived by examining the public services provided in the various age groups and are based on "subjective" judgements as well as empirical facts[19]. Note that the matrix I(j,x) is identical across government levels but age cost profiles differ because the government sectors spend different amounts of money in the various categories. **Figure 6** presents estimates of per capita spending on each age group aggregated across all government functions by level of government in 2002 in Germany.[20] The highest per capita expenditures arise at the federal level for the elderly due to the massive transfer payments of the federal government to the public pension system. State and local government spending on the other side is biased towards the younger generation. The main reason for this is the fact that responsibility for the education system - including kindergarten - rests upon state and local governments.

Figure 6: Net spending per capita of the relevant age group across all government functions in Euro in 2002 by level of government in Germany
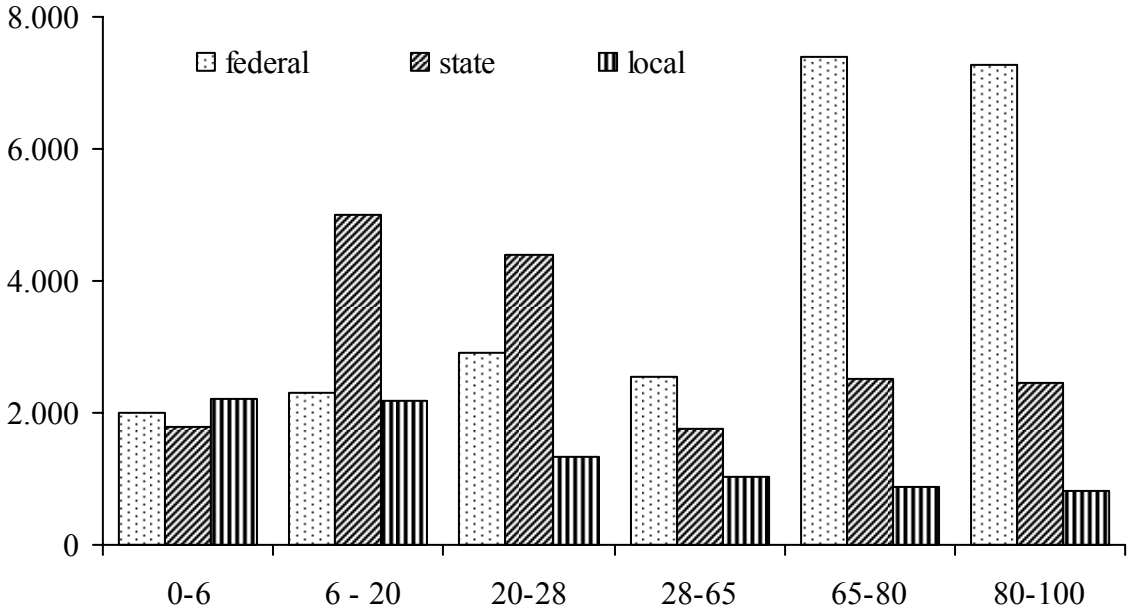
Source: Own calculations based on assumptions as set out in table 4 and data on net expenditures provided by the Federal Statistical Office.

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[19] For instance, we collected data on the age structure of students, social assistance recipients, people imprisoned, etc. See Seitz (2004) for detailed evidence. In our future work we will discuss the rationale of the entries in table 4 in more detail.
[20] By assumption, these are identical to the age cost profiles in 2030 with the exceptions mentioned above.

In a second step we calculate *aggregate age expenditure shares* for the different levels of government, f:

$$(13) \qquad \varepsilon(x,f) = \frac{\sum_{j=1}^{J} e(x,j,f)N(x)}{\sum_{j=1}^{J} E_j^f} \; .$$

$\varepsilon(x,f)$ denotes the share of expenditures at government level f[21] devoted to age group x.[22] It is important to note the differences between age cost profiles and age expenditure shares. Whereas age cost profiles provide information about per capita spending per person at some specific age, the age expenditure shares provide information about the share of public expenditures spent on a specific age group.[23] Using the age cost profiles derived above and most recent population forecasts we calculate age expenditure shares. The results are presented in **figure 7a** (federal), 7**b** (state) and 7**c** (local). We can see that the share of expenditures devoted to the younger generation drops significantly for all levels of government whereas spending shares on the elderly increase. Taking into account our discussion above as well as the trend towards the ageing of the society this result is, as a matter of course, no surprise. However, the crucial questions are, whether these changes result in an increase in total expenditures and whether this process is accompanied by vertical fiscal expenditure imbalances.

Figure 7a: Age specific expenditure shares across all government functions at the federal government level in 2002 and 2030
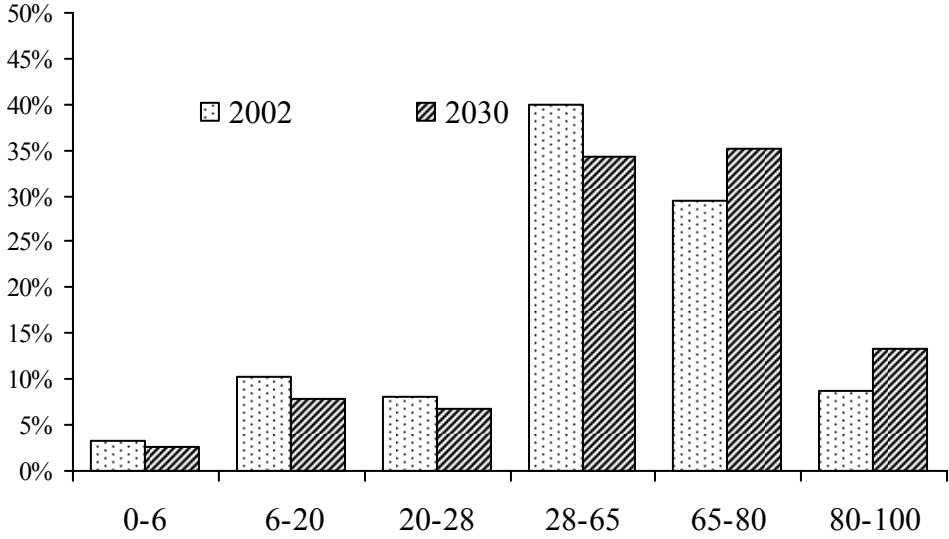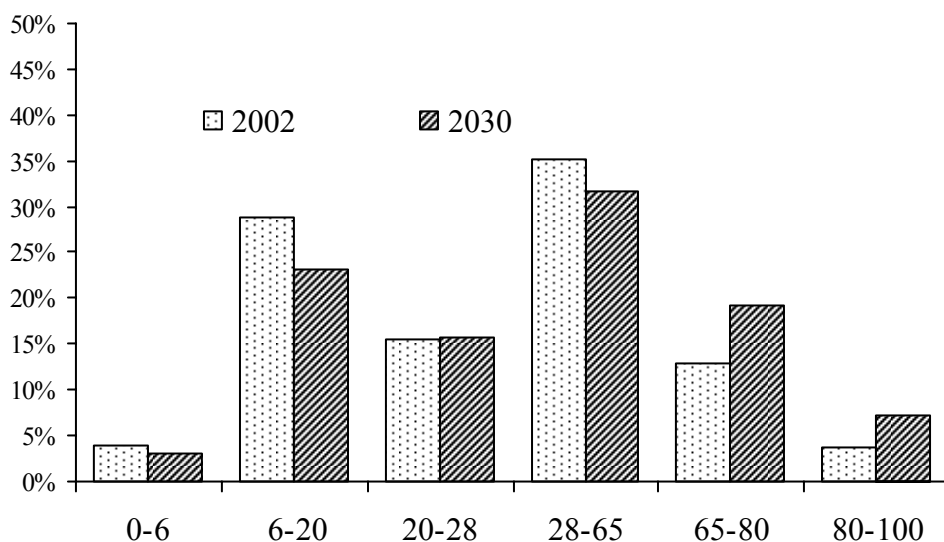

Source: Own calculations based on assumptions as set out in table 4 and data on net expenditures provided by the Federal Statistical Office.

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[21] By construction, expenditure shares within *each* spending categories are identical across the three layers of government.
[22] In equation (3) and (4) we suppressed the time index t for the sake of convenience.
[23] Recall that in our definition the social security system is not part of the government sector and therefore social security spending is not included in the list of functions covered in table 4.

Figure 7b: Age specific expenditure shares across all government functions at the state government level in 2002 and 2030

Source: Own calculations based on assumptions as set out in table 4 and data on net expenditures provided by the Federal Statistical Office.

Figure 7c: Age specific expenditure shares across all government functions at the local government level in 2002 and 2030
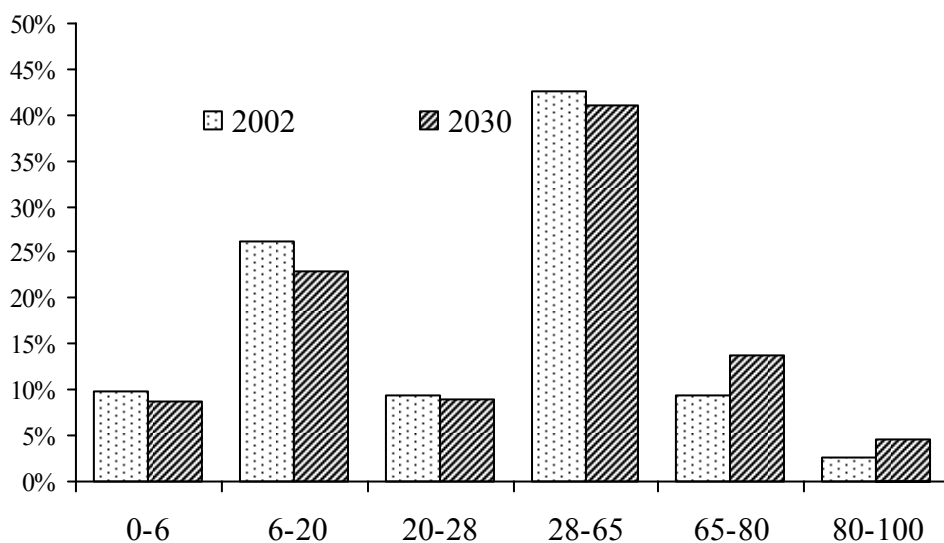
Source: Own calculations based on assumptions as set out in table 4 and data on net expenditures provided by the Federal Statistical Office.

In t**able 5** we report the calculated expenditure changes for the 29 government functions, both in % as well as in absolute numbers. In many cases we estimate cost savings effects at all levels of government. Despite the fact, that we introduced a participation effect of 1.35 for spending on universities as well as for research outside universities, total expenditures on education and research will decline by about 7% at the state and by about 16% at the local level. This reflects the sharp drop in the school-relevant age-cohort which decreases by about 20% in the period 2002 - 2030.

Table 5: Estimation results by spending category

	%-change of net expenditures 2002 - 2030			Change of net expenditures 2002 - 2030 in mill. Euro		
	Federal	State	Local	Federal	State	Local
General public services and administration	-1.6%	-1.6%	-1.8%	-192	-204	-274
Defence	-1.6%	-	-	-387	-	-
Public order & safety	-5.8%	-5.8%	-6.1%	-137	-743	-380
Jurisdiction & prison	-10.5%	-10.5%	-	-33	-1,090	-
Education and research, thereof:	17.1%	-7.2%	-16.2%	1,811	-4,808	-3,076
Schools	-19.2%	-19.2%	-19.8%	-8	-7,683	-1,991
Kindergarten	-	-17.0%	-17.0%	-	-530	-1,190
Universities	15.8%	15.8%	-	335	2,914	-
Financial support to students	11.7%	11.7%	11.5%	142	181	143
All other education	-17.3%	-17.3%	-17.4%	-71	-201	-84
Research outside universities	20.9%	20.9%	20.6%	1,412	512	46
Culture	-3.6%	-3.6%	-3.9%	-14	-133	-171
Health and environmental protection	-5.8%	-5.8%	-6.1%	-57	-330	-454
Housing & community amenities	-7.9%	-7.9%	-8.1%	-131	-418	-1,415
Agriculture, forestry & fishing	-10.5%	-10.5%	-10.7%	-123	-409	-21
Fuel & energy & water	-9.6%	-9.6%	-9.9%	-641	-609	-175
Transportation & communication	-7.4%	-7.4%	-7.6%	-738	-438	-534
Other economic affairs and public property administration	-1.6%	-1.6%	-1.8%	-378	-65	-142
Pensions for retired public servants	-4.0%	68.1%	31.8%	-241	14,318	1,311
Interest payments	-1.6%	-1.6%	-1.8%	-585	-324	-92
Administration of social welfare	-1.6%	-1.6%	-1.8%	-3	-21	-56
Transfers to the pension system	27.6%	-	-	20,574	-	-
Other transfers to the social security system	-4.4%	-4.4%	-	-416	-20	-
Social assistance	-1.6%	-1.6%	-1.8%	-8	-135	-356
Youth welfare	-18.0%	-18.0%	-18.3%	-26	-443	-1,191
Support for families and mothers	-18.6%	-18.6%	-19.1%	-1,101	-641	-234
Other social welfare	-1.6%	-1.6%	-1.8%	-88	-30	-9
Labour market policy and support for the unemployed	-10.5%	-10.5%	-	-1,802	-242	-
interjurisdictional unconditional transfers	-46.5%	69.4%	-7.9%	-11,530	9,230	2.300
other expenditures	0.0%	-313%	-321%	0	-9,248	-2,300
total	1.4%	1.5%	-7.4%	3,752	3,197	-7,267

Source: Own calculations.

At the federal level, education expenditures increase by about 17% because the federal government does not profit from a reduced school population as school expenditures at the federal level are very small. The most important item that pushes expenditures upward at the federal level are subsidies to the social security system which will increase by almost 30% - net of productivity and inflation effects. However, almost 60% of this expenditure increase is counterbalanced by the drop in unconditional transfer to the East German states. At the state level, the expenditure push is due to the strong increase in public pension payments, which increase by about 68%. However, a significant share of these additional expenditures is balanced by cost savings in other functions (e.g. schools). Local governments achieve significant savings in the education sector, because the population in the age groups 0-6 and 6-20 drops by about 20%. Savings are also calculated for youth welfare and housing whereas pension payments for retired public servants will increase by about 32%.

Table 6: Changes in expenditures by level of government induced by demographic change in the period 2002 - 2030 and vertical fiscal balance indicator, VFI, in 2030

	total expenditure growth	total per capita expenditure growth	VFI(2003)
Federal government	1.35%	2,98%	0,66%
State Government Sector	1.48%	3,11%	0,56%
Local Government Sector	-7.41%	-5,70%	-1,22%
Total Government Sector (federal, state and local governments)	-0.05%	1,55%	-
Subnational government sector (state and local governments)	-1.29%	0,29%	-0,66%
Memo item: population growth 2002-2030	-1.6%		

Source: Own calculations based on assumptions as set out in table 4 and data on net expenditures provided by the Federal Statistical Office.

In **table 6** we report our estimated expenditure changes by level of government in the period 2002-2030. The *level* of total government expenditure is likely to stay virtually constant. Federal expenditures increase slightly by about 1.4% and state expenditures by approximately 1.5% whereas local government expenditures will drop by about 7.4%. Due to the shrinking population in the period 2002 to 2030, per capita spending of the federal government will grow by about 3%, and approximately 3.1% at the state level. Per capita local government spending will decrease by roughly 5.7%. However, if we compare the federal government and the subnational government sector - state and local government - we find a significant expenditure growth gap of almost 3%. The total subnational government sector will achieve expenditures savings of about 1.3%. Thus, a redistribution of revenues between the federal government and the subnational government sector is necessary as well as a redistribution of revenues within the subnational government sector. In addition, **table 5** reports the vertical fiscal imbalance indicator, VFI, which shows that the spending share of the federal government increases by almost 0.7% which can also be used as an estimator of necessary revenue adjustment.

Thus, our simulation results suggest that demographic change will not change total government expenditures that much. Increases in pension payments to retired public servants as well as in federal subsidies to the social security system will be counterbalanced by demographic savings in other functions as well as the reduction of federal transfers to the East German states. However, per capita expenditures increase slightly which means that either

expenditures (more precisely: benefit levels) have to be cut or taxes have to be increased in order to avoid deficits. In addition, the expenditure structure by government function has to be adjusted to the changing age structure of the population. This means that demographic savings that arise in many functions have to be mobilized in order to finance expenditure increases in other functions, such as pension payments to retired public servants or contributions of the federal government to the social security system. Because our results suggest fiscal imbalances between the federal government sector and the subnational government sector as well as within the subnational government sector, a redistribution of tax revenues across the different layers of government is necessary.

Finally, we take a short look at the impact of demographics on the fiscal stance of the various levels of government. As we argued above, the predominance of joint taxes as well as intensive intergovernmental transfers will virtually smooth away demographically induced differences of revenue capacity across federal, state and local governments. The results presented by Bach et al. (2002)[24] suggest that in the period 2002 - 2030 the impact of the changing age structure on tax revenues will be quite small and the population elasticity of tax revenues is about 1.0, which means, that a 1% decline of the population will lead to a 1% loss of tax revenues. Consequently, we can derive an estimate of the impact of demographic change on deficits using the results in **table 5**. The total government sector will run a deficit of about 1.6% of total expenditures. The subnational government sector is almost balanced. However, there are marked differences between state and local governments. The federal government runs a deficit of about 3%. Thus, not only the vertical expenditure imbalances but also the estimated demographic impact on deficits indicates the need of redistributing revenues and/or tasks in the German federal system.

6. Conclusions and prospects for further research

The paper discussed the fiscal consequences of demographic change in a federal system taking Germany as an example. Using a very simple technique, we derived estimates of the likely impact of the ageing of the society on federal, state and local government expenditures. The revenue side has been completely disregarded because of the peculiarities of the German system of revenue distribution across the various levels of government. Our results suggest that the federal government will have to bear a higher fiscal burden from demographic change as compared to subnational governments. At all levels of governments significant expenditure savings arise especially in those spending categories that are targeted towards the younger generation, as for example education. This applies despite the fact that we took into account a considerable increase in university enrolment rates. Demographically induced increases in spending are due to pension payments either because the number of retired public servants increases or the increase in federal transfers to the social security system. Our results suggest that in the near future significant, albeit not dramatic, vertical imbalances will occur in Germany between the federal and subnational government level. This calls for an adjustment of revenue distribution in the federal system. It is interesting to note, that a recent study for Canada, see Conference Board of Canada (2002), arrived at quite different conclusions. This study predicts that ageing in Canada will put pressure on provinces and will contribute to an improvement of the fiscal stance of the federal government. The main reason for the differences between Canada and Germany seems to be that the Canadian Provinces are responsible for providing tax financed health care. Thus, the federal distribution of the fiscal

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[24] The calculations of Bach et al. (2002) rest upon tax legislation in 2005.

burden of demographic change can be quite different across federal countries due to varying institutional frameworks.

Much work has still to be done in future research. In our study, we introduced changes in the age cost profiles only in some government functions but one should expect that more if not all government functions will live to see significant changes in the age cost profile. In addition, an estimate of age cost profiles supported by refined data is necessary in order to substitute our very simple (ad hoc) estimate. Another important step is to extend our work towards a general study of sustainability by incorporating the revenue side and an analysis of public debt. As a matter of course, our "age cost profile approach" used in this paper is not the only research strategy to examine the impact of demographic change on budgetary variables. Thus, it would be interesting to compare results obtained from using different estimation strategies, including those obtained from econometric methods, as for example presented by Hondroyiannis and Papapetrou (2000).

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