Demographic Change and Public Sector Budgets in a Federal System

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Abstract

This paper examines the effects of demographic change on public finances in a federal system. We develop a simple methodical procedure to measure the effect of demographic changes on public revenues and expenditures. We apply our method to the local, state and federal government sector as well as on the social security system in Germany. Our results suggest that demographic change will lead to significant vertical fiscal imbalances between the different layers of government. In addition we show, that subnational governments can generate a demographic dividend whereas the social security system and the federal government have to carry an additional burden due to ageing.

JEL Code: H11, H68, H77, J11.

Keywords: fiscal federalism, demographic change, sustainability of public finances.

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I. Introduction

Societies in industrialized countries are graying around the globe and Germany is one of the most severely affected countries. These demographic changes will have a significant impact on economic developments[1] and on government budgets and the social security system. The latter is of special importance for countries that suffer from problems of fiscal sustainability because of high public debt and deficits in the design of social security systems. With respect to the sustainability of public finances and the social security system Germany is in some trouble because of the high costs of German reunification and the dramatic increase in public debt since 1990, see OECD (2006). In recent years some reforms have been introduced and the current economic recovery has contributed to an improvement of the fiscal stance at all levels of government but the critical issue is the question whether these reforms have been sufficient to meet the challenges imposed by the significant demographic change in the decades ahead.

There is a considerable literature on the interrelations between demographics and public finances (e.g. Cutler, Elmendorf and Zeckhauser 1993, Hondroyiannis and Papapetrou 2000 or Sanz and Velázquez 2007). The bulk of this literature addresses the social security system (see e.g. Börsch-Supan 2000, Gruber and Wise 2001, Roig 2006, Disney 2007, Werding 2007) or central government budgets (see Franco and Munzi 1997 for EU countries, van Ewijk et al. 2006 for the Netherlands or Bach et al. 2002 for Germany). In addition, some researchers have focused their attention on specific spending components, with education being the most prominent subject (see e.g. Poterba 1997 or Harris, Evans and Schwab 2001). However, an issue that is looked upon only rarely are the repercussions of demographic change on the budgets of the different layers of government in federal systems. Lee and Edwards (2001) for the U.S., the Conference Board of Canada (2002) for Canada, and Seitz and Kempkes (2007) as well as Seitz (2007) for Germany examined this issue and show that the different layers of government are affected quite differently by changes in the number and age composition of

[1] See for example Lindh and Malmberg (1999), Zhang and Zhang (2005), Batini, Callen and McKibbin (2006) or Echevarría and Iza (2006).

the population.[2] These might result in vertical fiscal imbalances[3] across the various levels of governments, see for example Lazar, St-Hilaire and Tremblay (2003) and Ruggeri (2001), which raises the question whether the distribution of revenues across the different layers of government has to be adjusted to cope with demographic changes.

In this paper we examine the effects of demographic change on the fiscal position of the federal, state and local government sector as well as the social security system in Germany extending our previous work on this subject, see Seitz and Kempkes (2007) and Seitz (2007). As compared to centrally managed states, federal countries have some peculiarities that make the management of adjustment to demographic change more difficult because more policy makers with conflicting attitudes are involved and issues of the distribution of expenditures and revenues across the layers of government are of considerable importance in politics. Thus, in many federal states, such as in Germany, interjurisdictional fiscal transfers are quite significant and create vertical fiscal spillover effects. In addition, the distribution of tasks across the different levels of government is quite heterogeneous and thus the effects of demographic change on fiscal budgets vary across the layers of government. In Germany, as in many other countries too, another problem arises because the social security system is financed both out of social security contributions of employees and employers as well as tax-financed transfers. Because in general the social security system is rather sensitive with respect to demographic change, such as the pension system, government levels responsible for financing these tax transfers are more severely affected than other levels of government. Thus for example, the Conference Board of Canada (2002) has calculated that in Canada the provinces, which are responsible for financing health services, will have to carry a significant burden of demographic changes whereas the central government is not that much affected. In Germany, see Seitz (2007), it is the central government which has to provide transfers to the social security system. Consequently, in federal systems the effects of demographic changes across the levels of governments crucial depends upon the design of the federal system and the interrelations between the public sector and the social security system.

[2] Echevarria (1995) has studied this issue theoretically.
[3] For the concept of vertical fiscal imbalances see Boadway and Tremblay (2006).

The paper is organized as follows. Section II develops a method to inspect the impact of demographic change on government budgets, taking restrictions on fiscal sustainability into account. The empirical part of the paper applies our method in several steps. In a first step, section III presents estimates of age cost and age revenue profiles by level of government in Germany. Using these estimates, section IV develops simulations to study the impact of demographic change on government budgets taking fiscal transfers between the various levels of government into account. Finally, section V summarizes our findings and presents conclusions for fiscal policy in Germany as well as future research.

II. The age profile approach

The basic idea of the concept of age cost and revenue profiles consists of estimating the distribution of public expenditures and revenues across age groups. The age profile concept is quite distinct from the generational accounting approach (GA) as pioneered by Auerbach and Kotlikoff (1987).[4] Whereas GA examines the benefit and tax burden profile of each generation, the age profile approach takes a cross-section view of the public budget and thus fits well into the sustainability approach as developed by Blanchard et al. (1990) which is used for policy analysis by the OECD. One advantage of the age profile approach is that the informational requirements are far more modest as compared to the information necessary to run a GA analysis. However, this goes at the expense that no estimates of the distribution of benefits and burdens across generations can be derived. Nevertheless, both approaches share the same purpose namely linking public budgets to demographics and examining the question whether demographic change will worsen or improve the sustainability of public finances.

The starting point of the analysis is the dynamic government budget constraint:

$$B_t = B_{t-1}(1+i) + E_t - R_t \tag{1}$$

where B denotes the level of public debt and E and R identify primary expenditures and public revenue in period t. i is the nominal interest rate, which is assumed to be time invariant throughout our theoretical exposition.

[4] The generational accounting approach is discussed extensively in Auerbach et al. (1991) and Auerbach et al. (1994).

Expenditures are assigned to different age cohorts by using *age cost profiles* at each level of government and in each function, such as education, administration etc, see Seitz and Kempkes (2007) or Seitz (2007). Thus expenditures in year *t* at government level *f* are given by:

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

$E^f_{,t}$ denotes total expenditures at government level *f* (federal, state and local government sector and the social security system), *N(x,t)* denotes the population of age *x* in period *t*, with $\bar{x}$ the maximum age, and $\Sigma_x N(x,t) = N_t$ is total population. The term *e(x,j,f,t)* is the age cost profile which captures information on per capita spending on citizens aged *x* for the public good *j* (such as education, health, etc.) at government level *f* in period *t*:

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

If the public good *j* is not age-specific (such as defense) the entries in *e(x,j,t,f)* are identical across all age groups.

If information about age specific spending is available one can derive a naïve forecast of the future development of total public spending if age cost profiles are assumed to be time-invariant in which case future expenditures up to period $t+\tau$ evolve according to:

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

In such a setting public expenditures are exclusively driven by changes both in the number as well as the age composition of the population.

However, there are numerous factors that can bring about changes in age cost profiles: Inflation and real productivity growth that affect virtually all expenditures alike, see for example Franco and Munzi (1997), cohort size effects (Poterba 1997, Baum and Seitz 2003), effects induced by changes in political preferences which can be depicted by the age composition of the electorate (Poterba 1997 or

Brunner and Balsdon 2004) and participation effects or cohort effects (Pearson, Smith and White 1989) are the most important reasons for age cost profiles to change over time, see Lee and Edwards (2001) for a more detailed discussion. In addition, changing demographics bring about adjustments in the economy, such as real productivity growth, factor prices, the taxation capacity etc. which will have repercussions on both the expenditure and revenue side of public budgets (see for example Galor 2005). As a matter of course, incorporating all of these effects is hardly possible in an empirical investigation and in our subsequent empirical work we take into account only the most important factors.

Adjustments in age cost profiles due to the above mentioned effects can be incorporated in the forecasting mechanism by adding an adjustment parameter, $\lambda_e(x, j, t+\tau, S, f)$, to equation (4) that captures all changes in age cost profiles in the period t through $t+\tau$. The vector S ($S_1,\ldots,S_Z$) denotes a set of variables that drive the adjustment parameter, such as productivity growth, price adjustments, changes in political preferences, the behavior of firms and individuals, etc. S also captures changes in policy which have already been implemented but do not yet have visible effects on revenues and expenditures.[5] Moreover, S can include policy measures that are on the top of the political agenda[6] and have a high probability to be put into effect in the years ahead. Thus in a more general setting, spending at government level f evolves according to:

$$(4') \qquad E^f_{t+\tau} = \sum_{j=1}^{J} \sum_{x=1}^{\bar{x}} N(x, t+\tau) e(x, j, t, f) \lambda_e(x, j, t+\tau, S, f) .$$

In this more general setting the age cost profile in period $t+\tau$ is given by

$$e(x, j, t+\tau, f) = e(x, j, t, f)\ \lambda_e(x, j, t+\tau, S, f) .$$

At the revenue side we proceed similarly:

$$(5) \qquad R^f_t = \sum_{x=1}^{\bar{x}} \sum_{k=1}^{K} N(x, t) r(x, k, t, f) .$$

[5] Thus for example, in Germany changes in pension laws have already been introduced but fiscal effects will not arise before the next decade.

[6] An example is the current debate on the increase in kindergarten services in Germany, which has already resulted in proposals in the legislation process but the legislation process is not yet finished.

Public revenues R_t^f in year *t* for government level *f* result out of *k* different sources. The age revenue profile *r(x,k,t,f)* denotes the average per capita revenue at government level *f* collected from age group *x* in category *k* (such as income taxes, property taxes, etc.). For revenues too we introduce an adjustment factor, $\lambda_r(x, j, t+\tau, S, f)$, in order to incorporate changes in the revenue profile to derive more realistic estimates of future revenue growth.

Next we examine the impact of demographics on the fiscal stance. Suppressing the index *f* we can write the budget restriction in the following form:

$$(6) \qquad B_{t+\tau} = (1+i)B_{t+\tau-1} + \sum_{x=1}^{\bar{x}} \sum_{j=1}^{J} E(x, j, t+\tau) - \sum_{x=1}^{\bar{x}} \sum_{k=1}^{K} R(x, k, t+\tau) .$$

In order to examine the question whether demographic change will lead to sustainability problems we have to set appropriate sustainability targets, such as a balanced-budget rule or a fixed debt-GDP ratio, which makes it possible to derive tax and/or expenditure adjustments necessary to ensure sustainability. In addition, we have to fix the set of policy instruments that are used to achieve sustainability which is in our case primary expenditure growth. In federal systems with a high degree of tax sharing among the different tiers of government, such as in Germany, manipulating primary expenditures is much easier than changing tax laws, because the different tiers of government can independently adjust expenditures whereas changing tax laws usually requests a complicated and time consuming coordination process which involves all 16 state governments[7] and the federal government. As sustainability target we impose a balanced budget rule which yields a simple equation for total primary expenditures, $\widetilde{E}_t$, which can be financed under the balanced budget rule:

$$(7) \qquad \widetilde{E}_t = R_t - iB_{t-1}$$

To examine the impact of demographic change as well as the impact of changes in the other variables taken into account in our modeling framework we differentiate primary expenditures in equation (4´) with respect to time:

[7] In Germany, for example, the state governments have virtually no power to tax. The bulk of state tax revenues comes from shared tax resources and even most of taxes that accrue to the state level are fixed by federal law.

(8) $$\frac{dE_t}{dt} = \sum_j \sum_x e(x,j,t)\lambda_e(..)\frac{dN(x,t)}{dt} + \sum_j \sum_x \sum_{z=1}^{Z} N(x,t)e(x,j,t)\frac{\partial \lambda_e(..,S)}{\partial S_z}\frac{dS_z}{dt}.$$

The first term on the right hand side is the change in primary expenditures induced by demographic change, taking public service levels as given. The second component denotes the impact of the set of the *S*-variables taken into account in our policy simulation. However, the time path of E_t as calculated in equation (8) need not be identical to the time path of sustainable primary expenditures $\widetilde{E}_t$ as calculated in equation (7). To close this gap we define another component of sustainable expenditure growth which we call residual expenditure, E_t^R:

(9) $$E_{t+\tau}^R = \widetilde{E}_{t+\tau} - E_{t+\tau}$$

Residual expenditure growth can be both positive as well as negative. In the former case, expenditure changes induced by demographics as well as the variables captured by the *S*-vector do not exhaust sustainable expenditure growth and thus there is scope for additional expenditure growth. In the latter case, demographics and the *S*-variables demand a spending volume that cannot be financed under conditions of sustainability and thus future generations have to cut expenditures. The variable E^R closes the gap between the components on the right hand side of equation (8) and sustainable primary expenditure, $\widetilde{E}_t$. To ensure identification, we assume that residual primary expenditure growth affects all age groups and spending functions identically and consequently residual primary expenditure growth is used as a scaling factor to ensure sustainability. In addition, we note that residual expenditure growth can be used as an indicator of the freedom to act of future generations. The larger (smaller) residual expenditure growth is the less (more) current politics as well as demographic developments restrict future generations. Therefore, the method outlined makes it possible to evaluate the burden current policy puts on future generations by calculating the impact on residual expenditure growth.[8]

[8] It should also be stressed that our procedure brings about an endogenization of the age-cost profile that ensures a balanced budget.

III. Empirical Application I: Estimating age cost and revenue profiles

Official statistics rarely provide direct information on the distribution of public expenditures and revenues across age groups, and therefore we have to develop estimates of both age cost and age revenue profiles. To derive such estimates we use the indicator matrix method as suggested by Seitz and Kempkes (2007) and Seitz (2007) which yields the following estimate of the age-cost profiles for government level *f* and function *j:*

$$e(x, j, f) = \frac{E_j^f}{\sum_{x=1}^{7} I_e(x, j) N(x)} I_e(x, j) . \tag{10}$$

E_j^f denotes net expenditures, defined as total expenditures minus transfers received from upper level of government in function *j* at government level *f*. The indicator matrix $I_e(x,j)$, which is the key element of the estimation procedure, contains all information and assumptions about the demand of a representative citizen in age group *x* in function *j*.[9] In the empirical investigation we subdivide the population in 7 age groups. The entries in the indicator matrix can be looked upon as estimates of the (normalized) degree of utilization of the public good in question by the various age groups. We normalize the entries such that the age group that demands the specific public service most intensively is assigned the value "1". A "0" entry in the I_e matrix means that the specific age group does not consume the public good provided within the specific government function. If all entries in a row are "1", this public service is consumed by all age groups with the same intensity. To derive an estimate of the age revenue profile we proceed similarly by constructing an indicator matrix for tax revenues, $I_r(x,k)$, which can be used to estimate an age revenue profile

The entries in the expenditure indicator matrix I_e are derived by using data on the age structure of clients/users in the various fields of activities as well as a-priori reasoning.[10] The elements of the revenue indicator matrix I_r are constructed by examining micro-data on tax payments and evidence

[9] Note that the indicator matrix is assumed to be identical across all levels of government because more detailed information is not available.

[10] In the case of general public administration, defense, etc. there is no reason to assume that different age groups are served differently, and consequently each age cohort is assigned the value "1" in the age-cost indicator matrix. For more details on how to derive the entries in Table 4, see Seitz and Kempkes (2007).

presented by Bach et al. (2002). It should be noted that revenues and expenditures are measured in terms of net values, which means, that transfers from other (usually upper) levels of government are subtracted from both revenues as well as expenditures. The reason for this is that we examine all levels of government in a federal system. Looking at gross rather than net revenues and expenditures would result in double-counting of interjurisdictional transfers at both the grantor as well as the recipient government level.

Table 1 and table 2 show the indicator matrices for primary expenditures and revenues. E. g. in the case of spending on "Jurisdiction and Prisons" the age group 50 - 65 is assigned a value of 0.6 whereas the age group 18-30 has the highest entry "1". This means that on the average per capita spending in this function on the age group 50 - 65 amounts to about 60% of per capita spending on the age group 18 - 30. The entries in the function "Jurisdiction & Prison" have been derived by examining the age structure of prisoners as well as persons prosecuted for crime. In the case of income taxes, to take one example out of the revenue indicator matrix, inhabitants in the age group 30 - 50 make the highest per capita tax contributions. As compared to this age group, the age group 18 - 30 has an average per capita income tax burden that amounts to only about 31% of the age group 30 - 50.

In figure 1 and figure 2 we show the age-cost profiles and age-revenue profiles across all functions by level of government based upon primary expenditure and revenue data for Germany in fiscal year 2004. There is a considerable variation of per capita spending and revenue collection across the age groups within and across the different levels of government. As can be seen, age cost profiles of subnational governments (state and local government sector) are biased towards the young whereas the federal budget and in particular social security spending is strongly biased towards the elderly. This is not surprising because in Germany state and local governments are responsible for the provision of education - including kindergarten services - whereas the federal government makes only modest contributions to education financing. The high burden of the federal government for spending on the elderly is due to the massive transfers of the federal government to the public pension system. On the revenue side of the budget, age profiles are rather similar across all levels of government which is due

to the income taxation and income-related social security contributions with the highest burden at the age 30-50. In addition, in Germany the bulk of tax revenues are collected out of joint taxes and the revenues from these joint taxes are shared among all levels of government.

In figure 3 we present estimates of the net burden[11] of public service provision by age for the three layers of government which is calculated by:

$$(11) \qquad s(x,f) = \sum_{k=1}^{K} r(x,k,f) - \sum_{j=1}^{J} e(x,j,f)$$

Age groups which are net-beneficiaries of public service provision have a negative balance, $s(x,f) < 0$ whereas net-payers have a positive balance, $s(x,f) > 0$. As can be seen only the age groups 30 - 65 have a significant net payer position whereas all other age groups are net recipients of public services.[12] Taking into account the decline in the labor force in Germany expected in the years ahead, figure 3 suggests that without changes in the level and structure of taxes and expenditures Germany might run into severe sustainability trouble without adjustments in policy, an issue which we will address below.

IV. Empirical Application II: Demographics and Sustainability across levels of Government

As many other industrialized countries Germany faces rather dramatic demographic changes in the decades ahead which poses the question, which challenges these changes imply for fiscal policy. In table 3 we present some background data on demographic developments in Germany. The most current population forecast[13], which is used throughout our investigation, suggests that the population in Germany will drop by about 5% in the period 2006 - 2030 with strong disparities between West Germany (about - 2.5%) and East Germany (about - 15%). Even more important is the change in the age structure of the population. The labor force - age group 18-65 - will drop from about 63% of the

[11] Because expenditures cover primary expenditures only the net burden has to be looked upon as the primary balance.
[12] At the federal level the age group 18-30 has a modest net payer position. At the state and local level the age group 65-80 has a modest net-payer position.
[13] We use the average of variant 1-W1 and 1-W2 of the 11th population forecast of the Federal Statistical Office (2007a).

population in 2006 to about 57% until the year 2030 and the share of the population in the age group 6 - 28, which demands the services of the education sector ranging from schools to universities, will decrease by more than 4.5 percentage points. However, the most significant change we observe for the elderly, 65+, whose population share increases from about 20% to about 28% within a period of 25 years.

Thus, demographic shifts in Germany are quite significant and our age cost profiles derived in the preceding section suggests that this should have a quite different impact on the various levels of government. In our subsequent empirical application the federal structure of Germany is incorporated in our simulation model by taking into account the interactions between the different levels of government induced by the flow of funds between government levels. Interjurisdictional transfers create fiscal spillover effects between the various levels of government that are also affected by demographic changes. Thus for example the ageing of the society puts expenditure pressure on the social security system and because a considerable share of social security expenditures is financed out of tax financed transfers provided by the federal government, the federal budget is considerably affected fiscally, despite the fact that the federal government hardly provides any direct transfers to the elderly.[14] As table 4 shows, interjurisdictional vertical transfers are quite significant in Germany. In the upper part of the table we report transfer payments in terms of the total expenditures of the grantor government. About 45% of federal expenditures are transfers to the social security system (~ 32%) and the state government level (~ 13%). About 20% of state government expenditures are transfers to the local government level. In the lower part of the table transfers are reported from the point of view of recipient governments. About 14% of state expenditures are financed out of transfers from the federal government and more than 30% of local government expenditures are financed out of state transfers. The social security system covers almost 20% of total expenditures out of tax financed transfers provided by the federal government.

[14] The only exception is the financing of pension payments for retired public servants of the federal government.

General assumptions

Based upon the estimated age profiles of expenditures and revenues derived above this section presents simulation results on the future development of the fiscal stance of the various levels of government in Germany covering the period up to 2030. We proceed in three steps: *First* we present simple simulation results that completely disregard policy changes and rest upon equation (4) on the expenditure side and an analogous equation for revenues. A *second* model simulation introduces a wide set of assumptions about policy changes that have already been implemented or are about to enter the legislation process. A *third* simulation adds the government budget restrictions and imposes a simple sustainability restriction, namely a balanced budget rule, and derives estimates of the room of maneuver of future generations.

All subsequent simulations disregard general inflation and productivity growth and therefore the results have to be interpreted in real terms net of general economic growth. This is by no means a restrictive assumption because inflation and real economic growth is usually taken into account by assuming that revenue and expenditure growth keeps up with productivity growth across all revenue and expenditure items and thus growth is neutral with respect to the share of primary expenditures devoted to spending in the various functions. Sector effects that means effects upon the expenditure structure by function, arise only if we assume that in some functions price increases deviate from the general inflation rate[15] or that real expenditure growth in some functions is above or below general productivity growth because of policy priority shifts.[16] However, we have to admit that the tax revenue structure is not neutral with respect to productivity growth because there are both taxes which are highly correlated with GDP as well as taxes that are only weakly correlated with GDP, as for example tobacco tax, motor vehicle tax, real property tax, etc.[17] We estimate that at least about 85% of

[15] It is frequently assumed that prices in the health sector increase faster than the general price index, see for example Lee and Edwards (2001).
[16] One should note, that neglecting productivity growth does not mean that we disregard growth let alone that we believe that there will be no real growth. Suppressing the effects of productivity growth merely implies that both expenditures as well as tax revenues - in per capita terms - rise at the rate of productivity growth, an assumption quite common in the literature, see for example Lee and Edwards (2001).
[17] Lee and Edwards (2001) assume that all tax revenues with the exception of property taxes rise with the rate of productivity growth. In Germany, property taxes are only of only small importance and amount to only about 3.3% of total tax revenues (property tax plus tax on acquisition of real estate).

tax revenues in Germany belong to the former category and thus our assumption of neutrality of the tax structure with respect to productivity growth is not that far fetched.

Finally, we have to make some remarks on the social security system. Roughly[18] speaking the statutory social security system in Germany consists of five branches. The bulk of revenues of the social security system are compulsory contributions of employers and employees. In addition, the federal government pays tax financed transfers to the social security system and most of these transfers go to the statutory pension insurance. In our model simulation we assume that the federal government contributes a fixed ratio of *net* expenditures of the various branches of social security. Based upon data for the year 2004 we calculated the following ratios:

- Statutory occupational accident insurance ~ 2.3%
- Statutory health insurance ~ 1.7%
- Statutory long-term care insurance ~ 0%
- Statutory pension insurance ~ 49.7%
- Statutory unemployment insurance ~ 10.1%[19]

Using these transfer financing ratios, we introduce a link between social security and federal government spending.

Model I: Naïve model simulations: Only demographics matter

In a first step we take a "pure demographic view" ignoring behavioural and policy changes as well as the budget restriction. Thus we answer the question: Which fiscal performance are expected if age cost and revenue profiles are kept unchanged and changes in behaviour and politics are completely disregarded in the period 2004 - 2030?

The results of this rather fictitious experiment are shown in figure 4 in terms of the primary balance as a percentage of net primary expenditure of the year 2004. The fiscal imbalances induced by

[18] For a detailed description of the German social security system see the brochure "Social Security at a Glance", available at the homepage of the Federal Ministry of Labor and Social Affaire, www.bmas.de.
[19] This ratio has been adjusted in 2007, which is taken into account in our policy simulations reported below.

demographic change differ significantly across levels of governments. Subnational governments benefit fiscally from these changes, which is due to the fact that expenditures are biased toward the younger generations and thus the decline in the absolute number and the share of the younger generation results in expenditure savings taking per capita expenditures on each age group as given. The "demographic dividend" amounts to about 5% of net primary expenditures until 2030 and the projected decline of public revenues is more than compensated by savings in the education sector that are due to the shrinking of the young age cohorts that attend schools and universities. In addition, as can be seen from the age cost profiles presented above, local and state governments do not have to pay for the elderly that much and consequently the increase of the share of the elderly does not affect the subnational government sector significantly.[20] In contrast, the federal government level faces a demographically induced fiscal deficit, which increases steadily to about 12% of net primary expenditures at the federal level until 2030. A similar picture, but even more dramatic, arises for the social security system. The shift of the age structure towards the elderly leads to an enormous burden for the social security budgets. The demographic gap is estimated to increase to about 25% of net expenditures until 2030. Thus, demographic change has a considerable impact on the overall public budget, mainly caused by expenditure pressure in the social security system and results in significant vertical fiscal imbalances in the German federal system. These imbalances ask for changes in the vertical distribution of tax revenues and indicate that - without changes in service provision - social security contributions or tax financed transfers to the social security system have to increase considerably. However, we once again have to stress that these results have been derived from a highly stylized comparative static experiment that identifies "pure demographic change effects". Behavioural changes, policy changes etc. are completely disregarded. Therefore, in a next experiment we relax these very restrictive assumptions.

Model II: Policy simulations without imposing sustainability restrictions

After examining the pure demographic change case we next take into account changes in behaviour and politics but do not yet impose a sustainability restriction which will be introduced in the next

[20] The only exception is the increase in the number of retired public servants especially at the state level, which pushes up state spending on pension payments for retired public servants.

subsection. We start with the formulation of a set of 11 assumptions for our policy simulations. Assumptions 1, 3, 5, 6, 8 and parts of assumption 9 are in fact no assumptions but merely quantify the effects of policy measures that have already been introduced or are currently in the legislation process, such as the increase in kindergarten services. Most of our assumptions on reforms in the social security system as well as the unemployment rate are adapted from Werding and Kaltschütz (2004) and Werding (2007) which have been developed in projects related to the sustainability report of the German Government.

Assumption 1: The value added tax rate has been increased on Jan. 1st in 2007 from 16% to 19%. This increase was associated with a change in the distribution of sales tax revenues in favor of the federal government which uses the additional tax revenues to increase tax financed transfers to the unemployment insurance to finance a cut of the contribution rate of employers and employees to the unemployment insurance.

Assumption 2: In the 70s about 12% of the population aged 20-28 studied at universities. The current ratio is about 26% and is forecasted to increase to about 31% up to the year 2015.[21] We assume that this is accommodated by an increase in real per capita expenditures in the function „university" and „research outside universities" by 20% at the state and federal government level until 2030.

Assumption 3: Relative spending on pensions for retired public servants will decrease by 23% at the federal level and increase by about 39% at the state level whereas there is no significant change at the local government level.[22]

Assumption 4: Since late 2005 the German economy is on an economic recovery path and there has been a considerable drop in the unemployment rate. We assume that the reduction in the unemployment rate will result in savings in social assistance expenditures, the bulk of which has to be covered by the local government sector. We assume that these expenditures drop by 10% per capita up to 2012 and will remain at this lower level until the end of the simulation period.

[21] Because of the German vocational education system university enrollment in Germany is lower as compared to many other OECD countries.

[22] These figures result out of the changing relation of retired public servants and the population 65+. Estimates are derived from the most recent forecast on retirement in the public sector provided by the Federal Ministry of the Interior (2005).

Assumption 5: A legislation process has been started to increase kindergarten service provision for children below the age of 3. Despite the fact that local governments are responsible for the provision of kindergarten services a recent draft bill puts the burden of financing this policy measure on the federal and state government sector whereas the local government sector will have to cover only negligible costs. In table 5 we specify the fiscal flows in detail.[23]

Assumption 6: Since 1990 the East German states receive considerable transfers from the federal government to finance the reconstruction of the public infrastructure capital stock. These transfers are steadily reduced and will expire in 2019. Therefore we reduce federal expenditures - according to the rules fixed in a federal law - by 12.6 bn. Euro until 2019. In addition we reduce revenues and expenditures of the East German states by 1.2 bn. Euro until 2019 because of the decline in transfers received from the EU. On the other hand, we increase per capita tax revenues of the East German local government sector. Currently per capita local tax revenues in East Germany amount to about 60% of the West German average value and we assume that this ratio will increase linearly to 75% in 2030.

Assumption 7: Interest rates are currently at a historical low level. We assume an increase in the real interest rate on government bonds by 1 percentage point up to the year 2015.[24]

Assumption 8: In recent years there have been many reforms in the statutory pension insurance system the effects of which will become effective in our simulation period. Calculations by Werding and Kaltschütz (2004) show that per capita benefits of the pension insurance system will drop by about 15% until the year 2030. This assumption is also carried over to pension payments for retired public servants. In addition, recent legislation increased retirement age by about 2 years until the year 2030 which will have three fiscal effects: i) Per capita pension payments to retired persons decrease in real terms, ii) income tax payments increase and iii) social security contributions increase where the latter two result out of the longer working life. These three effects are taken into account in our simulations.[25]

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[23] The legislation process to improve kindergarten services for children below the age of 3 has already started and the figures presented in table 5 correspond to those discussed in the legislation process. The very complicated legislation process and the scheduled financing are described in more detail in Seitz (2008).

[24] This assumption does not affect the results in our model II simulations because we look at primary expenditures only. However, in our model III simulations this assumption is relevant for determining residual primary expenditure growth.

[25] Currently, in German politics is discussed abandoning some of these reform steps which might result in a reduction of the quite significant reform effects introduced in recent years. However, it is virtually impossible to

Assumption 9: Many adjustments have also been made in the unemployment insurance system which contributed to a reduction in benefit payments. In addition there has been a change in the financing scheme because on Jan. 1st 2007 the unemployment contribution rate has been reduced form 6.5% to 4.2%. The associated loss in revenues has been compensated by an increase in federal transfers to the unemployment insurance which are financed out of the increased sales tax rate which became effective concurrently. We take these changes into account and in addition, we follow Werding and Kaltschütz (2004) and assume a significant drop of the unemployment rate in Germany to about 4% up to the year 2010. This results in i) declining unemployment compensations, ii) increasing income tax payments increase and iii) increasing social security contributions. These three effects are taken into account in our simulations.

Assumption 10: Whereas there have been many reforms in the public pension system in the health insurance system reforms are rather difficult to achieve by policy makers and therefore no policy assumptions are taken into account in this branch of the social security system. However, the literature intensively discusses the change in health expenditures that might occur because of changes in life expectations as well as the impact of technological change on health expenditures. In our simulations we follow the literature, see for example Lee and Edwards (2001), and assume that the prices for health services increase by 1% above the GDP deflator. In addition, we adapt the assumption of Werding (2007) and assume a flattening of the age cost structure in health services because of the increase in longevity by about 1.2 years until the year 2030.

Assumption 11: Reforms in the long-term care insurance system are permanently discussed in Germany but did not yet result in concrete legislation processes.[26] However, as in the health insurance system we take into account the flattening of the age cost profile induced by the increase in longevity.

Table 5 summarizes our assumption and provides information on the technical implementation of the assumed policy changes.[27] Our simulation results are depicted for each level of government

evaluate the long-run impact of this change in policy and therefore we stick to the institutional settings valid in 2007.

[26] A legislation process to reform the long-term care insurance system has been initiated quite recently in spring 2008. These reform measures are not taken into account in our policy simulations.

separately. In figure 5 we compare fiscal developments in the social security system in model I and model II. In our policy simulations the deficit of the social security system is significantly reduced as compared to model I which disregards all changes in politics and does not take into account the improved growth conditions of the German economy.[28] In the short-run, the change in the financing of the unemployment insurance system results in a downward shift of net expenditures and net revenues in the year 2007 as compared to the previous years. The flattening of the expenditure growth path is largely due to the reduction of pension benefits as well as the assumed drop in the unemployment rate. Model I and II have dramatically different implications for federal transfers to the social security system. Whereas in model I these transfers increase by about 25% in the period[29] 2007 - 2030 model II predicts a vertically stagnating transfer volume.

Next we turn to the federal government level, see figure 6. Due to the increase in the VAT rate in 2007 and the increase in tax financed transfers to the unemployment insurance (see assumption 1) both net primary expenditures and net revenues increased significantly in 2007. In the next years real expenditures - net of productivity growth effects - are forecasted to decrease significantly for several reasons. A very important factor is the expiring of the transfer payments to the East German states in 2019 which amount currently to about 4% of federal expenditures. Another major effect is the decline in transfers to the social security system, especially the statutory pension insurance system, see assumption 8. Net revenues remain rather stable in the period 2007 - 2020 but decrease slightly in the following years due to demographic developments. Whereas in model I the net primary balance deteriorated throughout the simulation period in model II there is a steady improvement, which is due to declining primary expenditures and in the years after 2020 a surplus of 5% is expected.

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[27] We have to admit that we are not able to incorporate one important policy change that occurred in 2005. In 2005 the financing and "rules of the game" for the provision of social assistance has been changed considerably. Official statistic do not yet provide a sufficiently serious data base to study the impact of this reform on federal and subnational government finances and we therefore have to disregard this reform at our current stage of research.

[28] However, expenditure growth of the various branches of the social security system is rather heterogeneous. Thus for example, real expenditure growth of the health insurance and long-term care insurance increase by about 40% up to 2030 whereas expenditure growth in the pension insurance system is rather modest due to the reforms that have already been introduced.

[29] Because of the shift in the financing structure of the unemployment insurance in 2007 comparison is restricted to this period.

At the state level, see figure 7, net primary expenditures in model I and II do not deviate that much. Net primary expenditures in model II are about 3 percentage points above expenditures forecasted in model I because of the assumed increase in resources devoted to university education and research as well as the increase in kindergarten services. Large differences we get at the revenue side because of the increase in the VAT rate as well as the general tax revenue increase resulting out of the current speed-up of growth in the German economy. Consequently the primary balance in model II is significantly improved as compared to model I. This is also in accordance with the most recent developments at the state level because in 2007 most states already presented a balanced budget.

The simulation results for the local government level look rather similar to those at the state government level but the calculated surplus is much higher, see figure 8. The primary balance steadily increases to about 18% of total net primary expenditures and by comparing the development of revenues and expenditures in model I and II we see that demographics is the most important factor that drives down expenditures and contributes to the primary balance surplus.

Finally, we compare the fiscal performance of the federal government sector and the total subnational government sector (local plus state government sector) to check whether fiscal imbalances arise. Figure 9 shows that the subnational government sector can improve the primary balance significantly by almost 400 Euro per capita up to the year 2030 whereas the federal government can achieve a surplus of only about 150 Euro per capita. This results in differences in the political room for maneuver at the federal and subnational government level.

Model III: Imposing sustainability restrictions

Whereas in model I and II no sustainability restriction has been taken into account, model III imposes a balanced budget. We assume that federal, state and local government have a balanced budget as from 2010 in each year. As set out in equation (8) this restriction is achieved by adjusting net primary expenditures. In the social security system we impose the reasonable restriction that a balanced budget is achieved by adjusting compulsory social security contribution rates. As a matter of course, an

increase in spending pressure will also put pressure on the provision of benefits. Thus, imbalances in the budgets of the social security system could be avoided by both spending and revenue adjustments. However, assumptions on expenditure adjustments would be rather vague and therefore we consider revenue adjustments only.

To take the most recent developments in Germany into account - strong increase in real growth as well as tax revenues - our sustainability calculations start with the fiscal year 2007 and use a preliminary estimate of the total budget balance at each level of government. In the period 2008 - 2010 we adjust primary expenditures such that the budget deficit is steadily decreased and a balanced budget is achieved in 2010. Using our method described in section II, we can decompose the growth rate of primary expenditures into three components: primary expenditure growth induced i) by demographic change, ii) by politics and iii) residual primary expenditure growth. Similarly, we can decompose the growth rate of net revenues in a demographic and policy induced component. However, in the social security system residual primary expenditure growth is zero by assumption because sustainability is achieved by adjusting social security contributions and thus in this sector there is a third component of revenue growth, namely revenue growth necessary to achieve sustainability.

Table 6 presents the decomposition of revenue and expenditure growth by level of government in the period 2007 - 2030. Revenues and expenditures of the social security system increase by 8.0%. Net revenues decrease by almost 10% due to demographic changes. The various policy measures introduced as well as the assumptions on improved economic conditions in Germany result in an increase by about 14%. However, to achieve sustainability a further increase of revenues by an upward adjustment of social security contributions by about 4% is necessary. Expenditures increase by over 16% due to the ageing of the German society whereas policy measures bring about an expenditure decrease by about 8.2%.

Revenues at all levels of government will be affected negatively by demographic change whereas policy induced measures result in an increase in revenues. However, the total effects on revenue

growth are rather limited. At the federal government level revenues decrease by 3.0% and by about 2.3% at the local government level. At the state government level the negative demographic effects and the positive policy-induced effects almost balance and leave revenues virtually unaffected.

On the *expenditure* side the effects are much more significant and diverse across the various levels of government. At the federal level, demographic change puts strong pressure on primary expenditures growth (+ 5.6%) whereas at the state and local government level expenditures drop by 6.9% and 9.1%, respectively. These differences are due to the change in the age structure towards the elderly and the fact that federal expenditures are biased towards the older generations whereas subnational government expenditures have a youth bias. Policy-induced effects are quite strong at the federal government level and amount to almost -15%. The two factors that contribute most to the improvement of the fiscal stance of the federal budget are the reforms introduced in the pension insurance system and the phasing-out of transfer payments to the East German states. At the state government level, policy measures do have only a minor impact on primary expenditure growth and at the local government level primary expenditures decrease by about 3%, which is due to the assumed drop in welfare spending induced by the decline in unemployment.

Strong asymmetries we observe for *residual primary expenditure growth*. Whereas the local government sector can increase primary expenditures in the period 2007 - 2030 by about 16% and the state government sector by about 0.2%, the federal government level has to introduce further cuts in primary expenditures by about 1.3% in order to ensure sustainability. Total net primary expenditures have to be cut by about 10% at the federal level and by about 4% at the state level whereas local governments can increase primary expenditures by about 4%.

From these results we can draw several policy-relevant conclusions:

1) Demographic developments create windows of opportunity to realize expenditure savings without reducing per capita benefits of the relevant age groups at the subnational government level in Germany. However, governments have to adjust the volume of expenditure in each function to

changing cohort sizes. As a matter of course, we are well aware of the fact that in the short run this is not possible without creating severe frictions because staff downsizing or adjusting infrastructures is not that easy and cannot be achieved instantly. However, within a period of 20 years these adjustments have to be manageable especially because the facts about demographic change are well-known to policy makers. At the federal government level and especially in the social security system demographics put further upward pressure on expenditures and social security contribution rates.

2) Policy measures as well as the expected economic recovery contribute to an improvement in the fiscal stance of all public sector budgets. Reforms introduced in the social security system in Germany in recent years have indeed contributed to an improvement of sustainability conditions. However, according to our simulation results there is still need for reforms because a further increase in social security contribution rates would be necessary. The rather small policy-induced increase in state government spending is caused by the assumed increase in real resource provision in the university system and the increase in kindergarten service provision. Thus these policy measures do not reduce the room for maneuver of future generations significantly at the state level.

3) From a political perspective a rather critical result is the fact that our simulation results suggest significant vertical fiscal imbalances across the various levels of government. The federal government has to cut primary expenditures by 10.3% and at the state level an expenditure cut by about 4.1% is necessary whereas the local government sector can increase primary expenditures by 4.1%. If no corrections in the vertical distribution of revenues are introduced, the share of federal government spending, see table 7, will in the period 2007 - 2030 drop by more than 2.6%, whereas the state and local government spending share increases by about 0.6% and 2.0% respectively. Thus the crucial (political) question is which level of government should be enabled to set new future spending priorities and thus requests a higher share of total government resources.

V. Summary and Conclusions

The paper introduced a simple method to study the impact of demographic change on the fiscal stance of governments in a federal system. We estimated age cost and revenue profiles for Germany by level

of government and used these estimates to derive simulation results on the future development of public finances. In a first step, we studied the impact of pure demographic change showing that the federal government and especially the social security system will experience a deterioration of fiscal conditions whereas the subnational government sector can realize a demographic dividend. In a second step we incorporated policy reforms as well as assumptions on changes in the demand for public services to inspect the question, whether recent policy reforms will contribute to an improvement of fiscal conditions. Our simulation results suggest that recent policy reforms as well as the currently observed improvement in general economic conditions significantly reduced the pressure on fiscal budgets. In a final step, we incorporated our method into a simple model of fiscal sustainability and calculated expenditure adjustments necessary to keep public budgets balances.

The main conclusion from our study is the fact, that demographics have quite different effects upon public budgets of the different layers of government in a federal system. Because of the ageing of the society, governments which have an expenditure biased towards the elderly will live to see a worsening of the political room for maneuver whereas governments with a focus on the younger generations gain scope for political action. Thus the tendency towards vertical fiscal imbalances in the German federal system also creates political vertical fiscal imbalances.

As a matter of course, our approach has some shortcomings that have to be addressed by future research. Our simple indicator matrix used to estimate the distribution of expenditures and revenues across various age groups can be refined or substituted for example by econometric estimates. In addition, we did not take into account feedback effects between the public and the private sector of the economy. One should expect that changes in social security contribution rates affect wage costs and thus repercussions on the labor market and on economic developments and tax revenues to be of some importance. These shortcomings suggest that simulations should be run within the framework of a general equilibrium model. Another issue is the fact that with the exception of our ad-hoc assumption on university attendance, cohort affects are virtually neglected. This means, that our simulations rest upon the assumption of almost identical behavior of present and future generations. However,

modeling cohort behavior is not an easy business and far beyond the scope of the present study but has to be addressed by future research. Despite these shortcoming we believe, that the study contributes to our understanding of the channels by which fiscal effects induced by demographic change work through the highly interrelated budgets of governments in federal systems.

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Tables and Figures

Table 1 Indicator matrix for primary expenditures for Germany

	age group						
Function	0-6	6-18	18-30	30-50	50-65	65-80	80+
General public services/administration	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Defense	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Public order & safety	0.33	0.57	1.00	0.63	0.48	0.40	0.38
Jurisdiction & prison	0.51	0.68	1.00	0.73	0.62	0.56	0.54
Schools	0.00	1.00	0.19	0.00	0.00	0.00	0.00
Kindergarten	1.00	0.08	0.00	0.00	0.00	0.00	0.00
Universities	0.00	0.00	1.00	0.11	0.00	0.00	0.00
All other education	0.00	1.00	1.00	1.00	1.00	0.00	0.00
Research outside universities	0.00	0.00	1.00	1.00	1.00	0.00	0.00
Culture	0.23	0.35	0.55	1.00	0.96	0.76	0.30
Health and environmental protection	0.50	1.00	1.00	1.00	1.00	0.50	0.50
Housing & community amenities	0.50	1.00	1.00	1.00	1.00	0.50	0.20
Agriculture, forestry & fishing	0.00	0.00	1.00	1.00	1.00	0.00	0.00
Fuel & energy & water	0.20	1.00	1.00	1.00	1.00	0.20	0.20
Transportation & communication	0.50	1.00	1.00	1.00	1.00	0.50	0.20
Economic affairs/property administration	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Pensions for retired public servants	0.00	0.00	0.00	0.00	0.17	0.63	1.00
Administration of social welfare	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Transfers to the pension system	0.00	0.00	0.00	0.02	0.25	1.00	0.78
transfers to the social security system	0.00	0.00	1.00	1.00	1.00	0.50	0.20
Social assistance	1.00	0.58	0.43	0.48	0.36	0.27	0.77
Youth welfare	0.20	1.00	0.35	0.00	0.00	0.00	0.00
Support for families and mothers	1.00	1.00	0.00	0.00	0.00	0.00	0.00
Other social welfare	1.00	1.00	1.00	1.00	1.00	1.00	1.00
unconditional transfers to other levels of government	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Other expenditures	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Pension insurance	0.00	0.00	0.00	0.02	0.25	1.00	0.78
Casualty insurance	0.00	0.01	0.17	0.39	0.71	1.00	0.90
Health insurance	0.25	0.17	0.18	0.24	0.38	0.72	1.00
Unemployment insurance	0.00	0.00	0.67	1.00	0.82	0.00	0.00
Long term care insurance	0.00	0.00	0.00	0.01	0.02	0.23	1.00

Source: Own calculations, data sources are provided in the appendix.

Table 2 Indicator matrix for revenues for Germany

	age group						
Category	0-6	6-18	18-30	30-50	50-65	65-80	80+
Income tax (J)	0.00	0.00	0.31	1.00	0.94	0.25	0.21
Corporation tax (J)	0.00	0.00	0.31	1.00	0.94	0.25	0.21
Value-added tax (J)	0.33	0.33	0.82	0.97	1.00	0.93	0.88
Trade tax (J)	0.00	0.00	0.31	1.00	0.93	0.25	0.21
Tax on interest rebate (J)	0.00	0.00	0.24	0.83	1.00	0.96	0.93
Insurance tax (F)	0.00	0.00	0.52	0.95	1.00	0.67	0.57
Tobacco tax (F)	0.00	0.00	1.00	0.87	0.82	0.24	0.00
Coffee tax (F)	0.00	0.00	0.42	0.78	0.96	0.88	1.00
Monopoly on brandy (F)	0.00	0.00	0.45	0.73	1.00	0.83	0.00
Sparkling wine tax (F)	0.00	0.00	0.45	0.73	1.00	0.83	0.00
Petroleum tax (F)	0.09	0.09	0.92	1.00	0.83	0.53	0.31
Solidarity surcharge (F)[1]	0.00	0.00	0.31	1.00	0.94	0.25	0.21
Other federal taxes (F)	0.00	0.00	1.00	1.00	1.00	1.00	1.00
Inheritance tax (S)	0.00	0.00	0.00	0.00	0.21	0.89	1.00
Motor vehicle tax (S)	0.19	0.19	0.82	1.00	0.97	0.85	0.74
Beer tax (S)	0.00	0.00	0.45	0.73	1.00	0.83	0.00
Other state taxes (S)	0.00	0.00	1.00	1.00	1.00	1.00	1.00
Property tax (L)	0.26	0.26	0.32	0.64	1.00	0.85	0.70
Other local tax (L)	0.00	0.00	1.00	1.00	1.00	1.00	1.00
Other duties and taxes	0.00	00.00	1.00	1.00	1.00	1.00	1.00
Other revenue items[2]	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Pension insurance contributions	0.00	0.00	0.52	1.00	0.67	0.00	0.00
Casualty insurance contributions	0.00	0.00	0.46	1.00	0.62	0.00	0.00
Health insurance contributions	0.00	0.00	0.49	1.00	0.80	0.70	0.55
Unemployment insurance contributions	0.00	0.00	0.46	1.00	0.62	0.00	0.00
Long term care insurance contributions	0.00	0.00	0.49	1.00	0.80	0.70	0.55
Note: J=Joint taxes, F= pure federal taxes, S=pure state taxes, L=pure local taxes							

[1] This is a surcharge on income taxes introduced to finance German unification.
[2] User fees etc.
Source: Own calculations, data sources are provided in the appendix.

Table 3 Age structure of the German population (%-share of total population)

Age groups	2006	2010	2020	2030
0-6	5.2%	4.9%	4.9%	4.6%
6-18	12.2%	11.3%	10.1%	10.1%
18-30	14.2%	14.3%	12.8%	11.5%
30-50	30.3%	28.9%	25.2%	25.0%
50-65	18.4%	20.0%	24.0%	20.4%
65-80	15.2%	15.3%	15.7%	20.2%
80+	4.6%	5.2%	7.3%	8.0%
labor force[1]	62.9%	63.3%	62.0%	56.9%
age group 6-28	24.1%	23.2%	20.5%	19.5%
age dependency ratio[2]	19.8%	20.5%	23.0%	28.3%
total dependency ratio[3]	37.1%	36.7%	38.0%	43.1%
total population in 1.000	82.299	81.962	80.692	78.480

[1] age group 18-65 years [2] age group 65+ [3] age group 0-18 years and 65+

Source: Calculated from the 11th population forecast of the Federal Statistical Office (2007). Calculations are basing on the average of variant 1-W1 and 1-W2.

Table 4 Flow of transfers between the levels of government in Germany in 2004[1]

Transfers paid in % of total expenditures of the grantor government level

grantor ↓	transfer paid in % of total expenditures	recipient government level			
		federal	state	local gov.	social security
federal gov. thereof: - transfers to East German states	45.2%	0.0%	12.6% 3.8%	0.3%	32.3%
state gov.	24.4%	1.2%	2.9%	20.1%	0.2%
local gov.	1.0%	0.1%	2.8%	0.0%	0.1%
social security system	0.0%	0%	0%	0%	0%

Transfers received in % of total expenditures of the recipient government level

recipient government level ↓	transfers received in % of total expenditures	grantor government level			
		federal	state	local gov.	social security
federal gov.	0.9%	0.0%	0.9%	0.0%	0.0%
state government thereof: - transfers to East German states	18.8%	14.2% 4.1%	2.9%	1.6%	0.1%
local gov.	32.1%	0.5%	31.6%	0.0%	0.5%
social security system	18.9%	18.9%	0.0%	0.0%	0.0%

[1] Expenditures are measured in terms of gross rather than net expenditures.

Source: Calculated from data supplied by the Federal Statistical Office.

Table 5: Outline of the policy assumptions

Assumption	short description
1. Increase of the VAT rate on January. 1st. 2007	λ_r for VAT is set to 1.1875 at the federal level and 1.125 at the state and local government level as from 2007.
2. Increase in student enrollment in universities	In the function "Universities" and "Research" the λ_e is linearly increased from 1 to 1.2 in 2015.
3. Changing ratio of retired public sector servants and the elderly 65+	In the function "Pensions for retired public servants" the adjustment parameter λ_e is changed to take into account the changing number of retired public servants in relation to the elderly. 65+. Up to the year 2030 at the federal level λ_e decreases to 0.77 and at the state level λ_e increases to 1.39. At the local government level no change is assumed.
4. Economic recovery and decline in welfare expenditures	Due to the currently observed recovery of the German economy we assume a decrease in welfare spending - especially social assistance expenditures - reducing λ_e in this function from 1.0 in 2007 to 0.9 in 2019.
5. Improving the provision of kindergarten services for children below the age of 3	i) In the period 2008 - 2013 the federal government provides investment grants for kindergarten infrastructure investment of 360 mill. Euro per year. Additional net investment expenditures arise also at the state (335 mill. Euro p.a.) and local government level (133 mill. Euro p.a.). These expenditures are assigned to the age group 0-6. ii) The federal government supports the increase in kindergarten service provision by redistributing tax revenues to the state government sector. This amount increases to 770 mill. Euro up to the year 2014 and will be kept at this amount in the following year. Symmetrically revenues of the state government sector as well as expenditures are adjusted by the same amount. iii) Net expenditures on kindergarten services at the state level increase to about 2.6 bn. Euo in the year 2014 and slightly decrease in the following years. These expenditures are assigned to the age group 0-6.
6. Transfer payments to East German states	i) The federal government reduces the volume of transfers to support infrastructure investment in East Germany as set out in a federal law in 2002 (a reduction of 12.6 bn Euro up to 2019). ii) Due to the cut of transfers from the EU to the East German states. there is a reduction of both revenues and expenditures by about 1.2 bn. Euro up to 2019. iii) Per capita tax revenues of local governments in East Germany in relation to West Germany increase by about 25% up to 2030. This implies that λ_r for local tax revenues in Germany increase from 1 to about 1.039 up to the year 2030.
7. Interest rate increase	The real interest rate on government debt is linearly increased by 1 % up to the year 2015.
8. Reduced pension benefits and increase of the retirement age	i) In the function "Pension insurance" the parameter λ_e is reduced from 1 to 0.85 in the year 2030. ii) The increase of the retirement age reduces the number of pension recipients in the age group 65-80 which is taken into account by reducing the parameter λ_e in the function "Pension insurance" for the age group 65-80 from 1 to 0.84 in the year 2030. iii) Increasing the retirement age corresponds to an increase in social security contributions of the relevant age group which we achieve by introducing an adjustment parameter on the revenue side of all social security systems. The same procedure is applied to income tax revenues.
9. Effects of a reduced unemployment rate	i) A strong and sustainable reduction of the unemployment rate is assumed which lowers expenditures of the unemployment insurance. The corresponding λ_r-parameter is reduced to 0.35 up to 2030. ii) The decrease in the unemployment rate results in higher income tax revenues which we take into account by adjusting the corresponding λ_r-parameter to 1.12 for the age group 18-65 up to the year 2030. Similarly we take into account the increase in social security contributions. iii) On Jan. 1st 2007 the contribution rate to the unemployment insurance has been reduced from 6.5% to 4.2%.
10. Health insurance	i) Health expenditures increase by 1% above the GDP inflation rate. ii) The increased longevity is taken into account by a flattening of the age cost profile which is achieved by introducing an adjustment factor for the age group 80+ which decreases from 1 in 2004 to 0.9 in 2030.
11. Long-term care insurance	Assumption 10 ii) is also applied to long-term care insurance.

Table 6: Decomposition of net revenue and net primary expenditure growth by level of government level in Germany in the period 2007 – 2030

	social sec.	federal gov.	state gov.	local gov.
net revenue growth				
total	8.0%	-3.0%	0.0%	-2.3%
- induced by demographics	-10.0%	-6.0%	-4.3%	-5.4%
- policy induced	13.8%	3.0%	4.2%	3.1%
- adjustment to achieve sustainability	4.3%	- [1]	- [1]	- [1]
net primary expenditure growth				
Total	8.0%	-10.3%	-4.1%	4.1%
- induced by demographics	16.2%	5.6%	-6.9%	-9.1%
- policy induced	-8.2%	-14.6%	2.6%	-3.1%
- residual expenditure growth	- [1]	-1.3%	0.2%	16.3%

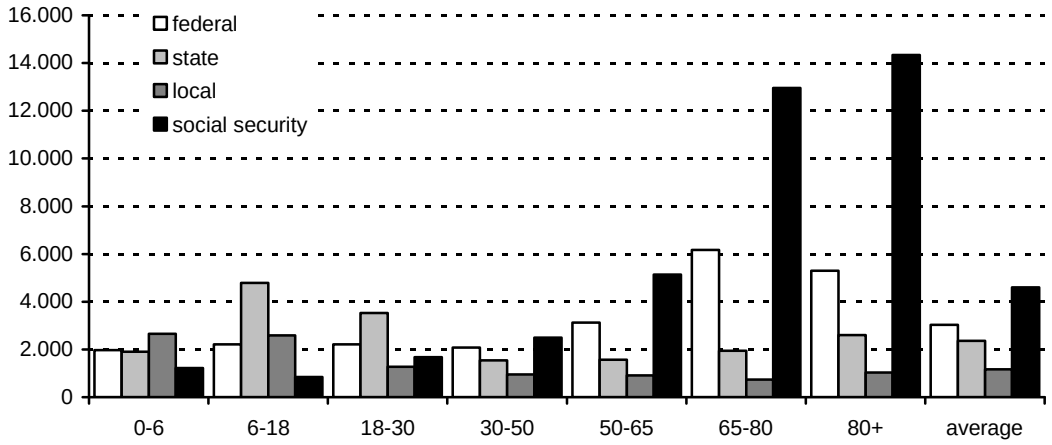
[1] Zero by assumption.
Source: Calculations by the authors.

Table 7 Distribution of sustainable net primary expenditures across levels of government in Germany[1]

	federal government	state government	local government
2007	46.0%	36.3%	17.7%
2010	44.3%	36.2%	19.5%
2020	43.7%	36.5%	19.7%
2030	43.4%	36.9%	19.7%

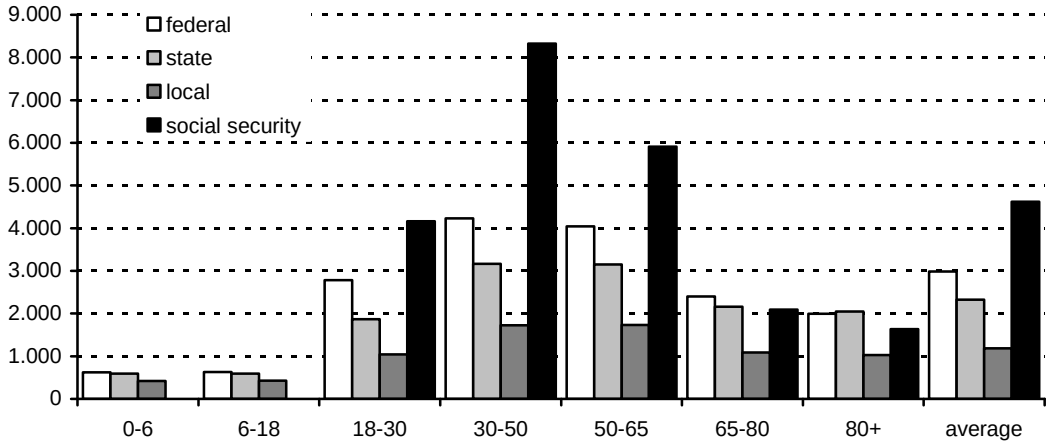
[1] Without taking into account the social security system.
Source: Calculations by the authors.

Figure 1 Age cost profiles for Germany in 2004 by level of government (Euro per capita)[1]



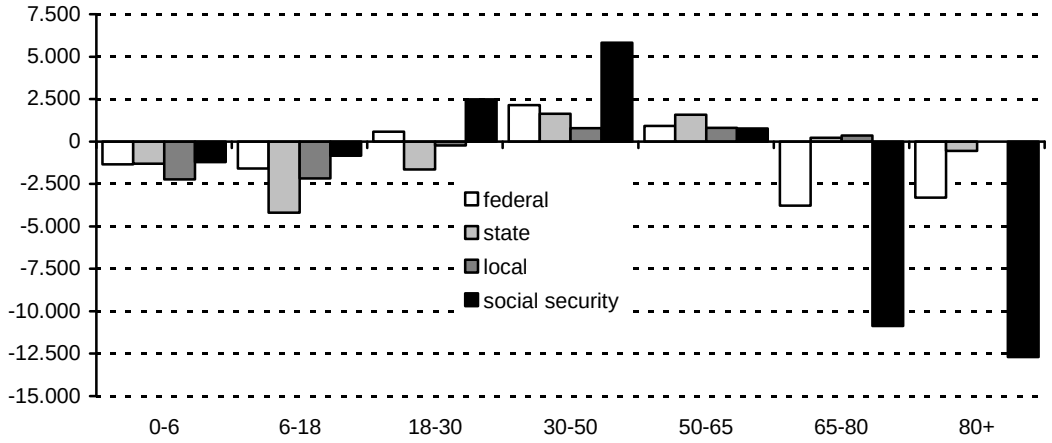
[1] Only primary expenditures are taken into account. Source: Calculations based upon data provided by the Federal Statistical Office, Wiesbaden, Germany.

Figure 2 Age revenue profile for Germany in 2004 by level of government (Euro per capita)



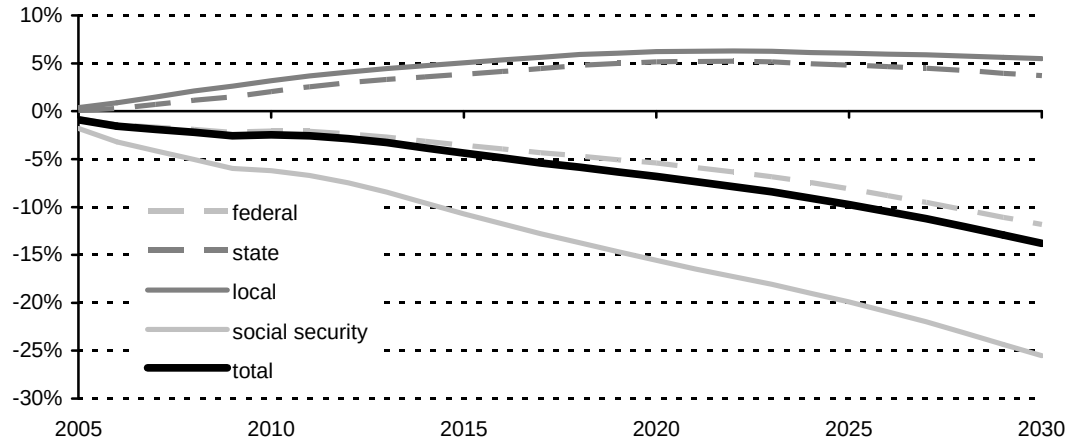
Source: Calculations based upon data provided by the Federal Statistical Office, Wiesbaden, Germany.

Figure 3 Net burden by age groups and by level of government 2004 (Euro per capita)[1]



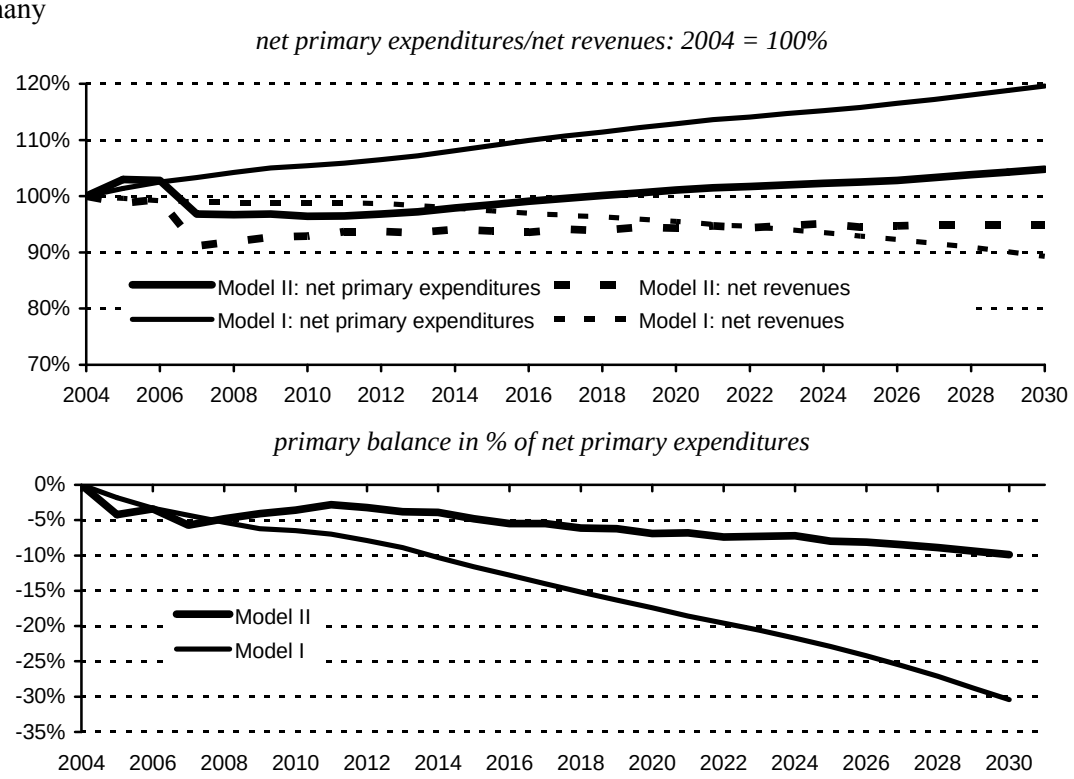
[1] Since only primary expenditures are taken into account. net burden has to be interpreted as the per capita primary balance. Source: Calculations based upon data provided by the Federal Statistical Office, Wiesbaden.,Germany.

Figure 4 Fiscal deficit and surplus induced by pure demographic change by level of government in % of net primary expenditures



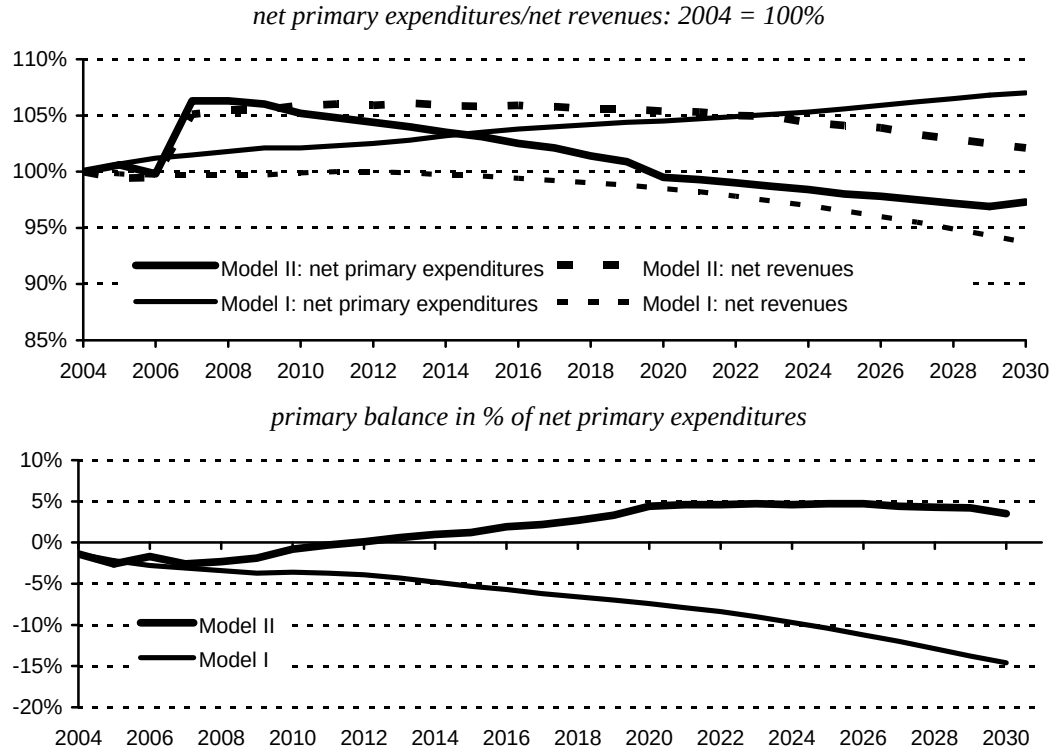
Source: Calculations by the authors.

Figure 5 Expenditure and revenue growth as well as primary balance of the social security system in Germany



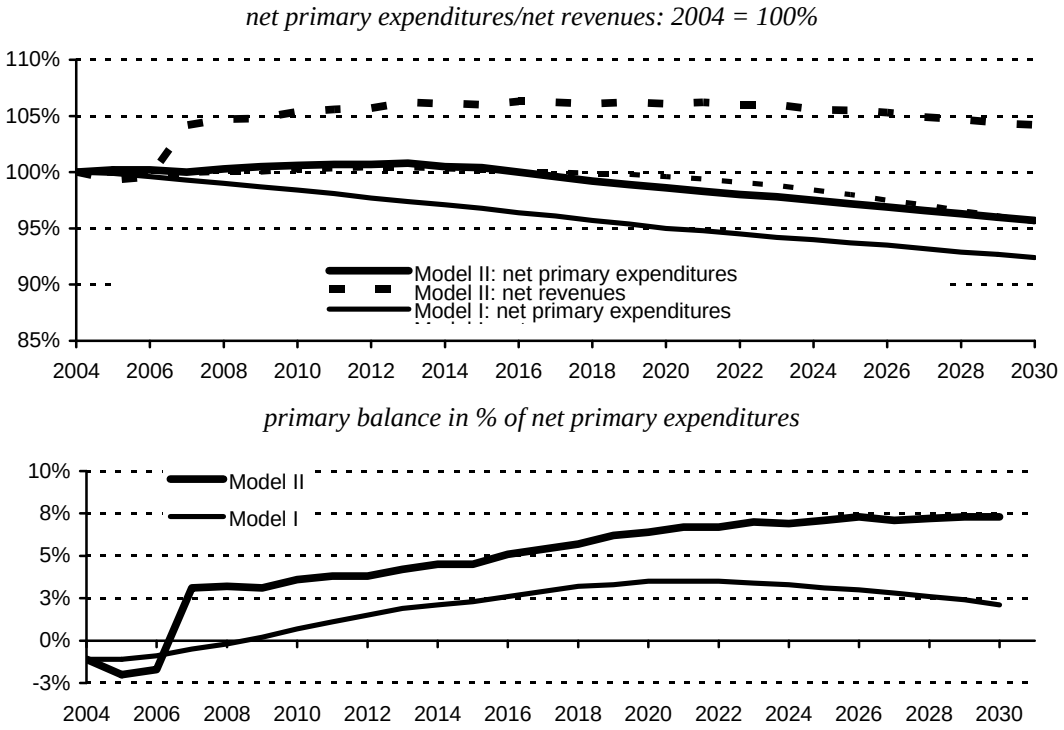
Source: Calculations by the authors.

Figure 6 Net primary expenditures and net revenues as well as primary balance in % of total net primary expenditures at the federal government level



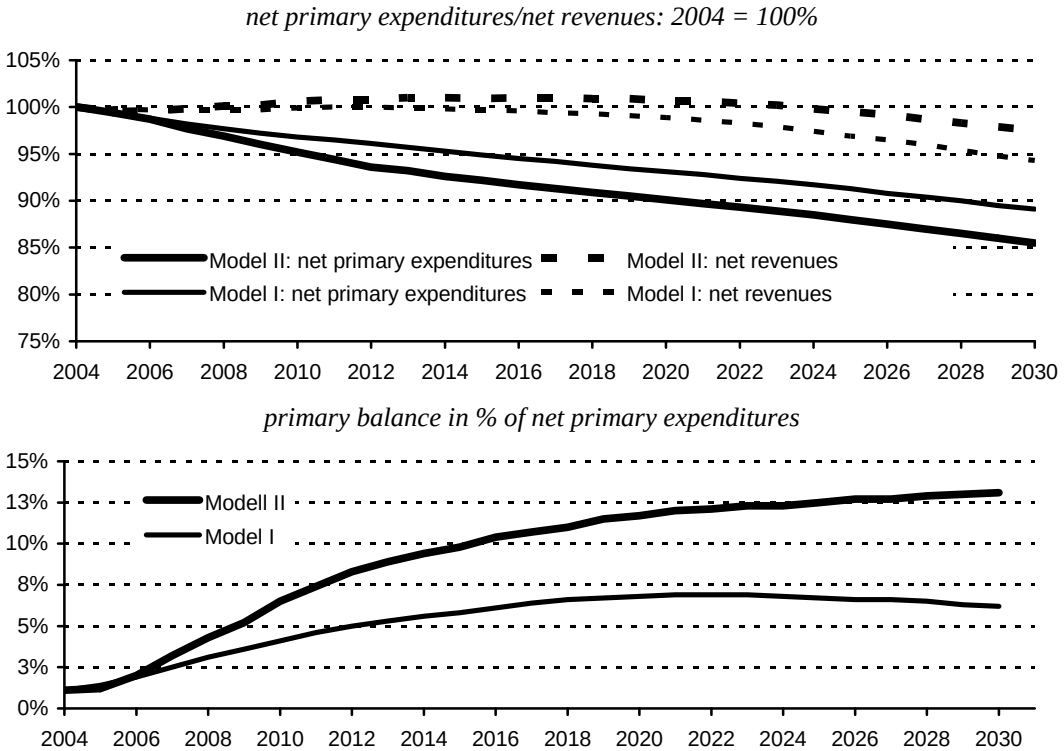
Source: Calculations by the authors.

Figure 7 Net primary expenditures and net revenues as well as primary balance at the state government level



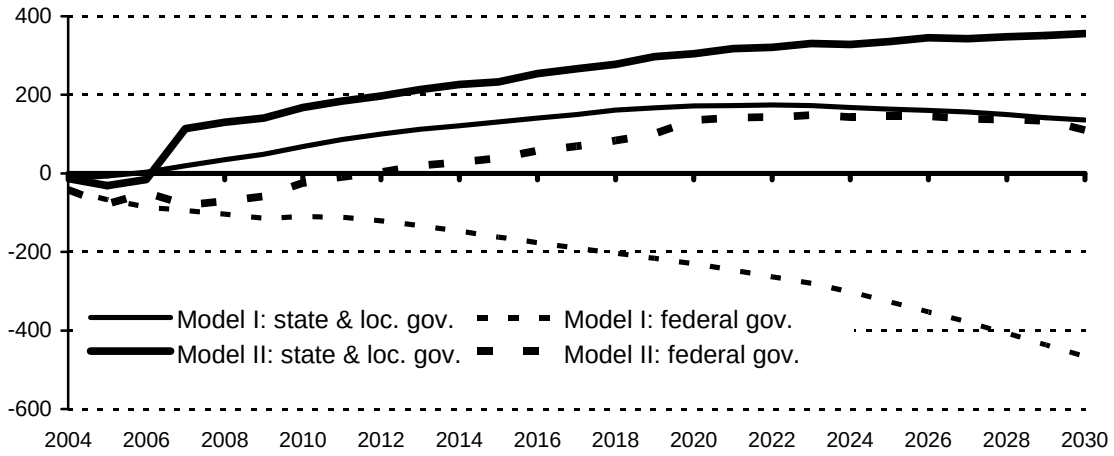
Source: Calculations by the authors.

Figure 8 Net primary expenditures and net revenues as well as primary balance at the local government level



Source: Calculations by the authors.

Figure 9 Primary balance of the federal government and subnational government sector in Germany in Euro per capita



Source: Calculations by the authors.

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