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# Generational Accounts in the Czech Republic

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## 1. Introduction

People pay taxes and receive benefits according to their position in the life-cycle. If we divide society into three age groups (young, middle-aged, elderly), then only the middle-aged pay more to the public budgets than they receive. On the contrary, the young and elderly contribute to public budgets to a very limited extent. Thus, a representative agent of a certain age is either a net contributor or a net beneficiary. Based on these arguments, it follows that the size and structure of population decisively affects the balance of public budgets.

Indeed, the government does not have to pay all of its expenditure immediately using only tax revenues and privatization receipts. In the case that the government's expenditures exceed its revenues, the government takes out a loan or issues bonds. Still, these obligations will have to be repaid one day. From the generational point of view, this means that the use of the alternative ways of financing results in shifts of the financial burden from current to future generations, i.e. intergenerational redistribution takes place. Thus, the actual fiscal policy affects the net wealth of not only presently living generations but also of generations not yet born.

Unfortunately, neither commonly used public budget deficits nor public debt records any intergenerational shifts or the way in which current fiscal policy influences net wealth of a representative current and future agent. One of the tools which can be used to assess an intergenerational balance or imbalance is generational accounting. This approach reflects long-term implications of current fiscal policy arrangements for intergenerational redistribution and fiscal sustainability when taking into account expected demographic development. This methodology was developed by Auerbach, Gokhale and Kotlikoff in 1991. The main issue was to quantify the impact of a government policy on the net wealth of current as well as future generations.

We would like to stress that generational accounting is not a generational equilibrium model-based approach, but only an indicator based on a trend projection. On the contrary, this projection is elaborate, introduces some economic theory and expected demographic development. The goal is to com-

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pare the present value of the growth-adjusted lifetime burden, faced by a representative current and future agent, under the condition that the intertemporal budget constraint holds. Alternatively, it is possible to calculate the total amount of the government's liabilities stemming from the current fiscal-policy proceeds indefinitely. Moreover, alternative scenarios could help to identify potential ways of improving intergenerational imbalance.

The purpose of this paper is to assess the sustainability of the present fiscal policy in the case of the Czech Republic using generational accounting methodology.<sup>1</sup> In what follows, Sections 2, 3 and 4 review the standard methodological framework of generational accounting. Section 2 discusses the theoretical framework of generational accounting. Section 3 specifies the variables and the parameters necessary to calculate generational accounts of the current generations. Section 4 presents two main methods of assessing fiscal sustainability. In Sections 5, 6 and 7 applied data and empirical results are presented.

## 2. Intertemporal Public Budget Constraint

The government intertemporal budget constraint says that the present value of current and future government revenues has to be equal to the sum of the present value of current and future government purchases and the level of net debt. Put formally, the government intertemporal budget constraint is stated as follows:

$$\sum_{k=t-L}^t N_{t,k} + \sum_{k=t+1}^{\infty} N_{t,k} = \sum_{y=t}^{\infty} G_{t,y} + D_t \quad (1)$$

where  $G_{t,y}$  stands for the present value of year  $y$  net public purchases in period  $t$  (base year).<sup>2</sup>  $G_{t,y}$  is calculated as the present value of the difference between public expenditures and revenues not affected by size of the population.  $D_t$  is defined as a public debt in year  $t$  less the present value of expected privatization revenues.<sup>3</sup> Finally,  $N_{t,k}$  denotes the present value of net taxes, which will be paid throughout the lifecycle by agents born in year  $k$ .<sup>4</sup> It is obvious that the first item on the left-hand side corresponds to the sum of the present values of all net taxes paid by currently living agents from now to the end of their lives. The second item on the left-hand side tallies with the cumulative present value of lifetime net taxes of agents not yet born.

<sup>1</sup> An overview of the application of generational accounting in different countries is provided by Auerbach, Kotlikoff and Leibfritz (1998).

<sup>2</sup> All fiscal data ( $G_{t,y}$ ,  $D_t$  and total  $N_{t,k}$ ) come from GFS in 2004 (consolidated public budgets). For details see *Appendix 1*.

<sup>3</sup> Sometimes government net wealth  $W_t$  is used instead of net public debt with the opposite sign. Because of the lack of data on government net wealth in the Czech Republic we prefer the variable  $D_t$ . The arguments can be found in the Section 5.4.

<sup>4</sup> The symbolism is similar to (Bonin, 1997). Another, probably widely used specification comes from Auerbach, Kotlikoff and Liebfritz (1998).

### 3. Specifications and the Projections of Variables and Parameters

#### 3.1 Lifetime Net Taxes of Current Generations

In the great majority of applied studies, generational accounts are constructed as a forward-looking indicator. This means that we reflect only the current and expected development of population size and its structure. It follows that the total net taxes of currently living generations in present terms do not take into account the development of taxes and transfers before the base year.<sup>5</sup>

The current generations are defined as all agents who live in the present. Let  $t$  be the base year and  $L$  be the maximal lifespan, then current agents were born between  $t - L$  and  $t$ . Thus, the present value of all net taxes paid by currently living agents is quantified over the period from  $t$  to  $t + L$ , i.e. until the youngest agent (born in the base year  $t$ ) from the current generations die. The first term on the left-hand side in (1) can be expressed as:

$$\sum_{k=t-L}^t N_{t,k} = \sum_{k=t-L}^t \sum_{i=t}^{k+L} t_{i,k} + P_{i,k} (1+r)^{t-i} \quad (2)$$

where  $P_{i,k}$  is the number of people born in  $k$  and still living in  $i$ . Next,  $t_{i,k}$  represents the absolute level of the net taxes paid in period  $i$  by a representative agent born in  $k$ . The discount rate  $r$  converts future net taxes to the base year.

The base-year age-specific per capita taxes and transfers  $t_{i,k}^l$  of type  $l$  are projected by applying the time invariant growth rate  $g$ .<sup>6</sup> It is usually assumed, for projection purposes, that growth rate  $g$  should reflect labor productivity growth, i.e. age- and gender-adjusted per capita taxes and transfers grow at the rate of labor productivity. Thus, applying constant  $g$  does not alter the shape of the particular average absolute tax and transfer age profiles. It follows that the share of the corresponding items in the income of a representative agent of the same age and gender is constant over time.<sup>7</sup> The  $t_{i,k}^l$  can be calculated for different  $k$  in each year  $i$  using the formula (3).

$$t_{i+j,k}^l = (1+g)^j t_{i,k-j}^l \quad (3)$$

where  $t_{i,k}^l$  expresses the average tax or transfer of type  $l$  of the representative agent born in  $k$  in year  $i$ .<sup>8</sup> In the case that  $t_{i,k}^l$  is positive (negative) then the item represents a tax (transfer) paid (obtained). Finally, aggregating all the taxes and transfers of type  $l$ , we get the absolute net taxes of a representative agent born in  $k$  in year  $i$ , i.e.  $t_{i,k}$ .<sup>9</sup>

<sup>5</sup> Gokhale and Page (1997) calculated total net taxes of all current generations taking into account demography together with taxes and benefits also before the base year.

<sup>6</sup> Identically to the case of  $r$  we presume  $g$  to be constant over the whole period, but alternative scenarios are presented in Section 6.

<sup>7</sup> Introducing this assumption seems to be the standard approach to generational accounts. Conversely, reflecting potential changes in age-specific profiles as a result of population's ageing could make projections more reliable.

<sup>8</sup> Section 5 provides a detailed description of different types of taxes and transfers. Data used for estimation purposes are described as well. In addition, Appendix 2 presents graphs of different  $t^l$ .

$$t_{i,k} = \sum_l t_{i,k}^l \quad (4)$$

It is worth noting that neither in the residual approach nor in the sustainability approach<sup>10</sup> is the total present value of the net taxes of the current generations restricted.

### 3.2 Generational Accounts of Current Generations

The length of the remaining lifespan ( $k + L - t$ ) of currently living agents varies in the base year because of different  $k$ . Thus, the present value of the remaining lifetime net taxes of the currently living generation born in  $k$ , defined as  $N_{t,k}$ , are not directly comparable among themselves. But it is possible to compare the net taxes in the present value terms of a representative agent of age  $i - k$  in the base year  $t$ . Finally, we define a year  $t$  account of the generation born in  $k$  as the present value of taxes paid reduced by the present value of transfers obtained throughout the remaining lifespan divided by the number of agents in the base year  $t$ . Generational accounts for different  $k$  are calculated according to the formula (5) and labeled as  $GA_{t,k}^{CUR}$ .

$$GA_{t,k}^{CUR} = \frac{\sum_{i=t}^{k+L} t_{i,k} P_{i,k} (1+r)^{t-i}}{P_{t,k}} \quad (5)$$

Using equation (2) we can present the generational account equivalently as shown in formula (6). Put differently, the generational account stands for the present value net taxes of a representative agent born in  $k$  and still living in  $t$ .

$$GA_{t,k}^{CUR} = \frac{N_{t,k}}{P_{t,k}} \quad (6)$$

### 3.3 Government Purchases

It has to be pointed out, that  $G_{t,y}$  has a different meaning than the government consumption in national accounts. According to generational accounts methodology  $G_{t,y}$  is composed of revenues and expenditures whose size does not depend on the size of living population. The projection method of government purchases is similar to the one discussed before in relation to the projection of age-specific tax and transfer profiles.

## 4. Intergenerational Imbalance and Fiscal Sustainability Appraisal

The theoretical concept of generational accounting is widely accepted. To assess the intergenerational imbalance (sustainability of public finances),

<sup>9</sup> Taxes are treated in positive terms, whereas transfers are treated in negative terms.

<sup>10</sup> Both the residual as well as the sustainability approach are discussed in detail in Section 4.

different indicators based on the generational accounting methodology can be constructed. In the following parts two major approaches will be discussed, the residual and the sustainability approaches. But alternative ways can be also applied.<sup>11</sup>

#### 4.1 The Residual Approach and Generational Accounts of Future Generations

In the residual approach we assume that the government is not willing to change the current setting of the system for the time being. As a result, all necessary changes to attain fiscal sustainability will be faced by future generations.

The residual approach proceeds in the following steps: First, the total present value of the net taxes of all currently living agents is calculated applying no constraint on its value, using formula (2). Second, the present value of expected net public debt and net public purchases is calculated. Finally, the intertemporal budget constraint is applied to calculate the sum of the present value of the net taxes of future agents. Since the intertemporal budget constraint must hold, the sum of the present value of the net taxes of all future generations is calculated as a residual, as presented in equation (7).

$$\sum_{k=t+1}^{\infty} N_{t,k} = \sum_{y=t}^{\infty} G_{t,y} + D_t - \sum_{k=t-L}^t N_{t,k} \quad (7)$$

Usually generational accounts of future agents are assumed to be equal except for a productivity growth adjustment.<sup>12</sup> Taking into account these assumptions, the generational account of the representative future agent is calculated as follows:

$$\sum_{k=t+1}^{\infty} N_{t,k} = \sum_{k=t+1}^{\infty} P_{k,k} GA_{k,k}^{FUT} \left( \frac{(1+g)}{(1+r)} \right)^{k-t} \quad (8)$$

Because generational accounts of both generations ( $GA_{t,t}^{CUR}$ ,  $GA_{k,k}^{FUT}$ ) reflect expected lifetime growth-adjusted net tax payments of a representative agent discounted to the base year, they are directly comparable.

In the residual approach, the condition for examining the sustainability of a particular fiscal policy is based on the comparison of growth-adjusted net taxes of the current and future representative agents. It follows that a different treatment of current and future generations from the point of view of the net taxes of a representative agent is a criterion for deciding about the size and direction of the intergenerational redistribution. In other words, comparing the value of  $GA_{t,t}^{CUR}$  and  $GA_{k,k}^{FUT}$  reflects intergenerational shifts necessary to sustain public budgets. This means that when applying the residual approach a fiscal strategy which differently affects current and future agents ( $GA_{t,t}^{CUR} \neq GA_{k,k}^{FUT}$ ), is called intergenerationally imbalanced.

<sup>11</sup> For example Cardarelli, Sefton and Kotlikoff (1999) consider a necessary change in government purchases or a change in the specific net tax rate to close the sustainability gap as an alternative indicator of intergenerational imbalance/fiscal sustainability.

<sup>12</sup> Unfortunately, introducing the above assumptions, the residual approach does not enable us to express anything about the redistribution within the future generations.

Because intergenerational shifts are necessary to assure validity of the intertemporal budget constraint, such a fiscal policy is also deemed unsustainable. Looking at the problem from the other perspective, we see that a sustainable fiscal policy will not lead to any intergenerational redistribution and  $GA_{t,t}^{CUR} = GA_{k,k}^{FUT}$ .

## 4.2 The Sustainability Approach

The sustainability approach looks at current and future generations in the same manner. This means that the total lifetime net taxes of current as well as future generations are constructed using the same procedure, i.e. using formula (2) and its modification for future generations. Consequently, the total lifetime net taxes of all generations are constructed without applying the intertemporal budget constraint.

The items of the budget constraint in formula (10) are constructed in the same way as in the residual approach except for the sum of the total present value of net taxes of future generations. The criterion of the fiscal sustainability is the “sustainability gap”.<sup>13</sup> This is defined as the total amount of the government liabilities resulting from the current fiscal policy pursued indefinitely, i.e. the imbalance in the intertemporal budget constraint. Alternatively, the sustainability gap equals the total present value of insufficient public revenues, which is required to fulfill the intertemporal public budget constraint. On the one hand, if the sustainability gap is positive, the present value of all potential public expenditures exceeds the present value of all public revenues. On the other hand, a negative sustainability gap indicates the government’s intertemporal surplus and the option for reducing net taxes.

$$SG_t = \sum_{y=t}^{\infty} G_{t,y} - \sum_{k=t-L}^t N_{t,k} - \sum_{k=t+1}^{\infty} N_{t,k} + D_t \quad (10)$$

where  $N_{t,k}$  indicates the total present value of the net taxes of future agents proceeding the actual fiscal policy indefinitely. Because the sustainability approach does not distinguish between current and future generations, we can simulate the impact of a tax or a transfer on both living as well as future generations. But at the same time, compared to the residual approach, we know nothing about intergenerational redistribution.

Since the absolute present value of the sustainability gap is hard to interpret, it is recommended to relate the sustainability gap to GDP. Such a ratio can be used for an international comparison. As well as in the previous approach the final result should not be used as the public indebtedness forecast.

## 5. General Data Description

Creating generational accounts for the Czech Republic, we follow the standard procedure. The empirical evaluation of the intertemporal bud-

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<sup>13</sup> It is possible to find other names for this indicator, for example Cardarelli, Sefton and Kotlikoff (1999) call it “intertemporal budget gap”.

get constraint requires projections of population, taxes, transfers, government purchases and the initial value of net public debt. At the same time the value of the parameters  $g$  and  $r$  has to be set. We start with 2004 data. The main sources of data used are the FoS UK (Faculty of Science of the Charles University, Prague) population projection, the CSO (Czech Statistical Office) household budget survey and MF (Ministry of Finance) government financial statistics.

## 5.1 Demography

Generational accounting is based on a long-term population projection by Burcin and Kučera (2004). Because generational accounts ( $GA_{t,k}^{CUR}$  as well as  $GA_{t,k}^{FUT}$ ) are defined as per capita net taxes in present terms, the value is influenced by the size of the generation. Since the size of future generations is expected to fall in the coming decades, the total amount of net taxes  $N_{t,k}$  is divided by a smaller number  $P_{k,k}$ . In other words, this means that the accumulated public debt will have to be financed by a smaller number of people. In addition, the structure of the population critically influences the absolute amount of net taxes.

## 5.2 Age Specific Revenues and Expenditures<sup>14</sup>

The main part of revenue and expenditure age profiles was taken from the Household Budget Survey of 2002. In our particular case we constructed age-specific profiles using only data from 2002. The raw data are rather erratic though an apparent age-specific profile can be recognized. Following generational accounting literature and trying to make our analysis and graphs more tractable, we filtered all data using the HP filter. After that the relative age profiles were calculated and recalculated to fit the actual budget data.

There is uncertainty about future productivity growth and the discount rate. Moreover it is hard to choose specific values for  $r$  and  $g$ . Therefore, we introduced a set of both parameters into our empirical analysis. The value of  $r$  is influenced by the government revenues and expenditure risk which is hard to judge from the current perspective.<sup>15</sup> In the case of labor-productivity growth we took into account mainly long-term factors and the convergence of the Czech economy with the EU average. We have calculated generational accounts for current as well as future generations and the sustainability gap using variants  $g$  (0.01, 0.02, 0.03) and  $r$  (0.03, 0.05, 0.07).

### 5.2.1 Revenues

For the empirical evaluation of the generational accounts, gathering the age-specific profiles of taxes and transfers of both genders is necessary.

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<sup>14</sup> Bonin (1997) shows that using term “Age-specific” and “Non-age specific” could be misleading. We notify the argument, but continue using it, because of its broad utilization.

<sup>15</sup> Lau (2000) applied varying discount rate according to age for different agents.

Taxes and transfers are broken down into several categories. First, public revenue and expenditure items, whose size depends on the number and age of people, have to be identified. In the case of the Czech Republic the following revenue items have been chosen: Value Added Tax (VAT) (19.3 %)<sup>16</sup>, Excises (E) (9 %), Personal Income Tax (PIT) (12.6 %), Social Security Contributions (SSC) (36.6 %), Inheritance Tax (IT) (1.4 %), Corporate Income Tax (CIT) (11.3 %) and Other Age-Specific Revenues (OR) (3.7 %). Second, all public-budget revenue items are assigned to individual age groups on the basis of the Household Budget Survey of 2002. The only exception is the Corporate Income Tax, which is treated like a tax on labor income (Personal Income Tax), i.e. relative age profiles of both personal as well as corporate income taxes are identical.<sup>17,18</sup>

### 5.2.2 Expenditures

We found the following expenditure items to be age specific: Old-Age Pensions (P) (19.9 %), Disability Pensions (DP) (4.2 %)<sup>19</sup>, Unemployment Benefits (UB) (3.4 %), Education Expenditures (EE) (10 %), Health Expenditures (HE) (15.1 %), Sickness Benefits (SB) (2.1 %), Other Social Expenditures (OSE) (5.8 %) and Other Age-Specific Expenditures (OE) (31.2 %).

Data concerning all forms of pension benefits come from the Czech Social Security Administration database. The information concerning Education Expenditures was provided by the Ministry of Education, Youth and Sports. The General Health Insurance Company provided the health care data. As in the case of revenue, the remaining age-specific expenditure profiles were obtained from the Household Budget Survey of 2002.

Our study shows that the most important part of age-specific expenditures is comprised of other age-specific expenditures, i.e. with flat age profile. This could appear unsatisfactory at the first sight, but we have to bear in mind that this item is a sum of expenditures on General Public Services, Defense, Housing, Public Order and Safety. In our view it is impossible to quantify which age group uses more/less of these public expenditures. So, for example, we assume that the level of expenditures on defense depends on the size of population, but not on its age structure.

### 5.3 Government Purchases

Government purchases were quantified as a balance of non-age-specific expenditures and non-age-specific revenues. The ratio of non-age-specific revenues (expenditures) to total revenues (expenditures) is about 6.0 %

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<sup>16</sup> The number indicates the percentage of the total revenue.

<sup>17</sup> See (Cardarelli – Sefton – Kotlikoff, 1999) for details.

<sup>18</sup> The idea behind this argument states that the burden of corporate income tax is finally carried mainly by employees, next by consumers or share-holders. Some working papers elaborate on a Corporate Income Tax more sophisticatedly. See for example (Auerbach – Chang, 2003).

<sup>19</sup> Other forms of pension benefits (survivor's pensions) were assigned to old-age.



(12.9 %).<sup>20</sup> The absolute amount of  $G_t$  reaches CZK 86 billion in 2004, i.e. the value of non-age-specific expenditures exceeds the value of non-age-specific revenues by CZK 86 billion in 2004. We detected the following non-age-specific revenue items: Property Income (2.5 %), Capital Revenue (1.1 %), Grants (2.4 %). The following expenditures were assessed so as not to be dependent on the number of people and their age: Fuel and Energy (0.2 %), Agriculture and Forestry (2.5 %), Mining and Mineral Resources (0.2 %) and Transport and Communications (10.0 %).

#### 5.4 Public Net Wealth and Net Debt

Net wealth is defined as a part of assets financed entirely by own resources. In other words, it is a potential source of privatization revenues. In fact, it is difficult to determine the actual market price of public assets.<sup>21</sup>

In the case of the Czech Republic the most important government assets are non-financial assets. These comprise fixed assets such as roads, public buildings, land and so forth. Unfortunately, the size and value of this public property has not been precisely specified in the Czech Republic yet.<sup>22</sup> The key issue is whether and to what extent these fixed assets could be sold to obtain the lacking revenues. In addition, it is hard to imagine that the government would sell all of its assets.<sup>23</sup>

In our view, government net wealth according to the national accounts overestimates the value of property which can actually be privatized. As a result, we define  $D_t$  as the gross public debt less the actual privatization revenues and the expected present value of future privatization revenues for the next few years.<sup>24</sup>

### 6. Results

The analysis covers the entire public sector during the period from 2004 to 2150. Because of the differences between the sexes we calculated the generational accounts separately for males and females.

Following the structure of the theoretical part, the generational accounts of the currently living agents were computed at the beginning. Consequently, they were applied when the residual as well as the sustainability approaches were followed. *Tables 1* and *2* show the present value of the remaining lifetime taxes and transfers of a representative agent when labor

<sup>20</sup> For details see Appendix 2 – General Government Operations, 2004.

<sup>21</sup> As an alternative, some authors try to estimate the market value of public net wealth as the sum of the present value of the financial flows from public assets.

<sup>22</sup> Public finances have been growing in deficit since 1995. Regardless of this unfavorable development the net public wealth is rising continually according to the CSO. The government's wealth is not rising because of prudent government financial policy, but due to the evolving accounting procedures at the CSO with respect to the recording public assets.

<sup>23</sup> To overcome this problem some authors estimate the value of the government's wealth that can be privatized. See for example (Gál – Simonovits – Szabó – Tarcali, 2000).

<sup>24</sup> The estimates of current and future privatization revenues come from the government's document *Projection of Revenues and Expenditure in 2006*. The document offers a rough estimate of privatization revenues in 2006 and 2007.

TABLE 1 Generational Accounts and Their Components for Females (2004) (CZK thousand)

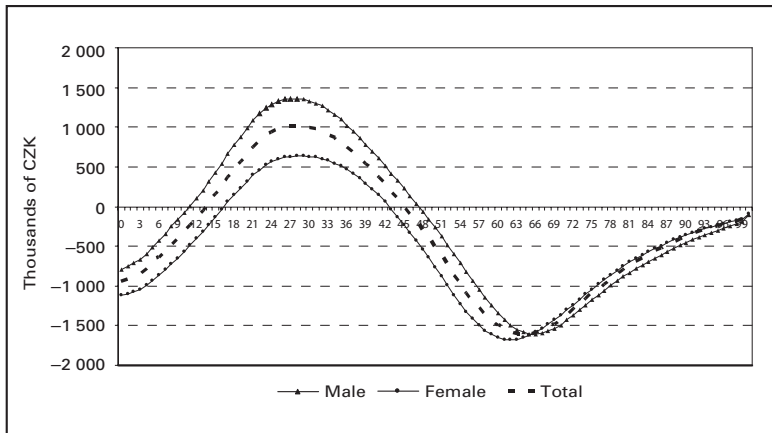
Age	VAT	E	PIT	SSC	IT	CIT	OR	P	DP	SB	UB	OSE	EE	HE	OE	GA 2004
0	599	243	260	769	37	234	136	-368	-77	-62	-108	-260	-739	-483	-1298	-1117
5	660	281	301	891	42	271	135	-427	-89	-71	-125	-259	-760	-498	-1286	-933
10	690	304	326	963	46	293	127	-450	-95	-77	-136	-252	-591	-498	-1219	-571
15	720	333	356	1054	49	320	121	-478	-104	-85	-151	-242	-363	-506	-1155	-130
20	751	364	403	1196	54	362	118	-535	-117	-93	-159	-230	-134	-531	-1127	321
25	720	356	428	1275	54	384	111	-577	-125	-88	-140	-207	0	-530	-1059	602
30	673	339	438	1308	53	394	104	-640	-134	-75	-117	-182	0	-533	-997	631
35	640	329	440	1303	54	395	101	-751	-148	-66	-99	-156	0	-564	-970	508
40	583	308	403	1167	54	362	95	-846	-156	-58	-80	-118	0	-578	-912	224
45	529	282	337	940	53	303	89	-967	-157	-50	-60	-79	0	-591	-856	-227
50	459	240	245	656	49	220	81	-1085	-142	-36	-37	-51	0	-580	-779	-758
55	384	193	143	365	43	128	73	-1213	-115	-20	-13	-37	0	-559	-701	-1329
60	309	152	55	127	37	49	65	-1169	-92	-6	0	-29	0	-527	-620	-1649
65	244	120	12	19	29	10	56	-1005	-73	0	0	-25	0	-480	-531	-1624
70	192	93	0	0	22	0	46	-802	-54	0	0	-20	0	-410	-436	-1369
75	148	71	0	0	17	0	36	-598	-36	0	0	-13	0	-326	-342	-1043
80	112	53	0	0	13	0	27	-423	-21	0	0	-7	0	-248	-257	-752
85	80	38	0	0	10	0	19	-290	-12	0	0	-5	0	-183	-184	-527
90	55	26	0	0	7	0	13	-188	-8	0	0	-4	0	-131	-127	-355
95	39	18	0	0	5	0	9	-116	-6	0	0	-3	0	-92	-89	-233
100	16	7	0	0	2	0	4	-41	-3	0	0	-1	0	-37	-36	-90

TABLE 2 Generational Accounts and Their Components for Males (2004), (CZK thousand)

Age	VAT	E	PIT	SSC	IT	CIT	OR	P	DP	SB	UB	OSE	EE	HE	OE	GA 2004
0	572	231	361	1068	36	325	143	-358	-81	-68	-118	-262	-747	-526	-1363	-789
5	624	265	416	1230	41	374	140	-413	-93	-78	-134	-262	-760	-522	-1337	-509
10	642	283	444	1313	44	399	131	-426	-99	-84	-145	-248	-588	-501	-1248	-83
15	663	307	482	1425	47	433	122	-441	-106	-92	-159	-229	-359	-495	-1167	432
20	687	333	543	1611	51	488	117	-482	-118	-100	-167	-210	-132	-515	-1121	987
25	658	326	577	1716	51	518	109	-510	-124	-95	-147	-186	0	-521	-1043	1330
30	616	311	582	1729	50	523	102	-562	-134	-82	-124	-163	0	-541	-977	1331
35	592	307	567	1667	50	509	100	-670	-152	-71	-109	-143	0	-598	-953	1096
40	535	286	505	1449	49	453	92	-747	-162	-61	-89	-114	0	-621	-880	695
45	481	266	438	1210	48	393	85	-855	-170	-54	-70	-81	0	-648	-814	228
50	414	233	351	935	44	315	76	-956	-163	-44	-48	-52	0	-646	-725	-266
55	344	195	251	655	39	226	67	-1102	-141	-28	-23	-35	0	-634	-640	-826
60	273	155	140	362	33	126	58	-1186	-106	-11	0	-24	0	-599	-556	-1335
65	212	119	43	113	27	38	49	-1100	-77	0	0	-16	0	-545	-472	-1608
70	162	90	0	14	21	0	41	-899	-53	0	0	-9	0	-467	-387	-1488
75	122	68	0	0	14	0	32	-689	-33	0	0	-4	0	-376	-307	-1174
80	92	51	0	0	10	0	25	-515	-19	0	0	-3	0	-288	-238	-884
85	69	39	0	0	7	0	19	-377	-11	0	0	-2	0	-212	-179	-647
90	51	29	0	0	6	0	14	-255	-6	0	0	-2	0	-155	-132	-450
95	37	21	0	0	4	0	10	-156	-4	0	0	-1	0	-112	-96	-297
100	15	8	0	0	2	0	4	-51	-2	0	0	0	0	-44	-38	-107

Note: Value Added Tax (VAT), Excises (E), Personal Income Tax (PIT), Social Security Contributions (SSC), Inheritance Tax (IT), Corporate Income Tax (CIT), Other Age-Specific Revenues (OR), Old-Age Pensions (P), Disability Pensions (DP), Sickness Benefits (SB), Unemployment Benefits (UB), Other Social Expenditures (OSE), Education Expenditures (EE), Health Expenditures (HE), Other Age-Specific Expenditures (OE)

GRAPH 1 Generational Accounts of Current Generations by Gender (2004) (CZK thousand)



productivity growth is set at 2 % and the discount rate is set at 5 %. Different columns represent particular tax and revenue items. Finally, the generational accounts of current generations are defined as a sum of all columns in Tables 1 and 2.

The same, but aggregated, information is depicted in *Graph 1*. The horizontal axis represents the age of the agent in year 2004. The vertical axis depicts the cumulated present value of all taxes and transfers which is paid by a representative agent of a different age between 2004 and the end of his/her life, i.e. generational account.

It is possible to reach some important conclusions using the tables and the graph. A significant part of Graph 1 lies below zero. This means that a significant part of the current population gets more from the public budget than it pays in taxes during the remaining lifetime. In other words, only people aged approximately from 12 to 45 (in 2004) will produce positive a difference between remaining lifetime taxes and transfers. Conversely, the rest of the population will generate a deficit. If we take into account the population's ageing and worsening age structure, the current system of taxes and transfers looks unsustainable even when checking the graph visually.

The generational account of a representative agent who was born in year 2004 (see figure for age 0 in Graph 1) is negative, i.e. the agent will obtain more from the public budget than he/she will pay over his/her entire lifespan. In the case that the government cannot finance these deficits using additional sources of revenue, intergenerational shifts of the fiscal burden are expected. So, even without quantifying generational accounts of future generations and the sustainability gap we can say that the current fiscal policy leads to adverse intergenerational redistribution of the fiscal burden and should be changed.

The difference between male and female generational accounts seems to be important. We admit that addressing the differences between sexes is not the main goal of our analysis. Nevertheless, it is interesting to realize

TABLE 3 Generational Accounts of Current and Future Generations under Different Scenarios (CZK thousand)

$g$ (%)	1			2			3		
$r$ (%)	3	5	7	3	5	7	3	5	7
GA current	-1081	-902	-862	-1 497	-948	-883	-2 629	-1 090	-904
GA future	2761	2021	1 682	4 655	2 910	2 122	8 534	4 512	2 849
Sustainability gap (% GDP)	454	211	131	797	297	131	1 608	460	214

how differences concerning the position on the labor market, consumption behavior, etc. can influence the sustainability of public finances.

When building generational accounts, we explicitly assume that age- and gender-adjusted absolute per capita taxes and transfers grow in relation to labor-productivity growth. Moreover, to make different generational accounts comparable we have to discount future values to the base year 2004. Thus, the present value of future taxes and transfers heavily depends on the size of the discount rate and labor-productivity growth rate.<sup>25</sup> Introducing different values of the two key parameters affects the results as shown in *Table 3*.

When testing the sensitivity of fiscal sustainability with respect to  $g$  and  $r$ , we reached the following conclusions. Increasing the productivity growth leads to the gap widening between public expenditures and revenues.<sup>26</sup> Simply put, both taxes and transfers are indexed by the same measure. So the gap, whether positive or negative, grows at the same rate if the structure and the size of the population do not change. Unfortunately, in the case of the Czech Republic the gap is negative and demographic development will even worsen the situation.

The higher the discount rate the lower the generational account of current generations. The same conclusion refers to the size of the generational account of future generations as well as to the sustainability gap.

In all cases of different  $g$  and  $r$  the present value of the net tax burden of a representative agent is negative, i.e. this agent obtains more transfers than he/she pays on taxes over his/her entire lifetime. On the contrary, the generational accounts of future generations, calculated using the residual approach, are positive. This implies that future generations will face the opposite situation compared with the currently living generations from the tax and transfer point of view.

If the structure or public revenues and expenditures remain fixed and the demography develops in accordance with our projection, we estimate the sustainability gap to be positive regardless of the combination of  $g$  and  $r$ . For example, if the discount rate equals 5 % and productivity grows at 2 %, the government accumulates debt between 2004 and 2150 of 297 % of 2004

<sup>25</sup> The problems of choosing  $g$  and  $r$  are discussed in Section 5.2.

<sup>26</sup> The sentence holds true if revenues and expenditures are strictly indexed on labor-productivity growth. Under this condition and applying our approach we could say that productivity growth does not help. But we have to be cautious. It is tempting to say that the paper finds the current setting of fiscal policy to be unsustainable when indexed to productivity growth. Again we have to stress that our approach does not include the reaction of the rest of the economy to fiscal policy and *vice versa*.

TABLE 4 Sustainability Gaps in Different Countries (% GDP)

	Baseline scenario	No Demographic Change	Zero Initial Debt
United States	159	22	97
Japan	337	77	309
Germany	156	-8	81
Italy	223	18	98
Sweden	-31	-67	-45
Belgium	107	63	-218
Hungary	424	119	384
Czech Republic	248	152	226

Note: In the case of the Czech Republic the base year is set to 2004. The rest of the data relate to 1995.

GDP, as presented in Table 3. In the case that  $g$  increases by only one percentage point to 3 %, the ratio of the sustainability gap to GDP rises to 460 % *ceteris paribus*. It seems indexation of taxes and benefits is an important factor in the potential development of public finances.

Since the beginning of the 1990s generational accounts have been constructed for many countries all over the world. To give a reader some idea about the situation in the rest of the world, we present the results concerning some other countries.<sup>27</sup> All the results are calculated setting  $g$  to 1.5 % and  $r$  to 5 %.

Comparing the results on the sustainability gap to GDP in Table 4 for different countries, we can draw the following conclusions.<sup>28</sup> First, the No Demographic Change scenario indicates how large the sustainability gap would be if the size and the structure of the population remain stable. Table 4 demonstrates that changing demography seems to be a significant factor which negatively affects the intergenerational imbalance in all the countries. Second, leaving aside the impact of the public debt alleviates the intergenerational imbalance. But its extent, except in the case of Belgium, appears to be substantially smaller than that of changing demography. The equivalent outcome holds in the case of the Czech Republic, i.e. the impact of changing population size and structure overvalues the impact of the zero initial debt. Third, in the case of the Czech Republic the difference between the Baseline scenario and the No Demographic Change value seems to be smaller. It appears that there are also other important factors apart from worsening demographic conditions. As previously mentioned, the intergenerational imbalance would not disappear with higher labor-productivity growth. This indicates that the system of taxes and transfers in the Czech Republic faces structural problems, i.e. under the current set-up

<sup>27</sup> See (Auerbach – Kotlikoff – Leibfritz, 1998) for results concerning the United States, Japan, Germany, Italy, Sweden, and Belgium, and (Gál – Simonovits – Szabó – Tarcali, 2000) for results on Hungary.

<sup>28</sup> We are conscious of the fact that the methodology of generational accounts is not unified. In addition, the results concerning countries other than the Czech Republic are almost ten years old. This means that important changes relating to demography and fiscal policy could have occurred since that time.

TABLE 5 The Impact of 10% Adjustment in Taxes and Transfers (CZK thousand)

	Baseline	↑ VAT	↑ PIT	↓ P	↓ HE	TOTAL
GA current	-948	-889	-917	-912	-897	-771
GA future	2910	1613	1673	1535	1604	1079
Sustainability gap (% GDP)	297	275	284	269	274	204

TABLE 6 Growth Adjusted Generational Accounts of Future Generations in Different Years (CZK thousand)

	2004	2009	2014	2019
GA future	1 782	2 265	2 845	3 531
base year = 100	100	127	160	198

of public revenues and expenditures the system of public finances is pre-disposed to deficit financing.<sup>29,30</sup> In addition, the impact of demographic factors aggravates the fiscal/intergenerational imbalance.

To sketch the potential impact of intentional adjustments in taxes and transfers, we present mechanistic simulations of the impact of a variation in selected age-specific profiles on intergenerational redistribution and fiscal sustainability. On the revenue side the 10% increase in the age-specific profile of value added tax (VAT) and personal income tax (PIT) is introduced. On the expenditure side the 10% decrease in the age-specific profile of old-age pensions (P) and health expenditures (HE) is introduced. In other words, a representative agent will pay/obtain 10 % more/less in absolute terms compared with the Baseline scenario.<sup>31</sup> The results are presented in *Table 5*. Indeed, all of the presented scenarios improve the intergenerational imbalance and fiscal sustainability indicators. The improvement appears to be significant but not sufficient. The combination of all refinements reduces the ratio of the sustainability gap to GDP by almost 100 percentage points. Still, this is not enough to solve the problems of intergenerational redistribution and fiscal sustainability. We should stress again the pure mechanistic nature of these results.

Finally, *Table 6* presents information about the impact of altering demographic factors on generational accounts of future agents. The results indicate the present value of growth-adjusted net taxes of a representative future agent which guarantees fiscal sustainability.<sup>32</sup> According to our calculations, it is evident that the generational account of the future agent increases over time in the case of the Czech Republic. Moreover, if no changes in taxes and transfers are undertaken, the per capita burden of future agents, necessary to restore fiscal sustainability, will almost double over the next 15 years.

<sup>29</sup> Even if no negative demographic factors come into effect.

<sup>30</sup> See for example (Bezděk – Dybczak – Krejdl, 2003).

<sup>31</sup> As well as in most of the presented results  $g = 2\%$  and  $r = 5\%$ .

<sup>32</sup> The results are calculated applying the residual approach. For details see Section 4.

The timing of fiscal reform is therefore a very important factor from the intergenerational point of view, since the population is getting smaller and older. In other words, the number of people really facing the burden accumulated by previous generations is decreasing. This implies that the government should not hesitate too long to revise the current system if it wishes to sustain fiscal policy without dramatic changes in taxes and transfers of future generations. The costs of delayed action seem to be important.

## 7. Conclusions

We have presented the first set of generational accounts for the Czech Republic. Compared to traditional indicators such as the budget deficit and public debt, generational accounts are forward looking and provide us with information about potential intergenerational redistribution and sustainability of public finances. The generational accounting approach captures sustainability from both the aggregated macroeconomic as well as the representative agent's point of view.

We show that the current fiscal policy is not sustainable due to the unequal treatment of current and future representative agents. According to our analysis, a representative living agent born in 2004 obtains more benefits than he/she pays in taxes over the rest of his/her life. On the contrary, a representative agent not yet born will face the opposite situation. Moreover, the total amount of government liabilities, resulting from the current fiscal policy pursued to 2150, reaches about 300 % of GDP in 2004. Thus, when taking into account future demographic development and the strict indexation rule, the fiscal policy appears to be unsustainable. Finally, according to our results, the costs of delayed modification of taxes and benefits seem to be important because of the worsening demographic factors.

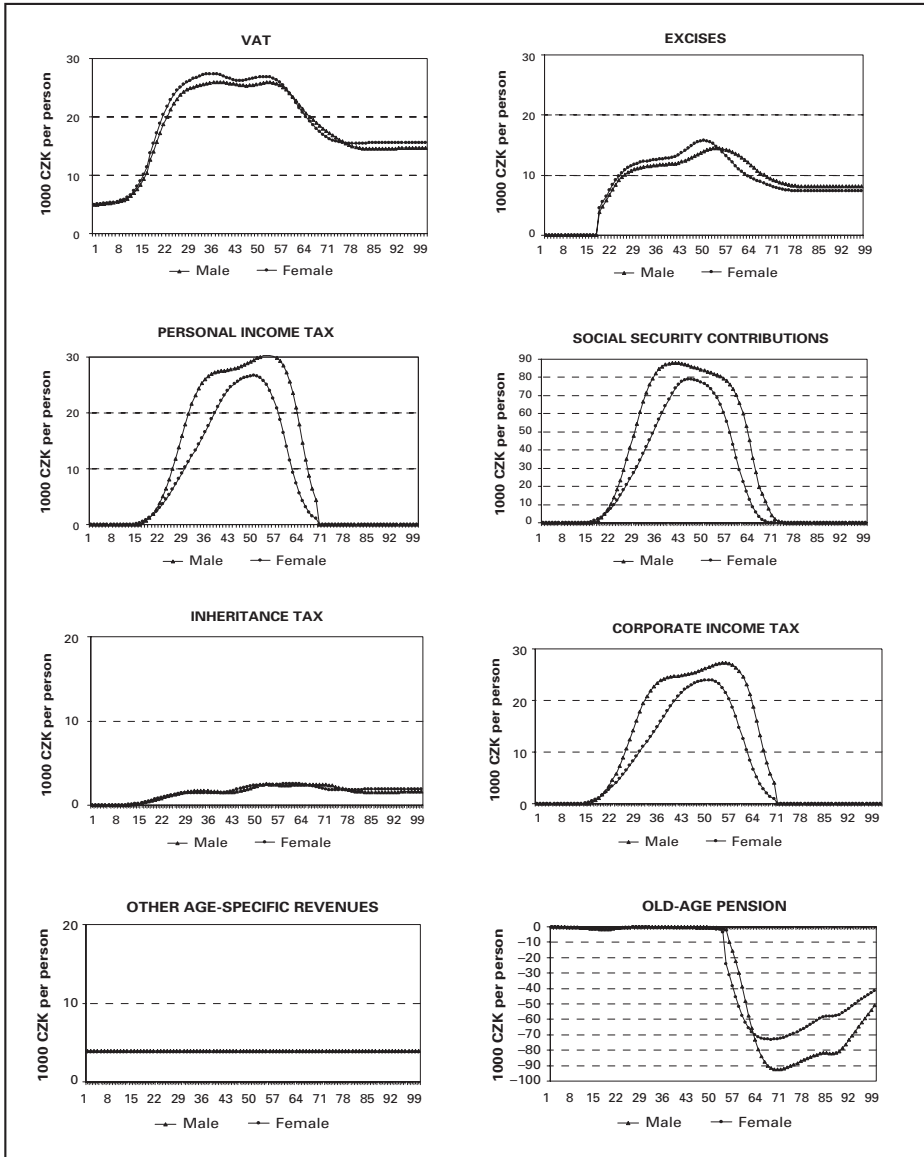
**APPENDIX 1**
**General Government Operations, 2004 (GFS 1986 methodology) (CZK billion)**

TAX REVENUE	963	General Public Services	78
Income Profits & Capital Gains Tax	253	Defense	51
Individual	133	Public Order & Safety	39
Corporate	120	Education	116
Social Security Contributions	388	Health	175
Taxes on Property	15	Social Security & Welfare	356
Domestic Taxes on Goods & Services	302	Old age pension	231
General Sales, Turnover & Value-Added Taxes	182	Sick benefits	25
Excises	96	Social security benefits	33
Taxes on Special Services	1	Other benefits	43
Taxes on Use of Goods & Services	16	Passive employment policy	7
Other Taxes on Goods & Services	7	Welfare	15
Taxes on International Trade & Transactions	4	Other	10
Import Duties	4	Housing & Community Amenities	84
Other Taxes	0	Recreation, Cultural & Religious Affairs & Services	30
NONTAX REVENUE	62	Fuel and Energy	3
Entrepreneurial & Property Income	27	Agriculture, Forestry, Fishing and Hunting	29
Administrative Fees & Charges, Nonind. and Incidental Sales	24	Mining & Mineral Resources, Manufacturing & Construction	3
Fines & Forfeits	4	Transportation & Communication	116
Other Nontax Revenue	7	Other Economic Affairs & Services	36
CAPITAL REVENUE	12	Other Expenditures	45
GRANTS	25		
<b>TOTAL REVENUE</b>	<b>1 062</b>	<b>TOTAL EXPENDITURE</b>	<b>1 160</b>
		<b>DEFICIT</b>	<b>-98</b>
		<b>DEBT</b>	<b>659</b>
		<b>NET WEALTH</b>	<b>4 710</b>
<b>Age Specific Revenue</b>	<b>998</b>	<b>Age Specific Expenditure</b>	<b>1 010</b>
Income Profits & Capital Gains Tax	253	General Public Services	78
Social Security Contributions	388	Defense	51
Taxes on Property	15	Public Order & Safety	39
Domestic Taxes on Goods & Services	302	Education	116
Taxes on International Trade & Transactions	4	Health	175
Other Taxes	0	Social Security & Welfare	356
Administrative Fees & Charges	24	Housing & Community Amenities	84
Fines & Forfeits	4	Recreation, Cultural & Religious Affairs & Services	30
Other Nontax Revenue	7	Other Economic Affairs & Services	36
		Other Expenditures	45
<b>Non-age Specific Revenue</b>	<b>64</b>	<b>Non-age Specific Expenditure</b>	<b>150</b>
Entrepreneurial & Property Income	27	Fuel and Energy	3
Capital Revenue	12	Agriculture, Forestry, Fishing and Hunting	29
Grants	25	Mining & Mineral Resources, Manufacturing & Construction	3
0	0	Transportation & Communication	116
<b>TOTAL REVENUE</b>	<b>1 062</b>	<b>TOTAL EXPENDITURE</b>	<b>1 160</b>

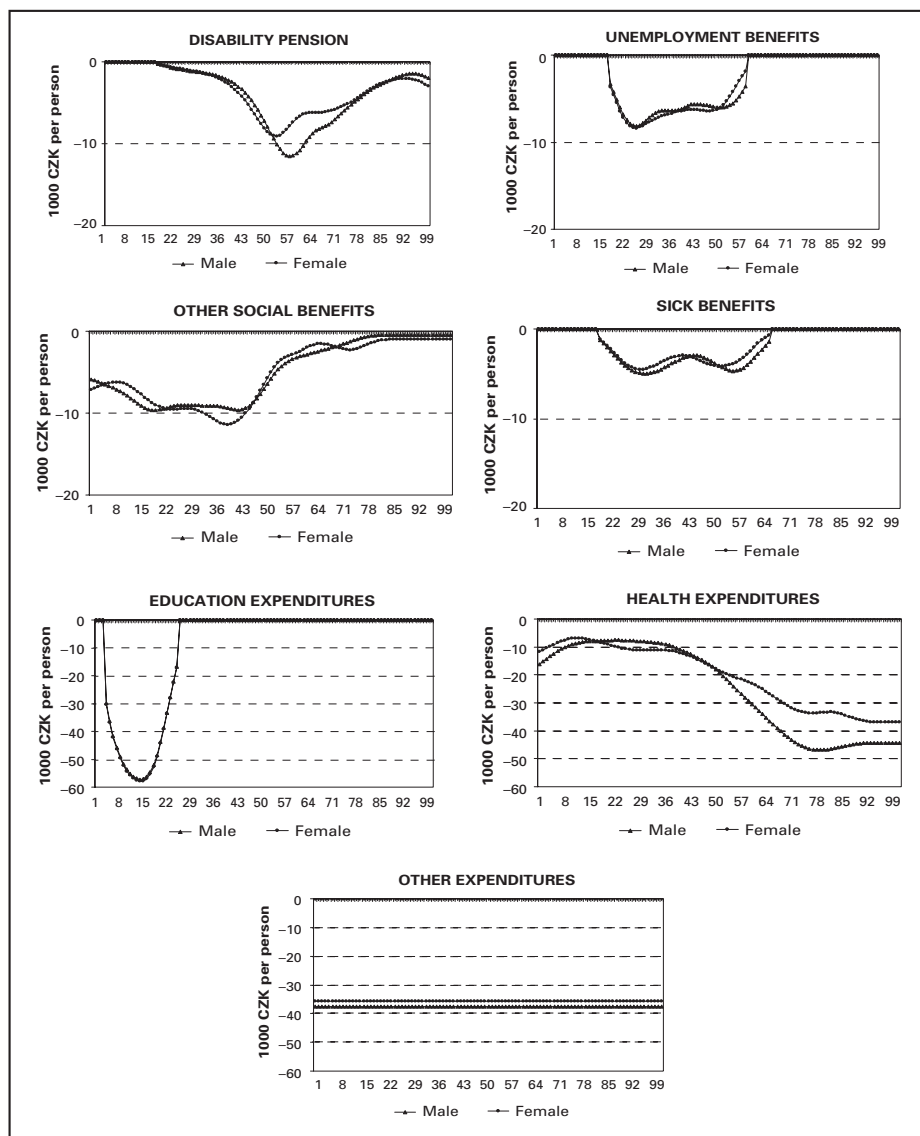


**APPENDIX 2**  
**Age-Specific Taxes and Transfers (CZK thousand)**

The major part of the age-specific profiles of a representative male and female were calculated using the Household Budget Survey of 2002 provided by the Czech Statistical Office. Data concerning all forms of pension benefits come from the Czech Social Security Administration database. Data reflecting Education Expenditures were provided by the Ministry of Education, Youth and Sports. Finally, the General Health Insurance Company provided the healthcare data.



The presented age-specific taxes and transfers (*graphs of different  $t'$* ) give us an idea of people's behavior during their lifecycle. Moreover, we can infer from its level and shape how people contribute to the public budget or benefit from public transfers depending on their age.



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## SUMMARY

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# Generational Accounts in the Czech Republic

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The generational accounting approach used in this paper incorporates projected demographic development and the parameters of current Czech fiscal policy into an intertemporal government budget constraint. Compared with public-debt and deficit data, the economic indicators based on generational accounting are forward looking and yield additional information about fiscal policy.

To assess the sustainability of Czech public budgets, the authors constructed the first set of generational accounts for the Czech Republic. They found that, for 2004, a representative agent obtained more benefits than paid taxes; that is, the generational account of the representative agent was negative. In addition, the total amount of government liabilities resulting from the current fiscal policy, projected to 2150, was estimated at about 300 percent of the national GDP in 2004. The authors conclude that Czech fiscal policy is not sustainable; current taxes and benefits should be modified in line with demographic projections in an effort to stabilize public budgets.