

## WORKING PAPER SERIES 2

Kamil Dybczak:  
Generational Accounts in the Czech Republic

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Reviewed by: Radka Štiková (Czech National Bank)  
Roberto Cardarelli (International Monetary Fund)  
Marek Mora (European Commission)

Project Coordinator: Vladimír Bezděk

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Kamil Dybczak

# Generational Accounts in the Czech Republic

Kamil Dybczak \*

## Abstract

The government intertemporal budget constraint states that all public liabilities have to be financed by either current or future generations. The generational accounting approach incorporates the expected demographic development and the parameters of the current fiscal policy into the intertemporal government budget constraint. By contrast with the public debt and deficit, the indicators based on generational accounting are forward looking and provide us with additional information about the current fiscal policy. To assess the sustainability of public budgets we constructed the first set of generational accounts for the Czech Republic. We found that a representative living agent obtains more benefits than he/she pays in taxes in 2004, i.e. the generational account of this representative agent is negative. In addition, the total amount of the government liabilities resulting from the current fiscal policy pursued to 2150 reaches about 300% of GDP in 2004. Finally, the costs of postponed adjustment of government revenues and expenditures seem to be considerable. We conclude that the present fiscal policy is not sustainable, i.e. public budgets in the Czech Republic should be stabilized by changing the current system of taxes and benefits to reflect potential demographic development.

**JEL Codes:** H61, E62.

**Keywords:** Fiscal sustainability, generational accounting.

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\* Kamil Dybczak, Czech National Bank (kamil.dybczak@cnb.cz).

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## **Nontechnical Summary**

The government intertemporal budget constraint states that all public liabilities have to be financed by either current or future generations. Since the size and the structure of these generations vary over time, even unchanged fiscal policy can generate a different per capita lifetime burden of a representative current and future agent. The generational accounting approach incorporates the expected demographic development and the parameters of the current fiscal policy into the intertemporal government budget constraint. Afterwards, based on this methodology, different indicators of fiscal sustainability are derived. By contrast with the public debt and deficit, these indicators are forward looking and provide us with additional information about the current fiscal policy.

Unlike the previous studies of fiscal sustainability in the Czech Republic, the generational accounting approach captures sustainability from both the aggregate macroeconomic and representative agent's point of view. In our analysis both the residual and the sustainability approaches were implemented. We found no effect of different values of the discount rate, labour productivity growth and combinations thereof on the main results of our analysis. A representative living agent obtains more benefits than he/she pays in taxes in 2004, i.e. the generational account of this representative agent is negative. By contrast, a representative agent not yet born will face the opposite situation. Thus, the present fiscal policy is not sustainable, owing to the unequal treatment of current and future representative agents. In addition, if the discount rate equals 5% and productivity grows at 2% per year, we quantified the total amount of the government liabilities resulting from the current fiscal policy pursued to 2150 at about 300% of GDP in 2004. Thus, taking into account future demographic development and a strict indexation rule, the fiscal policy appears to be unsustainable. Finally, we found the costs of postponed adjustment of government revenues and expenditures to be considerable and rising over time.

To summarise, we found the system of revenues and expenditure in the Czech Republic to be facing structural problems. So, even when the discount rate and labour productivity growth are set propitiously, the system of public finances remains unsustainable. In addition, the negative impact of demographic changes will aggravate the development of public finances in the future. According to the present analysis, the public budgets in the Czech Republic should be stabilized by changing the current system of taxes and benefits to reflect potential demographic development.

## **1. Introduction**

The government provides a number of public services and commodities, such as health care, education, infrastructure etc. Some people take advantage of consuming them more than others. For example, education expenditures are aimed mainly at young people, while older people do not take advantage of the public education system at all. By contrast, pensioners receive retirement pensions which are not addressed at young people, etc. Since public services and commodities are consumed differently through the lifespan, it follows that the amount of public expenditure is affected by the size and structure of the population.

At the same time, all expenditures have to be financed. The main part of government revenues comes from taxes and wealth sales. Unfortunately, government wealth is limited in general, i.e. privatization revenues are at the government's disposal to only a limited extent. Usually other revenue sources are also restricted.<sup>1</sup> Thus, the major part of expenditures has to be financed by taxes. This means that agents finance public services (commodities) indirectly through taxes. As in the case of expenditures, the total amount of public revenues depends on the size and the structure of the population.

Generally speaking, 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, old), then only the middle-aged pay more into the public budgets than they receive. By contrast, the young and the old contribute to the public budgets to a very limited extent. Thus, a representative agent of a certain age is either a net contributor or a net beneficiary. This idea comes from the life cycle hypothesis.<sup>2</sup> From our point of view it is important that people pay taxes and receive transfers differently over their lifespan. Based on these arguments, it follows that the size and structure of the population decisively affect the balance of public budgets.

In fact, the government does not have to pay all its expenditure immediately using just tax revenues and privatization receipts. Where the government's expenditures exceed its revenues, it 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 alternative ways of financing results in shifts in the financial burden from current to future generations, i.e. so-called 'intergenerational redistribution'. Thus, current fiscal policy affects the net wealth not only of generations alive at present but also of generations not yet born.

Unfortunately, neither the commonly used public budget deficit nor public debt records any intergenerational shifts or the way in which current fiscal policy influences the net wealth of a representative current and future agent. One of the tools which can be used to assess intergenerational balance or imbalance is so-called 'generational accounting'. This approach reflects the long-term implications of current fiscal policy arrangements for intergenerational redistribution and fiscal sustainability taking into account the expected demographic development. Thus generational accounting can provide us with additional information about the current state of

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<sup>1</sup> Although seigniorage can be an important part of public revenue, we do not include it in our analysis. This reflects the Czech reality. In the past the Czech National Bank (CNB) did not transfer seigniorage to the government because it was making losses. Moreover, since the CNB has accumulated a large stock of debt, the same fact holds for the near future.

<sup>2</sup> See Modigliani (1963).

fiscal policy and its potential implications next to the standard fiscal indicators. 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 and future generations. As a result, the tool is used as an instrument for assessing the sustainability of the current settings of public finances taking into account the expected demographic development.

It is important to note that generational accounts do not provide the exact level of future government deficits. This is definitely not a forecasting tool. The goal is to compare the present value of the growth-adjusted lifetime burden faced by a representative current and future agent on condition that the intertemporal budget constraint holds. Alternatively, it is possible to calculate the total amount of the government liabilities stemming from the current fiscal policy proceeds indefinitely. Moreover, alternative scenarios could help to identify potential ways of improving the intergenerational imbalance. The sustainability of various tax and expenditure variants could be assessed by the same token.

The classical generational accounting methodology evaluates taxes and transfers as monetary flows. Alternatively, generational accounts can be defined as a utility balance that results from the interaction between individuals and the public sector. In this case we would have to assess the individual's utility (disutility) of each component of net taxes over time. In our study we follow the monetary approach, since deciding on the utility of each public item seems very speculative.

There is some criticism of the generational accounting methodology from both the theoretical and practical points of view.<sup>3</sup> We would like to stress that generational accounting is not a generational equilibrium model based approach, but just an indicator based on a trend projection. On the contrary, this projection is elaborate, introducing some economic theory and expected demographic development. Using the generational accounting methodology we can infer what situation would arise if the present fiscal policy stayed unchanged provided that the rest of the economy does not react. The results can identify the intergenerational redistribution which would result from the government's current financing and spending decisions.

The purpose of this paper is to assess the sustainability of the present fiscal policy in the case of the Czech Republic using the generational accounting methodology. Whereas generational accounts have been widely used for more than a decade worldwide, this is the first version of the generational accounts for the Czech Republic.<sup>4</sup> Some authors have improved the generational accounts method, but we present more or less the original version without applying any special technique. 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. The third section specifies the variables and the parameters necessary to calculate the 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.

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<sup>3</sup> See, for example, Auerbach, Gokhale and Kotlikoff (1994), who provide an extensive response to the critique of the method of generational accounting.

<sup>4</sup> An overview of the application of generational accounting in different countries is provided by Auerbach, Kotlikoff and Leibfritz (1998).

## 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. In other words, net public debt  $D_t$  plus the present value of all net government purchases  $G_{t,y}$  have to be financed by the present value of the lifetime net taxes  $N_{t,k}$  paid by both current and future generations. 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>5</sup>  $G_{t,y}$  is calculated as the present value of the difference between public expenditures and revenues not affected by the size of the population.  $D_t$  is defined as the public debt in year  $t$  less the present value of expected privatization revenues.<sup>6</sup> Finally,  $N_{t,k}$  denotes the present value of net taxes which will be paid through the life cycle by agents born in year  $k$ .<sup>7</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. The following section discusses all the variables step by step.<sup>8</sup> Contrary to  $G_{t,y}$ ,  $N_{t,k}$  denotes the present value of the difference between public revenues and expenditures affected by the size of the population. The distinction between public revenues and expenditures whose development is or is not affected by the size of the population is a standard procedure for generational accounting construction.

## 3. Specifications and Projections of Variables and Parameters

### 3.1 Lifetime Net Taxes of Current Generations

The standard concept of generational accounting draws a line between the current and future 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 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

<sup>5</sup> All the fiscal data ( $G_{t,y}$ ,  $D_t$  and total  $N_{t,k}$ ) come from GFS 2004 (consolidated public budgets). For details see Appendix I.

<sup>6</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  $D_t$ . Arguments can be found in section 5.4.

<sup>7</sup> The symbolism is similar to Bonin (1997). Another, probably widely used, specification comes from Auerbach, Kotlikoff and Liebfriz (1998).

<sup>8</sup> Although we distinguish between genders in the results, we suppress sex subscripts in all equations.

year.<sup>9</sup> Put differently, since generational accounts are constructed as a forward-looking indicator we do not cover the development of net taxes over the whole lifecycle for all currently living generations. In fact, the only current generation which we follow over the whole lifespan is the youngest one, i.e. the one born in the base year  $t$ .<sup>10</sup>

The current generations are defined as all agents who live in the present. Let  $t$  be the base year and  $L$  be the maximum length of life, 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 dies. 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. We presume that  $r$  is constant over the whole period.

To quantify the total net taxes of currently living generations in present terms, according to formula (2), we need a projection of demographic development as well as the projection of the net taxes paid in period  $i$  by a representative agent born in year  $k$ . On the one hand, the demographic projection is usually received from the national statistical office or other institution and accepted as it is. On the other hand, the base-year age-specific per capita taxes and transfers  $t'_{i,k}$  of type  $l$  are projected by applying the constant (time invariant) growth rate  $g$ .<sup>11</sup> It is usually assumed, for projection purposes, that the growth rate  $g$  should reflect labour productivity growth, i.e. age- and gender-adjusted per capita taxes and transfers grow at the rate of labour 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, i.e. all individuals of the same age and gender face the same lifetime net tax rate.<sup>12</sup>  $t'_{i,k}$  can be calculated for different  $k$  in each year  $i$  using the formula (4).

$$t'_{t+j,k} = (1+g)^j t'_{t,k-j} \quad (3)$$

<sup>9</sup> Gokhale J., Page B. (1997) calculated total net taxes of all current generations taking into account demography together with taxes and benefits also before the base year.

<sup>10</sup> Later in this section we will show that this is the only generation out of the currently living population whose generational account will be used for evaluating the sustainability of the current fiscal policy.

<sup>11</sup> Just as in the case of  $r$  we assume  $g$  to be constant over the whole period, but alternative scenarios are presented in section 6.

<sup>12</sup> Introducing this assumption seems to be the standard approach to generational accounts. By contrast, reflecting potential changes in age-specific profiles as a result of population ageing could make the projections more reliable.

where  $t'_{i,k}$  expresses the average tax or transfer of type  $l$  of the representative agent born in  $k$  in year  $i$ .<sup>13</sup> If  $t'_{i,k}$  is positive (negative) then the item represents a tax (transfer) paid (obtained). We should stress that the key lies in deciding what taxes and transfers are influenced by the number of people and the age structure of the population.<sup>14</sup> It seems almost impossible to specify the components of net taxes precisely, since both the revenue and expenditure sides of the public budgets contain a wide variety of items. For some of them it is hard to decide which group they should belong to. Thus a close examination of the individual items is necessary.

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>15</sup>

$$t_{i,k} = \sum_l t'_{i,k} \quad (4)$$

It is worth noting that neither in the residual approach nor in the sustainability approach<sup>16</sup> is the total present value of the net taxes of the current generations restricted. Whatever approach we choose, the total present value of the net taxes of the current generations is quantified using the same procedure, i.e. formula (2) is applied.

### 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 values of the remaining lifetime net taxes of currently living generations born in  $k$ , defined as  $N_{t,k}$ , are not directly comparable among themselves. But it is possible to compare the net taxes in present value terms of a representative agent of age  $i-k$  in the base year  $t$ . Finally, we define a year  $t$  account of a generation born in  $k$  as the present value of taxes paid minus the present value of transfers obtained throughout the rest of the life divided by the number of agents in the base year  $t$ . Generational accounts for different  $k$  are calculated according to formula (5) and labelled as  $GA^{CUR}_{t,k}$ .

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

The expression  $P_{i,k}/P_{t,k}$  in formula (5) represents the ratio of the population born in  $k$  and still alive in  $i$  to the base year  $t$ , i.e. it can be called a survival probability. Since the population dies out, it is clear that  $P_{i,k} < P_{j,k}$  where  $i > j$ .<sup>17</sup> 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  $t$ .

<sup>13</sup> Section 5 provides a detailed description of the different types of taxes and transfers. The data used for estimation purposes are described as well. In addition, Appendix II presents figures of different  $t'$ .

<sup>14</sup> The inputs to the generational accounts will be discussed in section 5.

<sup>15</sup> Taxes are treated in positive terms and transfers in negative terms.

<sup>16</sup> Both the residual and sustainability approaches are discussed in detail in section 4.

<sup>17</sup> This effect can be mitigated by migration.

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

where  $N_{t,k}$  represents the present value of the lifetime net taxes which are paid by individuals born in  $k$  and still living in the base period  $t$ .

Identically to the end of the preceding subsection, we would like to note that the quantification of the generational accounts of currently living generations is not influenced by the following either residual or sustainability approach.

### 3.3 Government Purchases

It should be pointed out that  $G_{t,y}$  has a different meaning than government consumption in the national accounts. According to the generational accounts methodology,  $G_{t,y}$  is defined as the balance of expenditure and revenue items which do not count towards net taxes. In other words,  $G_{t,y}$  is composed of revenues and expenditures whose size does not depend on the size of the 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. The projection is even simpler, because it is not necessary to estimate the amount relating to the specific age group. The total amount is projected using the similar growth rate  $g$  as in the case of the age-specific tax and transfer profiles.

## 4. Intergenerational Imbalance and Fiscal Sustainability Appraisal

The theoretical concept of generational accounting is widely accepted. But there are several ways of constructing generational accounts. Many countries now publish their generational accounts complete with the methodology used. The main idea is uniform, but important partial differences can still be found. To assess the intergenerational imbalance (sustainability of public finances), different indicators based on the generational accounting methodology can be constructed. In the following sections, two major approaches will be discussed – the residual and the sustainability approach. But alternative ways can also be applied.<sup>18</sup>

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

The present fiscal situation can be resolved by introducing alternative adjustments. First, the net taxes of the present agents can be modified. Second, the government has the possibility of reducing the actual and potential level of its purchases. Third, the government might not want to solve the unfavourable situation immediately, i.e. it can defer solving the problem to the future. As a consequence, the total net taxes of future agents are implicitly increased. In the residual approach we assume that the government is not willing to change the current settings of the system for the time being. As a result, all the changes needed to attain fiscal sustainability will be faced by future generations.

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<sup>18</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 alternative indicators of intergenerational imbalance/fiscal sustainability.

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). Hence in the residual approach all fiscal parameters have already been fixed except the ones which influence the total present value of the net taxes of future generations. This is the only variable which can vary. Put differently, a current fiscal policy that improves current agents' wealth will *ceteris paribus* burden future generations in the negative direction, and vice versa.

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

The size and structure of future generations vary over time. In addition, labour productivity is increasing. Thus, it is not possible to directly compare the absolute levels of the present value of the total lifetime net taxes of the currently living and future generations as calculated using formulas (2) and (7). Indeed, we have to reflect expected demographic development as well as the growing labour productivity if we want to compare the fiscal burden which will be faced by a representative current and future agent.

We have already presented the way in which the generational accounts of currently living generations are computed using formula (5) or (6). There is only one current generation which we follow over the whole lifespan, i.e. the youngest one. Its generational account ( $GA_{t,t}^{CUR}$ ) will be compared with the generational accounts of future generations.

There are few ways of calculating future generational accounts. Usually the generational accounts of future agents are assumed to be equal except for a productivity growth adjustment.<sup>19</sup> Taking into account these assumptions the generational account of a representative future agent is calculated as follows:

$$\sum_{k=t+1}^{\infty} N_{t,k} = \sum_{k=t+1}^{\infty} P_{k,k} GA_{k,k}^{FUT} \left( \frac{(1+g)}{(1+r)} \right)^{k-t} \quad (9)$$

Because the generational accounts of both generations ( $GA_{t,t}^{CUR}$ ,  $GA_{k,k}^{FUT}$ ) reflect the 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 comparing the growth-adjusted net taxes of current and future representative agents. It follows that 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

<sup>19</sup> Unfortunately, introducing the above assumptions, the residual approach does not enable us to express anything about redistribution within future generations.

intergenerational redistribution. In other words, comparing the value of  $GA^{CUR}_{t,t}$  and  $GA^{FUT}_{k,k}$  reflects the intergenerational shifts necessary to sustain public budgets. It means that when applying the residual approach a fiscal strategy which affects current and future agents differently ( $GA^{CUR}_{t,t} \neq GA^{FUT}_{k,k}$ ), is called intergenerationally imbalanced. Because intergenerational shifts are necessary to ensure the validity of the intertemporal budget constraint, such a fiscal policy is also called unsustainable. Looking at the problem from the other perspective, we see that a sustainable fiscal policy will not lead to any intergenerational redistribution and  $GA^{CUR}_{t,t} = GA^{FUT}_{k,k}$ .

## 4.2 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 and 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 sustainability approach takes into consideration the overall demographic development of all generations.

The sustainability approach slightly modifies the 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 fiscal sustainability is the so-called ‘sustainability gap’.<sup>20</sup> It 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 lacking public revenues which is desired to fulfil 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. Thus, the gap shows the size of the liabilities that the government will have to redeem. On the other hand, a negative sustainability gap indicates a government intertemporal surplus and the option of 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 resulting from pursuing the present 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 and future generations. But at the same time, by contrast with 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. This ratio can be used for international comparison. As in the previous approach the final result should not be used as a forecast of public indebtedness.

<sup>20</sup> It is possible to find other names for this indicator; for example, Cardarelli, Sefton and Kotlikoff (1999) call it the ‘intertemporal budget gap’.

## 5. General Data Description

In creating generational accounts for the Czech Republic, we follow the standard procedure. The empirical evaluation of the intertemporal budget constraint requires projections of population, taxes, transfers, government purchases and the initial value of net public debt. At the same time the value of parameters  $g$  and  $r$  has to be set. We start with the 2004 data. The main data sources used are the FoS UK (Faculty of Sciences, Charles University, Prague) population projection<sup>21</sup> the CZSO (Czech Statistical Office) household budget survey and the MF (Ministry of Finance) government financial statistics.

### 5.1 Demography

Generational accounting is based on a long-term population projection, i.e. demography plays a key role in determining the size of the intergenerational imbalance. Because generational accounts ( $GA^{CUR}_{t,k}$  and  $GA^{FUT}_{k,k}$ ) 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, 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.

The original idea presented in the previous sections assumes that all government obligations have to be financed over an infinite time horizon. In practice it is not realistic to project all the necessary data to infinity. It is presumed that a nearly 150-year time horizon is long enough.<sup>22</sup>

There are important differences between males and females. Women live longer than men on average, but there are other distinctions which significantly affect the generational accounts. For example, due to wage discrimination, the wage of the average woman is not as high as that of the average man, so direct taxes and social security contributions are also different. In addition, the amount of indirect taxes differs as a result of the different consumption behaviours of the two genders.

### 5.2 Age-Specific Revenues and Expenditures<sup>23</sup>

The main part of the revenue and expenditure age profiles was taken from the Household Budget Survey 2002. In our particular case we constructed age-specific profiles just using year 2002 data. First, it is difficult to acquire and treat the data. Second, we believe that a change in age-specific profiles needs strong incentives and moreover takes more years. Thus, we found no major flaws using just one year observations. The raw data is rather erratic, but a still apparent age-specific profile can be recognized. Following the generational accounting literature and trying to make our analysis and figures more tractable we filtered all the data using an HP filter. Again, the filtering does not influence the results of our analysis. After that, the relative age profiles were calculated and recalculated to fit the actual budget data.<sup>24</sup>

<sup>21</sup> Burcin B. and Kučera T. (2004).

<sup>22</sup> Thanks to discounting, the present value of all variables beyond this period is negligible.

<sup>23</sup> Bonin (1997) shows that using terms 'Age-specific' and 'Non-age-specific' could be misleading. We acknowledge this argument, but continue using them because of their broad utilization.

<sup>24</sup> For detailed information, see Appendix II – Age-Specific Taxes and Transfers

We are conscious of the fact that many important relations proposed by the economic theory are neglected when constructing generational accounts. Nevertheless, we did not apply any sophisticated projection method. Instead, we projected all net taxes using formula (4) presented in the previous section. Once more, we would like to stress the role of generational accounts as a *ceteris paribus* indicator of intergenerational imbalance and fiscal sustainability.

There is uncertainty about future productivity growth and the discount rate. Moreover, it is hard to choose specific values for  $r$  and  $g$ . So, we introduced a set of both parameters into our empirical analysis. This seems to be the standard approach to generational accounting in order to show the sensitivity of the results to adjustment in the values of  $g$  and  $r$ . The value of  $r$  is influenced by the government revenues and expenditure risk, which is hard to judge from today's perspective.<sup>25</sup> In the case of labour productivity growth we mainly took into account long-run factors and the convergence of the Czech economy to the EU average. We calculated generational accounts for current and future generations and the sustainability gap using variant  $g$  (0.01, 0.02, 0.03) and  $r$  (0.03, 0.05, 0.07).

### **5.2.1 Revenues**

Using the 2004 GFS methodology the total government revenues (expenditures) amounted to CZK 1,062 (1,160) billion. The ratio of age-specific revenues (expenditures) to total revenues (expenditures) is about 94 (87) %.<sup>26</sup>

For the empirical evaluation of the generational accounts, gathering the age-specific profiles of taxes and transfers of both genders is necessary. 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>27</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%)
- 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 2002. The only exception is Corporate Income Tax, which is treated like a tax on labour income (Personal Income Tax), i.e. the relative age profiles of both personal and corporate income taxes are identical.<sup>28</sup> The idea behind this argument is that the burden of corporate income tax is ultimately carried mainly by employees, followed by consumers and shareholders.

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<sup>25</sup> Lau (2000) applied a varying discount rate according to age for different agents.

<sup>26</sup> For details see Appendix II – General Government Operations, 2004.

<sup>27</sup> The number indicates the percentage of the total revenue.

<sup>28</sup> Some working papers elaborate on Corporate Income Tax more sophisticatedly. See, for example, Auerbach and Chang (2003) or see Cardarelli R., Sefton J. and Kotlikoff L. J. (1999) for details.

When inspecting the age-specific profiles we clearly see that the personal income tax and social contributions paid by an individual depend on his/her age. It is evident that agents aged between 18 and 60 earn more than children and pensioners, so the direct taxes paid by this specific age group are the highest. Since private consumption evolves in line with income, the same conclusion holds for indirect taxes. Thus, value added tax and excises also depend heavily on the age of the individual.

### **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>29</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%)
- Other Age-Specific Expenditures (OE) (26.5%).

The data concerning all forms of pension benefits comes from the Czech Social Security Administration database. The information on 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 2002.

It is assumed that Other Age-Specific Revenues and Other Age-Specific Expenditures are distributed evenly over all age groups. First, in a few cases it is hard to even recognize if there is any age-specific profile. Second, it is difficult to obtain all the profiles.

Our study shows that the largest part of age-specific expenditures is other age-specific expenditures, i.e. with a flat age profile. This could appear unsatisfactory at first sight, but we have to bear in mind that this item is the sum of expenditures on General Public Services, Defence, 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 expenditure on defence depends on the size of the population, but not on its age structure.

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<sup>29</sup> Other forms of pension benefits (survivor's pensions) were assigned to old-age.

### 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 (12.9) %.<sup>30</sup> We detected the following revenue items:

- Property Income (2.5%)
- Capital Revenue (1.1%)
- Grants (2.4%)

and the following expenditure items:

- Fuel and Energy (0.2%)
- Agriculture and Forestry (2.5%)
- Mining and Mineral Resources (0.2%)
- Transport and Communications (10.0%)

not to be dependent on the number of people and their age. The absolute amount of  $G_t$  is CZK 86 billion in 2004, i.e. the value of non-age-specific expenditures exceeds that of non-age-specific revenues by CZK 86 billion in 2004.

### 5.4 Public Net Wealth and Net Debt

The last but not least item from the intertemporal budget constraint is government net wealth or public net debt. There is no difference in applying either net wealth or net debt, but finding the appropriate number is not as easy as it seems at first sight. Net wealth is defined as the 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>31</sup> To summarize, the evaluation of public assets is definitely not an easy task.

In the case of the Czech Republic the most important government assets are non-financial assets. They comprise fixed assets such as roads, public buildings, land and so forth. Unfortunately, the size and value of that public property has not been precisely specified in the Czech Republic yet.<sup>32</sup> The key issue is whether and to what extent these fixed assets could be sold to raise lacking revenues. In addition, it is hard to imagine that the government would sell all of its assets.<sup>33</sup>

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<sup>30</sup> For details see Appendix II – General Government Operations, 2004.

<sup>31</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>32</sup> Public finances have been growing in deficit since 1995. Regardless of this unfavourable development, net public wealth has been rising continually according to the CZSO. Government wealth is rising not because of prudent government financial policy, but due to evolving accounting procedures at the CZSO with respect to the recording of public assets.

<sup>33</sup> To overcome this problem some authors estimate the value of government wealth that can be privatized. See, for example, Gál R.I., Simonovits A., Szabó M. and Tarcali G. (2000).

In our view, government net wealth according to the national accounts overestimates the value of property which can really be privatized. Unfortunately, no such estimate is available for the Czech Republic. As a result, we define  $D_t$  as gross public debt less actual privatization revenues and less the expected present value of future privatization revenues for the next few years.<sup>34</sup>

## 6. Results

Following the standard generational accounting methodology, we quantified the first set of generational accounts for the Czech Republic. 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 both the residual and the sustainability approach were followed. Tables 1 and 2 show the present value of the remaining lifetime taxes and transfers of a representative agent when labour productivity growth is set to 2% and the discount rate to 5%. The different columns represent particular tax and revenue items. Finally, the generational accounts of current generations are defined as the sum of all columns in Tables 1 and 2.

**Table 1: Generational Accounts and their Components for Females (2004, thousand CZK)**

Age	VAT	E	PIT	SSC	IT	CIT	OR	P	DP	SD	UB	OSE	EE	HE	OE	GA2004
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

**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), Unemployment Benefits (UB), Education Expenditures (EE), Health Expenditures (HE), Sick Benefits (SB), Other Social Expenditures (OSE), Other Age-Specific Expenditures (OE).

<sup>34</sup> The estimates of current and future privatization revenues come from the document: *Projection of Revenues and Expenditure in 2006*. The document offers a rough estimate of privatization revenues in 2006 and 2007.

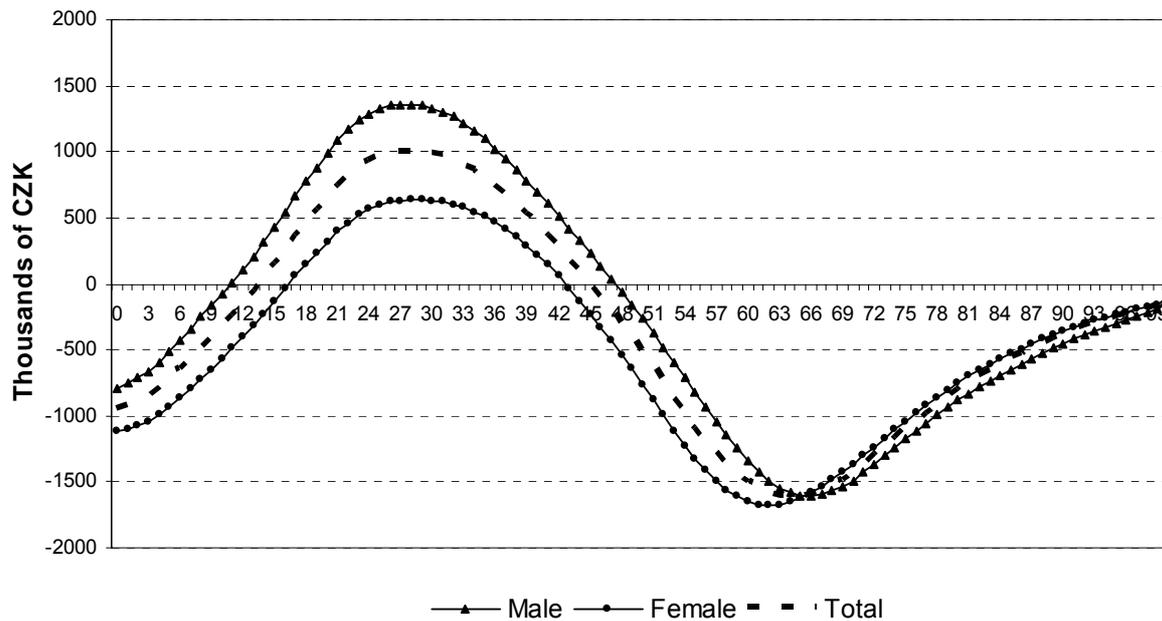
**Table 2: Generational Accounts and their Components for Males (2004, thousand CZK)**

Age	VAT	E	PIT	SSC	IT	CIT	OR	P	DP	SD	UB	OSE	EE	HE	OE	GA2004
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), Unemployment Benefits (UB), Education Expenditures (EE), Health Expenditures (HE), Sick Benefits (SB), Other Social Expenditures (OSE), Other Age-Specific Expenditures (OE).

The same, but aggregated, information is depicted in Figure 1. The horizontal axis represents the age of the agent in 2004. The vertical axis depicts the average remaining lifetime net tax burden (generational account) of each current generation. In other words, the vertical axis shows the cumulated present value of all taxes and transfers which is paid by a representative agent of different age between 2004 and the end of his/her life. To be more specific, the average male who is 30 years old in 2004 will pay taxes and receive transfers for an additional 70 years. As a result he accumulates a surplus whose present value is about CZK 1,331,000 in 2004. Put differently, such a male on average pays CZK 1,331,000 more on taxes than he receives in benefits over the rest of his life (between years 30 to 100), without taking into account previous taxes paid and expenditures received (between years 0 and 29). By contrast, an average male at the age of 70 in 2004 accumulates a deficit of CZK 1,488,000 over the next 30 years, i.e. the government pays him CZK 1,488,000 more than he pays in taxes (between years 70 and 100).

To help the reader get through all the numbers easily it is important to realize where all the characteristics can be found. Since we are interested in comparing the accounts of current and future generations, we only take into account generations that last a whole life cycle. In the case of currently living generations there is only one possibility, i.e. we concentrate on the generation which came into existence in 2004. The generational account of agents born in 2004 of both sexes can be found in the first row and the last column of Tables 1 and 2 (-1117 and -789). Actually, the last columns of Tables 1 and 2 are depicted in Figure 1. The overall generational account, which neglects the differences between the sexes, is a weighted average of the generational accounts of males and females (the dashed line). Since Tables 1 and 2 and Figure 1 show calculations based on the growth rate set to 2% and the discount rate set to 5%, the same numbers can also be found in Table 3.

**Figure 1: Generational Accounts of Current Generations by Gender (2004, thousand CZK)**

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

The generational account of a representative agent who was born in 2004 is negative, i.e. the agent will obtain more from the public budget than he/she will pay over his/her entire lifespan. When the discount rate equals 5% and labour productivity growth equals 2%, the generational account of a representative agent born in 2004 is CZK -948,000. In other words, each agent born in 2004 will on average cumulate a lifetime deficit whose present value in 2004 is CZK -948,000. If the government cannot finance these deficits using extra revenue sources, intergenerational shifts of the fiscal burden are expected. So, even without quantifying the generational accounts of future generations and the sustainability gap we can say that the current fiscal policy leads to an intergenerational redistribution of the fiscal burden and should be changed.

The difference between the male and female generational accounts seems to be important. We admit that addressing the differences between the sexes is not the main goal of our analysis. Nevertheless, it is interesting to realize how differences in position on the labour market, consumption behaviour etc. can influence the sustainability of public finances. Figure 1 shows that the average man born in 2004 accumulates a lifetime deficit lower than that of the average woman by almost CZK 330,000 in terms of the year 2004.

When building generational accounts, we explicitly assume that age- and gender-adjusted absolute per capita taxes and transfers grow in relation to labour productivity growth. Moreover, to make the different generational accounts comparable we have to discount future values to the base year

2004. Thus, the present value of future taxes and transfers depends heavily on the size of the discount rate and the labour productivity growth rate.<sup>35</sup> Introducing different values of the two key parameters affects the results as shown in Table 3.

**Table 3: Generational Accounts of Current and Future Generations under Different Scenarios (thousand CZK)**

g (%)	1			2			3		
r (%)	3	5	7	3	5	7	3	5	7
GA current	-1081	-902	-862	-1497	-948	-883	-2629	-1090	-904
GA future	2761	2021	1682	4655	2910	2122	8534	4512	2849
Sustainability gap (%GDP)	454	211	131	797	297	131	1608	460	214

When testing the sensitivity of fiscal sustainability with respect to  $g$  and  $r$ , we found the following conclusions. Increasing productivity growth leads to the gap between public expenditures and revenues broadening.<sup>36</sup> Putting it simply, 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 size of the population are not changing. Unfortunately, in the case of the Czech Republic the gap is negative, and demographic development will make the situation even worse.

The higher the discount rate the lower the generational account of current generations. The same conclusion applies to the size of the generational account of future generations and to the sustainability gap. Since the discount rate is used to translate future values into present terms, a higher  $r$  improves the current value of future deficits.

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 pays in taxes over his/her whole lifetime. By contrast, the generational accounts of future generations, calculated using the residual approach, are positive. This implies that next generations will face the opposite situation to currently living generations from the tax and transfer point of view. The higher generational account of future generations indicates that the present fiscal policy is not sustainable and should be changed.

If the structure of public revenues and expenditures is held 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  $r$ . The sustainability gap indicates the size of the adjustment needed to achieve fiscal sustainability, i.e. it is defined as the accumulated present value of future deficits owing to changes in demography parameters and unchanged fiscal policy between 2004 and 2150.<sup>37</sup> For example, if the discount rate equals 5% and productivity grows at 2%, the government accumulates debt of 297% of 2004 GDP between 2004 and 2150, as presented in Table 3. If  $g$  increases by just 1 percentage point to 3%, the ratio of the sustainability gap to GDP rises to 460% *ceteris paribus*. It seems that indexation of taxes and benefits is an important factor for the potential development of public finances.

<sup>35</sup> The problems of choosing  $g$  and  $r$  are discussed in section 5.2.

<sup>36</sup> The sentence holds if revenues and expenditures are strictly indexed on labour 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 this paper finds the current fiscal policy settings to be unsustainable when indexed to productivity growth. Again we have to stress that our approach lacks the reaction of the rest of the economy to fiscal policy and vice versa.

<sup>37</sup> The level of the sustainability gap is presented in relation to GDP.

Since the beginning of the 1990s generational accounts have been constructed for many countries all over the world. To give the reader some idea about the situation in other countries we present part of the results from Auerbach, Kotlikoff and Leibfritz (1998) and Gál, Simonovits, Szabó and Tarcali (2000).<sup>38</sup> All the results are calculated setting  $g$  to 1.5% and  $r$  to 5%.

**Table 4: Sustainability Gaps in Different Countries (% of 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 relates to 1995.

Comparing the results on the sustainability gap to GDP in Table 4 for different countries, we can draw the following conclusions. First, The No Demographic Change scenario indicates how large the sustainability gap would be if the size and 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 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 exceeds the impact of 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 other important factors in addition to worsening demographic conditions. As already mentioned, the intergenerational imbalance would not disappear with higher labour 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 of public revenues and expenditures the system of public finances is predetermined to generate deficit financing.<sup>39</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 a 10% increase in the age-specific profile of value added tax (VAT) and personal income tax (PIT) is introduced. On the expenditure side a 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%

<sup>38</sup> We are conscious of the fact that the generational accounts methodology 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.

<sup>39</sup> Even if no negative demographic factors come into effect. See, for example, Bezdek, Dybczak and Krejdl (2003).

more/less in absolute terms compared to the baseline scenario.<sup>40</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 the refinements reduces the ratio of the sustainability gap to GDP by almost 100 percentage points. This is still not enough to solve the problems of intergenerational redistribution and fiscal sustainability. We should stress again the pure mechanistic nature of these results.

**Table 5: The Impact of a 10% Adjustment in Taxes and Transfers (thousand CZK)**

	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

Finally, Table 6 presents information about the impact of changing demographic factors on the generational accounts of future agents. The results indicate the present value of the growth-adjusted net taxes of a representative future agent which guarantees fiscal sustainability.<sup>41</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 during the next 15 years.

**Table 6: Growth-Adjusted Generational Accounts of Future Generations in Different Years (thousand CZK)**

	2004	2009	2014	2019
GA future	1782	2265	2845	3531
<i>base year=100</i>	100	127	160	198

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 with revising 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 considerable.

<sup>40</sup> As well as in most of the presented results  $g=2\%$  and  $r=5\%$ .

<sup>41</sup> The results are calculated by applying the residual approach. For details see section 4.

## 7. Conclusions

We have presented the first set of generational accounts for the Czech Republic. By contrast with 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 the sustainability of public finances. The generational accounting approach captures sustainability from both the aggregated macroeconomic and representative agent's point of view.

We show that the present fiscal policy is not sustainable, owing 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. By contrast, 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, taking into account future demographic development and a strict indexation rule, fiscal policy appears to be unsustainable. Finally, according to our results, the costs of postponed modification of taxes and benefits seem to be considerable, because of the worsening demographic factors.

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## Appendix I

General Government Operations, 2004 (GFS 1986 Methodology)  
(billions of CZK)

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		Mining & Mineral Resources, Manufacturing &	
Incidental Sales	24	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>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 & Con:	3
0	0	Transportation & Communication	116
<b>TOTAL REVENUE</b>	<b>1 062</b>	<b>TOTAL EXPENDITURE</b>	<b>1 160</b>

## **Appendix II**

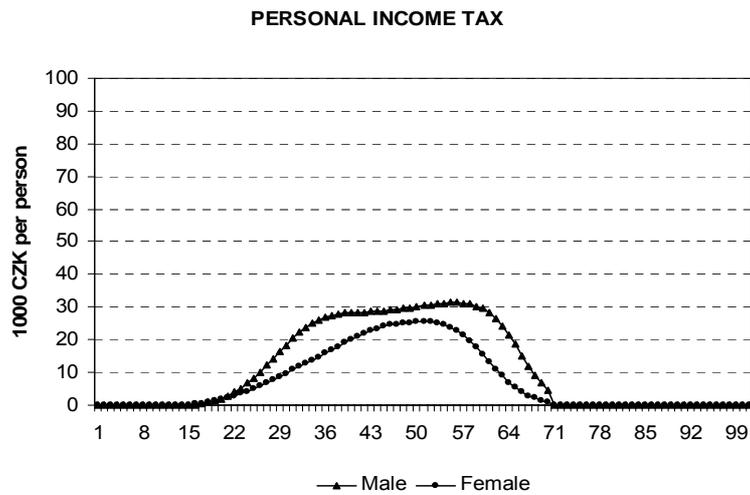
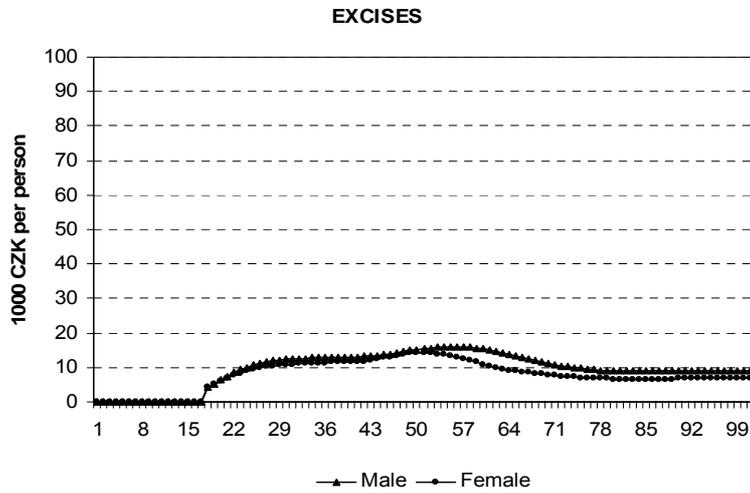
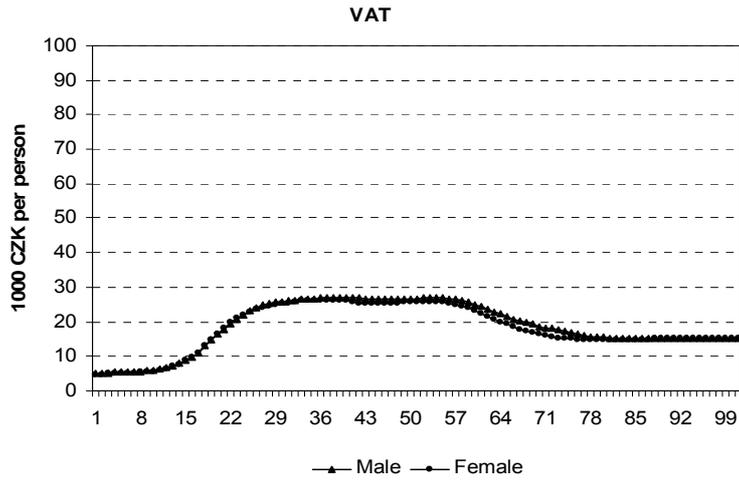
### **Age-Specific Taxes and Transfers (thousand CZK)**

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

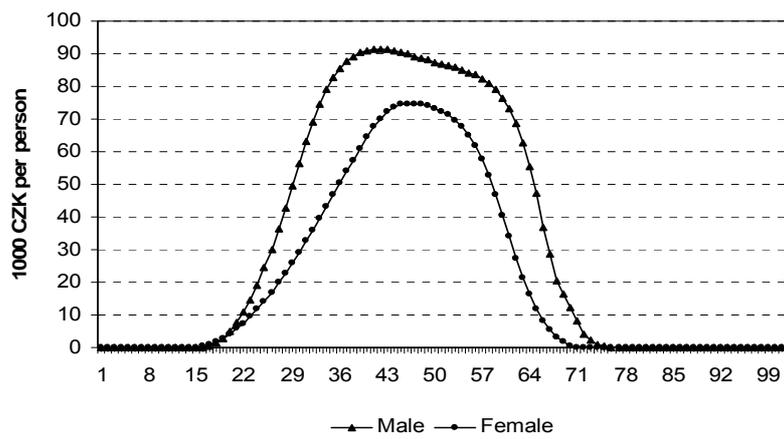
The presented age-specific taxes and transfers give us an idea of people's behaviour during their lifecycle. Moreover, we can infer from their level and shape how people contribute to the public budget or benefit from public transfers depending on their age. For example, the amount of direct taxes (Personal Income Tax and Social Security Contributions) depends on an individual's wage rate and employment. First, in the neoclassical framework, the real wage rate is a function of labour productivity. Many factors can influence the productivity of labour, but we assume it depends mainly on the stock of human capital accumulated by an employee, i.e. experience accumulated over time. Generally, young people increase the stock of their human capital more easily than older people. Moreover, the stock of capital depreciates over time, and if no new experience is added the capital stock decreases. This implies that an employee becomes less productive and his/her real wage rate potentially falls. Usually, older people are not capable of adjusting to new conditions and their stock of human capital just decreases due to depreciation. In other words, the real wage rate seems to depend on the age of the employee, i.e. it increases with age for the young and decreases for the old. Second, people start working after finishing at least the statutory level of education. Usually, they stop working after reaching retirement age. Thus, when applying the provided arguments the shape of the age-specific profiles of direct taxes can be explained. It follows that the amount of personal income tax and social security contributions paid by an individual depends on his/her age.

The shape of the age-specific profiles of indirect taxes can be explained as follows. The consumption of a representative agent develops according to his/her needs and the level of his/her income. As a result, the amount of indirect taxes (VAT and Excises) is either low or zero for children. Then, as income increases, the amount of goods consumed increases, as does the amount of indirect taxes. Finally, as an agent retires, he/she starts consuming accumulated savings and lowers consumption.

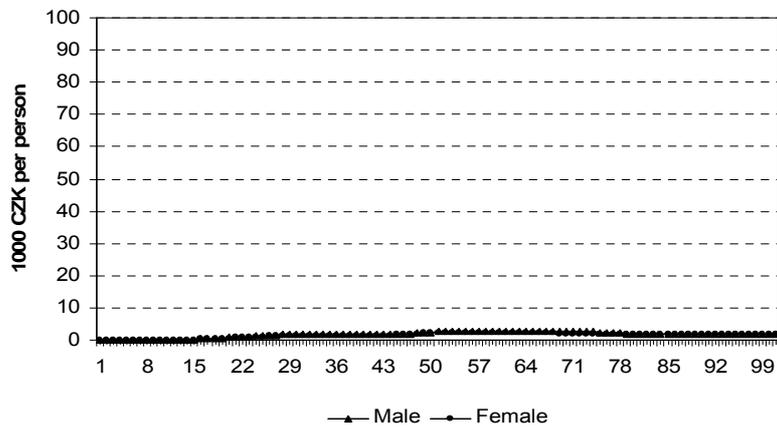
The government redistributes income among individuals using public expenditures and transfers. In many cases public expenditures and transfers depend on the size and age structure of the population. It follows that age-specific profiles of different public expenditure items can be constructed as well. For example, the government provides retired people with old-age pensions. If an individual does not reach a certain age, he/she cannot consume these pensions. By contrast, the government finances a substantial part of education expenditures, but after reaching a specific age, an individual has to finance education by himself. Next, government health expenditures are affected by the sickness rate of different age groups. Usually, the government pays more for children and old people, since their sickness rate is higher than that of people of productive age.



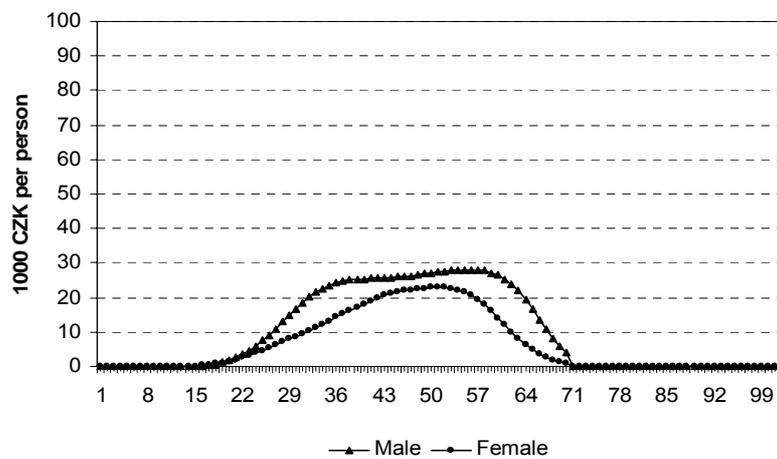
**SOCIAL SECURITY CONTRIBUTIONS**



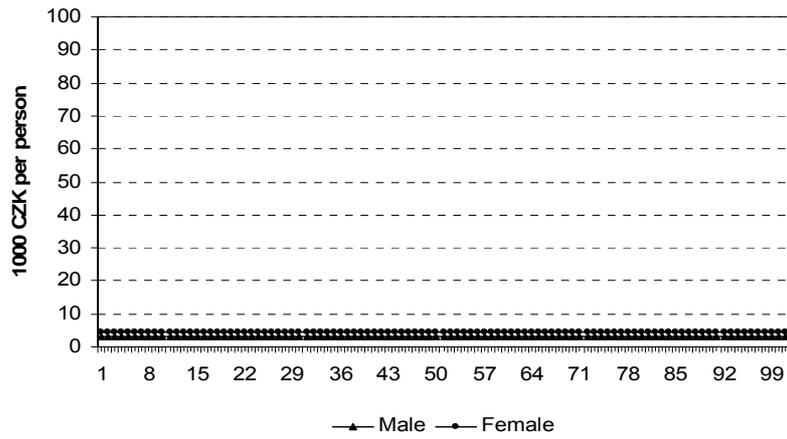
**INHERITANCE TAX**



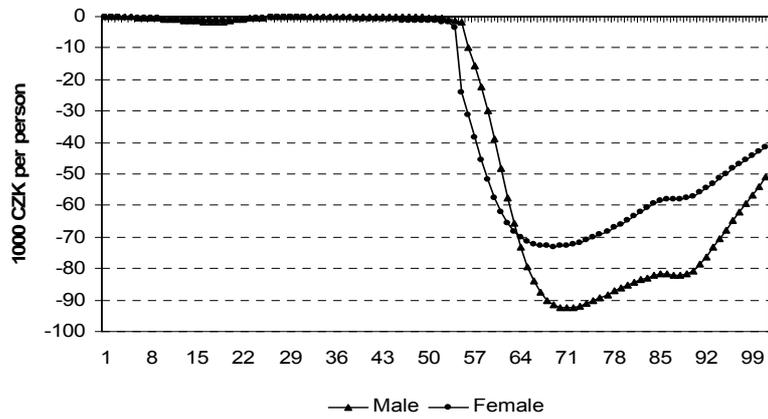
**CORPORATE INCOME TAX**



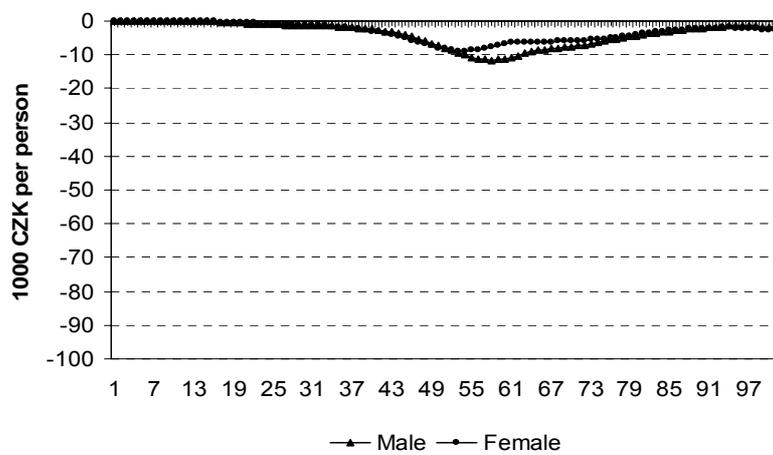
OTHER AGE-SPECIFIC REVENUES



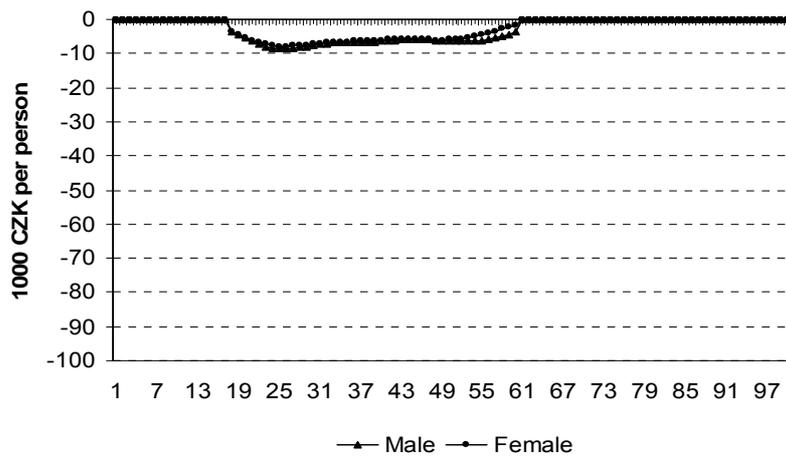
OLD-AGE PENSION



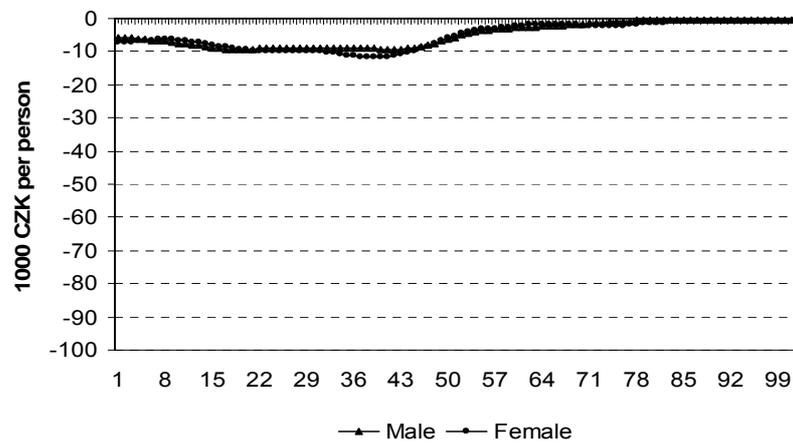
DISABILITY PENSION



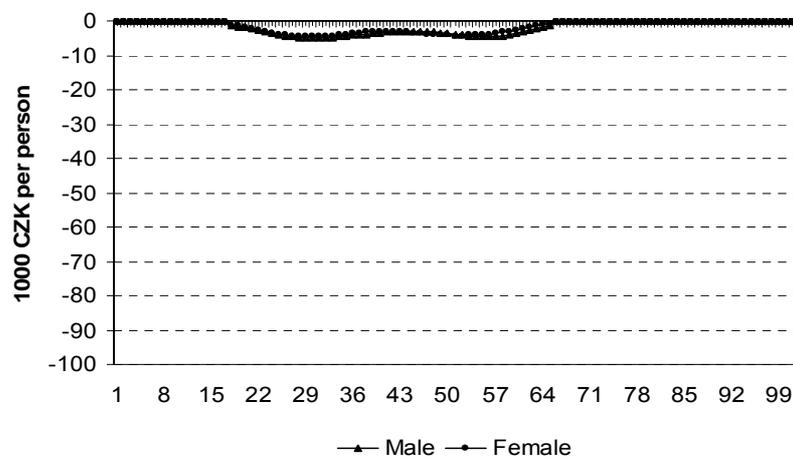
### UNEMPLOYMENT BENEFITS



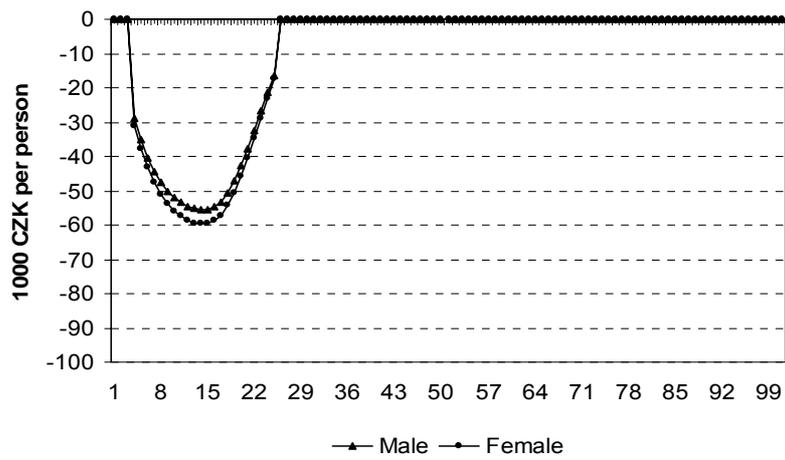
### OTHER SOCIAL BENEFITS



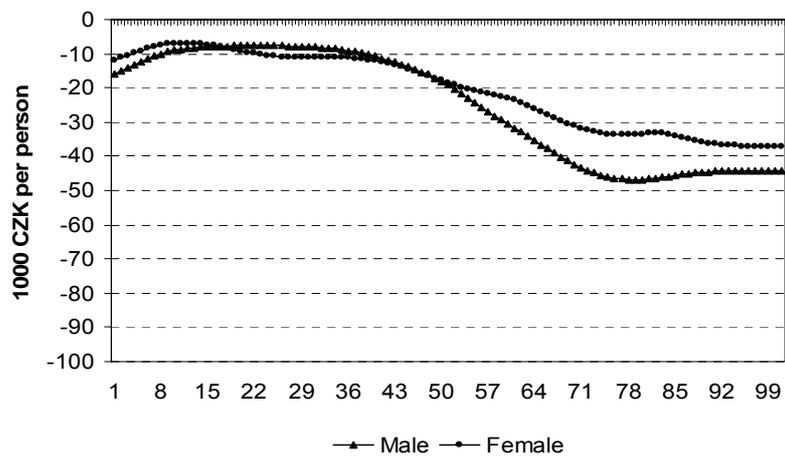
### SICK BENEFITS



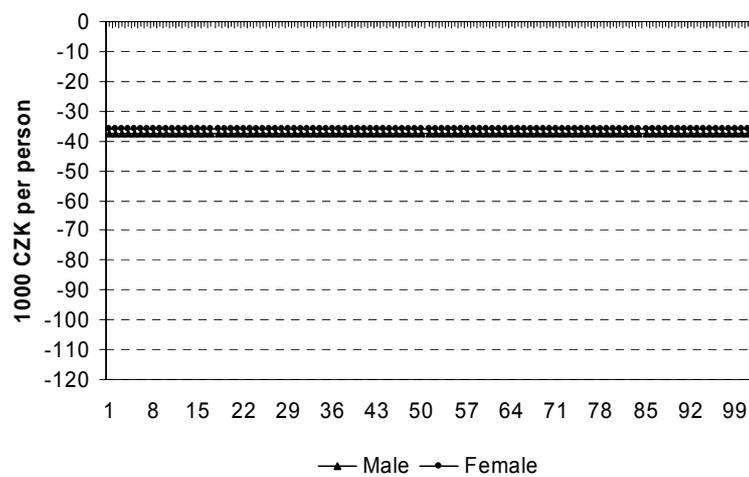
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Czech National Bank  
Economic Research Department  
Na Příkopě 28, 115 03 Praha 1  
Czech Republic  
phone: +420 2 244 12 321  
fax: +420 2 244 14 278  
<http://www.cnb.cz>  
e-mail: [research@cnb.cz](mailto:research@cnb.cz)