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Generational Equality in Iceland

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This paper presents generational accounts for Iceland over the period 1994–1998. A longer analysis period allows us to assess whether the economic boom during the latter part of the 1990s was more favourable to current- or future generations. We find that the restrictive government policy of the period moved the economy towards intergenerational equality. We also examine the generational impact of a resource tax for the exploitation of the Icelandic fishing grounds, using the revenue to cover the government's unfunded pension liabilities. Finally, we employ Monte Carlo analysis to assess the sensitivity of the accounts to changes in the discount- and growth rate. JEL Classification: C1, E6, H6

In many respects it is fair to say that the Icelandic economy came of age in the 1990s. At the beginning of the decade a crucial victory was won in the battle against the high inflation that plagued Iceland in the 1970s and 1980s. After 1990, a 2–3% rate of inflation became the norm compared to 30–60% in earlier years. Also, in the 1990s, the policy of repeated currency devaluations was shelved and more sensible policy measures adopted. In 1993, Iceland became a part of the European Economic Area (EEA), which opened the economy up to a free flow of labour, goods, services, and capital from

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Europe. Important reforms in the financial markets were implemented, and when long- and short term capital movements were fully liberalized in 1995 the Icelandic economy went through a structural change. Another significant development was the increased diversity of the Icelandic export industries, which reduced the dependency on the fishing industry.

The latter part of the 1990s was a period of high growth and economic prosperity. Government revenue (as a ratio of GDP) grew considerably, parallel to an actual decrease in government expenditure. The fiscal policy aimed at preserving economic stability and as of 1997 the budget of the central government was run with a surplus. At the beginning of a new millennium there are some signs that the economy is slowing down. The currency has depreciated and inflation has increased. Also, the current account deficit has been widening.

This paper uses generational accounts to examine the impact of recent fiscal policy and economic conditions on current- and future generations in Iceland. The first generational accounting study in Iceland was conducted in 1997 by the Institute of Economic Studies (IoES, 1997a) for the base year 1995. Since then, the IoES has published accounts for the base years 1994, 1996, 1997 and 1998 (IoES, 2000). Unlike the previous studies, the methodology developed in a European Commission study on generational accounting in Europe (EU, 1999), detailed in the paper by Raffelhüschen (2001) in this volume, is applied here.

The paper consists of three main parts. The first gives an overview of the Icelandic economy in a historical sense and of recent economic developments. We also discuss main trends in Icelandic fiscal policy over the years, focusing on the changes in government revenue and expenditures during the latter part of the 1990s. The second part presents Icelandic generational accounts for the base years 1994 to 1998. We start with a brief description of the main assumptions behind the Icelandic accounts. We then examine the development of the accounts between 1994 and 1998 in light of the economic conditions and fiscal policy of the period. Some baseline results concerning the distribution of the net tax burden of current generations are presented and finally we examine the impact of imposing a resource tax on the exploitation of the Icelandic fishing grounds. The third part of the paper contains a sensitivity analysis, using Monte Carlo methods to asses how the accounts react to changes in the discount- and growth rate.

Economic Conditions and Fiscal Policy in Past and Present

The Icelandic Economy

Iceland is a small open economy in the middle of the Atlantic ocean, separated from the markets on the mainland. Although the ocean contributes to the isolation of the country it also contains its main source of income, the rich fishing grounds. Through the years, the fishing industry has produced a large proportion of the economy's export revenue and made up roughly 56% of total exports of goods and services at the end of the 1980s. However, the fishing industry is subject to great uncertainty. The stock size, which determines the yearly catch quota, is affected by external biological factors such as sea temperature and plankton supply. The fish price on foreign markets is determined by several factors, such as the size of the fishing stock of other Atlantic fishing nations that supply the same markets and world fish prices in general. Due to the importance of the fishing industry, a close connection can be observed between the value of the yearly catch and GDP growth in the past. This largely

explains business cycle volatility, which has been more pronounced in Iceland than in most other industrialized countries. During the 1990s, the economy became somewhat less dependent on the fishing industry and in 1999 the share of the fishing industry in total exports of goods and services was down to 45%. This is mainly due to a greater variety of the Icelandic industries, e.g. the development of power-intensive industries, tourism, and high-tech industries. Obviously, the fishing industry is still extremely important for the Icelandic economy, although a lessened dependence should reduce the volatility of the business cycle.

The relationship between GDP growth and revenue in the fishing industry contributed to the belief that the best way to stabilize the economy was to stabilize the fishing industry through a variable nominal exchange rate. The period between 1960 and 1990 was characterized by frequent currency devaluations. In 1988, when the catch quota was decreased and market conditions were unfavorable, the currency was devalued three times.

Through the 1970s and 1980s, inflation was perceived by the public and politicians alike to be the main challenge. Before loan indexation was introduced by law in 1979, inflation had caused great transfers of wealth. During this period, inflation played the part of a negotiator in the labour market, employers agreed to high nominal wage increases which soon were nullified by devaluation and price increases. At the end of the 1980s it was clear that the soft exchange policy could not be sustained. Inflation during this decade was very high, amounting to three digits in 1983. In 1990, a systematic approach was used for the first time to battle inflation. It consisted of a sort of a national consensus, employees agreed to low nominal wage increases, the government fixed the exchange rate to a nominal anchor and the banks promised to lower interest rates. This worked to decrease inflation, which stayed low throughout the 1990's.

Compared to the turbulence of the 1970s and 1980s, the 1990s were a period of relative economic stability. After a period of stagnation early in the decade, the Icelandic economy prospered. The year 1994 marks the beginning of the longest standing period of high growth in Icelandic economic history, which still has not ended. In 1997, the central government budget was run with a surplus for the first time since 1984, which has been sustained from then on. The professed aim of central government has been to run a contractive policy and try to ensure a *soft landing* of the economy after the high growth of recent years. The central government has paid down debt and aims at a zero net debt in 2003–2004. Also, efforts have been made to reduce government involvement in the economy by privatization. At the beginning of a new millennium, the economic boom is still on, although warning signs can be observed, such as a depreciating exchange rate, rising inflation, and a large current account deficit.

Fiscal Policy and Government Budget

International economic bodies report a significant increase in the size and scope of the public sector in the last decades for most of the industrialized countries. Although there is no formal way to measure the size of the public sector, an estimate is often obtained by looking at some key figures, such as government revenue and expenditures as a ratio of GDP, or government employees as a ratio of the total work force. Such figures show that the public sector in Iceland is smaller than in most other Northern-European countries. However, the composition of government expenditures has evolved along similar lines.

A significant part of the expenditures of these welfare states is allocated to education, social and welfare affairs, and the principal problems are connected to budget deficits and growing government debt.

When trends in the expenditures and receipts of the Icelandic government are examined, a considerable growth of the public sector is apparent. In 1970, total government revenue amounted to 30.1% of GDP compared to 37.4% in 1998.[1] At the same time, total expenditures grew from 28.9% in 1970 to 36.9% in 1998. The increase in expenditures from 1970 was to a large extent driven by growth in social transfers. The ratio of social transfers to GDP rose from 16.5% in 1970 to 23.8% in 1998. This increase is mainly due to a large increase in health-care expenditures, which more than doubled its share of GDP during this period, and also to increases in expenditures on primary and secondary education, social and welfare affairs, as well as to a changing age structure of the population. Finally, there has been a remarkable increase in interest expenditures which went from 0.6% of GDP in 1970 to 3.6% in 1998.

During the 1970s and the first years of the 1980s the budget was run with small surpluses most of the time. A long succession of deficits followed, but from 1997 onwards the budget has been run with surpluses. During six of these years the deficit was 2–3% of GDP and for four years it was 4–5% of GDP. The balance in public finances in this period is more or less reflected by the change in the net debt of general government, which rose from 5.8% of GDP in 1984 to 37.1% in 1997. In the 1990s, special efforts were made to fight the budget deficits and growing expenditures and together with a favorable economic environment, fiscal policy has succeeded to turn the budget into a markable surplus in recent years. A look at a more recent period shows that total government expenditure actually decreased between 1994 and 1998, from 40.0 to 36.9% of GDP, while total revenue grew from 35.2 to 37.4% of GDP in the same period. The proclaimed policy of central government in recent years has been to use the budget surplus to reduce its debts, both the general debt and its unfunded pension liabilities. The objective is to eliminate the general net debt of the central government before the end of 2003 or 2004. These efforts have resulted in the lowering of the general net debt of the government from 37.1% to 30.8% of GDP between 1997 and 1998. However, the unfunded pension liabilities of the government have increased greatly at the same time. Increased pension liabilities result from changes in the wage system of the central government which took place in 1997/1998. Recent wage contracts with primary and secondary school teachers are estimated to increase the pension commitments of central government by 19 billion ISK, or around 2.8% of GDP.

The Icelandic Accounts 1994 to 1998

Assumptions and Data

The sources of the Icelandic data are thoroughly covered in earlier work on generational accounting in Iceland, where the estimation of initial government debt and government consumption is also detailed.

There are, however, some aspects of the Icelandic accounts that require a further discussion here. The first concerns the quality

1. The figures in this section are obtained from the National Economic Institute, see National Economic Institute (1999) and National Economic Institute (1998b), also available at www.ths.is

of the Icelandic data. One of the advantages of a small economy is that data in Iceland is relatively readily available. For example, real payments in the social security system and in most of the direct tax groups were used to construct the micro profiles. This is not an option in many countries and should enhance the reliability of the Icelandic generational accounts. A high percentage of government revenue can be distributed by age and gender, between 90 and 92%, while only 46 to 56% of government expenditures can be thus divided, due to the non age-specific nature of a large part of government expenditures.

The Icelandic accounts rely on a population forecast by the IoES (IoES, 2001). The projections start in 1999 and reach through to 2050. From then on the population is assumed to remain unchanged. According to UN fertility data, Iceland had the third highest fertility rate in Europe in 1995, only surpassed by Albania and Macedonia. However, the total fertility rate in Iceland has been slowly decreasing during the last two decades, from 2.48 in 1980 down to 1.99 in 1999. The projections assume that the fertility rate continues to decrease, reaches 1.9 in 2015 and stays constant from then on. As the forecast assumes mortality to decrease during the next 20 years, life expectancy at birth increases from 76.29 to 79.20 years for males, and from 80.77 to 83.81 years for females. Moreover, zero net migration is assumed as net migration has fluctuated around the zero point in the past. According to the forecast, total population in Iceland will reach a maximum of 330 thousand in 2038 and then decline to 327 thousand in 2050.

Like in other European countries, there is an aging process going on in Iceland. However, as the fertility rate is still quite high, the aging process starts rather late. The old age dependency ratio[2] in 1995 was about 29%, and according to our projections it will be around 36% in 2015. The old age dependency ratio increases more rapidly during the next decades, to 52% in 2035 and to 57% in 2055, with almost three out of every five classified as elderly.

Generational accounts assume government revenue and expenditure to increase at the rate of GDP growth.[3] Unless otherwise mentioned, we use a 1.5% growth rate as a base case, a standard assumption in the generational accounts of most countries. Also, we use a 6% discount rate to calculate the present value of payments made in the future. This is a higher interest rate than is commonly used in most other countries. The reason is a high risk-premium due to the smallness of the country and its dependence on a volatile natural resource.

Development of the Accounts

Generational accounts are reliant on the business cycle, as well as on the fiscal policy. An economic boom increases the income of households and firms and provides the government with increased tax revenue. The allocation of the extra income by the government then determines whether or not the result will be a decrease in the intergenerational imbalance.

2. The old age dependency ratio is calculated as the ratio of people aged 60+ to those aged 20–59. This ratio should perhaps be calculated differently in Iceland, as the effective retirement age is between 65 and 70 years of age. The ratio of individuals aged 65+ to those aged 20–64 in Iceland was 20% in 1999, 23% in 2015, 36% in 2035 and around 40% in 2055.
3. Social benefits in Iceland are neither indexed by wages or the cost of living. All increases are made in increments determined by the government.

Table 1.
Development of the Intergenerational Imbalance

	1994	1995	1996	1997	1998
Explicit debt (% of GDP)	42	44	43	40	39
Implicit debt (% of GDP)	78	28	-6	-40	-55
IPL (% of GDP)	120	72	38	0	-16

As mentioned earlier, the Icelandic accounts have been constructed for the period 1994 to 1998. It is instructive to examine the development of the intergenerational imbalance in the context of the economic conditions and government policy in Iceland during this period. Table 1 reports the intertemporal public liabilities (IPL)[4] and the explicit- and implicit debt of the government as a ratio of GDP for the five base years.[5]

We note that the IPL decreases throughout the period and in 1998 there are even small intertemporal public assets. Clearly, generational accounts based on the years 1994 and 1998 tell a very different story. Accounts for the base year 1994 indicate that the fiscal policy of that year is unsustainable and that taxes on future generations must be raised in order to fulfill the government's intertemporal budget constraint. On the other hand, accounts based on 1998 suggest a sustainable policy and even allow for a small cut in the taxes of future generations.

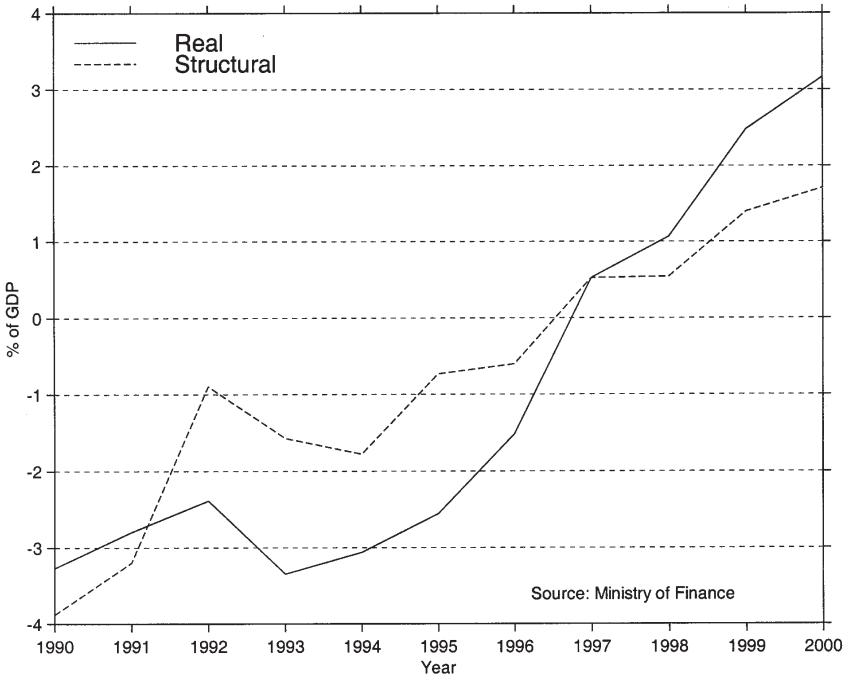
Table 1 also shows that the decrease in the IPL is mainly due to a fall in the implicit debt, which turns into implicit assets in 1996. The changes in the implicit debt between 1994 and 1998 can largely be traced to the business cycle. During this period, economic conditions were particularly favourable and government revenue rose from 35.2% to 37.4% of GDP. However, it must be observed that the ratio of government expenditure to GDP decreased from 40.0 to 36.9% between 1994 and 1998. The fall in the implicit debt can thus also be attributed to a restrictive fiscal policy.

The explicit debt decreased from 42 to 39% of GDP between 1994 and 1998. Although this decrease in the explicit debt has a negligible effect on the IPL when compared to the change in the implicit debt, it again indicates a contractive fiscal policy. It can thus be said that the Icelandic government ran a policy favourable to future generations in the period 1994–1998.

From our brief overview of recent developments in Icelandic economic conditions in an earlier section, it is clear that the years 1994 to 1998 were particularly pro-

4. Intertemporal public liabilities indicate how far short the government falls of fulfilling the intertemporal budget constraint, given a continuation of current fiscal policy. Positive IPL imply an unsustainable fiscal policy. The IPL are made up of explicit- and implicit debt. Explicit debt is government debt in the base year, estimated from official statistics (for the estimation of initial government debt, see IoES (2000)). Implicit debt is the debt that will be accumulated by future net tax payments of current- and future generations. IPL = explicit debt + implicit debt. See Raffelhüschen (2001) in this volume for a detailed discussion.
5. The exchange rate used is the average one year ask price; 82.72, 83.61, 83.26, 79,96 and 79.60 ISK/ECU in the years 1994 to 1998, respectively.

Figure 1.
Budget Performance and Structural Budget performance 1990–2000



sperous. An obvious question is therefore whether the generational imbalance is likely to turn again as soon as the business cycle takes a downward turn. Figure 1 strongly suggests that the prosperity of this period was not entirely due to the business cycle. The figure displays the real budget performance of the central government as well as the structural budget performance[6], which equals the real budget performance when the business cycle has been corrected for, for the period 1990 to 2000.

In the beginning of the 1990s, the central government was run with a deficit. However, this deficit has been declining since 1994 and from 1997 on there has been a budget surplus. It is natural to connect the improved position of government finances to increased business in the economy. However, the structural budget performance indicates that the improvement cannot solely be traced to the business cycle, it also seems that a real change has occurred in the running of the treasury. This implies that some of the changes in the Icelandic economic conditions during the period should be permanent, even if the business cycle swings downwards.

Baseline Results

Table 2 reports the generational accounts of all living cohorts[7], newborns to 90 years and older for the base year 1998. The first column

6. Calculated following standard OECD procedures.
7. Here, government consumption is included as a non-age-specific expenditure, according to the methodology proposed in EU (1999).

Table 2.
Distribution of the Lifetime Net Tax Burden

Generation's age in 199	Average	Male	(1000 ECU*) Female
0	-71.4	-34.9	-109.1
5	-53.2	-9.5	-97.0
10	-13.9	37.5	-69.8
15	35.6	106.1	-36.2
20	74.6	153.4	-5.6
25	116.6	204.2	23.5
30	134.6	224.0	41.8
35	132.6	216.3	48.5
40	126.9	206.7	47.8
45	103.0	171.3	30.6
50	66.3	132.1	1.6
55	24.7	81.8	-31.2
60	-21.7	27.4	-71.3
65	-69.4	-30.5	-105.4
70	-102.0	-72.1	-129.8
75	-110.8	-85.7	-130.7
80	-112.8	-90.1	-128.8
85	-110.7	-88.7	-124.2
90	-22.3	-19.9	-23.5
Increase in all taxes, future (%)	-10.6	-	-
Future generational account	83.2	-50.9	-116.9
Absolute difference	-11.8	-16.0	-7.8
IPL (% of GDP}	-16.0	-	-

reports the combined net tax burden of males and females, while the other two display the gender specific accounts.

We note that the average newborn has a significantly negative net tax burden, receives around 71 thousand ECU net of taxes over his lifetime. The accounts stay negative until the age of 12, when they turn positive due a lower discounting of future taxes. The net tax burden increases steadily with age until it reaches a peak at the age of 31 when the net tax is around 140 thousand ECU. From then onwards the accounts decrease and turn negative again at the age of 58. At this point, future pension receipts, health care benefits etc. outweigh the taxes that remain to be paid. The lifetime net transfer receipts reach their maximum at the age of 74 years and gradually decrease from then on due to a shorter life expectancy. As a result, a typical life-cycle pattern can be observed. Cohorts aged 12–57 face positive tax burdens, i.e. on average Icelanders are net taxpayers for around 46 years of their lives. All other living generations receive net transfers in present value terms.

As is apparent from Table 2, the gender-specific differences in net tax burdens are large. While the average newborn male receives a net transfer of 35 thousand ECUs over his lifetime, an average female receives

109 thousand ECUs. One of the reasons is that children's benefits are usually paid to the mothers, while some taxes, such as property taxes, are more often connected to the men. However, the major reason is that on average, women receive lower wages and thus pay lower taxes.

The government's intertemporal public liabilities are negative for the base year 1998 as can be seen in Table 2. The surplus in the government's intertemporal budget constraint generated by the continuation of present fiscal policy is about 16% of GDP. This means that future generations will receive a bonus, despite the explicit debt of 39% of GDP. Therefore, all taxes of future cohorts can be reduced by 10.6[8]. This means that future newborns can expect to pay ECU 11.800 less than the 1998 generation, on average.

The above accounts are not intergenerationally balanced. In order to ensure equality between current- and future generations, an immediate tax reduction of 1.46% or increase in transfers by 1.74% would suffice.

Instigation of a Fishing permit Fee

The fishing industry in Iceland has undergone considerable changes in the last decades. Following the expansion of the territorial waters to 200 nautical miles in 1975, the fishing grounds were exploited without consideration for the stock size. In 1984, the fisheries management system of total allowable catches and individual transferable quotas was introduced to control the exploitation of the resource. As such, the system has proved its worth. However, some of its factors have received increased criticism in recent years. This especially applies to the right to transfer the quota to a third party, i.e. to profit from selling a share in a national resource that was allocated free to them in the beginning.

In recent years, the discussion on whether to collect a fee for the exploitation of national resources, the fishing grounds in particular, has been prominent in the national debate. In order to propose some solutions, a committee was established and published a report in September 2000 where it recommends that all natural resources should be declared a property of the nation and a fee collected for their utilization.

The question is, how would the proceeds of a tax for the exploitation of the Icelandic fishing grounds, a so-called fishing permit fee (FPF), be spent. As the tax would be collected for the utilization of a national property, the proceeds should be used for the benefit of the nation as a whole. The idea here is to establish a generational fund to cover the unfunded pension liabilities of the government, which have grown considerably in the 1990s.[9]

Clearly, the instigation of a FPF will involve redistribution of wealth, as only the owners of the fisheries will be subject to the tax. As such, it is interesting from the point of view of generational accounting. Table 3 reports the results of a policy experiment where a yearly FPF, sufficient to cover the government's pension liabilities, is implemented. The revenue from the FPF is distributed by age and gender using the distribution of stock ownership. This is only a rough approximation, as a large part of firms in the fishing industry is in private ownership. Also, firms in the fishing industry are only 17 out of the 73 enterprises and funds on the Iceland Stock Exchange. The first two

8. We talk about changes in taxes and transfers as a percentage of total taxes or transfers.
9. This idea originates with Tryggvi Thor Herbertsson, IoES.

Table 3.
Results of Fishing permit Fee Experiment

Base year	Pension liabilities*	Fishing permit fee*	IPL baseline (% of GDP)}	IPL with FPF (% of GDP)	% Tax change**
1994	1,158	49	120	91	9.71
1995	1,187	50	71	43	4.49
1996	1,305	55	37	9	0.90
1997	1,420	60	0	-28	-2.98
1998	1,810	77	-16	-47	-4.84

* 1,000,000 ECU, each years value
** Tax change needed to reach intergenerational balance after implementation of FPF

columns of Table 3 show the government's pension liabilities and the yearly FPF needed to cover them, for the base years 1994 to 1998. The next two columns report the IPL before and after the implementation of the FPF. The final column displays the tax adjustment needed in addition to the FPF to achieve generational balance.

The first point we note is that the FPF needed each year to cover the government's pension liabilities is very high, or between 9.1 and 10.4% of GDP. If implemented at all, the FPF would never be this high, 1% of GDP would be a more realistic figure. Another point of interest is that the FPF could actually increase the intergenerational imbalance according to the 1997 and 1998 accounts. Additional policy changes would be needed to achieve generational balance. For the 1998 accounts, taxes on current and future generations would have to be decreased by 4.84% to reach intergenerational equality.

Monte Carlo Sensitivity Analysis

As has been extensively documented in the generational accounting literature, the accounts are particularly sensitive to the choice of discount- and growth rate. Moreover, the accounts do not always behave in an a priori specified manner when those parameters are altered. Therefore, some sort of a sensitivity analysis is necessary.

Frequently, the sensitivity of the accounts is assessed by computing the results for a few different values of the discount- and growth rate, like we do in Table 4. However, while such experiments indeed reveal that the choice of those parameters greatly affects the outcome of the accounts, they are lacking in other respects. Most importantly, they do not reveal how key elements of the accounts move with the discount- or growth rate. As we will see later the IPL, for example, can be decreasing over some intervals of the growth- or discount rate and increasing over others. Therefore, these experiments do not usually reveal whether or not the accounts behave unexpectedly for any specific values of the discount- or growth rate. Furthermore, such a sensitivity analysis does not contribute much to the understanding and interpretation of the generational accounting model, of how and why the accounts react to changes in the discount- and growth rate.

In this paper, we use Monte Carlo analysis to assess the sensitivity of the generational accounts to changes in the discount- and

Table 4.
Sensitivity Analysis, 1998 Accounts

Growth rate	1%			1.5%			2%		
Discount rate	4%	6%	8%	4%	6%	8%	4%	6%	8%
Current generations (1,000 ECU)	-59	-73	-74	-52	-71	-75	-43	-68	-75
Future generations (1,000 ECU)	-76	-83	-72	-69	-83	-76	-61	-82	-79
IPL (% GDP)	-34	-11	2	-43	-16	-1	-56	-21	4

growth rate, the first time employed in this context to our knowledge. This approach involves repeated computations of the generational accounts, each time using a different, random discount- and growth rate. The Monte Carlo experiment presented here is based on 1998 data. The analysis looks at three important elements of the accounts, the net tax burden of the generation born in the base year, the net tax burden of future generations and the IPL. The following discussion has two focus points. First, how the IPL and the tax burden of current and future generations move with the discount- and growth rate. Second, how sensitive the accounts are in an interval close to our base case of a 1.5% growth rate and a 6% discount rate.

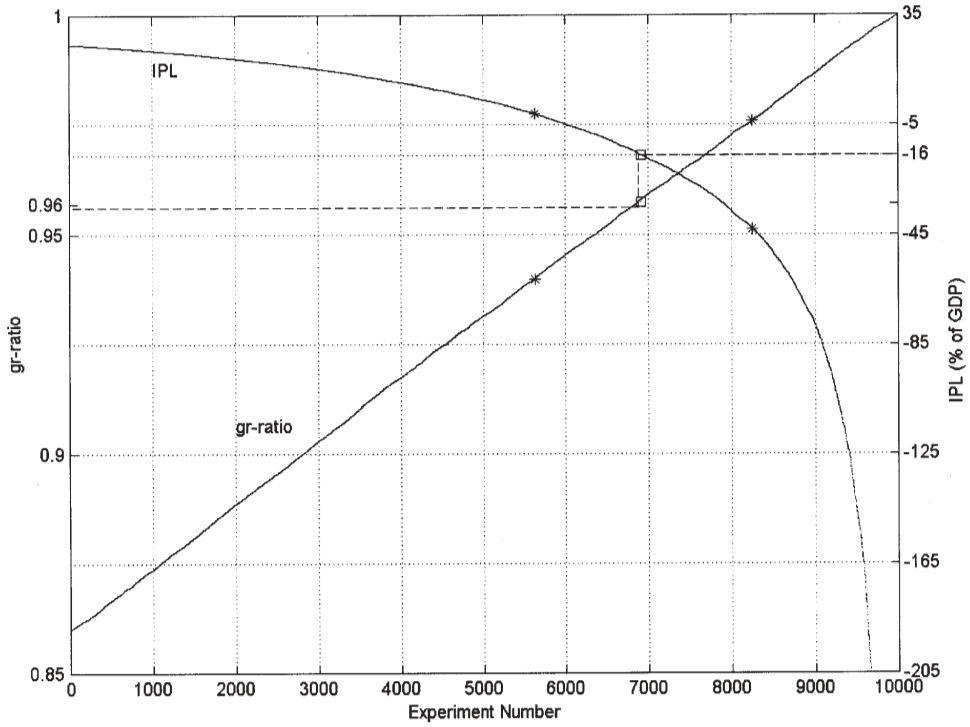
An important factor of the generational accounting model should be mentioned. If the model is closely examined, we note that the growth- or discount rate on their own do not determine the outcome of the accounts, rather the ratio between the two parameters, $\frac{1+g}{1+r}$, hereafter the *gr-ratio*. We note in particular that two different values of the discount- and growth rate yield the same generational accounts if the gr-ratio is the same in both cases. We took advantage of this property when conducting the Monte Carlo experiments.

The accounts were calculated for 10,000 different values of the gr-ratio, drawn from a random uniform distribution between 0.86 and 0.99.[10] This interval of the gr-ratio should contain all viable (and some not so viable) combinations of the discount- and growth rate[11]

We start by examining the relationship between the gr-ratio and the IPL. This is clearly displayed in Figure 2, a scatter diagram where the gr-ratio is plotted on the left y-axis against the corresponding IPL on the right y-axis. The experiments are ordered by the gr-ratio. We note that as the gr-ratio increases (which is equivalent to an increase in the growth rate or a decrease in the discount rate), the IPL initially decreases slowly. However, when the gr-ratio approaches 1, the IPL starts decreasing rapidly and it is clear that the IPL is very sensitive when the growth rate approaches the discount rate. The reason is

10. The value 0.86 of the gr-ratio corresponds e.g. to a 1.5% growth rate and an 18% discount rate, or a 5% growth rate and a 22% discount rate. The value 0.99 is obtained when the growth rate is almost equal to the discount rate.
11. Note, that generational accounting does not allow the growth rate to be greater than or equal to the discount rate. This would imply a dynamically inefficient situation where the government could allow debt to increase indefinitely, as income would grow at a higher rate than the interest payments.

Figure 2.
IPL vs. the gr-ratio



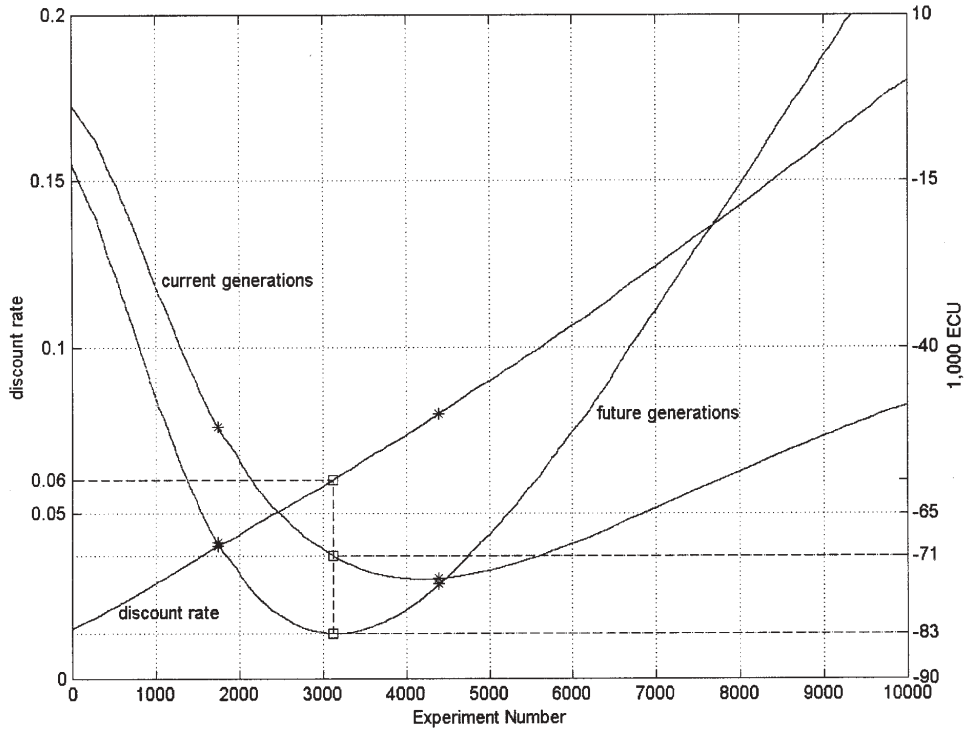
that when the interest rate is almost equal to the growth rate, the present value of payments made by generations born in the distant future is little less (in absolute value) than the value of payments made today. As time does thus hardly affect the present value of future payments when the growth rate is close to the discount rate, the absolute value of total net tax payments of future generations will approach infinity as the growth rate approaches the discount rate.

We have marked a few points in the figure. The points marked with a square corresponds to the base case of the accounts with a 6% discount rate and 1.5% growth rate. In this point, the IPL is – 16% of GDP. The points that are marked by a star represent a 4 and 8% discount rate and a 1.5% growth rate and the IPL in these points is –43% and 1% of GDP, respectively. By moving from a 6% to an 8% discount rate the intertemporal public assets change into intertemporal public liabilities.

Figure 3 displays how the tax burden of current- and future generations moves with the discount rate, when the growth rate is assumed to be constant at 1.5%.[12] We note that the tax burden of current and future generations is initially strictly decreasing, but when the discount rate exceeds a certain point the curves become increasing. To explain this behaviour, it is necessary to examine the raw profiles of the base year. We find that between

12. The discount rate is derived from the gr-ratio using the formula $r = (1+0.015)/\text{gr-ratio}-1$.

Figure 3.
Current- and Future Generations vs. the Discount Rate



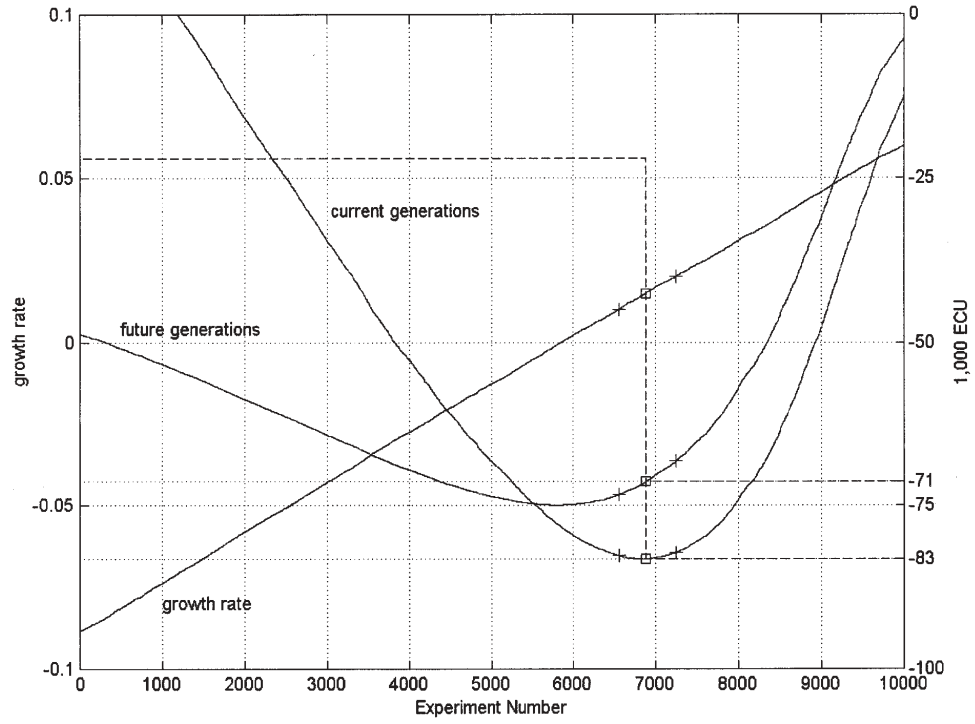
the ages of 0 and 19 individuals pay negative amounts to the government, receive net transfers. Between the ages of 20 and 68, however, they pay net taxes to the government. During the remainder of their lives, they receive net benefits from the government. Although a larger discount rate reduces all future amounts, it increases the weight of payments close in time. Therefore, it is normal that the curves in Figure 3 decrease initially. However, because the future tax payments are so much greater than the initial transfers, there comes a time when the increased weight of the initial transfers is not enough to counteract the reduction in monetary terms of a higher interest rate. At that point, the curves start to increase.

We have marked the base case of 6% discount rate in the figure, along with the points where the discount rate is 4 and 8%. The corresponding values for the tax burden of current- and future generations are reported in Table 4.

Figure 4 displays how the tax burden of current- and future generations moves with the growth rate, when the discount rate is assumed to be constant at 6%.[13] All the experiments are ordered by the growth rate. Initially, there is a large gap between the tax burden of current and future generations. However, this occurs for negative growth rates and is thus perhaps not particularly

13. The growth rate is derived from the gr-ratio using the formula g = gr-ratio*(1+0.06)–1.

Figure 4.
Current- and Future Generations vs. the Growth Rate



interesting. When the growth rate has exceeded zero, the tax burden of current and future generations is not widely separated. Another point to note is that the tax burden of future generations reaches a minimum when the growth rate is zero, while the tax burden of current generations reaches a minimum when the growth rate is close to 1.5%. The two curves intersect in one point, where intergenerational equality is reached.
We have marked the base case of 1.5% discount rate in the figure, along with the points where the growth rate is 1 and 2%. The corresponding values for the tax burden of current- and future generations are reported in Table 4, but it is clear from the figure that the accounts are not particularly sensitive over this interval for the growth rate.

We note that Figure 4 is the mirror image of Figure 3. The explanation as to why the net tax burden of current- and future generations are initially decreasing with the growth rate and then start to increase is parallel the one given when Figure 3 was considered. A larger growth rate increases the weight of future payments. When the growth rate is small (and even negative), the initial transfers carry more weight when the lifetime tax burden is computed. However, when the growth rate reaches a certain level the situation is reversed and the curves start to increase.

Conclusions

In the 1990s, the Icelandic economy achieved relative stability after high inflation and repeated devaluations of earlier decades. The

latter part of the decade was a prosperous period with high GDP growth and from 1997 onwards the budget was run with surpluses.

This paper employs generational accounts to examine the impact of the economic conditions and fiscal policy of recent years on current- and future generations in Iceland. We examine the development of the intergenerational imbalance between 1994 and 1998 in light of fiscal policy and economic conditions of that period. We find that the intertemporal public liabilities of the government decreased every year and in 1998 there are even intertemporal assets. This can largely be attributed to the business cycle, but the impact of a restrictive fiscal policy cannot be ignored. It can even be said that the fiscal policy of the Icelandic government over this period headed towards generational equality.

We also examine the effects of implementing a tax for the exploitation of the Icelandic fishing grounds, using the revenue to establish a generational fund to cover the unfounded pension liabilities of the government. The result is that the annual tax needed for that purpose would be unrealistically high, or between 9.1 and 10.4% of GDP. Such a policy would increase the intertemporal public assets of the government according to the accounts of 1998 and additional cuts in taxes would be needed to achieve intergenerational equality.

Finally, we performed a Monte Carlo analysis to assess the sensitivity of the generational accounts to changes in the discount- and growth rate. Such a sensitivity analysis gives additional information on how the accounts react to changes in the discount- and growth rate, as well as being informative on whether the accounts are particularly sensitive on any specific intervals for these parameters.

References

A. Auerbach, L. K. and Leibfritz, W., editors, 1999. *Generational Accounting around the World.* The University of Chicago Press.

Auerbach, A., Gokhale, J., and Kotlikoff, L., 1991. Generational Accounting. A Meaningful Alternative to Deficit Accounting. *NBER Working Papers*, no. 3589.

Auerbach, A. and Kotlikoff, L., 1995. *Macroeconomics. An Integrated Approach. South-Western College Publishing.*

Auerback, A., Gokhale, J., and Kotlikoff, L., 1994. Generational Accounting. A Meaningful Way to Evaluate Fiscal Policy. *Journal of Economic Perspectives,* 8(1):73-94.

Auerback, A., Kotlikoff, L., and Leibfritz, W., 1998. *Generational Accounting Around the World.* Bank of Japan, 2 edition.

Banks, J., Disney, R., and Smith, Z., 1999. What Can We Learn About Pension Reform from Generational Accounts for UK? *The Istitution for Fiscal Studies,* working paper series, 99(16).

Banks, J., Disney, R., and Smith, Z., 2000. What Can We Learn From Generational Accounts for the United Kingdom. *The Economic Journal,* 110(467):575-597.

Benediktsson, H., Magnússon, G., Herbertsson, T., and Skúladóttir, M., 1998. Kynslódareikningar fyrir Ísland 1994 til1996. *Fjármálatídindi,* 2.

Boll, S., Raffelhüschen, B., and Walliser, J., 1994. Social Security and Intergenerational Redistribution: A Generational Accounting Perspective. *Public Choice,* 81:79-100.

Cardarelli, R., Sefton, J., and Kotlikoff, L., 2000. Generational Accounting In the UK. *The Economic Journal,* 110(467):547-574.

Congressional Budget Office, 1995. Who Pays and When? An Assessment of Generational Accounting. *A Congressional Budget Office Study.*

EU (1999). Generational Accounting in Europe. *European Economy,* 6.

Gjersem, C. and Steigum, E., 1994. Generasjonsregnskap for Norge. Beregningsgrunnlag og resultater. *SNF -rapport,* 87.

Gjersem, C. and Steigum, E., 1997. Generations Accounting and Depletable Natural Resources: The Case of Norway. *NHH Institute of Economics Working Paper,* 3.

Gudmundsson, M., Herbertsson, T., and Zoega, G., editors, 2000. *Macroeconomic Policy. Iceland in an Era of Global Integration.* University of Iceland Press.

Haveman, R., 1994. Should Generational Accounts Replace Public Budgets and Deficits? *Journal of Economic Perspectives*, 8(1):95-111

IoES, 1997a. *Kynslódareikningar fyrir Ísland.* IoES. Contractual Research Report, C97:07.

IoES, 1997b. *Menntun, mannaudur og framleidni.* IoES. Contractual Research Report, C97:02.

IoES, 1998. *Um ávöxtun og núvirdingu.* IoES. Research Report, R98:02.

IoES, 1999. *Generational Accounts for Iceland.* IoES. Working Paper, W99:06.

IoES, 2000. *Thróun kynslódareikninga fyrir Ísland milli áranna 1994 og 1998.* IoES. Research Report, R00:02.

IoES, 2001. *Population Forecast for Iceland.* IoES. Research Report, R01:01.

Jensen, S. and Raffelhüschen, B., 1996. Public Debt, Retirement and Intergenerational Distribution of Tax Burdens in Denmark. *EPRU Working Paper Series,* 22.

Jensen, S., Raffelhüschen, B., Jacobsen, P., and Junge, M., 1996. Et generationsregnskab for Danmark. *EPRU Working Paper Series,* 12.

Kotlikoff, L., 1992. Generational Accounting. Knowing Who Pays, and When, for What We Spend. *New York, the Free Press.*

Ministry of Finance, 2000. *Frumvarp til fjárlaga 2001.* Ministry of Finance.

National Accounting Office, 1994, 1995, 1996, 1997, 1998. *Ríkisreikningur*. National Accounting Office.

National Economic Institute, 1994, 1995, 1996, 1997, 1998a. *Thjódarbúskapurinn.* Number 18, 20, 22, 23, 25. National Economic Institute.

National Economic Institute, 1998b. *Sögulegt yfirlit hagtalna*. Number 24. National Economic Institute.

National Economic Institute, 1999. *Búskapur hins opinbera 1994-1998*, volume 18. National Economic Institute.

Raffelhüschen, B. , 2001. In this volume.

Snævar, S. , 1993. *Haglýsing Íslands.* Heimskringla.

Statistics Iceland, 1994, 1995, 1996, 1997, 1998a. *Landshagir*. Statistics Iceland.

Statistics Iceland, 1994, 1995, 1996, 1997, 1998b. *Sveitasjódareikningar*. Statistics Iceland.