



Ministry of Finance

THE ICELANDIC ECONOMY

The macro-economic impact of the construction of power plants and aluminium smelters

Nr 1: 2003
10 January 2003

INTRODUCTION

At the request of the Ministry of Industry, the Economic Department of the Ministry of Finance has assessed the impact upon the economy of the construction of hydro-power projects, an aluminium smelter at Reyðarfjörður in Eastern Iceland and the enlargement of the Norðurál smelter at Grundartangi in the vicinity of Reykjavík. The assessment covers the following cases:

1. The production capacity of the Norðurál smelter would be increased by 90,000 tons in 2005 and further by 60,000 tons in 2009. Alcoa would build an aluminium smelter at Reyðarfjörður with a capacity of 322,000 tons which would commence production in 2007.
2. The production capacity of the Norðurál smelter would be increased by 90,000 tons in 2005 and further by 60,000 tons in 2009. The Reyðarfjörður smelter would not be built.
3. Alcoa would build a 322,000 ton smelter at Reyðarfjörður that would commence production in 2007. The production of the Norðurál smelter would not be increased.

These three cases are examined in comparison to a reference case where none of these projects are included. In addition, two scenarios of special counter-cyclical measures to dampen the economic fluctuations due to these investment projects are discussed. The conclusions of the examination are presented as a deviation from the reference case and therefore they do not show a total for each relevant economic figure. The deviations are shown as percentages rather than as a proportion of the entity in question.

1 CONCLUSIONS

General

- The methodology of these projections is basically the same as has been applied in similar projections in recent years. The conclusions are published in the form of deviations from a given reference case, assuming no power and smelter investments, a case identical to the Ministry's December 2002 forecast.
- The reference case of the economy is of great importance for the projections. For example, the inflationary pressure might turn out to be lower if unemployment turns out to be greater than assumed in the reference case.

-
- An important assumption in the reference case is that the exchange rate index will remain constant at 130 throughout the investment period, i.e. slightly below the 2002 average.
 - It is important to bear in mind that a forecast of this nature is subject to much uncertainty. The size of the proposed investments in relation to the Icelandic economy is such that it is difficult to capture their economic impact in full in a macro-econometric model.
-

The Norðurál expansion

- Both GDP and GNP will be 1½ per cent higher during the investment period of the first phase of the Norðurál expansion in 2003-2006 than in the reference case. For the latter phase, the level could be 1 per cent higher¹. The impact on the annual growth rate is expected to be considerably lower². The long-term incremental impact on GDP is expected to be close to ½ per cent.
 - Total investment is expected to be 12 per cent higher than in the reference case in the first phase of the project expansion period and 5 per cent higher during the second phase. Unemployment should be reduced during the first phase and inflation pressure would tend to build up. These effects are expected to be relatively moderate and inflation would probably stay within the tolerance limits set by the Central Bank during the investment period, based on a 2-2½ per cent inflation rate in the reference case.
 - Imports of investment goods and increased demand will lead to an increase in the current account deficit during the construction period, equivalent to 1½ per cent of GDP on average. Total exports could be 5 per cent higher than in the reference case during the first decade after the construction is complete.
-

The Alcoa aluminium smelter

- It is estimated that the level of output, GDP and GNP, would be 3 per cent higher than in the reference case during the 2003-2006 construction period. The annual growth rate is expected to be 1½ per cent higher. In the long run, GDP is expected to be 1 per cent higher and GNP ¾ per cent higher.
 - Total investment could be more than 30 per cent higher during the construction period, peaking at 47 per cent in 2005 and 2006.
 - The substantial economic upswing during this period, followed by a downswing upon completion calls for a dynamic economic policy. In the absence of counter-cyclical measures, economic growth could reach 5 per cent in 2005 and 2006 and inflation rise to 4½-6½ per cent. This could be followed by a 1 per cent lower annual growth rate in the years 2007-2010 than in the reference case.
 - The labour market will be subject to considerable fluctuations. Unemployment is estimated to be 1 per cent
-

¹ The difference between the gross domestic product and the gross national product consists of net factor payments to abroad, i.e. the balance of interest income and payments as well as dividends received and paid. The sum of these items has been in deficit for a number of years and GNP has therefore been lower than GDP.

² A distinction must be made between the level of output, as measured by GDP or GNP, on one hand and economic growth on the other. The former refers to total output over a certain period whereas the latter refers to the increase in output in real terms between two periods.

lower during the peak of the construction activity. On the other hand, unemployment may increase by 1½ percentage points after completion.

- The current account balance could show a deficit that would be 4½ per cent higher during the construction period with the result that the external debt position of the economy would increase by 15 per cent. The increase in aluminium exports should however create conditions for gradually reducing foreign debt upon completion of construction. Based on a constant nominal exchange rate, merchandise exports are estimated to increase by 10-14 per cent over the next two decades following the construction period.

The Alcoa aluminium smelter and the Norðurál expansion

- Estimates indicate that the level of output, both GDP and GNP, will be 3-4 per cent higher during the 2003-2010 period. The annual growth in GDP will most likely be 1¾ per cent higher in the years 2003-2006. GNP and GDP are likely to be 1 and 1¾ per cent higher in the long run.
- Total investment in the economy is expected to be 67 per cent higher in 2005-2006 and 25 per cent higher on average for the years 2003-2010. Sharp changes in investment tend to lead to sharp fluctuations in the economy as a whole. Economic growth could reach a peak of 5-7 per cent and inflation 5-8 per cent. A sharp decline in investment could lead to a temporary stagnation. The current account is estimated to deteriorate during the 2003-2010 construction period by 5 per cent of GDP.
- As in the previous examples, an increase in aluminium exports creates conditions for the reversal of the current account balance and a higher real exchange rate. Based on a constant nominal exchange rate, annual export earnings are projected to be 14-20 per cent higher for the years 2010-2025.

The impact of counter-cyclical measures

- These investment projects, particularly the Alcoa smelter, will have a substantial impact upon economic developments, particularly when construction activity is at its peak. It is therefore important that economic policy be formulated in light of these circumstances. This applies both to monetary and fiscal policy.
- A rise in interest rates and a reduction in public investments will offset increased domestic demand and thereby inflation. For example, a 2 per cent increase in real interest rates³ could lead to a reduction in inflation of ½-1 per cent on average, in the absence of other economic policy measures. If public investment were at the same time reduced by 10 per cent, the impact would be greater. Inflation could be further reduced by 1½-2½ per cent on average in 2005 and 2006. Taken together, such measures could reduce inflation by 2-

³The Central Bank base rate is the chief monetary policy instrument available to affect the real exchange rate. Changes in the base rate affect other interest rates in different ways and with different time lags, all depending on circumstances. It is therefore not possible to state beforehand by how much or when the base rate must change to bring about a given change in the real interest rate. This must be subject to the assessment of the Central Bank in each instance.

3½ per cent, thus contributing to the Central Bank's policy of keeping inflation under control.

- These simulations probably underestimate the impact of interest rate changes upon inflation, since they are based on the historical experience nested in the applied macro-economic model. The considerable structural changes in the Icelandic economy in recent years have contributed to a more effective monetary policy, particularly as regards the impact of interest rate changes upon the economy.

2 METHODOLOGY, BASIC ASSUMPTIONS AND STIPULATIONS

The study is largely based on the same methods as earlier studies in recent years. The same macro-econometric model has been used for simulation exercises. The conclusions are generally presented as divergences from a given reference case, where no aluminium smelter and power project investments are included. This reference case is identical to the national economic forecast of the Ministry of Finance which was published at the beginning of December 2002. That forecast estimated that GDP would increase by 1¼ per cent in 2003 and 2½-3 per cent a year in 2004-2007. It also forecast inflation at just over 2 per cent a year and unemployment in the region of 2-2½ per cent. The condition of the economy in the reference case is of great importance for the outcome of the simulations. For example, the pressure of inflation could be lower if unemployment turned out to be higher than assumed in the reference case.

The simulations are on one hand based on the general economic assumptions of the reference case and on the other hand on information from the investors regarding construction costs, manpower and timing. A constant exchange index of 130 throughout the construction period is an important assumption. This rate is slightly lower than the 2002 average. A second important assumption is that public consumption will increase by an average of 2½ per cent and public investment by 1½ per cent. In all three cases it is assumed that one-fourth of the manpower for the construction will come from abroad and leave the country upon completion. It is also assumed that 85 per cent of the disposable income of imported manpower will be spent abroad. Sixty-five per cent of materials for the construction of the smelters are assumed to be provided through imports and 53 per cent for the power projects. Should these percentages prove higher, the pressure on inflation may be assumed lower. The impact of changed assumptions will be discussed more fully in the closing chapter.

The cost of construction is assessed at average domestic prices in 2001 and a US dollar exchange rate of 85 krónur, the average for November 2002, for cost estimates denominated in foreign currency.

The assessment of the long-term impact of the investment takes account of the conclusions of earlier studies which revealed that the GDP-level increases in the longer run because the investment will tend to increase the productivity of the economy, i.e., because productivity in aluminium production is expected to be higher than the average for the economy as a whole.

In interpreting the conclusions it is important to remember that a simulation of this type is subject to uncertainty. At least in two cases the size of investments in relation to the size of the Icelandic economy that it is difficult to assess its impact within the given time frame, i.e. from one year to the next. The assessment of the impact for the period as a whole is probably more certain.

The following section deals exclusively with the Norðurál expansion. The next section thereafter discusses the Alcoa expansion and the third these two projects taken together.

3 THE NORÐURÁL EXPANSION

This section examines the impact of a 90 thousand ton expansion in 2005 and a further 60 thousand tons in 2009 of the Norðurál aluminium smelter in Grundartangi. The estimated cost of the expansion is close to 90 billion krónur, for the smelter and power projects taken together. The main impact of the first phase of the expansion will fall on the years 2004 and 2005 and the second phase on 2008 and 2009. The expansion would increase total investment in the economy by 12 per cent in 2003-2006 and be about one-fifth higher than in the reference case at the peak of construction activity. The annual manpower requirement for construction would average 400 in the years 2003-2006, about $\frac{1}{4}$ per cent of estimated total manpower in the labour market. Upon completion, the Norðurál smelter at Grundartangi would create 240 new jobs at the smelter. Imports of investment goods and increased economic activity on the whole will increase the current account deficit during the construction period by an average of 2 per cent of GDP in 2003-2006, compared to the reference case.

The conclusions of this simulation are that both GDP and GNP will increase by $1\frac{1}{2}$ per cent on average during the first phase. The impact on the annual growth rate will be considerably less. Since the Nordural expansion will take place in two separate phases, a substantial contraction is not expected when the construction is completed, although economic growth may be expected to slow down below the rate in the reference case during the first year after the completion of the first phase.

The price impact is expected to be rather moderate and the upper target limit of the Central Bank of 4 per cent inflation may be expected to hold without special measures, although inflation may approach the upper limit in 2005. Unemployment could be $\frac{1}{4}$ per cent below the level in the reference case.

Table 1. The impact of the Norðurál project
Deviations from the reference case

	2003	2007	2003
Changes in per cent	-2006	-2010	-2010
Gross national product*	1½	1	1¼
Gross domestic product*	1½	1¼	1½
Average annual GDP growth	¼	0	0
Investment	12¼	5	8½
Inflation	¾	-½	¼
Current account (p.c. of GDP)	-2	-1	-1½
Unemployment	-¼	¼	0
Exports	1¼	4¾	3
Long-term impact in per cent			
Gross national product*	½		
Gross domestic product*	½		
*Level of output.			

In the long run, there is no reason to assume that the Norðurál expansion will have an impact on inflation and the level of employment. Production and exports will however be positively influenced. Both GDP and GNP are expected to be ½ a per cent higher in the long run as a result of the expansion. The increase in exports depends on the real exchange rate and the world price of aluminium. Based on the development of aluminium prices assumed in this study⁴ and the constant króna exchange rate, exports will be 5 per cent higher than in the reference case in 2005-2025. Should the real exchange rate turn out to be lower than indicated by the simulation conclusions, the impact upon exports and the current account could be more favourable. This would of course also apply to the cases discussed below.

4 THE ALCOA SMELTER

The estimated investment cost of the Kárahnjúkar power project and the Alcoa smelter at Reyðarfjörður amounts to 165 billion krónur. According to the plans that are used as a basis for this study, the construction of the smelter will be completed in 2007 and full production capacity of 322 thousand tons a year will be reached in 2008. Construction activity will peak in 2005 and 2006 and more than half of the total investment cost will be incurred in those two years. Total investment in the economy will be about 30 per cent higher than in the reference case during the 2003-2006 construction period and close to 50 per cent higher in 2005-2006. The annual manpower requirement will exceed 1,250 on average in 2003-2006, about 0.8 per cent of estimated manpower in the labour market. In addition, the indirect effect of these activities is estimated to lead to 800-900 jobs during this period. The smelter will employ 500 once in full operation.

⁴ It is assumed that the price of aluminium increases in nominal terms by 1-2 per cent a year in foreign currency terms, based in part on the long-term prospects of CRU International Ltd.

Table 2. The impact of the Alcoa project
Deviations from the reference case

	2003	2007	2003
Changes in per cent	-2006	-2010	-2010
Gross national product*	3	1½	2¼
Gross domestic product*	3	2¼	2½
Average annual GDP growth	1½	-1	¼
Investment	30¼	4	16½
Inflation	2	-¾	½
Current account (p.c. of GDP)	-4½	-2	-3¼
Unemployment	-¾	1	0
Exports	-½	11¾	6
Long-term impact in per cent			
Gross national product*	¾		
Gross domestic product*	1		
*Level of output.			

GDP is estimated to be 3 per cent higher on average during the construction phase than in the reference case. The annual growth rate is expected to reach 5 per cent in 2005 and 2006. The upper inflation limits of the Central Bank will probably be breached, unless offsetting measures are undertaken. On the other hand, the annual growth rate in 2007-2009, i.e. after construction is completed, may be expected to be below 1½ per cent unless offsetting measures are resorted to. The level of employment would reflect the economic growth rate. Unemployment will decline considerably in 2005 and 2006 and increase commensurably thereafter.

Increased imports of investment goods in connection with the construction activity and increased economic activity in general will lead to an increased current account deficit during the construction period, equivalent to an average of 4½ per cent of GDP in 2003-2006. On the other hand, increased aluminium exports will have a positive effect on the current account, and total exports during the first decade after completion is estimated to be 12 per cent higher than in the reference case. In the long run, GNP is expected to be ¾ per cent and GDP 1 per cent higher than in the reference case.

***THE ALCOA SMELTER AND THE
NORÐURÁL EXPANSION***

This case study discusses the largely simultaneous expansion of Norðurál and the Alcoa smelter. This would be the largest construction ever to take place in Iceland. Should this be realised, aluminium production would triple. Total investment in smelters and power projects would amount to 250 billion krónur in 2003-2010. Annual manpower needs would be about 2,000, or more than 1¼ per cent of total labour supply in 2004-2006. Total investment in the economy would be 55 per cent higher than in the reference case. Economic growth could peak at 5-7 per cent and unemployment dip below 1 per cent.

**Table 3. The combined impact of the Alcoa and
Norðurál projects**
Deviations from the reference case

	2003	2007	2003
Changes in per cent	-2006	-2010	-2010
Gross national product*	4½	2	3¼
Gross domestic product*	4¾	3	3¾
Average annual GDP growth	1¾	-1¼	¼
Investment	44¼	8¼	25½
Inflation	3½	-1½	1
Current account (p.c. of GDP)	-6½	-3½	-5
Unemployment	-1	1½	¼
Exports	½	16	8¾
Long-term impact in per cent			
Gross national product*	1		
Gross domestic product*	1¾		
*Level of output.			

There will inevitably be a stagnation in economic growth in 2007 when construction comes to an end which is wholly attributable to the sheer size of the construction project. Construction would again commence in 2008 when the latter phase of the Norðurál project begins. The macro-economic simulations indicate that the economy will again move towards equilibrium after 2010 with a growth rate of 3 per cent on average.

These projections indicate that GDP would be 4 per cent higher on average during the 2003-2010 construction period than in the reference case. In the long run, the investment would have a positive influence on production, exports, the current account and the real exchange rate. GDP growth could exceed the growth rate of the reference case by 1¾ per cent.

6 COUNTER-CYCLICAL MEASURES

The pending construction of the above smelters will have a profound influence on economic activity over the next several years. Large changes in investment will cause substantial fluctuations in economic activity. It is therefore important that economic policy be directed to meet these circumstances. The following section discusses possible measures to offset these fluctuations. It should be noted that the cases discussed are limited in scope. They are shown in order to demonstrate how influential the economic policy tools at the Government's disposal can be. The previously discussed stipulations regarding the sheer size of the investments in relation to the size of the economy must be reiterated.

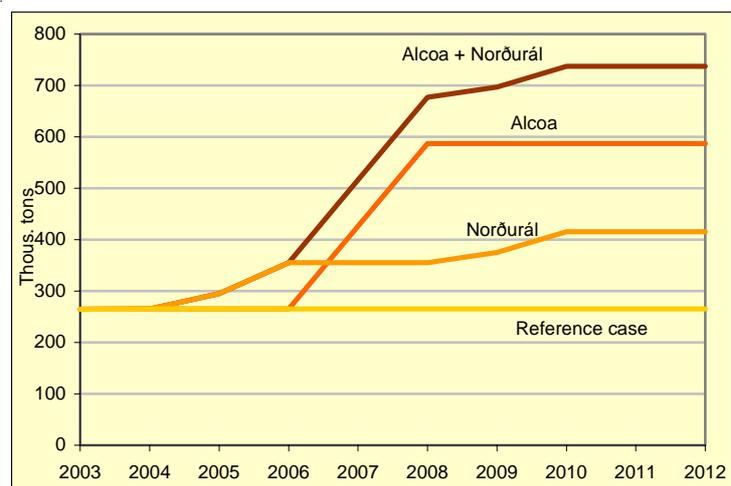
How will the impact of these investments affect the economy? A simple description would run like this. The investments would cause a large inflow of foreign capital, through foreign borrowing by domestic parties such as Landsvirkjun and through direct investment in the smelt-

ers. The latter could either be financed through borrowing or with equity financing. As a direct result of these investments, the demand for labour and other production factors will increase which in turn will reduce unemployment. Should demand for labour exceed the reduction in unemployment, as would be in this case, wage pressures will emerge. The supply of foreign exchange will increase which in turn will raise the króna exchange rate. A current account deficit will be inevitable during the period of investment goods imports. The foreign debt of the country will also increase, but it must be kept in mind that the smelter operators are foreign entities, Norðurál and Alcoa.

Once the bulk of the construction activity is over, there will be an inevitable decline in economic activity. The demand for labour will decline and so will economic growth and inflation. The balance of payments will however improve, once the investments increase export earnings which in the end will finance the debt service of the foreign borrowing undertaken to finance the investments. Once the period of contraction after the completion of the construction is over, the economy will adjust slowly to a new equilibrium where the output level of the economy will have increased by the amount of new production and the total effect caused thereby.

Chart 1 shows how total aluminium production will develop in the near future under the three cases studied, in addition to the reference case with unchanged production. The chart shows that the entry of the Alcoa smelter will

Chart 1. Estimated aluminium production in Iceland 2003 - 2012, thous. tons.



more than double the tonnage of aluminium production and still more if the Norðurál expansion is included. This indicates the size and scope of these investments.

The economic impact of these three cases also differs. The accompanying charts summarise the main conclusions for the two periods under discussion.

The charts show deviations from the reference case

Chart 2: Economic growth

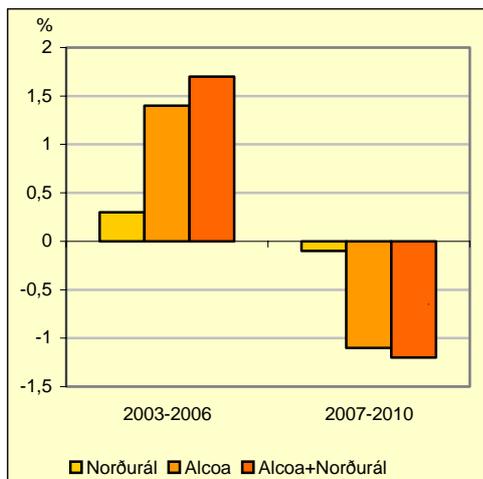


Chart 3: Investment

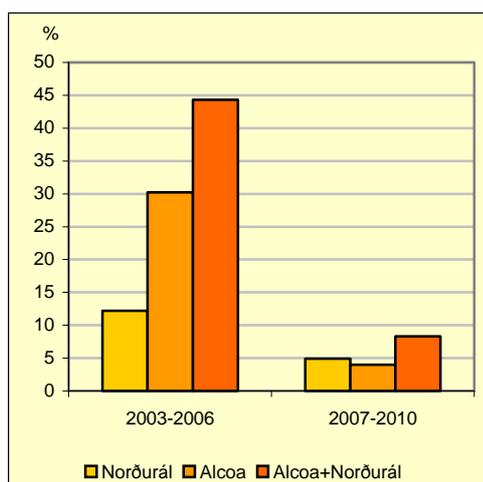
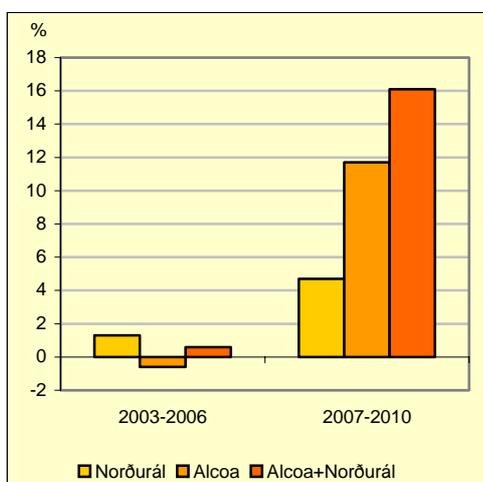


Chart 4: Exports



What economic measures are possible under these circumstances? First, the Central Bank can raise interest rates in order to fight inflation and dampen excess demand. Second, both the central government and municipalities can contribute by reducing or postponing investments during the peak of activity and increasing them thereafter.

There seems to be little reason to apply special economic measures if the Norðurál project alone is implemented. This does not apply to the other two cases, where simulations indicate that the economic cycle will be far stronger. The impact of the following measures will be examined for both cases:

Offsetting measure	2003-2006	2007-2010
Change in public investment	-10%	10%
Change in real interest rate	2%	-1½%

The measures are based on an average deviation from the reference case and are only presented in order to give an idea of their total impact. This applies both to the size and composition of the measures. Taking account of these measures, one may conclude as follows:

The Alcoa smelter. A two per cent increase in the real interest rate in the first phase would lead to a decline in inflation of at least ½ per cent on average. If public investment were reduced by 10 per cent, the impact would be greater still, about a 1½ per cent decline in inflation in 2005 and 2006. Despite these measures, the risk exists that inflation will exceed the Central Bank's upper inflation limit. Such measures would constrain economic growth in the first phase, whereas reduced interest rates and increased investment in the second phase would stimulate growth.

Table 4. The Alcoa project, taking measures into account
Deviations from the reference case

Changes in per cent	2003 -2006	2007 -2010	2003 -2010
Measure:			
Change in public investment	-10	10	
Change in real interest rate	2	-1½	
Gross national product*	1	3	2¼
Gross domestic product*	1¼	3½	2½
Average annual GDP growth	½	½	½
Investment	17	12¼	14½
Inflation	1	¾	1
Current account (p.c. of GDP)	-3	-2½	-2¾
Unemployment	-½	0	-¼
Exports	-¼	12	6

*Level of output.

If half of the manpower needed for the construction came from abroad, instead of one-fourth, the simulations indi-

cate that it would lead to $\frac{1}{4}$ per cent lower inflation in 2003-2006.

The Alcoa smelter and the Norðurál expansion. As before, a 2 per cent increase in the real interest rate would reduce inflation by $\frac{3}{4}$ per cent on average in 2003-2006. If public investment were also reduced by 10 per cent, inflation would on average be $1\frac{1}{4}$ per cent less in the same period. These simulations indicate that these measures would not by themselves suffice to keep inflation within the Central Bank's upper inflation limit. It should again be kept in mind that the predictive power of the econometric model from one year to the next is subject to much uncertainty and these figures should be viewed as indicative only. Reverse offsetting measures, as regards the real interest rate and public investment in the years 2007-2010, would substantially reduce the downturn in the economy.

Table 5. The combined Alcoa and Norðurál projects, taking measures into account
Deviations from the reference case

	2003	2007	2003
Changes in per cent	-2006	-2010	-2010
Measure:			
Change in public investment	-10	10	
Change in real interest rate	2	-1½	
Gross national product*	2½	4	3½
Gross domestic product*	2¾	4¾	3¾
Average annual GDP growth	1	½	¾
Investment	29½	18½	23¾
Inflation	2	½	1¼
Current account (p.c. of GDP)	-4¾	-3½	-4¼
Unemployment	-¾	0	-¼
Exports	1	16½	9¼
*Level of output.			

Assuming that half the manpower temporarily employed with the construction is foreign instead of one-fourth, it would according to these simulations lead to an inflation rate that were $\frac{1}{2}$ per cent less on average for the period 2003-2006.

Uncertainties associated with the simulations. The conclusions of these two examples show the importance of an active economic management over the construction period, both on the fiscal and monetary side. It should be emphasised that only two examples are examined in order to show a possible scope for such measures.

These simulations probably underestimate the impact of interest rate changes upon inflation, since they are based on historical experience. The considerable changes in the Icelandic economy in recent years, particularly in the financial sector, have contributed towards a more effective response of the economy towards interest rate changes.

Monetary policy has thus become more effective, particularly as regards the impact of interest rate changes upon the economy.

Furthermore, the simulations assume that the nominal exchange rate remains constant throughout the period. This is an important stipulation which makes it possible to compare difference alternatives against each other and against the reference case. It may be expected however that during the period before and at the beginning of construction, the króna exchange rate will rise due to a large inflow of foreign capital, especially in the large projects associated with the Alcoa smelter. It is of course very difficult to assess how much the króna exchange rate would strengthen, but it will clearly contribute towards lower inflation. It may also be assumed that the operating environment of export and import-competing sectors will weaken due to a rising real exchange rate. This may be mitigated through the intervention of the Central Bank in the foreign exchange market. Such intervention must be assessed with regard to other measures that may be undertaken.