TØI report 907/2007
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Summary:

Forecasts for Norwegian freight transport 2006 – 2040

Introduction and summary results

Every fourth year, the Norwegian Ministry of Transport and Communications develops a national master plan for transport infrastructure. As a reference scenario related to this 2010-19 master plan, the Institute of Transport Economics (TØI) has calculated base forecasts for freight transport within Norway and connected to imports and exports.

The forecasts have been worked out by means of the national transport model system for Norway. This system consists of a macroeconomic forecasting model, a Spatial Computable General Equilibrium (SCGE) model called Pingo, and a logistics model. The Pingo model produces regional growth rates for domestic production, import and export consistent with the national aggregates projected by the macroeconomic forecasting model, MSG, operated by Statistics Norway.

The calculations are based on (i) exogenous input on economic growth within 38 sectors, as given by the Ministry of Finance, (ii) a spatial general equilibrium model for Norwegian regions, and (iii) the national model for freight transport in Norway. The forecasts cover the road, rail and sea modes. For the period 2006 to 2040, a 1.37 per cent annual increase in domestic freight transport (tons transported) is projected, and the increase in ton kilometres comes out at 1.45 per cent annually. The highest growth is expected within rail freight (2.01 per cent per year), while trucking is expected to grow by 1.48 per cent per year. For domestic (coastal) sea freight, the estimated annual growth rate is 1.33 per cent in the period 2006-2040. Since the capacity constraints affecting the rail network are not adequately reflected in the model, rail market shares are likely to be overestimated in the forecasts. Unless the bottlenecks in the rail network are removed, the road freight mode will experience a higher growth rate at the expense of rail.

Trends in the Norwegian freight market 1985 - 2005

Freight volumes as measured in tons have grown by a moderate 0.8 per cent annually between 1985 and 2005. Domestic sea freight shows the highest increase in transported tons, while rail freight has decreased by 1.2 per cent per year during 1985-2005. In the period from 2000 to 2005, however, the railway has the highest increase in transported tons, while the sea mode has the highest increase in the period from 1995 to 2000. The only period where the trucking had the highest growth rate was from 1985 to 1995.

Railway and domestic sea transport had a small decrease in ton kilometers from 1985 to 1995, while the road mode shows a stable growth in the whole period from 1985 to 2005. The average growth in ton kms for all modes was 1.4 per cent from 1985 to 1995.

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Table S1. Development in transported tons by mode from 1985 to 2005. Yearly growth rates in per cent.

	1985-2005	1985-1995	1995-2000	2000-2005
Ship	1,1 %	-3,3 %	9,1 %	2,3 %
Rail	-1,2 %	-6,8 %	5,6 %	4,1 %
Truck	0,8 %	0,3 %	3,0 %	-0,3 %
Sum	**0,8 %**	**-0,2 %**	**3,5 %**	**0,0 %**

Source: Rideng, 2007.

There was a significant change in the growth level for ton kms from 1995. This change is partly a result of the centralization of production and warehousing, where scale effects in these activities resulted in increasing lengths of haul for all modes of transport. In the period there has also been an increase in average length of haul for each mode, as short rail and sea trips have been transferred to road transport. From the year 2000 the growth rates in ton kms decreased, but from 2004 the growth rates have picked up again, especially for road and rail transport.

Table S 2. Development in ton kms by mode from 1985 to 2005. Yearly growth rates in per cent.

	1985-2005	1985-1995	1995-2005	2000-2005
Sea	2,9 %	-0,9 %	7,1 %	2,5 %
Rail	1,1 %	-0,7 %	3,0 %	4,5 %
Road	4,6 %	4,2 %	5,1 %	4,0 %
Sum	**3,5 %**	**1,4 %**	**5,8 %**	**3,4 %**

Source: Rideng, 2007

During the second half of the 1990s average vehicle utilization increased within various payload sizes, and the average utilization increased more than within each payload class. This is so because an increasing part of the transports were carried out by heavy vehicles that have higher average utilization rates than smaller cars. The transports are becoming more efficient, i.e. the vehicles kilometers grow at a slower rate than ton kms. This same trend has also been observed in Denmark (Kveiborg and Fosgerau, 2004).

Both imports and exports are increasing more in value than in volume. This means that the unit value for both production and import is increasing. High value imports are to an increasing extent carried by trucks. However, the dominant import and export freight mode in Norway is by sea.

The model tool

In the national freight model system for Norway, one can distinguish between the freight demand and supply sides, respectively. The demand part consists of 32 freight base matrices and the forecasting model, Pingo, while the supply part consists of the logistics model and a network model. The base matrices represent the freight flows of 32 separate commodity classes between municipalities in Norway and between these municipalities and abroad. Pingo is a model for regional and interregional freight forecasts and analysis. In the logistics model, shipment sizes, transport solutions and route choice are optimized through a cost minimization algorithm.

Tests runs on the model have revealed that for many commodities the calibrated model version gives rise to odd results. This has lead to the decision to use the uncalibrated version of the model for the forecasts. In this version the modal split does not coincide

with official statistical sources in terms of tons or ton kms, i.e. rail and road freight are overestimated, while seaborne transport is underestimated in the model.

Exogenous assumptions in the forecasts

GDP growth

Growth rates by industry at the national level are given by a macroeconomic model for Norway, MSG, operated by Statistics Norway. The growth path is the reference scenario underlying the Low Emission Alternative in the white paper on environmental policy for Norway (St.meld 34 2006-2007). Forecasts on gross product, imports, exports, private and public consumption and investments are given for the years 2004, 2006, 2010, 2015, 2020, 2030 and 2040. All forecasts from MSG are expressed in real terms, i. e. referred to the 1999 price level.

In making forecasts in terms of value for changes in the amount of tons, we assume that the unit value of each aggregate commodity is fixed during the forecasting period. This is a critical assumption. If the value of some commodities increases during the forecasting period, the growth as measured in tons will be overestimated, and vice versa.

Transport costs

It is assumed that there will be no changes in the relative transport costs between the modes. By implication, it is also assumed that none of the modes meet capacity constraints before the other ones. Similar assumptions apply to ports and terminals.

Infrastructure changes

Planned infrastructure investments in road and rail are accounted for and coded in the network model for the years 2006, 2010 and 2014. This results in different “Level of Service” (LOS) matrices, affecting the competition between modes and between transport solutions.

Population

Forecasts for population development at county level are based on the medium alternative worked out by Statistics Norway.

Transit

There are two main transit flows through Norway. Iron ore is shipped by railway from Kiruna in Sweden via the Norwegian port of Narvik to the European and American continents. Secondly, petroleum is shipped from Murmansk in Russia, passing all the way along the coastline of Norway. Forecasts for the first of these flows are based on trend analyses of freight volumes handled by Narvik port. Projections for the second flow are based on CNIIMF (2001).

The forecasts

Mode specific freight flows

Table S.3 shows the development in mode specific freight flows including and excluding foreign trade. The growth is higher in the beginning of the forecasting period. Growth rates are also high for railway. However, the rail freight is probably overestimated by the model, and parts of its growth will instead be captured by the road mode.

Comparing the forecasts to the historic development in tons, from table S.1, one notes that the growth in total freight flows has been lower than the forecasts for nearly all periods. This suggests that the forecasts as measured in tons may be somewhat overestimated.

Table S.3. Annual growth in domestic freight flows, foreign trade and in total, excluding crude oil and natural gas. Figures in million tons and per cent.

		2006	2006-2010	2010-2014	2014-2020	2020-2030	2030-2040
Domestic	Road	359,3	1,46 %	1,57 %	1,31 %	1,37 %	1,30 %
	Sea	17,6	1,02 %	0,71 %	1,84 %	1,91 %	1,74 %
	Rail	12,4	3,10 %	2,57 %	2,11 %	2,11 %	1,73 %
	Sum	**389,3**	**1,49 %**	**1,57 %**	**1,36 %**	**1,42 %**	**1,34 %**
Foreign trade	Road	12,5	1,46 %	2,45 %	1,02 %	1,37 %	1,30 %
	Sea	76,4	1,81 %	1,92 %	0,85 %	1,01 %	1,14 %
	Rail	22,4	1,20 %	0,99 %	1,02 %	1,02 %	1,11 %
	Sum	**111,2**	**1,67 %**	**1,80 %**	**0,90 %**	**1,05 %**	**1,15 %**
Total	Road	371,8	1,46 %	1,60 %	1,30 %	1,37 %	1,30 %
	Sea	94,0	1,66 %	1,70 %	1,03 %	1,18 %	1,26 %
	Rail	34,8	1,89 %	1,59 %	1,45 %	1,47 %	1,38 %
	Sum	**500,5**	**1,53 %**	**1,61 %**	**1,26 %**	**1,34 %**	**1,30 %**

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Mode specific ton kms

Forecasts for mode specific ton kms on Norwegian territory (including the domestic ton kms connected to import and export) and for domestic freight flows are shown in table S.4. Projected ton kms after 2010 grow at a lower pace than the freight flows as measured in tons, decreasing average length of haul.

Table S.4. Annual growth in domestic ton kms, domestic part of foreign trade, and total ton kms on Norwegian territory excluding crude oil and natural gas. Figures in million ton kms and per cent.

		2006	2006-2010	2010-2014	2014-2020	2020-2030	2030-2040
Domestic	Road	23 764	1,97 %	1,52 %	1,06 %	1,25 %	1,13 %
	Sea	8 479	0,43 %	0,36 %	1,63 %	1,61 %	1,77 %
	Rail	7 023	2,91 %	2,58 %	2,05 %	1,95 %	1,46 %
	Sum	**39 265**	**1,81 %**	**1,49 %**	**1,37 %**	**1,47 %**	**1,33 %**
Foreign trade	Road	2 177	0,50 %	3,09 %	0,91 %	1,00 %	1,09 %
	Sea	40 616	1,38 %	1,41 %	0,76 %	0,92 %	1,05 %
	Rail	3 134	2,28 %	1,42 %	1,57 %	1,56 %	1,68 %
	Sum	**45 927**	**1,40 %**	**1,49 %**	**0,82 %**	**0,97 %**	**1,10 %**
Total	Road	25 941	1,85 %	1,65 %	1,05 %	1,23 %	1,13 %
	Sea	49 095	1,22 %	1,24 %	0,90 %	1,04 %	1,18 %
	Rail	10 156	2,72 %	2,23 %	1,91 %	1,84 %	1,52 %
	Sum	**85 192**	**1,59 %**	**1,49 %**	**1,08 %**	**1,21 %**	**1,22 %**

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Since the forecast is made by means of an uncalibrated model, the mode split in the model is not consistent with the mode split in official statistical sources. We have therefore computed the growth in transported tons and ton kms based on mode split from national statistical sources (Rideng, 2007), under the assumption that the total growth rates across all modes are given from the extrapolated freight flow matrices. The calculation is based on an assumption that the main competition takes place between rail

and road or between the sea and road modes. Exceeding tons from rail transport from the freight model runs are transferred to the road mode, while exceeding tons for road transport are transferred to sea freight until the mode split in tons and ton kms from the transport model in 2006 coincides with Rideng (2007).

Table S.5. Adjusted growth in tons by mode. Mode split in 2006 according to official figures for Norway (Rideng, 2007). Figures in million tons and per cent. Excluding transit, crude oil and natural gas.

		2006	2006-2010	2010-2014	2014-2020	2020-2030	2030-2040
Domestic	Road	253,1	1,46 %	1,60 %	1,30 %	1,37 %	1,30 %
	Sea	35,2	1,53 %	1,63 %	1,20 %	1,30 %	1,28 %
	Rail	7,0	1,89 %	1,59 %	1,45 %	1,47 %	1,38 %
	Sum	**295,3**	**1,49 %**	**1,57 %**	**1,36 %**	**1,42 %**	**1,34 %**
Foreign trade	Road	10,8	1,70 %	1,36 %	1,54 %	1,37 %	1,30 %
	Sea	63,6	1,65 %	1,69 %	1,06 %	1,19 %	1,26 %
	Rail	1,7	1,89 %	1,59 %	1,45 %	1,47 %	1,38 %
	Sum	**76,1**	**1,67 %**	**1,64 %**	**1,14 %**	**1,22 %**	**1,27 %**
Total	Road	263,9	1,47 %	1,59 %	1,31 %	1,37 %	1,30 %
	Sea	98,8	1,61 %	1,67 %	1,11 %	1,23 %	1,27 %
	Rail	8,7	1,89 %	1,59 %	1,45 %	1,47 %	1,38 %
	Sum	**371,4**	**1,51 %**	**1,61 %**	**1,26 %**	**1,34 %**	**1,30 %**

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Table S.6. Adjusted growth in ton kms by mode. Mode split in 2006 according to official figures for Norway (Rideng, 2007). Figures in million ton kms and per cent. Excluding transit, crude oil and natural gas.

		2006	2006-2010	2010-2014	2014-2020	2020-2030	2030-2040
Domestic	Road	16 125	2,19 %	1,78 %	1,31 %	1,44 %	1,22 %
	Sea	15 693	1,25 %	1,00 %	1,32 %	1,41 %	1,43 %
	Rail	2 374	2,91 %	2,58 %	2,05 %	1,95 %	1,46 %
	Sum	34 192	1,81 %	1,49 %	1,37 %	1,47 %	1,33 %
Foreign trade	Road	1 992	2,17 %	1,53 %	1,53 %	1,52 %	1,64 %
	Sea	31 554	1,34 %	1,49 %	0,77 %	0,92 %	1,05 %
	Rail	464	2,28 %	1,42 %	1,57 %	1,56 %	1,68 %
	Sum	34 010	1,40 %	1,49 %	0,82 %	0,97 %	1,10 %
Total	Road	18 117	2,10 %	1,83 %	1,31 %	1,43 %	1,26 %
	Sea	47 247	1,33 %	1,31 %	0,93 %	1,07 %	1,17 %
	Rail	2 838	2,72 %	2,23 %	1,91 %	1,84 %	1,52 %
	Sum	68 202	1,59 %	1,49 %	1,08 %	1,21 %	1,22 %

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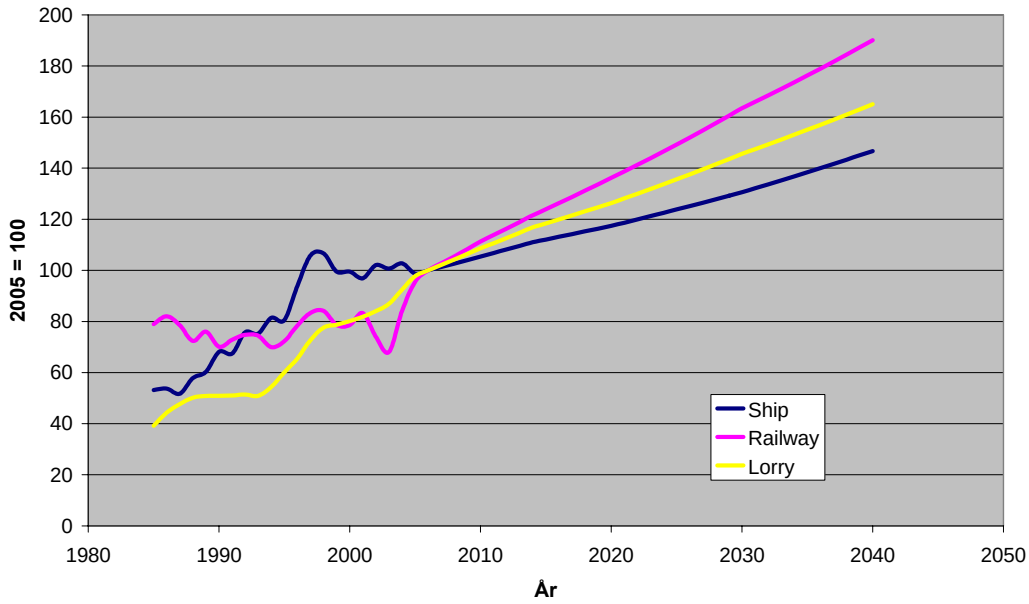
The adjusted growth rates indicate that in particular the growth rate for road for ton kms is underestimated by use of the uncalibrated model.

Figure S.1. Adjusted growth in ton kms by mode. Mode split 1985-2006 according to official figures for Norway (Rideng, 2007). 2006=100. Excluding transit, crude oil and natural gas.



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Traffic volumes

The logistics model will eventually include a module for computing traffic volumes. However, this module is not yet implemented. Historically, road traffic volumes have grown more slowly than ton kms since the mid-1990s. The reasons for this are increased average length of haul, increased vehicle size, and enhanced capacity utilization.

Comparison to other forecasts

The European Commission has worked out forecasts for freight and passenger transport related to the mid term evaluation of the white book *Time to decide*. Mode specific forecasts exist for each of the 27 member states, in addition to Norway, Switzerland and Turkey.

A comparison of the EU15 forecast and the EU forecast for Norway to the Norwegian (national) forecasts shows similar growth level in total ton kms, but differences within modes. Railway has the highest growth in the national forecasts, while trucking has the highest expected growth in the EU forecasts. However trucking has a very low market share in the EU forecasts for Norway. In the EU forecasts for Norway seaborne transport has zero growth until 2020, and decreasing volumes from 2020 to 2030.