SIKA Report 2005:2

Model Analyses of Goods Flows in Eastern Central Sweden

Statens institut för kommunikationsanalys

Preface

This study has been produced by SIKA in collaboration with the Swedish Maritime Administration and analyses goods transport flows in “Eastern Central Sweden”. The defined area extends along the coast from Norrköping in the south to Gävle in the north. Inland, it includes Lake Mälaren and its ports. The report is intended to provide documentation of the existing goods and transport flows and redistribution of traffic due to particular measures or various combinations of measures. In this way, the study provides a basis for the socio-economic analyses of measures to improve fairway connections to some ports in the region that are currently being made.

The study is focused on analysing the interaction between different ports and goods transport corridors – both between ports in the region and between the region’s ports and the port of Gothenburg. The national Samgods model is used for these analyses, which is also the model used to identify the goods corridors introduced by the Goods Transport Delegation. The report also presents a preliminary forecast for goods transport in the region in 2020.

The report has been produced by Inge Vierth (project manager), Henrik Edwards, Anna Johansson and John McDaniel at SIKA and Thomas Ljungström and Henrik Swahn at the Swedish Maritime Administration.

Kjell Dahlström

Director General
and
SIKA

Lars Vieweg

Head of Maritime Policy

Public Affairs, Swedish Maritime Administration

Goods flows in Eastern Central Sweden

Background to the study
The issue of what an efficient port and terminal structure should look like in different regions has come to the fore in a number of different contexts. The Goods Transport Delegation (GTD II) has indicated a number of strategic geographical port regions of special importance for goods transport. A structure for the network of Swedish combi terminals produced in collaboration with, amongst others, CargoNet (formerly Rail Combi) was presented in the National Rail Administration's sector programme.

Eastern Central Sweden is one of the strategic port regions indicated by GTD II. Investments are planned in many ports and terminals in the region and at different places for the land and marine infrastructure. The City of Stockholm has decided to carry out a study of Stockholm's ports. A key issue is whether a new container and oil port is to be built at Norvik near Nynäshamn. The Stockholm County Administrative Board and the Office of Regional Planning and Urban Transportation have initiated a parallel study of the port and terminal structure in the County of Stockholm. This study is being made with a broader collaboration with the Council for the Stockholm-Mälar Region. A year or so ago, the Swedish Maritime Administration carried out a technical and socio-economic analysis of a broadening of Södertälje lock and canal and quality assurance of the fairways in Lake Mälaren. At present, corresponding analyses are being made of a broadening/deepening of the fairways to Gävle and Norrköping.

An important aim of this study is to provide a basis for the ongoing and planned studies, in particular with regard to existing goods and traffic flows and traffic redistributions ensuing from particular measures or different combinations of measures.

The definition of Eastern Central Sweden

The defined area Eastern Central Sweden extends along the coast from Norrköping in the south to Gävle in the north. Inland, it includes Lake Mälaren and its ports. In 2001 (which is base year in the coming national goods transport forecast), 38.8 per cent of Sweden's population lived in the region. This share is expected to increase to 40.2 per cent by 2020. The proportion of persons with an earned income exceeding SEK 200,000 per year was considerably higher in Eastern Central Sweden than the average for Sweden in 2001. Up until 2020, the average income will increase for the whole country. However, the proportion of high-income earners is expected to be considerably greater in Eastern Central Sweden than the average for the country in 2020 as well.

The intensity of employment, i.e. the proportion of gainfully employed in relation to the population of working age is a few percentage points higher in Eastern Central Sweden than the national average, while unemployment is slightly lower. The intensity of employment is expected to decrease between 2001 and 2020 from 77 to 75 per cent in Eastern Central Sweden and from 75 to 73 per cent in Sweden as a whole. The proportional relationship between the area and the rest of the country will thus be maintained.

The business sector

"Trade, transport, warehousing and communications", "credit institutions, property management and corporate services", "health care, social services and veterinary services" and manufacturing groups are the groups of industries that employ the great majority of those in gainful employment in Eastern Central Sweden and in Sweden as a whole. The proportion employed in "credit institutions etc." and "trade" is higher in Eastern Central Sweden than in Sweden as a whole. The sectors "health care etc" and "manufacturing industry" account for a smaller proportion of employees in Eastern Central Sweden than in Sweden as a whole.

Of the industry groups of predominant importance for employment, manufacturing industry is particularly important for demand for goods transport. The sector that manufactures electronics and optical products is large in Eastern Central Sweden and employs up to around a quarter of all those gainfully employed in the manufacturing industry in the region. This is to be compared with a proportion of approximately 14 per cent in Sweden as a whole. Other clear differences concern manufacture of chemical products (in particular, pharmaceutical products) and manufacture in the publishing and graphic industries. These industries employed a considerably larger portion of those gainfully employed in Eastern Central Sweden in 2001 than in the rest of Sweden. The converse applied for wooden products, pulp and paper manufacturing. The industry "manufacture of electronics and optical products" is expected to increase its share of the manufacturing industry in Sweden as a whole from 14 per cent in 2001 to 16 per cent in 2020. The proportion employed in the manufacturing industry metal and metal goods is also increasing more than average. Without exception, developments in manufacturing industry in the region are in accordance with development in Sweden as a whole so that increases and decreases are taking place in a similar way between industries.

Transport infrastructure

The transport infrastructure is used for both passenger and goods transport. This can lead to conflicts in particular for rail transport, since goods trains compete with passenger trains for the same train paths. There may also be capacity problems in the road system. The same applies to large airports. The five freight airports in the region (Arlanda, Örebro, Skavsta, Norrköping and Västerås) accounted in 2001 together for over two-thirds of the total air freight. In maritime transport, there are physical limitations in the form of the draught of ships and the ships that can use different fairways and ports. The dimensions of the fairways and design of the locks entail restrictions on the ships that can pass. The

composition of the ships as regards gross tonnage (GT) varies between ports. In general, the difference between the largest ship in a category and the estimated average ship (total GT divided by the number of calls) is largest for the group tanker bulk cargo and other dry cargo vessels and least for container ships.

There are 13 large ports in Eastern Central Sweden (Gävle, Skutskär, Hargshamn, Hallstavik, Kapellskär Stockholm, Bergs oljehamn [oil port] in Nacka, Södertälje, Västerås, Köping, Nynäshamn, Oxelösund and Norrköping) with an aggregate annual cargo volume of almost 30 million tonnes in 2001. This means that these ports account for almost 20 per cent of the total quantity of goods carried by ship and ferry in Sweden. The Port of Gothenburg, which is by far and away the largest in Sweden accounted alone for approximately 33 million tonnes the same year. The four largest ports in Eastern Central Sweden, measured in loaded and unloaded tonnes by cargo vessel and ferry in 2001, are Stockholm, Oxelösund, Norrköping and Gävle. The container ports in the area are Gävle, Stockholm, Västerås, Norrköping and Södertälje. In 2001, they accounted together for approximately 13 per cent of the container-carried cargo quantity in Sweden, the port in Gothenburg accounting for almost 70 per cent. (All ports in the area have rail connections except Kapellskär and Bergs oljehamn in Nacka. The main passage into Lake Mälaren passes through Södertälje lock.)

Goods transport flows affecting Eastern Central Sweden

In 2001, a total of 366 million tonnes of goods were transported in, to and from Sweden (over distances exceeding 25 km). Around 60 per cent consisted of domestic transport and approximately 40 per cent of import and export. Goods transport with both origin and destination in Eastern Central Sweden accounts for around 10 per cent of the total aggregate quantity of goods transported that relate to Sweden (366 million tonnes). The same quantity is transported from other regions to Eastern Central Sweden. Moreover, 27 million tonnes of goods are transported from Eastern Central Sweden to other regions. This means that the inbound quantity of goods is slightly over 40 per cent larger than the outbound goods quantity. Eastern Central Sweden's "trade" is distributed fairly evenly between southern Sweden (south of Värmland and Dalarna), northern Sweden and abroad. Over 70 per cent of import and export is to/from Western Europe.

Foreign trade, accounts for about 85 per cent of the quantity of goods handled, in tonnes, both in Eastern Central Sweden and in Sweden as a whole. Over 25 million tonnes was transported by ship and ferry to/from ports in Eastern Central Sweden. Inbound and outbound transport by cargo vessel are unevenly distributed. Eastern Central Sweden accounts for 24 per cent of the total unloaded cargo and only 14 per cent of the total loaded cargo. Of these 25 million tonnes of goods, 33 per cent consists of liquid bulk cargo (crude oil and oil products etc.), approximately 65 per cent of dry cargo (round timber, steel and paper and pulp, etc.) and only two per cent of other dry products (food, machinery, glass and textiles which are not transported in containers). Ferries in Eastern Central Sweden transported around 5 million tonnes of goods in 2001, which is over 15 per cent of Sweden's total ferry cargo in 2001. There is an even distribution between exports and imports for ferries.

To obtain a picture of the type of goods transported in containers, and the countries from/to which container transport occurs, we studied data from the Goods Flow Survey, foreign trade statistics and port statistics. Measured in tones, approximately 8 per cent of all exported goods and approximately 4 per cent of all imported goods are transported in containers. The extent of containerisation is high for high-value products as well as food, paper and pulp. On the export side, paper and pulp predominate (47 per cent measured in tonnes and, 28 per cent measured in SEK) and high-value products (24 per cent measured in tonnes and 40 per cent measured in SEK). On the import side, high-value products (40 per cent in tonnes and 74 per cent in SEK) and food (28 per cent in tonnes and 11 per cent in SEK) account for the largest commodity groups.

Goods flows in the infrastructure in Eastern Central Sweden

With the aid of the Samgods model, we have calculated how the goods flows, in tonnes, are distributed in Eastern Central Sweden's transport infrastructure. Almost 120 million tonnes of goods are transported to and from the region. The most important means of transport are lorry and train (45 million tonnes each) if the flows are included that go to/from other regions in Sweden. Sea transport accounts for the largest proportion of transport shipments starting from or with their destination outside Sweden (27 million tonnes). In the case of land transport, the inbound and outbound flows are approximately the same size. For sea transport, the quantity of inbound goods is approximately twice as large as the quantity of outbound goods. Transport of bulk goods takes place almost exclusively by ship. Approximately 7 million tonnes of the group liquid bulk arrive by water to Eastern Central Sweden and are used in the region. Dry bulk is transported by all three modes of transport to, from and through Eastern Central Sweden. Inbound and outbound flows are estimated to be relatively in balance for road and railway. Other dry goods are mainly transported by lorry. Of the aggregate container goods, it is estimated that approximately 30 per cent arrive and depart by sea, while 70 per cent are expected to pass in/out by land in particular towards Gothenburg and Skåne.

Simulation of changes in the port-related infrastructure in Eastern Central Sweden

Based on demand and infrastructure in 2001, a number of "rough" sensitivity analyses have been made with the aid of the Samgods model. In this model, the choice of transport solution is governed by the aggregate transport costs and transport times from door to door. A further prerequisite in the model is that the quantity of goods transported in a particular year is independent of transport costs. The distribution of transport shipments according to means of transport does, however, respond to cost. A reduction of the volume of goods for one means of transport entails a corresponding increase of one or more other means of transport. Our scenario sheds light on how the regional and interregional goods flows concerning "the region" (although excluding transit through Sweden) are affected for different assumptions about the investments and other measures carried out in different parts of the region or in the vicinity of the ports. Taking into consideration the different production systems, we divide our sensitivity analyses

into container transport shipments (Scenario 1–4) and analyses for bulk and other dry goods (Scenario 5 and 6).

Scenario 1: Reduction of container handling costs and times in Gävle and Norrköping

To shed light on the effect of use of scale benefits and/or efficiency improvements, we simulate the effect of a 25-per cent reduction of both the handling cost and handling time at the ports in Gävle and Norrköping. The aggregate cost is assumed to decrease from SEK 811/TEU to SEK 608/TEU i.e. by SEK 203/TEU. The decreased handling costs (SEK 140/TEU) have a larger effect than the reduced handling time (SEK 63/TEU). In all, an increase of container flows to the ports in Norrköping (210 000 tonnes) and Gävle (110 000 tonnes). The redistribution from other ports in the region is estimated to take place in particular from Västerås (120 000 tonnes) and Stockholm (10 000 tonnes). Moreover, land transport from Gothenburg is calculated to decrease by approximately 160 000 tonnes. The model result indicates that changes of the relative cost for different container ports in the region is important for the distribution of container flows and that there is dependence between feeder traffic by rail and road to Gothenburg and the feeder traffic in the ports on the east coast.

Scenario 2: Moving of Stockholm's container port to Norvik

In this scenario, a moving of Stockholm's container port to Norvik in Nynäshamn is analysed with today's land connections. According to Stockholms Hamnar AB, a prerequisite for container and ro-ro transport in Norvik is that double-track railway line is constructed between Stockholm and Nynäshamn and a motorway between Nynäshamn and Västerhaninge. Stockholms Hamnar AB calculated on a volume of approximately 100 000 TEU in 2010 and approximately 300 000 TEU in 2027, partly by movement of existing traffic in the port of Stockholm and partly by new traffic.

In our simulation (for 2001) we assume the closure of Stockholm's container port and an establishment in Norvik. We assume handling costs of SEK 560/TEU and 12 hours handling time. According to the model calculations, Stockholm's goods (around 300 000 tonnes corresponding to 30 000 TEU) will be moved to Norvik. In addition, Norvik is expected to receive 120 000 tonnes (12 000 TEU) of container goods which are presently transported by rail via Gothenburg. The new port in Norvik is expected to have better conditions to take over goods from Gothenburg than the existing port in Stockholm.

I n contrast to Stockholms Hamnar AB's calculations, our estimates do not show any transfers from other ports in Eastern Central Sweden or Southern Sweden. Our volume for 2001 (42 000 TEU) is considerably under Stockholms Hamnar AB's estimate for 2010 of 100 000 TEU. As shown in Chapter 6, it is expected, however, that there will be a considerable growth in container flows in the region up to 2010. The container volume in Norvik would substantially double between 2001 and 2010 if it increased at the same rate as the total container volume.

Scenario 3: Concentration to three large container ports in Gävle, Norrköping and Norvik

In our third analysis, we simulate both a closure of Stockholm container port and a 25-per cent reduction of the cost for handling containers and of the handling time in the ports in Gävle, Norrköping and Norvik. This is expected to lead to almost 500 000 tonnes more in Eastern Central Sweden. The greatest increase is estimated for Norvik (490 000 tonnes), followed by Norrköping and Gävle (approximately 200 000 tonnes each). Stockholm, Västerås and Södertälje are expected to lose a total of 420 000 tonnes. In addition, it is expected that goods will be moved from land transport to/from the ports in Gothenburg and Skåne (totalling 430 000 tonnes). Gävle is expected to take over container traffic from Gothenburg and Stockholm. The new volumes that Norrköping receives come primarily from Västerås and Södertälje.

Scenario 4: New container port in Oxelösund

In the fourth analysis, we simulate that Stockholm container port is closed and that Oxelösund receives container transport shipments. We assume the same handling cost and time (SEK 560/TEU, 12 hours) in Oxelösund as in the neighbouring ports. Our calculations then show a movement of Stockholm's volumes to Oxelösund. In addition, a movement of approximately 70 000 tonnes from Södertälje is estimated. The aggregate quantity of goods transported to and from Eastern Central Sweden is estimated to be unchanged. No transfers to/from Gothenburg are estimated in this scenario, in contrast to scenario 2 above concerning Norvik.

Scenario 5: Reduction of handling cost for dry bulk cargo vessels in Gävle, Norrköping and Oxelösund

Transport by tanker, bulk cargo and other vessels can probably be made more efficient by using larger ships for particular shipments. In our fifth scenario, we simulate the effect of a decrease of loading and unloading costs by 25 per cent from SEK 50/tonne to SEK 37.5/tonne for dry bulk and other dry goods that are not transported by container in Gävle, Norrköping and Oxelösund. The handling time is assumed to be a constant 12 hours. The aggregate handling and time costs are then expected to decrease from SEK 63/tonne to SEK 51/tonne. The estimated effect is that transport to/from the ports in Eastern Central Sweden increase by a total of 2.7 million tonnes or 16 per cent.

One explanation of the relatively large effect is that all categories of goods except container goods and liquid bulk cargo are included. The product groups most affected are round timber, steel products and paper and pulp. The largest increase in goods turnover is calculated for the port of Gävle (2.1 million tonnes), followed by Oxelösund (1.1 million tonnes) and Norrköping (0.8 million tonnes). At the same time, the goods turnover in Västerås is expected to decrease by 0.9 million tonnes, and in Södertälje by 0.3 million tonnes. The sea transport shipments that

are expected to move to the region are sea transport that today uses ports north of Gävle (totalling 0.8 million tonnes), and land transport to/from Gothenburg, Skåne and the continent (totalling 0.9 million tonnes). The volumes of goods moving from Gothenburg (0.4 million tonnes) are expected to derive half from short sea shipping to/from Europe and half from trans-ocean traffic.

Scenario 6: Closure of Stockholms oljehamnar [Stockholm oil ports]

In this scenario a closure of Stockholms oljehamnar is simulated. The scenario is intended to analyse the effects of oil traffic via the port of Stockholm being moved. The model-calculated effect is that the transport shipments move to Södertälje in the first place and to Västerås in the second place. On the basis of these assumptions and the long distance to Arlanda, Gävle is not considered as a first-hand alternative. MariTerm and Sjöfartens Analysinstitut (SAI) assume in their analysis of the consequences of a closure of Stockholms oljehamnar that Södertälje (550 000 tonnes), Västerås (170 000 tonnes) and Norrköping (150 000 tonnes) would take over the port function for the major part of the oil apart from aviation fuel. It is assumed that aviation fuel (600 000 tonnes) would be unloaded in Gävle instead of in Stockholm. Our model results largely coincide with those of Mariterm and SAI's study.

Forecast for demand for goods transport in Eastern Central Sweden in 2020

In our preliminary analysis of goods flows in Eastern Central Sweden in 2020, we take as a basis the Long-term Planning Commission's increase in GDP of 1.8 per cent per year. The previous trend that foreign trade grows double as fast as GDP is assumed to continue, entailing an additional shift from domestic to international transport. We use the Swedish Export Council's assessments for the expected distribution of import and export to country groups that entail that the share of Central and Eastern Europe of total trade will double by 2020. Measured in kronor the quantity of goods transported is expected to more than double during the period 2001 to 2020, while measured in tonnes, it is only expected to increase by around 16 per cent. The domestic goods quantity is expected to increase by approximately 15 per cent and the quantity transported in international trade by approximately 17 per cent.

We base our scenario for 2020 on the development of global seaborne container transport shipments assumed by SAI for the period 2001 to 2010. SAI forecasts an increase in container transport shipments of 7 per cent per year for container-friendly goods and 12 per cent per year for non-container-friendly goods (measured in TEU). SAI assumes a total increase of container goods shipments of 7.6 per cent per year, which entails a quadrupling to 2020. It is possible that this growth is too large due to the trend slackening after 2010. We estimate 34 million tonnes of container goods by 2020 (compared with 9 million tonnes in 2001) although we are aware that this entails an extreme increase. Assuming that at most 70 per cent of the quantity of goods of a product group is transported by container, the quantity of goods transported in container is estimated at around 33 million tonnes. At a saturation ratio of 60 per cent, the quantity of goods is estimated at

approximately 31 million tonnes and at 50 per cent at just over 28 million tonnes. The calculations show that the main part of the growth is explained by increased containerisation. Despite the assumed larger increase for the no-container-friendly groups of products, the product groups that were largest in 2001 (high-value products, food and paper and pulp) are also expected to predominate in 2020.

Expected goods flows in the infrastructure in 2020

Following on from the assumed development of industry and the concentration of the regional development, the goods transport flows in, to, from and through Eastern Central Sweden are expected to increase more quickly than the other domestic goods transport flows. The goods flows relating to Eastern Central Sweden are expected to increase by 20 per cent, compared with 16 per cent for Sweden as a whole. The region's share of the country's transport shipments is expected to increase by approximately two percentage points. The intra-regional transport shipments in Eastern Central Sweden are expected to increase by 16 per cent. The corresponding increase for Southern and Northern Sweden is expected to be 15 and 7 per cent respectively. The domestic transport shipments to/from Southern and Northern Sweden are expected to increase by 26 per cent. Eastern Central Sweden's and Sweden's trade with Eastern Europe and the rest of the world is expected to increase – partly at the expense of trade with Western Europe.

In 2020, inbound transport is expected to exceed outbound transport by over 50 per cent. This means that the existing imbalance in the goods flows is expected to increase further. (In 2001 the inflows are expected to be over 40 per cent larger than the outflows.) In 2020 as well, there is expected to be a balance in flows by lorry and rail and an imbalance in sea transport flows. This development is partly explained by a higher growth in industrial use of products and household consumption in this region. Growth of inbound goods is also expected to be higher in Eastern Central Sweden than in Sweden for liquid bulk (16 per cent compared with 7 per cent), dry bulk (16 per cent compared with 12 per cent) and other dry goods (30 per cent compared with 22 per cent). The growth of inbound container goods is expected to be slightly lower, however, in Eastern Central Sweden than in Sweden as a whole. One explanation for the lower growth is that the "typical" consumption products are largely imported by container already today.

Conclusions

Our model analyses shed light on the significant internal dependencies that exist between different parts of the transport system. This applies to the ports in Eastern Central Sweden and in other parts of Sweden and Europe. Our analyses for container transport shipments indicate that the use of scale benefits and/or other efficiency improvements in Gävle and Norrköping (which is simulated by 25 per cent lower handling costs and handling times) would lead to a redistribution of the container flows from other ports in the region (Västerås and Stockholm) and from ports outside the region (Gothenburg, ports in Skåne) to these ports.

The model analyses also show that there is a dependence between the feeder traffic by rail and road to Gothenburg and feeder traffic to the east coast ports. If concentrate measures that lead to considerable cost reductions were to be made for container ports in Gävle, Norrköping and Norvik, substantial increases in container flows for these ports are expected at the expense of Stockholm, Västerås and Södertälje and land transport to/from Gothenburg and Skåne.

In the case where a movement of Stockholm's container goods to Oxelösund is simulated, a transfer is also expected to the neighbouring port in Södertälje. The total quantity of goods transported to and from Eastern Central Sweden is expected to be unchanged. In the event of a corresponding movement of Stockholm's container port to Norvik, transfers are also estimated from Gothenburg. These estimates indicate that a new port in Norvik would have better prerequisites to take over goods from Gothenburg than the existing port in Stockholm.

The effect of a reduction in loading and unloading costs for dry bulk and other dry goods (round timber, steel and paper and pulp) in Gävle, Norrköping and Oxelösund by 25 per cent is expected to be that transport shipments to/from these ports increase by a total of 2.7 million tonnes. At the same time, the turnover of goods in Västerås and Södertälje is expected to decrease. The sea transport shipments that are expected to move to the region are partly sea transport that presently uses ports north of Gävle, and partly land transport to/from Gothenburg and Skåne. Half of the volume moved from Gothenburg is expected to derive from European traffic and half from trans-ocean traffic.

Further work

SIKA is planning to continue work with the question dealt with in the report concerning the port and terminal structure. Within the project *How should an effective policy for goods corridors, terminals and intermodality be designed*, we intend to continue analytical work that can hopefully contribute to a basis for a successive development of an efficient Swedish transport policy as regards goods corridors and intermodality. We assume that the central starting points are socio-economic efficiency and long-term sustainability and use the proposals made by the two Goods Transport Delegations as a foundation.