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Price index for cargo handling services

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Category not applicable	.
Data not available	..
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Not for publication	:
Nil	-
Less than 0.5 of unit employed	0
Less than 0.05 of unit employed	0.0
Provisional or preliminary figure	*
Break in the homogeneity of a vertical series	—
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Decimal punctuation mark	.

Preface

This document is prepared based on the final technical implementation report produced for the Statistical Office of the European Communities (Eurostat) concerning grant contract 44402.2007.004-2007.359 meant to fund the development of the price index for cargo handling services.

The document intends to describe the development process starting by industry description, followed by methodological overview and finally index calculation and results. Additional documents that assist better understanding of this document are attached as appendices.

A copy of this document is available in PDF-format at the Statistics Norway's official website http://www.ssb.no/english/publications/.

Abstract

Traditionally more reliance was put on index of industrial production to gauge the performance of an economy. The decline of industrial production on the one hand and the rise of the service sector on the other in recent decades made it clear that producer price indices have to be complemented by price indices for services to accurately be able to measure the performance of a given economy. As manifestation of this realisation, Eurostat, through the regulation on short term statistics obliges member states and the EEA countries to implement a set of service price indices within stated time frame. The National Accounts Division at Statistics Norway also demands the development of service price indices for more accurate price measurements.

The price index for cargo handling services, NACE Rev. 2-code 52.240, was developed in compliance with the requirement set by the Statistical Office of the European Community (Eurostat), regulation (EC) No 1158/2005 and amending Council Regulation (EC) No 1165/98 concerning short-term statistics.

The objective of the project has been to develop a service price index for the industry that corresponds methodologically to international recommendations, and meet the National Accounts' needs for detailed price data at product level. Moreover, the index will provide important information about market trends to market agents in the industry.

To meet the aforementioned objectives, the development process was reliant on international documents on the subject and recommendations in conjunction with studying local markets. A close interaction with major participants in the Norwegian goods handling industry has been important through out the process. Efforts were also made to tap in to international experiences.

Quarterly survey is carried out on a sample of respondents. The survey data goes back to the first quarter of 2008 and the sampling frame is limited to enterprises operating in harbours which deliver stevedoring services to external customers.

The index for cargo handling services was publishes for the first time during the first quarter of 2011 with indices going back to the first quarter of 2006. Indices for 2006 and 2007 were estimated based on the wages index for the industry. Quarterly publication for this index is available at Statistics Norway's website under the umbrella for indices with in transport and storage at http://www.ssb.no/tpitralag_en/

Contents

1. The industry

Cargo handling is one of the sub-industries within the larger transport industry. Cargo handling takes place in harbours, airports and land-based terminals, but we will limit the coverage of this index to cargo handling in harbours (stevedoring services). This is in line with the recommendations of the trade union LTL (The Norwegian Logistics and Freight Association). According to LTL, the narrowing of scope does not entail a loss of accuracy as stevedoring accounts for a large part of the output of the industry, and hence a representative service. There is an added value in narrowing the scope of the index this way; we are better able to measure the price developments of a homogenous commodity. Finally, we have not identified any enterprises in land-based logistics that deliver cargo handling services as a separate service to a third party - it is usually an integrated part of a larger service provided to a customer.

Observe that the companies in the industry only provide services exclusively; they do not sell the goods that they handle. The survey only covers companies that provide the service to external customers. Those that only offer the service to a parent company do not participate in the survey.

Both according to the products defined by the Norwegian National Accounts and by EU`s industry standard, NACE Rev. 2, the industry is classified as follows:

Table 1.1. Industrial classification of cargo handling

NACE Rev. 2	Industry
52	Warehousing and support activities for transportation
52.2	Support activities for transportation
52.24	Cargo handling

The Norwegian cargo handling industry (NACE 52.24) is composed of 103 local KAUs, employing about 829 employees and accounting to a total industry turnover of 1083 NOK in 2007[1]. The European Union classifies small and medium-sized enterprises (SME) by number of employees and by turnover. The respective classifications are listed in table 1.1 and 1.2. It is evident from table 1.1 that most of the local KAUs have few permanent employees, and that the small ones (10-49 employees), which constitute 25 percent of the business population, have by far the highest share in the total turnover of the industry. In other words, if we look at employment figures, the sector appears to be controlled mainly by small local KAUs.

Table 1.2. Description of the industry by number of employees

Type of enterprise (EU-classification)[2]	Number of employees	Percent of local KAUs	Percent of turnover
Micro	0-9	44	29,5
Small	10 – 49	25	62,3
Medium	50 – 249	2	7,8
Other	Not given	29	0,4

A special feature of the Norwegian cargo handling industry is that many of its local KAUs only keep a small stock of permanent employees, and hire additional ones from the public harbor master's office when needed, in order to meet demand. Thus, the employment figures obtained from the business register may not always be an entirely accurate indicator of the activity level within a firm. Turnover figures should give a better overview of the composition of the industry by enterprise size. Table 1.2 shows the distribution of businesses by turnover. In terms of turnover, micro enterprises dominate. They constitute 62 per cent of the business population and have a share of 59.1 per cent of the total turnover of the industry.

[1] Structural Business Statistics, 2007

[2] http://ec.europa.eu/enterprise/enterprise_policy/sme_definition/sme_user_guide.pdf

Table 1.3. Description of the industry by turnover

Type of enterprise (EU-classification)	Turnover	Percent of local KAUs	Percent of turnover
Micro	≤ € 2 Million	62	59,1
Small	≤ € 10 Million	8	40,9
Medium	≤ € 50 Million	0	0
Other	Not given	30	-

2. Sample design

The statistical unit of the survey is local KAUs, the smallest legal unit Norwegian enterprises are divided into. The population consists of all local KAUs registered under NACE code 52.24. The sample was drawn from Statistic Norway's Business Register (BOF) using a purposive sampling technique based on knowledge of the industry. We decided early on to limit our sample to local KAUs that

- Reported revenues exceeding NOK 2 million in 2006
- Operate in harbours to deliver stevedoring services to external customers
- Run a stevedoring facility (i.e. local KAUs that only deliver manpower services are not included)

The first edition of the questionnaire was sent out to the 44 KAUs in the cargo handling industry that reported revenues exceeding NOK 2 million. In order for us to decide whether they should be in the sample or not, we needed to know if they provided stevedoring services, and so the first edition of the questionnaire asked the respondents to list the types of goods handling service they offered. The questionnaire also included a comments section, and upon receiving the completed forms, we contacted many KAUs by telephone and e-mail to sort out any remaining misunderstandings and obtain additional information we needed in order to determine whether the KAU should be in the sample or not. 26 of the KAUs were removed from the sample during this process. The reasons for removal fell into one or more of the following categories:

a) The KAU had terminated its involvement in the goods handling industry
b) The KAU did not operate in harbours
c) The KAU only offered manpower to other KAUs, and did not operate a goods handling facility
d) The KAU only offered the service to a parent company, and not to external customers.

18 KAUs remain in the sample today. Rotation has not yet been considered.

3. Methodology

3.1. Pricing method

In most respects, the price index for cargo handling services was easy to develop, and it will be easy to maintain as well. The industry is seldom subject to rapid changes in product portfolios or –technology, and the price index should thus be valid and accurate for several years before updates are needed.

Still, challenges occurred while making the index, mainly due to the heterogeneous nature of the services provided. Some remained even when the scope of the index was narrowed down to cover only cargo handling in harbours. One such problem that our respondents reported, was the fact that contracts with individual clients often are unique, and accordingly, that no service they offer will ever be "typical".

To meet this challenge, we opted for a fuzzy version of the method "direct use of prices of repeated services". With this pricing method, respondents are asked to define and price one or more services that may or may not be repeated at some point, and then re-price these in subsequent surveys. If they have not provided the specified service in a given quarter, we ask them to calculate a price based on the prices they charge for each component the service is comprised of.

After meeting with three large companies and one trade organization we defined the following types of cargo handling services:

- - loading/unloading of liquid bulk material
- - loading/unloading of dry bulk material
- - loading/unloading of container lolo (lift on – lift off)
- - loading/unloading of container roro (roll on – roll off)
- - loading/unloading of mobile self-propelled units
- - loading/unloading of mobile non-self-propelled units
- - loading/unloading of other mixed cargo

In the questionnaire, the local KAUs are asked to describe at least one such service, and list cargo volume and the amount of time it takes to load or unload it from a vessel.

The method meets to the following requirements set out by the Norwegian National Accounts for the use of a price index as a deflator:

- Quality changes must be included in volume and not price measurements
- Groups of sub-products must aggregate to products defined by the National Accounts
- Groups of sub-products must be homogeneous

3.2. Index calculation

Indices are calculated by assigning weights to individual or groups of price items, with weights determining the relative relevance of an item in the overall index. Statistics Norway has developed a standardized IT-system (ISEE – Integrated System for Editing and Estimation), and this index will be calculated according to the same main principles as the other SPPIs using ISEE

The lowest lever in the hierarchy of index estimation is the elementary index. An elementary index, an unweighted price relative, is calculated as the geometric average of price relatives. This formula is famously known the *Jevons index* formula and is denoted by:

$$I_i^{0,t} = \left(\prod_j^{ni} p_{ij}^t / p_{ij}^0 \right)^{\frac{1}{ni}} = \exp\left(\frac{1}{ni} \sum_j^{ni} \log I_{ij}^{0,t} \right)$$, where $I_i^{0,t}$ is the elementary index.

The elementary index is then aggregated in to higher level indices by use of weights. A price index is basically the product of a mathematical formula which brings together information on individual prices and allows them to be compared in a meaningful way. This is achieved by assigning weights to each price item, which reflect the importance of the item in the index being calculated. This transformation is carried for cargo handling services using the Laspeyres index formula.
The general form of the Laspeyres formula is:

$$L_i = \frac{\sum_{i=1}^{n} p_i^t q_i^0}{\sum_{i=1}^{n} p_i^0 q_i^0} \quad [1]$$

L_i = Laspeyres price index value

p_i^0, p_i^t = prices in period *0* (base period) and *t* (current period) respectively

q_i^0 = quantity in period *0* (base period)

This is known as the "expenditure aggregate" form of the index. Substituting the current price by notation [2] and rearranging the Laspeyres formula we arrive at [3].

$$p_i^t = \frac{p_i^t}{p_i^0} * p_i^0 \quad [2]$$

$$L_i = \frac{\sum_{i=1}^{n} \frac{p_i^t}{p_i^0} p_i^0 q_i^0}{\sum_{i=1}^{n} p_i^0 q_i^0} \quad [3]$$

Further, Let w_i stand for the weight share of an elementary group *i.* The weight share of an index at a given aggregation level would then look like:

$$w_i = \frac{p_i^0 q_i^0}{\sum_{i=1}^{n} p_i^0 q_i^0} \text{ Where } w_i > 0 \text{ and } \sum_{i=1}^{M} w_i = 1 \quad [4]$$

Rewriting equation [3] we arrive at equation 5 which states that an index at a given level of aggregation is the sum of price relatives weighted by their respective expenditure shares.

$$L_i = \sum_i w_i I_i^{0,t} = \sum \frac{p_i^0 q_i^0}{\sum_i p_i^0 q_i^0} \left(\frac{p_i^t}{p_i^0} \right) = \frac{\sum_{i=1}^{n} p_i^t q_i^0}{\sum_{i=1}^{n} p_i^0 q_i^0} \quad [5]$$

In practice, the formula we use deviates, some how, from the stricter definition of Laspeyres formula. For this reason Statistics Norway calls the derivative of Laspeyres index adapted to our practical use an L-type index. Lapeyres index requires that weights and base price belong to the same period as noted by equation [4], but this cannot be maintained for practical reasons. Expenditure shares are obtained on annual basis while base prices are of quarterly nature.

The use of this formula assumes, through fixed base weights, "inelastic demand".

4. Distribution of weights

Weights are key elements in the construction of an SPPI. An SPPI is calculated from many different prices that are collected for different types of services. Moreover, the units of a sample will differ in terms of turnover. Weights specify the relative importance of individual units and the price items that they report.

Weight components for cargo handling are collected once a year. Respondents are asked to report turnover share for cargo handling activity as well as the distribution of turnover between the services. Depending on this information we define two weight groups, in such a way that reflects the market share of the units in the sample and the individual services they render. A matrix of the distribution of weights of the different weight components are presented in table 6.1 below. The weight groups are organized as follows:

I. **Stratum weight**: The sample units are clustered into a stratum of small, medium or big depending on the enterprises' turnover ratio to sample total. The share of the stratum turnover to total turnover in the sample accounts then to the stratum weight. Enterprise with turnover amounting to less 5 % of total sample turnover are termed as small, enterprises with turnover ratio ranging between 5 % to 10 % as medium and enterprises accounting to more than 10 % of the sample turnover as big. Table 6.1 below is derived from a survey data carried out in 2008 and shows that small enterprises accounted for 35% of the weight while medium and big enterprises took the share of respectively 19 and 46 per cent.

II. **Weight distribution by service type**: Here the weight distribution reflects the relative relevance of the type of service rendered. Table 6.1 shows that a relatively balanced distribution of weights between both services. Loading services carry a weight of 49 per cent while unloading services carry slightly higher; about 51 per cent.

Table 4.1 Weight share matrix

	Small	Medium	Big	*Total*
Loading	16 %	19 %	15 %	***49 %***
Unloading	19 %	0 %	32 %	***51 %***
Total	***35 %***	***19 %***	***46 %***	***100 %***

5. Data collection

The survey is primarily web based, and respondents are asked to define standard products to be priced at the start of their participation. These services will then be re-priced for successive quarters. In addition, information on the share of weights is collected once every year during the first quarter.

Every quarter, respondents are informed about the upcoming survey and are provided with a username and password for logging in.The questionnaire is posted by the end of each quarter with two weeks deadline. Respondents that haven't returned the questionnaire by the deadline are given a postal reminder together with a one-week extension of the deadline. If the questionnaire still isn't returned, the respondent is given a fine and a one-week final extension. The fine comes into force following the deadline of the final extension.

Reported data is automatically uploaded in to Dynaver, part of ISEE (Integrated System for Editing and Estimation) dedicated to dynamic editing of data. Dynarev is where data collection is administered and micro level data editing begins.

6. Data editing

To ensure that the data collected is a true manifestation of market behaviour, the data has to satisfy certain guidelines set for quality assurance purposes. Statistics Norway carries out standardized data editing procedures when estimating price indices. These procedures can be summarized to two types:

1. Micro-level data editing
2. Macro- level data editing/statistical controls

6.1. Micro-level data editing

Micro-level editing begins automatically when data is uploaded in to Dynarev. Here data is checked, based on pre defined sets of controls, for logical errors and passivity with respect to proceeding periods. The main controls outlined in Dynarev for this index can be summarized as follows:

- **Value compared to previous period**: This function controls for the relative change of a given value/price against some period in the past. The reference period against which current values are compared against, is often set to the previous quarter or the same quarter a year earlier. If values tend to swing unrealistically, respondents are contacted for verification.

- **Passivity control**: This control works by comparing several periods in a row (five quarters is often used), and gives back a warning if the price remained unchanged through out the period.

In addition, the data is manually edited for missing values and other logical errors.

6.2. Macro-level data editing

At the macro level the data is treated collectively as a data set, and not individually by respondent or observation per se. The data set is fed in to an application called *Pris* which generates index estimates and statistical controls. *Pris* is an application developed by Statistics Norway (SSB) to serve as a system for editing and estimation of price indices. It is part of a wider system known as Integrated System for Editing and Estimation (ISEE).

Running *Pris* generates a set of statistical controls which are relevant in detecting outliers, and influential observations. The prominent ones of these controls are Rstudent, Dffits, HB and price-plot function.

Rstudent also known as studentized residual is a standardized (with constant variance) residual resulting from regressing current price on the base price. This technique is important in detecting outliers. The example presented in table 6.2.1 below shows Rstudent estimates. Ref-rstudent refers to the reference or boundary against which an absolute value of the statistic estimate is compared to. Absolute values of estimates exceeding the ref-rstudent are marked as outliers.

Table 6.2.1 Statistical estimates for an Rstudent control

Weight share	Base price	Respondent ID	Current price	Weight groups	Studentized residual without current Obs	Ref-rstudent
0,150464 …	26 950	98465XXXX	25 575	LA;MELLOMSTOR	-7,1306	2

Dffits is a diagnostic meant to show how influential a point is in an index estimate when regressing current price with respect to base price. It is an estimate showing the change in the predicted value for a point, obtained when that point is left out of the regression.

An output of Dffits estimates that *Pris* generates would look like table 6.2.2. Ref. Ref-Dffits is the reference point and Dffits estimates (in absolute value) exceeding Ref-Dffits are marked as critical values and hence appears in the table.

Table 6.2.2 Statistical estimates for Dffits control

Weight share	Base price	Respondent ID	Current price	Weight groups	Standard Influence on predicted value	Ref-Dffits
0,150464	26 950	98465XXXX	25 575	LA;MELLOMSTOR	-1,65414	0,5547
0,098149	108 000	98511XXXX	108 000	LO;LITEN	2,51397	0,5547

Price-plot is a graph and hence a visual aid and helps to detect extreme values and abnormal trends. It is obtained by plotting the base price against the current prices on an X-Y axis.

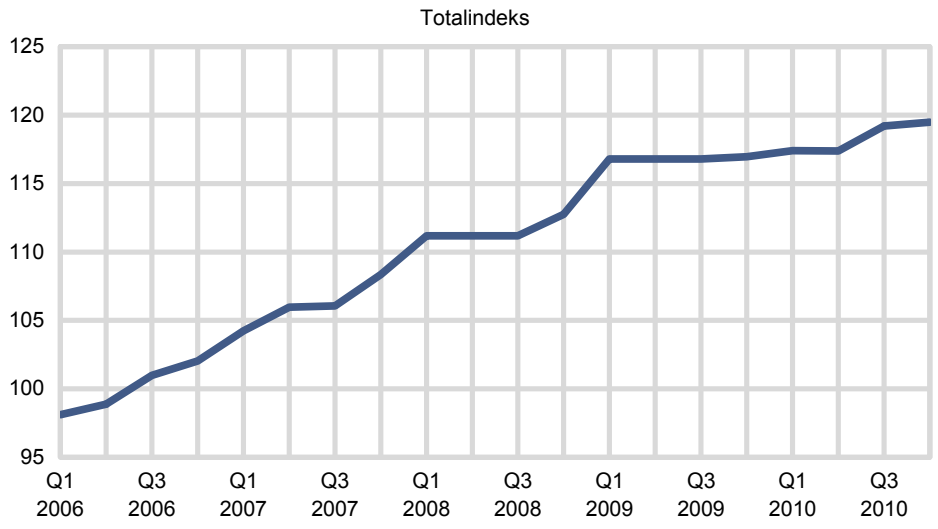
HB is a non parametric control and tries to detect abnormal price changes. This type of control requires a subjective judgment based on Index (industry) specific knowledge.

7. Results

In this section we will discus the results, and the statistics resulting from the index estimation process. The index is estimated using *Pris* on a survey data beginning with the first quarter of 2008. Since the base year is set to 2006 for all our SPPI's, indices for the quarters in 2006 and 2007 had to be estimated. This part will be dealt with in section 7.2 below.

Pris estimates an index by combining price data and information on the distribution of weights. Results are then presented in SAS-output form as a price development between the base price and the current price. To be meaningful, the price change in a given spot is chained to the index level ahead of the base price and then normalized with respect to the base year. One such index, i.e. a chained and normalized index for cargo handling is presented in figure 7.1. As shown in the graph, the index has generally been growing steadily, albeit slowly, since 2006. Between the first quarter of 2009 and the second quarter of 2010 the index had stayed stable with only half a percentage increase.

Figure 7.1 Service price index for cargo handling



The index estimation process generates, apart from index estimates, a set of statistics which are vital in measuring the uncertainty related to our estimates.

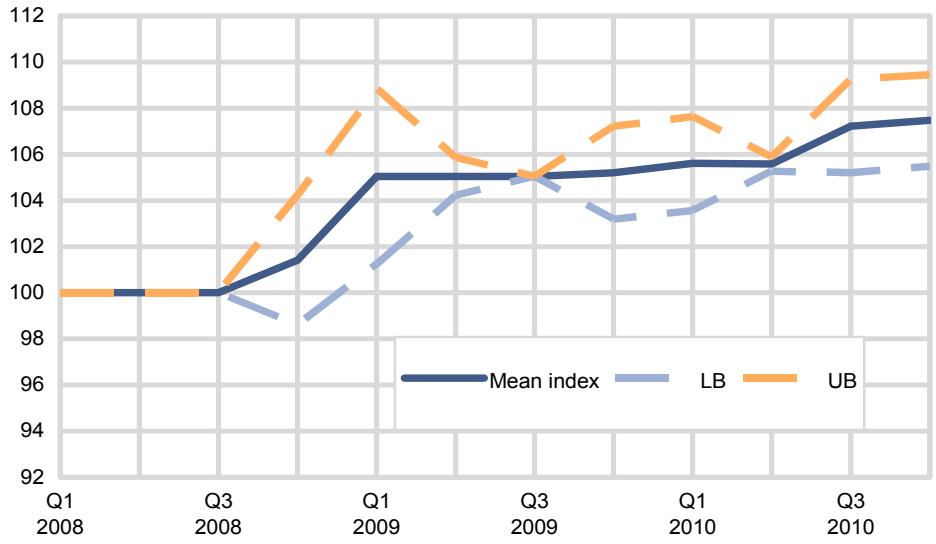
7.1. Evaluation of uncertainty

We employ stochastic approach to index numbers, which treats each price change as an estimate of some common price change. To be precise, the logarithm of each price relative, $\ln(P_i^1/P_i^0)$, is an unbiased estimate of the logarithm of the price change between periods 0 and 1 noted as:

$$\ln\left(\frac{P_i^1}{p_i^0}\right) = \beta + \varepsilon\,; \qquad i=1, 2, \ldots n,$$ where β is the logarithm of price change and ε the independently distributed stochastic error term with zero mean. The advantage of this approach is that it helps us to quantify uncertainty and measure the reliability of our estimates.

Estimates for standard deviation, variance and coefficient of variation (CV) are generated from *Pris*. Figure 7.1.1 below presents the mean index value plotted against the upper and lower boundaries of the index for a 95 per cent confidence level. The region between the upper and lower boundaries represents the interval with in which the true index would lie in 95 per cent of the cases in repeated sampling.

Figure 7.1.1 confidence interval of index estimates (95 per cent confidence level)



7.2. Estimation

The Council Regulation of European Union concerning short term statistics requires that the first reference period for transmission of the output price variable is not later than the first quarter of 2006. Hence, since our survey began in the 1st quarter of 2008, an index for the remaining periods has to be estimated such that the index series starts from the first quarter of 2006. The estimation is done by running a simple linear regression, with wages index for the industry as regressand. Estimation of an index back wards requires, however, a certain precaution. If an index has more than one weight groups, estimating an index at the highest level (f.eks. through regression) in the hierarchy violates the equality that an index is the weighted sum of its sub indices. Simply stated, the identity $I_{tot} \equiv I_a.w_a + I_b.w_b$ would be violated for:

I_{tot}: Totalindeks

I_a: Sub index for product A

I_b: Sub index for product B

W_a: Weight share for product A

W_b: Weight share for product B

To avoid this anomaly, estimates are generated for elementary aggregates at the bottom of the aggregation hierarchy. These estimates are then aggregated upwards by multiplying with their respective weight components.

7.3. Publishing

The objective of developing this index is primarily to comply with Eurostat regulations on short term statistics as well to be used for deflationary purposes in Statistics Norway's national accounts. The index is published nationally within 60 days after the termination of the relevant quarter. The index appears on Statistics Norway's website along side the indices for industries with in transport and storage at http://www.ssb.no/english/subjects/08/02/20/tpitralag_en/. The results are also reported to Eurostat not later than a day after the national publication.

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AMENDED by the REGULATION (EC) No. 1158/2005 of the EUROPEAN PARLIAMENT and of
the COUNCIL and by COMMISSION REGULATION (EC) 1503/2006 and by the REGULATION
(EC) No. 1983/2006 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 20
December 2006

Appendix A:

Questionnaire

Price index for goods handling services

Background information

1. What was the annual turnover of the enterprise in 2008?		1 000 NOK

2. If the enterprise has more than one business area, what share do goods handling services have in the total turnover?	%	

3. Please state where goods handling activities take place. Enterprises that provide goods handling services in harbours must proceed to question 4. Those who do not may submit the questionnaire now.		Harbour
		Airport
		Land-based terminal

4. What share do harbour-based goods handling services have in the total turnover of the enterprise?	%	

5. What share of the total turnover within harbour-based goods handling services do the following service types have?		% Liquid bulk goods
		% Dry bulk goods
		% Large container (lolo)
		% Large container (roro)
		% Mobile self-propelled unit
		% Mobile non-self-propelled unit
		% Other cargo not elsewhere specified

Price information. Please specify a representative service by its composition and price exclusive of value added tax, harbour dues, and rebates given to the customer.

6. Service type 1		Loading
		Unloading

7. Service type 2		Liquid bulk goods
		Dry bulk goods
		Large container (lolo)
		Large container (roro)
		Mobile self-propelled unit
		Mobile non-self-propelled unit
		Other cargo not elsewhere specified

8. Amount of goods to be handled		Ton
		Cubic meter
		TEU-container
		Other, please specify:

9. Amount of time it takes to provide the service		Hour
		24-hour period
		Week

10. Are additional services included? Please tick more than one box if necessary.		Storage
		Freight to external storage facility
		Other, please specify:

11. Price of service	Q1/2008	Q2/2008
	NOK	NOK

Q3/2008	Q4/2008	Q1/2009
NOK	NOK	NOK

12. Comments

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