

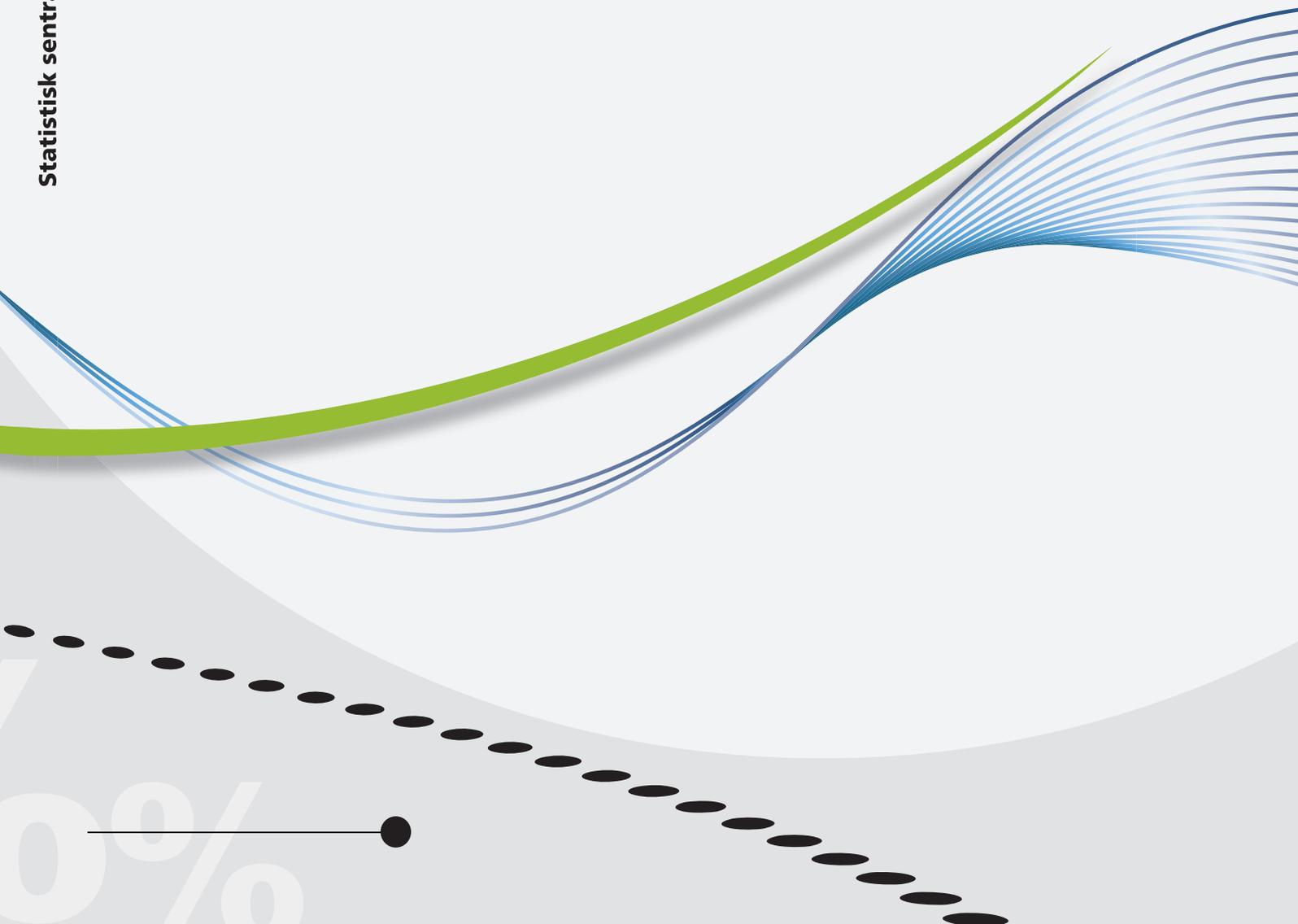
Stig Erik Holiløkk

Price index for technical testing and analysis

Statistics Norway



Statistisk sentralbyrå



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ISBN 978-82-537-8349-9 Printed version	Category not applicable	.
ISBN 978-82-537-8350-5 Electronic version	Data not available	..
ISSN 1891-5906	Data not yet available	...
Subject: 08.02.20	Not for publication	⋮
Published March 2012	Nil	-
Print: Statistics Norway	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	—
	Break in the homogeneity of a horizontal series	
	Decimal punctuation mark	.

Preface

The aim of this paper is to describe the measurement of the turnover and price development in the industry of technical testing and analysis in Norway. In the first chapter we describe the classification of this industry and the definition of the services included. In chapter 2 we take a closer look at the pricing unit of measure. Chapter 3 explains the market conditions and the constraints in the industry and chapter 4 gives the standard classification structure and product details. In chapter 5 we make an evaluation of the standard classification structure compared to the actual industry and market conditions. In chapter 6 we take a closer look at national accounts concepts and measurement issues for this industry. In chapters 7 and 8 we discuss the pricing methods, quality adjustments and methodology in general. In chapter 9 we evaluate the index comparability regarding turnover/output measures. In the last chapter we give a brief summary of the mini paper. The appendix provides the index results and the sample design.

Abstract

Statistics Norway has been developing an SPPI for technical testing and analysis since the beginning of 2010. The industry in Norway is dominated by a few large and global companies. Almost 80 per cent of the turnover is generated by the companies with more than 50 employees.

The price method for this SPPI is the direct use of prices for repeated services. The sample is drawn according to the principle of probability proportional to size, and counts between 80-90 enterprises. This gives 85 per cent coverage of the turnover in the population.

The CPA classification has been used as a starting point for breaking down the industry into more congruent sub-groups. However, some adjustments have been made and knowledge from the industry itself has contributed to a more general activity-oriented classification.

Statistics Norway will publish this index for the first time in the 2nd quarter of 2012.

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1. Definition of the service being priced

The industry of technical testing and analysis is classified in NACE Rev.2 in industry 71.200. According to the Statistical Classification of Products by Activity (CPA), 71.20 is divided into five 6-digit subcategories:

- 71.20.11 – Composition and purity testing and analysis services
This subcategory includes:
 - testing and analysis services for the chemical and biological properties of materials such as air, water, waste (municipal and industrial), fuels, metals, soil, minerals, food and chemicals
 - testing and analysis services in related scientific fields such as microbiology, biochemistry, bacteriology, etc.

- 71.20.12 – Testing and analysis services of physical properties
This subcategory includes:
 - testing and analysis services of physical properties such as strength, ductility, electrical conductivity and radioactivity of materials such as metals, plastics, textiles, woods, glass, concrete and other materials
 - tests for tension, hardness, impact resistance, fatigue resistance and high-temperature effects

- 71.20.13 – Testing and analysis services of integrated mechanical and electrical systems
This subcategory includes:
 - testing and analysis services for the mechanical and electrical characteristics of complete machinery, motors, automobiles, tools, appliances, communication equipment and other equipment incorporating mechanical and electrical components
 - The results of the testing and analysis generally take the form of an assessment of the performance and behavioural characteristics of the object tested. Tests may be performed using models or mock-ups of ships, aircraft, dams, etc.

- 71.20.14 – Technical inspection services of road transport vehicles
This subcategory includes:
 - periodical technical inspection services for automobiles, motorcycles, buses, lorries, trucks and other road transport vehicles

- 71.20.19 – Other technical testing and analysis services
This subcategory includes:
 - testing and analysis services of a technical or scientific nature that do not alter the object being tested
 - radiographic, magnetic and ultrasonic testing of machine parts and structures in order to identify defects. These tests are often conducted on site.
 - certification of ships, aircraft, dams, etc.
 - certification and authentication of works of art
 - radiological inspection of welds
 - analysis services of police laboratories
 - all other technical testing and analysis services not classified elsewhere

In the Norwegian CPA – survey we have chosen to extract the certification activities from 71.20.19 and treat these as an individual subcategory. One reason for doing this is that these activities are only carried out by a few companies in

Norway, which means they represent a homogenous and specialised field of activity.

In the development of the SPPI we have used the CPA as a starting point when breaking down the activities in the industry. However, based on input from the industry we have made some adjustments, and consequently ended up with a classification that focuses more on what kind of activities they do, and not what materials or products are involved in the activity. These are:

- Certification of systems
- Certification of products/personnel
- Tests and analyses
- Inspections and controls
- Measurement and validation services
- Classification

The details of these aspects are also discussed in chapter 5.

2. Pricing unit of measure

There are several pricing units of measure in the industry of technical testing and analysis. Which units are used obviously depends on what pricing method is chosen. We have chosen to use the concept of repeated services while collecting price information. This means that the prices we collect are actual transaction prices. The unit of measure, however, depends on which type of service is performed. The most common unit measures in our survey are:

- Price per hour
- Price per day
- Price per certification
- Price per test/analysis
- Price per inspection/control
- Price per calibration
- Price per classification

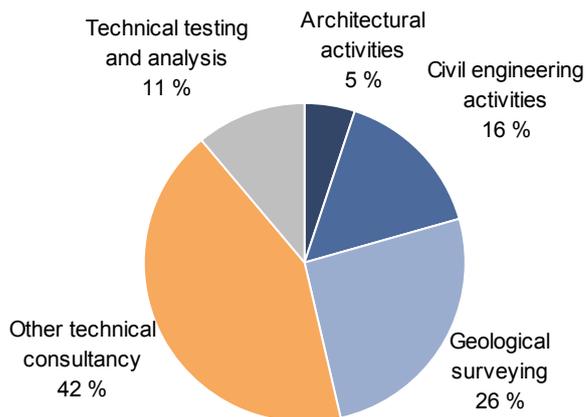
The invoiced charge for the services is often closely related to the wage costs. In other cases, machinery performs standard tests or analyses, where fixed prices per test apply.

3. Market conditions and constraints

3.1. Size of industry

According to Statistics Norway's Structural Business Statistics for 2009, the industry of technical testing and analysis accounts for almost NOK 11.5 billion (about EUR 1.5 billion). Compared with the other 5-digit industries in the division of NACE 71 (Architectural and engineering activities; technical testing and analysis), NACE 71.2 accounts for over 11 per cent of the total turnover. This division is dominated by NACE 71.129 to a large extent, with over 40 per cent of the turnover. Furthermore, the industries of civil engineering and geological surveying are larger than technical testing and analysis.

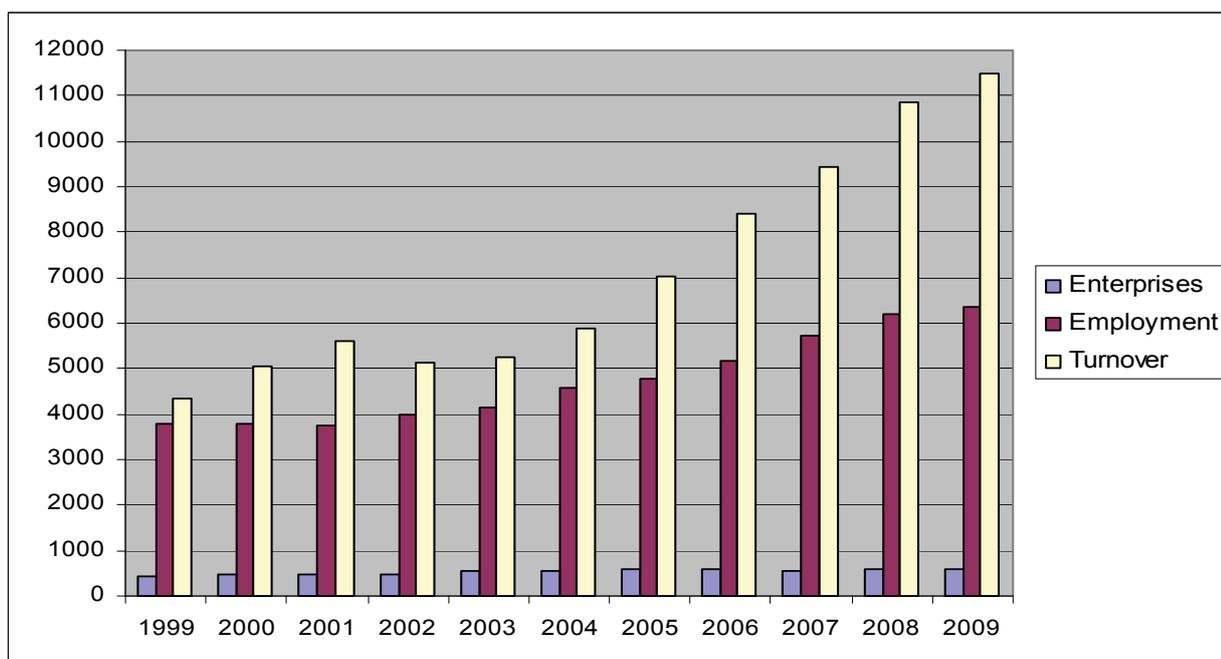
Figure 1. Distribution of the turnover in NACE Rev.2 71. Structural Business Statistics 2009



In figure 2 we can see that the industry has experienced a rather stable growth in turnover since 2003. There was a small decrease in 2002, but since 2003 the turnover has increased by almost 119 per cent. Between 2003 and 2008 the annual growth was between 10 and 20 per cent. In 2009, however, the increase was just above 5 per cent. This may be a consequence of the financial crisis.

From 2008 to 2009 the industry also experienced a decrease in the number of enterprises, which fell from 600 to 575. However, the total number of employees in the industry did not suffer from this. From 2008 to 2009 about 100 more people were employed in NACE 71.2.

Figure 2. Development in turnover (in millions) and number of enterprises and employees in NACE Rev. 2 71.2. 1999-2009. Structural Business Statistics



As shown in figure 2, there has not been any dramatic growth in the number of enterprises in this industry. Since 1999, about 150 new enterprises have been established, which makes a growth rate of just over 30 per cent. In line with the turnover, the number of employees has shown a stable increase since 2003.

The fact that the number of enterprises fell from 2008 to 2009, but not the turnover or the number of employees, is linked to this industry being mainly dominated by a few large and global companies.

Table 1. Selected variables, divided by employment groups. NACE Rev.2 71.2. Structural Business Statistics 2009

Employment groups	2009		
	Enterprises	Employment	Turnover
0	53.1	0.0	1.7
1-4	27.8	4.5	3.6
5-9	7.5	4.7	3.0
10-19	3.8	5.0	3.4
20-49	4.7	13.0	9.7
50 +	3.1	72.9	78.6
Total	100.0	100.0	100.0

In table 1 we can see that only 3 per cent of the companies in the population have more than 50 employees. Nevertheless, these companies account for almost 80 per cent of the turnover in the industry. Of the 25 companies that were lost between 2008 and 2009, half were sole proprietorships, and only one had more than 50 employees.

Statistics Norway has published annual (except for 2008) detailed turnover data at service product level (CPA). In the SPPI we have used a slightly different division of the business activities. In the CPA, a large part (above 60 per cent) of the turnover is located under “other technical testing and analysis services”. A large part of this post can probably be located in the classification category in our SPPI. In table 2, the differences in the service production classification between the SPPI and the CPA are shown. It should be borne in mind that the SPPI classification is based more on fields of activity than the actual product level.

Table 2. Percentual distribution of turnover in NACE Rev. 2 71.2 (SPPI weights vs. CPA)

SPPI - classification	%	CPA - classification	%
Total – Technical testing and analysis	100	Total – Technical testing and analysis	100
1.1 Certification of systems	6.0	2.1 Certification	8.4
1.2 Certification of products/personnel	2.9	2.2 Composition and purity testing and analysis services	9.2
1.3 Testing and analysis	34.0	2.3 Testing and analysis services of physical properties	5.3
1.4 Inspections and controls	23.7	2.4 Testing and analysis services of integrated mechanical and electrical systems services	4.2
1.5 Measuring and validation services	1.7	2.5 Technical automobile inspection services	0.8
1.6 Classification	31.7	2.6 Other technical testing inspection and analysis services	60.6
		2.7 Other additional products	11.4

Another possible reason for the differences can be related to the fact that the companies were not given an opportunity to place any turnover under “other – post” in the SPPI. Consequently, we can assume that much of the turnover placed in the two last groups (2.6 and 2.7) in the CPA can be relocated in 1.3, 1.4 and 1.6. Both the SPPI and the CPA are sample surveys, and both samples are based on the PPS principle, with a stratification based on number of employees.

3.2. Special conditions or restrictions

One of the aspects of the industry of technical testing and analysis that makes it special is its complexity. By complexity we mean the variety of services being produced. To exemplify this heterogeneity, in our sample we have one company that has classification of enormous tankers as its main activity; another company conducts small sample analyses of soil and seeds. The industry is dominated by a few large and global players, who offer a broad range of services. The remainder is

made up of many small companies that specialise in different niches. The small niche companies are often involved in services within testing and analysis, and inspections and controls, e.g. control and inspection of elevators, and are often located regionally. Services within certification and classification can usually be linked to the large global companies.

The size of the companies is not the only aspect that can be connected to the differences between the distinct fields of activity. Historically, the price development has also differed. For instance, services that include single tests or analyses have, to a large extent, become automated. Laboratory technicians seldom perform such standard services nowadays. This has naturally led to a lot less time being spent on performing services, which has consequently led to a price decrease. The prices within areas like certification and classification are much more correlated with the wage development among the engineers.

Obviously, technical services in Norway will be closely related to our biggest production sector, namely the oil and gas sector. Many of the companies, including the niche companies, in NACE 71.2 have their biggest customers within this sector. NACE 71.2 will naturally be affected by the production level and the price level in the oil and gas sector. Other major activities in the industry of technical testing and analysis are services connected to sea transport and the shipping industry, one of which is classification of ships and offshore installations. This industry obviously depends on the production level of ships. Another activity is analysing the quality of the petroleum that is used in the sea transport. This activity depends on the maritime transportation intensity.

Norway has a relatively large public sector and many of the services provided under NACE 71.2 depend on which priority areas the government chooses. For instance, if the Norwegian government decides to commission exploratory drilling and eventually oil production in northern parts of Norway, the industry of technical testing and analysis will experience an increased demand.

4. Standard classification structure

The Norwegian Standard Industrial Classification (SIC2007) is identical to NACE Rev.2 at the 4-digit level. SIC2007 does not have a more detailed level breakdown of activities in the industry of technical testing and analysis. However, an additional service is included to the definition; classification. Classification is further defined and explained in section 5.6.

5. Evaluation of standard vs. definition and market conditions

As mentioned in chapter 1, we have in our SPPI for this industry chosen a slightly different classification of services than the CPA. The classification is developed in cooperation with the industry, and may therefore be described as more activity-oriented than product-oriented. For instance, in the CPA we distinguish between the testing of purity, physical properties and mechanical and electrical systems. In the SPPI we have one class for every standard single test and analysis. Activities such as certification and classification are important parts of this industry in Norway, so it was natural for these to have their own class. General inspection and control services also have a large share of the market in Norway. The classification is also a result of how the different companies classify themselves by activities and competitors. Below we describe and define the classification groups that are used in the SPPI.

5.1. Certification of systems

Certification of systems is a collective term for services that entail a certificate or attestation being issued by a third party. The certification is based on an evaluation of whether a system is in accordance with a certain standard. The certification provides confirmation to the customer or the government that the company's systems satisfy various national and international standards. An example of such services is certification in connection with environmental management systems (ISO 14001/EMAS-verification).

5.2. Certification of products and personnel

The descriptions given under certification of systems also apply to this class, but the objects of certification are products or personnel and not systems. Examples of services placed under this category are CE marking of products and NS-EN ISO 9606 – approval of welders.

5.3. Testing and analysis

This class can be characterised as very broad, and basically contains every stand-alone test and analysis conducted outside certification and inspection assignments. This covers chemical, physical and other analytical testing of every kind of material and product. Standardised tests are typically designed to measure an aspect of an object's characteristic. Included in our sample survey we can, for instance, find ion analysis of water, pressure testing of various types of materials, petroleum analysis, breaking load test of lifting equipment, hygiene analysis in food etc. These examples clearly demonstrate the diversity of the testing and analysis activities.

5.4. Inspection and control

Inspections and controls often relate to routines aimed at ensuring that processes, products and services are performed in a way that meets the different quality requirements. This classification therefore has a lot in common with certification. One of the things that separates them is the frequency of the services, and the fact that a certificate is not necessarily issued. Another major difference is that certification is carried out by a third party, whereas an annual control or inspection is typically performed by the supplier or manufacturer. Within this area in our sample survey we have a selection of representative services, e.g. inspection of pipes with different dimensions, inspection of bulk and tank cargos, periodical technical inspection of vehicles, periodical security controls of elevators etc.

5.5. Measuring and validation services

The main activity in this category is calibration. This entails controlling and, where relevant, adjusting output signals from a measuring instrument, such as a multimeter. Other types of services that can be classified within this group are direct measuring services of noise and dust, for example.

5.6. Classification

There is a group of very few, but large companies that operate within this field of activity. They are especially involved in the classification of ships, oil rigs and other offshore vessels. Classification is a comprehensive verification service providing assurance that requirements laid down in rules and standards established by the classification society are met during design and construction, and maintained during operation. The rules and standards are aimed at ensuring safety from risks to the unit, personnel and environment. Classification entails an activity in which a ship or an offshore unit is inspected during construction on the basis of design approval, tested before being taken into service, and inspected regularly

throughout its operational life. The aim is to verify that the required safety standard is incorporated, observed and maintained (Det Norske Veritas¹).

6. National accounts concepts and measurement issues for the area

For NACE Rev.2 71, NA uses the following classification:

Table 3. Classification used by the NA. Classes covered by the Norwegian SPPI are in bold

711100	Architectural activities
711210	Civil engineering activities
711230	Geological surveying
711290	Other technical consultancy
712000	Technical testing and analysis

NA uses the structural business statistics as the main source for its calculations. Furthermore, NA uses the SPPIs to deflate figures. The structural business statistics are used as a basis for the final year national accounts, and the short-term statistics are used as a basis for the quarterly national accounts. In the groups where no SPPIs are available, the NA uses a more general cost price index, which is calculated on the basis of wage costs.

The Division for national accounts in Statistics Norway has not yet applied the SPPI for technical testing and analysis, since it has just been completed.

7. Pricing method used and the criteria for choosing this method

The pricing method used in calculating the SPPI for technical testing is mainly the direct use of prices for repeated services. During the early stages of developing this index we decided to emphasise the value of learning about the industry. We held a number of meetings with large and medium-sized companies that are involved in different types of services and connected to different sectors. The main conclusion from these meetings was that we had to divide the industry into a natural classification, which the companies could recognise themselves in. The diversity and complexity of this industry required quite a wide classification of fields of activity. The detailed service information, which the current price method emphasises, has to be specified at the level of the specific service being priced. This leads us to the second conclusion from the meetings. The players in this industry often offer a broad range of services, which are sometimes customised for the relevant clients. However, some core services remain stable over several periods, and these are the services that are covered in this survey.

During the company meetings, we identified the six main fields of activity, as discussed in chapter 5. In the questionnaire, the respondents are asked to give two representative and repeated services within the fields of activity they are involved. Typically, the companies offer services within two or three of the fields of activity, which usually gives us between four and six price quotations per company. Given the complexity of the services offered in this industry, the companies are asked to specify their services at a highly detailed level. In this way, we know that we are measuring the same service every quarter.

Information given on the services and prices in the previous quarters is pre-entered in the next quarter's questionnaire. Therefore, if there are no changes in the representation or the quality of the services, the respondent only needs to provide

¹ The definition of classification is taken from Den Norske Veritas' website.

the new prices for the services. More information about how we adjust for quality changes is given in chapter 8.

Statistics Norway collects price data from a sample of 80-90 enterprises. The sample is drawn according to the principle of a *stratified probability proportional to size*. This means that the more employees a company has, the more likely it will be selected to participate in the survey. The sample gives us coverage of over 85 per cent of the turnover generated in the entire population. The data is collected within three to four weeks after the end of the quarter, which enables us to publish the index within 45 days of the end of the quarter.

The price index is calculated as follows: first price relatives for every service stated within the different companies are calculated by comparing the current transaction price to the transaction price in the previous period. Then a Jevons index is calculated from these price relatives for each of the elementary groups. The elementary level is the lowest weighted level in the index structure. There are a total of 18 elementary groups in this index. The aggregation structure and the respective categories that a price relative can represent are described next.

Certification of systems	Certification of product/personnel	Testing and analysis	Inspection and control	Measuring and validation	Classification
	< 10 employees		10–49 employees	> 49 employees	

In the next step we use the weight information that we gather every two years. For this purpose we ask the companies to divide their annual turnover into the different fields of activity that they are represented in. After divided weights for the lowest level, we aggregate up to sub-index level, which in this case is field of activity level, namely six groups. We then use an Laspeyre-type index with a current price basis period. This means that we calculate the development in every elementary group from the previous to the present quarter. The geometric mean from each of the groups is weighted together, which provides us with a total price index for this industry. Because we always use the previous quarter as a base period we have to chain the index from period to period. The chained elementary index is calculated as follows:

$$\tilde{P}_i^t = P_i^{s,s'} P_i^{s',t}$$

In the last step of calculating the index for NACE Rev.2 71.2 we also need to chain the total index.

$$\tilde{P}_G^t(b) = \tilde{P}_G^{t-1}(b) P_G^{t-1,t}(b)$$

8. Quality adjustment methodologies

As mentioned earlier in this paper, the industry of technical testing and analysis consists of many complex and highly detailed services. However, most of the companies perform important and more standard services on a regular basis. When using repeated services as a method, these are the services we would like to capture and measure. The most important action for adjusting for structural changes between two quarters is to define the monitored services as detailed as possible. We therefore ask the companies to provide as detailed a description of the services as possible so that we can provide a reliable measurement of the same service as in the previous quarter. Information about the services is pre-entered in the questionnaire so that the companies can easily recognise the services they specified in the previous reporting.

Additionally, we ask the companies to state two other quality measures for the services; the typical length of time for performing the service, and the number of years of experience of the personnel that normally perform the service. If these indicators change between two quarters, any price changes can perhaps be due to a technical improvement that reduces the time of service execution, or a change in the degree of competence input in the service (a senior engineer will for instance have a higher hourly rate than an engineer).

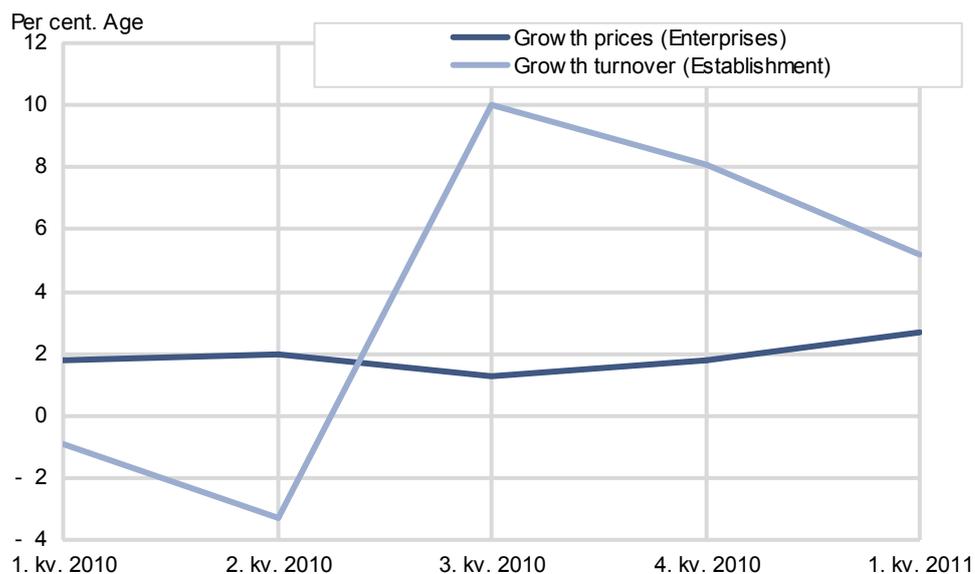
In an industry where many different types of services are produced, it may be a weakness that we only include a small fraction of them in the index. However, we endeavour to include services that are representative of the company activities. At the start of the questionnaire, the companies are asked if the services stated in the previous period are still representative of the company profile. If a company answers no to one of them, they are asked to replace it with another service that can be classified as representative.

All of these actions play a part in ensuring that we are able to adjust for some of the quality changes that may affect the price development. However, it is difficult to know all the facts behind any price change.

9. Evaluation and comparability with turnover/output measures

Short-term statistics on services turnover in Norway are produced on the basis of administrative register data. The statistics are a quarterly index and no absolute figures are published. For NACE Rev.2 71.2, information is available from the VAT register. The enterprises report their turnover to the tax authorities every two months. Data are available to Statistics Norway 58 days after the end of the reference period. The comparability between the SPPI and the short-term turnover data is high. First of all, both statistics use the same industrial classification; NACE Rev.2. Second, the reporting unit is enterprises,² and the high turnover coverage rate (over 85 per cent) in the SPPI means that many of the same enterprises are included in both statistics. Figure 3 shows the development in turnover and output prices from the 1st quarter of 2010 to the 1st quarter of 2011. The time series are fairly short, due to the fact that the SPPI has just been finalised. It is therefore probably too soon to draw any firm conclusions from this comparison.

² In the short-term statistics on turnover the reporting unit is enterprises. However, using distribution formulas from the Structural Business Statistics, the turnover is further broken down between the different activities within the enterprises.

Figure 3. Turnover and price. Growth rates. Q1 2010–Q1 2011. NACE Rev.2 71.2

Nevertheless, we can see that the price development has been rather stable, while the growth rates for turnover fluctuate in certain periods. This indicates that fluctuations are mainly caused by changes in the volume rate. The stable development in the growth rates for prices may be explained by a high correlation with the wage development.

Appendix

Table 4. SPPI for NACE Rev.2 71.2. Q1 2009-Q1 2011

2009				2010				2011
1st quarter	2nd quarter	3rd quarter	4th quarter	1st quarter	2nd quarter	3rd quarter	4th quarter	1st quarter
113.6	114.1	114.2	113.7	115.6	116.3	115,7	115,6	118,7
Change from same quarter in the previous year, per cent				1.8	1.9	1.3	1.8	2.7

Table 5. Sample design for SPPI - NACE Rev.2 71.2. 2010

Employment groups	Employees	Per cent	Enterprises	Per cent	Turnover	Per cent	Probability of inclusion in the sample	Enterprises in sample	Turnover in sample	Per cent
0	0	0	305	53.0	193 264	1.7	0	0	0	0
1-4	276	4.5	160	27.8	413 332	3.6	0.1	16	41 333	0.4
5-9	292	4.7	43	7.5	340 518	3.0	0.3	13	102 155	0.9
10-19	310	5.0	22	3.8	390 934	3.4	0.7	15	273 654	2.4
20-49	802	13.0	27	4.7	1 111 169	9.7	1	27	1 111 169	9.7
50+	4 512	72.9	18	3.1	9 018 155	78.6	1	18	9 018 155	78.6
Total	6 192	100	575	100	11 467 372	100		89	10 546 466	92.0 ¹

¹ There is a divergence between the sample coverage mentioned in the report and the sample coverage in table 5. The reason for this is that we have lost some companies since drawing the sample in 2010. Rotation of the sample and updating of the weights will take place in the first half of 2012.

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ISBN 978-82-537-8349-9 (trykt)
ISBN 978-82-537-8350-5 (elektronisk)
ISSN 1891-5906

ISBN 978-82-537-8349-9



9 788253 783499

