Statistics Norway

Statistisk sentralbyrå

Statistics Norway
Department of Economic Statistics

Bengt J. Eriksson, Anne B. Dahle,
Ronny Haugan, Lars Einar Legernes,
Jogeir Myklebust and Erik Skauen

Price Indices for Capital Goods

Part 2 - A Status Report

Preface

The project "Price Indices for Capital Goods - Part One" started at Statistics Norway in early 1998. The project was partly financed by Eurostat and aimed at studying how the products labelled "capital goods" had been treated concerning price statistics in different countries. The analysis was of the descriptive kind and ended with suggestions on how to treat the problems in this area in a new project with normative ambitions. The results from "Part one" are presented in Lunde, Røgeberg and Sandberg (2000).

In late 1999, the part two of the project started. This report provides a status for the work done in this area. In addition - another reason for writing this document has been to share the findings with a broader audience, especially at Statistics Norway. The intention is to improve the quality in the price statistics and in the national accounts at Statistics Norway. The report also points out some general statistical problems, common to all smaller country.

Throughout this work we have presented our findings at a handful of seminars. We will therefore take this opportunity to thank all our colleagues that in different ways have shared their viewpoints and criticism, and in so doing helped to improve this report.

CONTENTS

Appendices

LIST OF FIGURES

LIST OF TABLES

1 Introduction

1.1 Background

The background for this study is the project "Price indices for capital goods – Part 1". This is a descriptive study investigating and suggesting improvements of methods for handling the problems of quality changes and the uniqueness of capital goods in index calculations. The problem with quality changes is a general index problem, but the problem is regarded as particularly relevant when it comes to capital goods. The potential bias caused by this is considered to be a considerable problem in index calculations.

Part 1 of the study focused on which methods EU/EFTA countries and some other OECD countries actually used for capital goods.[1] A number of frequently used methods to adjust for quality changes in index calculations were presented (see Lunde, Røgeberg and Sandberg, 2000). In addition to give an overview of the practice in other countries, particularly in Western Europe, and examining the different methods used, the first part of the study came up with some conclusions that may be worth while to reiterate here.

One conclusion is that there is a great variety in which methods the different surveyed countries are using to handle quality changes. Another conclusion is that for some commodities, which are extremely difficult to find reliable price indices for, such as aeroplanes and ships, most countries exclude them from their price indices. The Council Regulation (EC) no.1165/98 of May 1998 concerning short-term statistics (Eurostat, 1998c) gives exceptions for certain commodities.[2] The problem is, however, only transferred to the national accounts divisions, which have to get reliable deflators for their constant price calculations. The fact is that, at least for small countries, these kinds of products may have important impacts on a country's economy.

The requirement for the short time statistics in general is strengthened in the Action Plan (ECB, 2000), and a special focus is on survey based price statistics. The ECB (European Central Bank) has in various contexts recommended that price indices for exports and imports do not rest on the unit value indices from the external trade statistics. These indices are usually far more erratic due to shift effects and varying populations. International manuals on price statistics in the national accounts conclude that the use of unit value indices does not satisfy the requirements for quality – neither the short-term variation in quality nor the medium-term trends in quality are properly dealt with.

Volume measurement in national accounts is concerned with valuing current flows of goods and services in the prices of a previous year (i.e. "constant prices"). This process is complicated by the fact that the production and consumption of goods and services may change from year to year. The characteristics of a product can change rapidly and to the extent that the prices in two different years cannot be directly compared. It may be that, even if the price has not changed, the user gets more value for his money. A value has then to be estimated for the change in the characteristics. This is commonly known as the problem of quality changes. During the last years several studies, such as Gordon (1990) and Boskin et.al. (1996), have focused on biases in the official price indices published by the statistical institutions, since the official price indices often fail to take proper account of these factors.

The quality issue is of course well known to the statisticians and has for a long time been handled in the price indices. The capability to handle such problems has however been restricted to the less complex cases (i.e. changes in unit of measurement). When it comes to the capital goods additional problems and challenges have been faced – though until recently not been handled in an appropriate way. Capital goods are highly complex goods, frequently subject to important changes in technology, and it is, particularly for this group of commodities, difficult to find identical commodities over time. Nonetheless, it is hardly any doubt that there is no other way to cope with this problem, than to explicitly try to take these quality changes into account. Effort has through the last decade been put into these issues, a fact illustrated by the

[1] All together 22 countries were included in the survey.
[2] Nevertheless a number of the EU Member States and others are examining their methodology with a view to move towards proper output prices in due course.

growing number of studies in this field, not the least by statistical institutes. The time when the quality problem could be neglected is definitely over. The quality issue has an international aspect related to comparability of statistics across countries. Differences in methods adopted by countries could lead to significant differences in growth rates for variables that are conceptually comparable.

1.2 Purpose of the study

The Producer Price system (PPI) constitutes a frame for these studies. The system comprises altogether three survey based statistics – the Producer Price Index, the Price Index for First-hand Domestic Sales and the Commodity Price Index for the Manufacturing Industries. The data capture is common for these statistics and provides price information covering three markets – domestic, exports and imports. In this report the acronym PPI refers to the Producer Price system in general although a special focus for the studies are on data covering imports.[3]

The main focus is on improving methods for calculating price indices for capital goods. When the study becomes more normative, the focus also becomes more geographically concentrated on the Norwegian markets and their particular circumstances. The study still tries to be quite general in that it takes on one of the problems not mentioned much in the literature, namely the dichotomy – the large versus the small country problem. It is a fact when it comes to solutions to this problem in a specific country – it is often a question of resources. The resources can in one dimension be measured in data observations or on the other hand – by resources available at the statistical institute for doing the studies required.

The large country versus small country dimension has yet another, maybe more important, element. Small countries are usually more dependent on import, and they are thereby more exposed to international price impulses. For Norway, who produce and export mainly raw materials and semi manufactured goods and energy, important price impulses come from imports of capital goods and consumer goods.

It should also be added that improved methods for calculating price indices for capital goods will be utilised in other statistics than those being a part of the PPI-system. Price indices for external trade based on unit values are relevant candidate areas for use of improved indicators. Furthermore – we hope that the study, even though concentrating on the Norwegian market, also will be useful for our statistical colleagues abroad.

1.3 Selected products

Different terms are used for the kind of goods to be studied here. What is called "capital goods" may also be labelled durables. Goods used for gross fixed capital formation as well as capital goods held by households are included. Capital goods is a product group that is affected by a fast pace of innovation, which means that it may be difficult to find "similar" products over time. Moreover, often the products will be especially designed to the user's needs and specifications. This may apply to both technical specifications and more exterior-type requirements. Furthermore, capital goods often have services attached affecting the price; the retail price of a mobile phone will depend on the choice of network operator, or the purchase price of a machine may depend on the degree of service provided.

Capital goods consists of two basic types of commodities:

i) Goods that are characterised by a high degree of heterogeneity and often also have a high speed of technological development. These can be found in different variants on the market, each variant having a specific set of product characteristics. The rapid technological development also gives rise to lots of new variants over time. Typical capital goods of this kind are e.g. cars and computers.

[3] The producer price index is following the rules and recommendations put forward in Eurostat (1998a). In appendix A there is a closer description of the index, as also can be found on the Internet address www.ssb.no/ppi_en. The other indices in the producer price system can be found using *vppi_en* and *pif_en*.

ii) Secondly, we have goods that are unique, which only exist in one item; both during the same time and in future time periods. These products are normally custom-made and sometimes, but not always, produced at the same place where they are going to be used. Examples of these types of products are plants of different kinds, like a factory of production. Other examples of unique products are found in construction.

In addition to the criteria of choosing important capital goods with high value, an ambition was to select representatives from both of the above-mentioned types of capital goods. In close connection with Eurostat five types of products were selected – three of type (i) and two of type (ii) above. All products should represent national account sectors of importance – though having a varying importance across countries. The study should also reflect different end-use categories – consumption goods and investment goods. The following products were selected:

1) Washing machines
2) Lorries
3) Tractors
4) Paper production machinery
5) Electronic utility generating equipment

During the project, a sixth group of products completed the list:

6) Computers

1.4 Outline of the report

The outline of this report is as follows:

- Chapter 2 presents the branch analyses of the selected products.
- Chapter 3 describes the data and the data collection process.
- Chapter 4 starts with a presentation of different methods and ends with a somewhat more thorough look at the selected and tested methods.
- Chapter 5 then goes through the results, i.e. the estimated indices – and gives some background information about the particular estimations done.
- Chapter 6 interprets the consequences for the regular PPI work, summarises the results and gives some suggestions for future work.

In this kind of report there is bound to be some abbreviations. A list of these is presented in table B.1 in appendix B.

2 Branch analyses

2.1 Introduction

An important piece of work prior to collecting data should be an analysis of the business sector. This is especially important when looking at sectors producing or importing e.g. capital goods. This section will seek to elaborate the meaning of these kinds of analyses by asking the questions:

- Why make a branch analysis?
- How to make a branch analysis?

The primary objective in making a branch analysis is to gather information about important statistical characteristics such as populations, units, markets, etc. Secondary objectives are, inter alia, to reduce, or at least not increase, the enterprises' burden when reporting data. When producing statistics a major part is to analyse the figures produced and/or data collected. When having thorough knowledge of the branch, the analysis will of course be more accurate. In some cases the enterprises are encouraged to electronically deliver data in an attempt to get more data, as well as to secure the quality of the data collected. A branch analysis will try to ensure that these objectives are met by

- scrutinising the populations of enterprises and products, and
- selecting enterprises and products (the sample), and part of this – the suitable unit for observation.

These points may be investigated by checking:

- The register of establishments and enterprises.
  This register consists of all known establishments and enterprises in Norway, which are coupled with important characteristics, like number of employees, NACE, etc.
- The establishments in the external trade statistics.
  All establishments that make cross-border trade have to go through the customs, and declare the imported (or exported) goods. The external trade statistics' system monitor among others a unique number for each company, and all products are classified according to the HS. An indication of the composition of products in the chosen product categories may also be found.
- Other statistics.
  Some supplementary information may be found in studies like the PPP. One example is important product characteristics.
- The Internet.
  Most establishments have their own web site. By investigating these important information about products and markets may be obtained.
- Trade organisations.
  Such organisations often have experts that may give valuable background information. They may also have relevant statistics and/or relevant data the NSI may use.
- Other ministries.
  The Ministry of Trade and Industry and other ministries make their own examinations of the economy. By investigating these sources supplementary information or data may be acquired.
- The establishments.
  Experts in the establishments have thorough knowledge about the products. By contacting the establishments the most effective way of collecting data may also be uncovered.

Outline of the branch analyses
Several branch analyses were conducted for the selected products as described above. Before entering the respective product analysis, we end this section with the set-up used in the branch analyses to come.

1. Definition of the product
The goal with this section is to define each product the project includes. The use of the HS may in some cases mean that the HS-number description covers far too many products. An example is size – some HS-numbers do not place any restriction on size, which may result in heterogeneous products in the HS-numbers. If necessary, the specification will thus be even narrower than the HS-number. Product specifications in earlier attempts to quality-adjust these products will also be evaluated.

2. Population
The larger producers or importers in each chosen sector were identified mainly using figures from external trade statistics. A search was also made for alternative sources that could give an indication of market players, which mainly would be trade organisations and public agencies.

3. Market analysis
While the first two sections just define the products and the populations, this section will give a brief overview of each market and include some aspects of the enterprises, the products, etc.

4. Previous attempts to quality-adjust prices
This section is a short description of some previous attempts to quality-adjust these products, be it in an academic journal or at a statistical institute.

5. Sources of prices and quality characteristics
The section presents the potential data sources that have been investigated. The sources are the enterprises themselves, the Internet, trade organisations, public agencies and the external trade statistics division at Statistics Norway. The sources have been investigated by means of e-mail or postal questionnaires, and the study of product catalogues and file extracts from the enterprises' databases.

A file extracted from the companies' databases must contain precise identification of the products, and import/export value and quantity for each month. This will enable us to update the product basket ourselves. Such a file may also contain additional data. If a trade organisation has a central database with the required information – this may be the best source of information. It is a viable solution if the trade organisations' bases contain sufficient data and the base maintenance is adequate.

6. Potential methods
This point should give an overview on which methods of quality adjustment that may be appropriate for each product and why these methods are chosen.

7. Concluding remarks
The concluding chapter summarizes what the branch analysis has uncovered and how to proceed.

2.2 Computers and computer equipment

2.2.1 Definition of a computer and computer equipment

2.2.1.1 External trade statistics
According to the HS, all computers and computer parts are grouped under chapter 84.71. The chapter includes desktops, portable computers, printers, monitors, storage units, scanners, etc. A complete listing of the different goods is given in appendix C. The value of imports for the year 2000 is also included. According to this list, the two most important goods are stationary PCs (84.71.5000), and portable computers (84.71.3000).

2.2.1.2 Other
As can be seen under section 2.2.4.2, Statistics Sweden (SCB) makes hedonic indices for computers. They decided to define a PC as "a processing unit plus hard disk but without display and keyboard", which means it should be placed under HS 84.71.5000. By excluding monitors, they avoid one of the causes for price differences. For portable computers – monitor and keyboard are of course included. In the USA

hedonic indices are being made for portable computers, PCs, servers, and large-scale computers. The products may or may not include monitors.

2.2.1.3 Our definition

Ideally, indices should be made for all the products under chapter 84.71. This is essentially what the Bureau of Labor Statistics (BLS) does – we will come back to the PPI from the BLS in 2.2.4.2. In the case of computers international experiences in general points at a hedonic quality adjustment procedure as the most relevant. Due to the amount of resources required we decided to limit the attention to PCs and portables. Both the SCB and this project define the PC as "a processing unit plus hard disk but without display and keyboard".

2.2.1.4 Characteristics

Traditionally, the most important characteristics have been those associated with speed and storage capacity, among them clock frequency, size of hard disk and memory size. Today, the speed of built-in CD-ROM drives, the existence of a built-in DVD drive, video cards, video memory, Ethernet cards, cache memory and so forth are also important characteristics. A discussion of the importance of the different characteristics will be carried out in 2.2.4, where other work in this area will be presented.

2.2.1.5 Special aspects of computers

The main difficulty in calculating price indices for computers is the rapid technological development. While the price of a regular desktop computer was roughly the same in 1991 as in 2001, the performance of the two "vintages" is almost beyond comparison. This rapid change makes it hard to make price indices using the traditional method of monitoring the price development of the same product over time. Therefore, some kind of method for quality adjustment is needed.

The hedonic method is well suited as

- there are many different models of PCs on the market,
- the number of relevant characteristics is manageable,
- the hedonic approach is already in use by other countries for the purpose of treating quality change in PCs.

2.2.2 Population and sample

2.2.2.1 External trade statistics

In the two HS-groups in question the largest importers were identified, ending up with a sample of 15 importers, all of which are represented in both groups. The coverage is 85 per cent of the value of portables, and about 80 per cent of the PCs.

2.2.2.2 Manufacturing statistics

No major manufacturers were identified. Some few establishments are importing computer parts and assembling them themselves. These firms are included in the sample, as they are also present in the external trade statistics.

2.2.2.3 Trade organisations

The "PC-Exchange" in the magazine Kapital Data is considered for historical series. This is a monthly survey of consumer prices and characteristics of a range of computers. The reporting units are asked to make sure that the sample of computers is updated every month. Thunes (1998) has been using data from this source in an attempt to make a quality-adjusted index for PCs in Norway from 1993 to 1998.

2.2.3 Market analysis

2.2.3.1 Competitors

Kapital Data ranks the ten largest firms in the categories professional PCs, home-PCs, and portables. They are ranked according to units sold, and the figures are from the six first months of 2000. See table 2.1.

Table 2.1 shows that there is considerably more PCs than portables sold. But according to one of the respondents the price of a portable machine is roughly three times that of a desktop, so the overall value of sales of the two kinds of computers is not that different.

Table 2.1: Computer units sold in Norway the first six months of 2000

Professional PC			**Home-PC**			**Portables**		
Firm	**Units sold**	**Of total**	**Firm**	**Units sold**	**Of total**	**Firm**	**Units sold**	**Of total**
Compaq	21672	16.6%	FujitsuSiemens Computers	14992	19.8%	Toshiba PC	14429	30.5%
Evercom	14156	10.9%	IBM	14500	19.2%	Compaq	9890	20.9%
Dell	12505	9.6%	Compaq	10074	13.3%	Dell	6433	13.6%
Getronics, Cinet PC*	11852	9.1%	Packard Bell NEC	7770	10.3%	IBM	4700	9.9%
MIPS/TCI	8682	6.7%	Hewlett-Packard	6663	8.8%	FujitsuSiemens Computers	2527	5.3%
FujitsuSiemens Computers	8116	6.2%	Getronics, Cinet PC*	6648	8.8%	Hewlett-Packard	2476	5.2%
Hattelco/Hyundai	7436	5.7%	Dell	5860	7.7%	Best Technology	1870	4.0%
IBM	6800	5.2%	MIPS/TCI	2002	2.6%	Hattelco/ Hyundai	1075	2.3%
REC Computers	6488	5.0%	Apple*	2000	2.6%	Getronics, Cinet PC*	1002	2.1%
Actebis Computer/Targa	5872	4.5%	Others*	2000	2.6%	Acer*	790	1.7%
Total	**130258**	**79.5%**	**Total**	**75622**	**95.7%**	**Total**	**47281**	**95.5%**

Source: Kapital Data 8/2000. (An asterisk after the firm's name indicates that Kapital Data estimates the number of units sold.)

2.2.3.2 Customers

For some of the establishments covered in this survey the customers are mainly retailers. Others serve the professional market, and yet others sell directly to consumers. The computers are distributed through different channels: Some are sold in specialised computer stores – where the system often can be tailor-made – and some over the counter in TV/Radio retailers. Computers are also sold on the Internet.

2.2.3.3 Terms of sale

Computers are sold on differing terms: When sold to consumers they are often sold as a complete solution, with monitor, speakers, support agreements, Internet subscription and standard software. When sold to the professional market, the "solution" is a network of many computers and of course supports agreements.

2.2.4 Previous attempts to quality-adjust computer prices

Many attempts have been made to make quality-adjusted price indices for computers, both historical and more contemporary. Some countries are already using more refined methods. Computers are also one of the most common products mentioned in literature covering the hedonic method. The following is some of the work that has been done.

2.2.4.1 Research papers[4]

Berndt et al (1993) used a large data set of PCs sold in the period 1989 to 1992 in the USA. Comparing arithmetic means of computer prices, show an annual decline of ten per cent. A matched model method gave a price decline of 19 per cent each year, while using a hedonic method produced a decline of more than 30 per cent every year.

[4] Some other recent studies can be found in Griliches et.al. (1994), Nelson et.al. (1994), Shiratsuka (1995), OECD (2000), Berndt and Rappaport (2001) and Moch (2001).

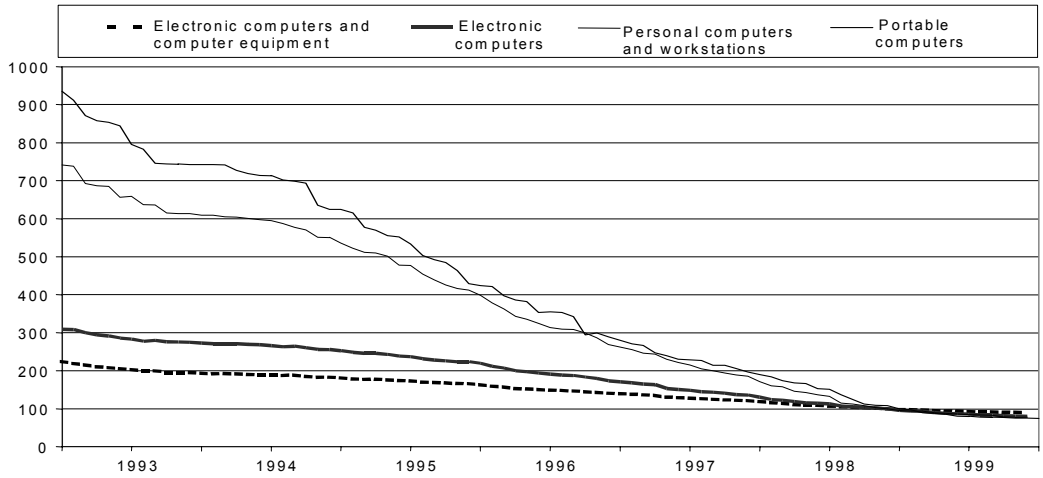
Thunes (1998) is one attempt to make quality-adjusted computer indices using data from the Norwegian market. The data set consists of 2400 observations from the period January 1993 to May 1998. 24 brands from more than 30 suppliers are covered. The data are taken from Kapital Data, and are collected on a monthly basis. The analysis uses a dummy-variable method, one of two main applications of the hedonic method. This means that he pools the data and uses dummies for years. The continuous variables used are clock frequency, size of hard drive, memory size, cache size, video memory, monitor and speed of CDR-player. There are also dummies for type of processor, software, and year. Based on the coefficients on these dummies, he estimates an annual decline varying from 9.1 per cent in 1994 to 45.3 per cent in 1997.

2.2.4.2 Statistical agencies

The USA[5]

The most comprehensive use of the hedonic method in monthly statistics is found in the USA. Separate models are constructed for four kinds of computers, with personal desktop computers as the most important kind. The models are estimated using secondary data, i.e. consumer prices and specifications found on the Internet web pages, while producer prices are collected through the ordinary PPI-channel. Variables used include CPU per MHz, type of processor, SDRAM/MB, GB of hard disk, zip drive, DVD, Video card (MB), speakers, modem, monitor size, bundled software, service level and company. The PPI, the CPI, and the International Price Programs (IPP) use the results jointly. To illustrate the significance of this method, an excerpt of some of the most important index series is reproduced in figure 2.1.

Figure 2.1: USA computer indices 1993-1999 (Dec. 1998=100)



The figure shows that the index for portables has fallen from more than 900 in the beginning of 1993 to below 100 in 1999. For PCs it has fallen from more than 700 to below 100 in the same period. The price decline is huge and very unusual compared with prices of other products. It is also high compared with the development in the computer indices of other countries. This was a topic in a Financial Times article of September 4th 2000, an article which concluded that "US methods of price indexing, particularly for computer-related products, exaggerate output compared with European rivals". In this article, as well as in subsequent comments, two major criticisms are brought forward: First of all, while the validity of this technique depends on having the right set of hedonic pricing characteristics, the choice of characteristics is essentially a subjective one. Furthermore, the hedonic method is not well suited when the technology develops in leaps instead of continuously.[6]

[5] This presentation is based upon Dalén's contribution in Eurostat (2000).

[6] Moch (2001) gives a comparison with Germany.

Statistics Sweden (SCB)

Beginning in 1991, the SCB has been using the hedonic method to quality-adjust the prices of computers. SCB's approach is of course less ambitious when it comes to resource demands than that of the BLS, and should therefore be more relevant for small countries like for instance Norway. As already mentioned, the SCB defines a PC as "a processing unit plus hard disk but without display and keyboard". The SCB collects data from 16 importers, who are asked to report on their three most-selling models every month. The variables are clock frequency, size of hard disk, memory size, dummy for portable/desktop, and access time (omitted because of lack of data). A model is estimated for one month, which is also the chaining month, and the estimates are used to quality-adjust the prices in the following months. A more comprehensive summary of the Swedish computer index is given in appendix G. We have been in contact with those operating this index, and they are quite satisfied with it. The extra workload is not too heavy, and there has been no problem getting data from the reporting units (paper-based questionnaires).

Eurostat

Work done by a task force assembled to examine the problem of quality change in computers resulted in the report "Volume measures for computers and software – Report of the task force" (Eurostat, 1999a). One conclusion is that the national accounts, the PPI and the CPI statisticians in the EU should join forces in order to harmonise the methods in this area.

OECD

The Statistical Working Party of the OECD Industry Committee has written "Handbook on quality adjustment of price indices for information and communication technology products" (OECD, 2000). The intention of this handbook is primarily to provide an accessible guide to the different approaches towards constructing deflators in this area. This work is complementary to the Eurostat work, but the handbook is much more detailed and practical in its approach.

2.2.5 Sources of computer prices and quality characteristics

Computer prices and characteristics may be obtained from many sources. Historically, data from magazines have been used, and lately such information is also made available on the Internet. Using catalogues from the importers/manufacturers is a possibility as well. There is also reason to believe that the importers/manufacturers have this information readily available.

There are many problems associated with using the publicly available data for PPI-purposes:

- Only consumer prices are quoted. To get import prices the importers have to be asked.
- This kind of data collection is very time consuming – the statisticians must constantly check the magazines or the Internet to make sure their sample is up to date.

These problems indicate being in favour of using the traditional data source – the firms themselves. The collection of data on characteristics as well as of prices will impose a heavier burden on these respondents than on others. At the same time it is important that makers of statistics are regarded "friends" not "foes", as the makers must rely on the respondents to constantly evaluate their sample, and – when necessary – update it.

These considerations call for flexibility when it comes to data collection. The respondents should of course be allowed to use the conventional means of data collection – the paper-based questionnaire – but other ways should also be offered. The most interesting way is to get the necessary information directly from the firm's data system. This will probably result in more information, and the information will always be up to date. It demands some extra work on Statistics Norway's part, but for the respondents this should mean considerably less work.

2.2.6 Potential methods

Based on the experiences from other surveys the hedonic approach has been preferred. In fact - this is the only method that has been seriously considered for the production of monthly indices for computers. For more about the method – see 2.2.1.5.

A part of the project is to estimate historical indices, at least back to 1995. If historical series are to be made, data from Kapital Data, as was seen in 2.2.4.1, should be investigated further. This source has monthly figures at least back to 1995. Data on quality characteristics are also reported, but the prices are of course consumer prices.

Using other countries' indices for historical series, back casting seems to be the most cost-effective method, where the USA and Sweden are obvious candidates, both making hedonic indices for computers.

2.2.7 Concluding remarks

The group computers is an area where much work has been done internationally and the hedonic approach is usually the main method examined. We see no need to investigate which methods that should be used on this product any further, and aim to use the hedonic method. The collection of data from the 15 identified firms in 2.2.2 started – with the goal of getting data for each month back to January 2000.

One assumption in the SCB-model is that the coefficients are the same for portables as for desktops. Only the intercept varies. If enough data could be obtained the objective was to estimate one model for portables, and one for desktops. Therefore each reporting unit was asked to give data on five models. Based on the data from January to December 2000 the plan was to estimate and test hedonic models, and use these to quality-adjust computer prices beginning with the index for January 2001.

2.3 Washing machines

2.3.1 Definition of a washing machine

2.3.1.1 External trade statistics

In the Harmonised System (HS) washing machines are placed in chapter 84.50. This chapter has the following structure:

84.50 Household or laundry-type washing machines, including machines which both wash and dry
- Machines, each of a dry linen capacity not exceeding ten kg:
  - 8450.1100 Fully automatic machines
  - 8450.1200 Other machines, with built-in centrifugal dryer
  - 8450.1900 Other
- 8450.2000 Machines, each of a dry linen capacity exceeding ten kg.
- 8450.9000 Parts

As there is no production or exports of washing machines from Norway the focus will be on imports. Table 2.2 shows the imports of washing machines distributed on the different HS numbers for the year 2000.

Table 2.2: Imports of washing machines 2000

HS	Unit	Quantity	Value (NOK)	Unit Price	Part of total value
8450.1100	Piece	171 248	462 923 718	2 703	88.1 %
8450.1200	Piece	89	820 634	9 221	0.2 %
8450.1900	Piece	326	3 178 222	9 749	0.6 %
8450.2000	Piece	566	27 862 316	49 227	5.3 %
8450.9000	Kg.	245 491	30 470 923	124	5.8 %

Figures from external trade statistics in 2000 show that the fully automated machines having a capacity not exceeding ten kg represent almost 90 per cent of the import value in 84.50. The second largest group of machines is the one with a capacity exceeding ten kg, but these products only represent about five per cent of the total imports in the chapter.

Washing machines with capacity up to ten kg, are first of all products for the private household market while washing machines having larger capacities have institutions and the professional market as the main users. Mainly due to minor importance in imports of the larger machines a decision was made to exclude these products from the survey commodity population. Due to the fact that somewhat different populations of importing establishments were identified for the two segments, the exclusion also enabled a more cost efficient data capture without loosing relevance.

2.3.1.2 Our definition

From here on this study will only discuss 8450.1100 – fully automatic machines, each of a dry linen capacity not exceeding ten kg. By focusing on this commodity the study will include front and top loading machines and exclude washer dryers. This group will hereafter only be referred to as washing machines.

2.3.1.3 Characteristics

To identify the products' most important characteristics a swift search through some web pages of companies – marketing washing machines – was carried out. The companies' web sites tend to list the following characteristics when describing their washing machines (see table 2.3).

Table 2.3: Characteristics of a washing machine

- Brand - Model - Barrel volume - Noise - Depth - Height - Width - Capacity - Spin speed - Door size	- Weight - Drying rating (water remaining in clothes) (scale A-G) - Energy efficiency (scale A-G) - Washing result (scale A-G) - Water consumption - Energy consumption - Special programs for wool and silk - Other functions (foam control system, imbalance correction system, continuous adjustment of temperature)

Some of these characteristics are rated from A to G, where A is top score (a European Community standard).

Using this list as a basis, the importers were asked which additional characteristics that could have an important influence on the price. The following additional characteristics were obtained:

Table 2.4: Additional characteristics of a washing machine

- Front/top loader - Remaining dampness - Program time - Timer mechanism - Anti-curl - Country of origin (maker)	- Display - Quick wash program - Hand wash program - Economy program - Extra rinse

A closer look at the PPP survey was carried out to obtain more information on which characteristics should be included. This survey lists the following characteristics in their questionnaires:

- Brand
- Model
- Washing capacity
- Spin speed
- Number of programs

- Loading (top or front)
- Dimensions (Height * Width * Depth)

This survey covers the technical characteristics, but fails when it comes to measuring the machine's efficiency. The variables of brand, model, washing capacity, spin speed and dimensions correspond directly to characteristics mentioned by the companies. Some of the special programs' characteristics mentioned by the companies or in table 2.4 may be more relevant than the mere number of programs asked for in the PPP-survey. The characteristic of top or front loading will be inherent information in the brand or model, but needs to be specified as a characteristic by itself as in table 2.4 and the PPP list.

2.3.1.4 Special aspects of washing machines

"Few significant innovations have taken place since the 1930s". This statement from an article in Financial Times, November 8, 2000 is partially correct, nevertheless several noticeable improvements have been made in later years.

Only a few years back households used twin tubes. These were machines with two sections; one for washing and one separate for the spin dryer. Today machines are fully automated and the two sections are merged into one, in addition washer dryers have made their entry into the market. New, more gentle programs have been developed to be used on wool and silk. Today's machines are more silent running and are more stable than the predecessors. Furthermore machines nowadays have stricter requirements to energy and water consumption. As newer machines have integrated computers – the ability to adjust the machines' performance has increased considerably.

The international washing machine industry is a highly competitive branch, and most large operators have sizeable research departments continuously trying to make their products more efficient and appealing. New concepts that have been investigated are for instance the "waterless machine" that uses ultrasound or liquid carbon dioxide to clean clothes. One of the latest new developments is a machine with two tubes outside each other. By going in the opposite direction of each other the tubes will – according to the manufactures – give the machine better washing results than today's units and be the closest you can come to hand washing.

A quick look at the importers' Norwegian web sites gives an indication of the number of different models available. This search shows that three of the importers marketed about ten different models each, while two of them had information on just fewer than 30 various models. A file from the electronic industry's trade organisation (Elektronikkforbundet) also gave an indication of how many machines that are on the market each year. This file consists of data for one year on sales from ten stores – containing more than one hundred different models. The multiplicity indicates that washing machine buyers have different demands.

It varies how often new models are introduced, but a model is seldom on the market for more than two years. It is important to take into consideration that changes in any characteristic might be described as a unique model (e.g. one is metallic the other one not). Some of the model changes seen in later years are a result of increased focus on the European Union standards on drying rating, energy efficiency and washing result. A majority of the machines sold in Norway are front loaders. Thus the data obtained will include only a small number of top loaders.

2.3.2 Population and sample

2.3.2.1 External trade statistics

Figures from external trade statistics from 2000 showed that concentrating the effort towards six enterprises would cover most of the import of fully automated machines with capacities not exceeding ten kg. Four of these already supply monthly data to the PPI. Elkjøp ASA, Electrolux Home Products AS, BSH Husholdningsapparater AS, Asko Elto AS, Whirlpool Nordic AS and Miele AS were included in the study.

2.3.2.2 Trade organisations

Elektronikkforbundet (Elfo) is the most relevant trade organisation that was located. This is the electronic retailer's organisation. The members are stores that sell products like white goods, brown goods and mobile

phones. The organisation administers a database to which the stores are expected to report on a daily basis. The following is some of the variables that in principle should be found in Elfo's database:

Table 2.5: Variables in Elfo's database

Variable	Contents
"Store number"	A numeric identification of each separate store
"Brand"	A numeric identification of the producer
"Model"	Model
"Product description"	Mainly the producers' description of the model
"Buying price"	Price paid by the store
"Date of arrival"	Date the product was received by the store
"Selling price"	Price paid by consumer
"Date of sale"	Date the product was sold to the consumer

Meetings with the organisation showed that the quality - relevance - of data did not match the requirements for this study. Some of the problems found were: Fragmented time series, a number of partial non-responses for important variables as well as unit non-responses, and non-relevant price concepts. Using this database as a main source, a substantial amount of supplementary data collection would have been unavoidable. To avoid handling problems of inconsistency a decision was made to solely use direct data collection from the sampled units.

The contact with such sources should be continued to improve the relevance and quality.

2.3.3 Market analysis[7]

2.3.3.1 Competitors

Most Norwegian importers deal in more than one brand (see table 2.6). Elkjøp differs from the rest of the importers as their organisation includes retailers, while the other large companies just import the goods.

Table 2.6: Selected companies and brands of washing machines

Name of company	Brands
Elkjøp ASA	AEG, Whirlpool, Bosch, Elto, Zanussi, Miele, Artison
Electrolux Home Products AS	Electrolux, Zanussi, Husqvarna, AEG
BSH Husholdningsapparater AS	Bosch, Siemens
Asko Elto AS	Asko, Elto
Whirlpool Nordic AS	Whirlpool, Bauknecht
Miele AS	Miele

Elkjøp is undoubtedly the largest importer of washing machines in Norway. Elkjøp is the Nordic countries' largest commercial enterprise within consumer electronics and electric household appliances. It is owned by Dixon Group plc.

2.3.3.2 Consumers

Elkjøp sells to end-users through their own sales organisation while the rest of the companies distribute their products to independent chains of retailers.

2.3.3.3 Terms of sale

The Norwegian importers have different arrangements with their suppliers abroad. Import prices may thus change from as often as monthly to as seldom as once a year.

[7] The facts in this chapter are collected from the different importers' web pages and through contacts with the firms.

2.3.4 Previous attempts to quality-adjust prices of washing machines

There are few instances of NSIs publishing quality-adjusted prices for washing machines, and we could locate only one research paper on this topic.

BLS has recently developed a hedonic model for washing machines. Since October 2000 this indicator has been published within the USA CPI. Unfortunately, the paper documenting this work has not yet been available. According to our knowledge the BLS is the only NSI so far to have established a quality adjustment model for washing machines.

Silver and Heravi (2000) have on an experimental basis developed quality adjustment models for washing machines using scanner data for 1998 from the UK. Their study evaluates three approaches for estimating quality-adjusted *consumer price* changes. The models studied are:

iii) The dummy variable approach:
The "usual" hedonic regression technique where the price of a product is regressed on its characteristics, and where dummy variables are used for the time periods.

iiii) Superlative and Exact Hedonic Index (SEHI):
Based on economic theory and an extension of the dummy variable approach. The advantages, according to Silver and Heravi, with this index are that
"it utilises the coefficients on the characteristics to adjust observed prices for quality changes. Second, it incorporates a weighting system using data on the value of sales of each model and their characteristics, rather than treating each model as equally important. Finally, it has a direct correspondence to a constant utility index number formulation defined from theory." (Silver and Heravi, 2000, page 8).

iiiii) Matching:
A method comparing only "like" with "like".

The variables used in the studies were price, volume, vintage (the year the model was introduced), make and outlet type. Other characteristics were e.g. type of machine (top loader, twin tub, washing machine, washer dryer with and without computer), drying capacity, height of machine, width, spin speed, water consumption, load capacity, and energy consumption.

The two first models approach the quality issue in a direct manner using well-known methods, while the matching model does not handle the quality issue in the same extensive manner. In the latter approach the quality problem is reduced to a task of re-sampling and chaining whenever a new model is introduced. Such a solution is enabled using scanner data comprising a large number of observations – covering both new and outdated models.

The regressions (the dummy variable and the SEHI approaches) were estimated using both a linear form and a semi-log form. The coefficients from the linear form were used in an arithmetic framework whereas the coefficients from the semi-log form were used in a geometric framework. All models had a distinct price fall during 1998, ranging from about 6 to 9.3 per cent in the geometric framework.[8]

An interesting result was that the price fall according to the matched approach was somewhat stronger than the others. The dummy variable approach does not use weights, which may explain why this approach has less price fall than the matched technique. The SEHI and the matched method results are close, and the difference may be arbitrary.[9]

[8] Table 3, "Quality-adjusted price indexes based on geometric means" (Silver and Heravi, 2000, page 37).

[9] The SEHI approach aggregates not over each model, but over meaningful characteristics. In table 3 (Silver and Heravi, 2000, page 37) make and outlet type is used. "In the limiting case of all variables being included the method collapses to the matched approach." (Silver and Heravi, 2000, page 17).

2.3.5 Sources of prices and quality characteristics for washing machines

2.3.5.1 Price

First, import prices collected by the external trade statistics division will be evaluated. If these prices are of too poor quality the next step is to turn to the importers themselves. With the help of this contact priority will be on extractions from the importers' databases. If these are seen unfit e-mail questionnaires will be considered.

2.3.5.2 Relevant characteristics

As much relevant information about the models as possible will be collected from the Internet and from brochures, additional information will be collected from the importers.

2.3.6 Potential methods

The available methods for quality adjustment depend on the quality and the amount of sampled characteristics and prices. Especially the sample size can be constraining for small countries like Norway with a modest population and limited resources for data sampling. The following methods are considered to be the most appropriate when it comes to quality adjustments of washing machines (for more information about these methods - see chapter 4).

- **Hedonic method**

Washing machines have some standard descriptive characteristics that presumably accounts for most of their values, for instance water consumption, spin speed and capacity. This makes them suitable for a hedonic regression.

- **Monthly chaining and re-sampling (MCR)**

The high number of different models also makes a monthly chaining and re-sampling approach possible. This method is best used on a rather large set of data, something that may be possible, especially if several data base extractions are obtained.

One must however bear in mind that this is not a method handling the quality issue in a broad manner. The quality problem is reduced to a task of re-sampling and chaining whenever a new model appears in the market. Furthermore - for this method to work efficiently the market concerned must be highly competitive.

- **Overlap pricing**

Overlap pricing is a third method that may be suitable when adjusting for quality change in washing machines. This method will be most useful if each company only supply data on a few models.

2.3.7 Concluding remarks

Success is mainly dependent on data collection and the degree of cooperation from the importers. Based on the information in this chapter a hedonic adjustment of these products should be possible to carry out. Through further contact with the six importers mentioned earlier, import prices on at least 30 to 40 products will hopefully be acquired.

2.4 Tractors

2.4.1 Definition of a tractor

'Tractors means vehicles constructed essentially for hauling or pushing another vehicle, appliance or load, whether or not they contain subsidiary provision for the transport, in connection with the main use of the tractor, of tools, seeds, fertilisers or other goods. Machines and working tools designed for fitting to tractors of heading No. 87.01 as interchangeable equipment remain classified in their respective headings even if presented with the tractor, and whether or not mounted on it.' (WCO, 1996)

2.4.1.1 External trade statistics

The tractors in external trade statistics in table 2.7 encompass all tractors other than the type used on railway station platforms, pedestrian controlled tractors, and road tractors for semi-trailers and track-laying tractors. The surveyed tractors are divided into five groups classified by motor output. Their main use is agricultural or forestry work.

Table 2.7: Imports of tractors into Norway in 2000

HS	Horse power (hp) range	Value	Percentage of total value	Quantity	Percentage of total quantity	Unit value
87019001	< 39	26 059 588	3.9	802	22.9	32 493
87019002	40 - 59	28 904 866	4.3	190	5.4	152 131
87019003	60 - 69	89 472 957	13.2	339	9.7	263 932
87019004	70 - 89	260 616 237	38.5	1 218	34.8	213 971
87019005	> 90	271 242 548	40.1	955	27.3	284 024
8701900	All	676 296 196		3504		

Source: External trade statistics, Statistics Norway.

The smallest tractors have far smaller unit values and are thus probably not comparable to the groups of larger tractors. The two groups containing the larger units represent a majority of the total value of imported tractors. In 2000, 62 per cent of the imported tractors were entered in the group 87.01.9004 (70-89 hp) or 87.01.9005 (over 90 hp).

2.4.1.2 Our definition

The study deals with only the larger tractors – above 70 horse power (hp). In 2000 this class of tractors covered 78.6 per cent of the total value of the imports (see table 2.7).

2.4.1.3 Characteristics

According to tractor brochures, the model name normally indicates the motor output, whether it has two or four-wheel drive and sometimes the type of cabin. These characteristics can also be expected to be among the best to explain price variations. However, prices are also highly influenced by some of the optional equipments. According to price lists received from importers, larger tyre sizes, front axle suspension and reversible seat mean considerable price increases. Some examples of available equipment that add to the price are front mounted hydraulic lifting device and power take-off (PTO), air-conditioning and pneumatic trailer brakes.

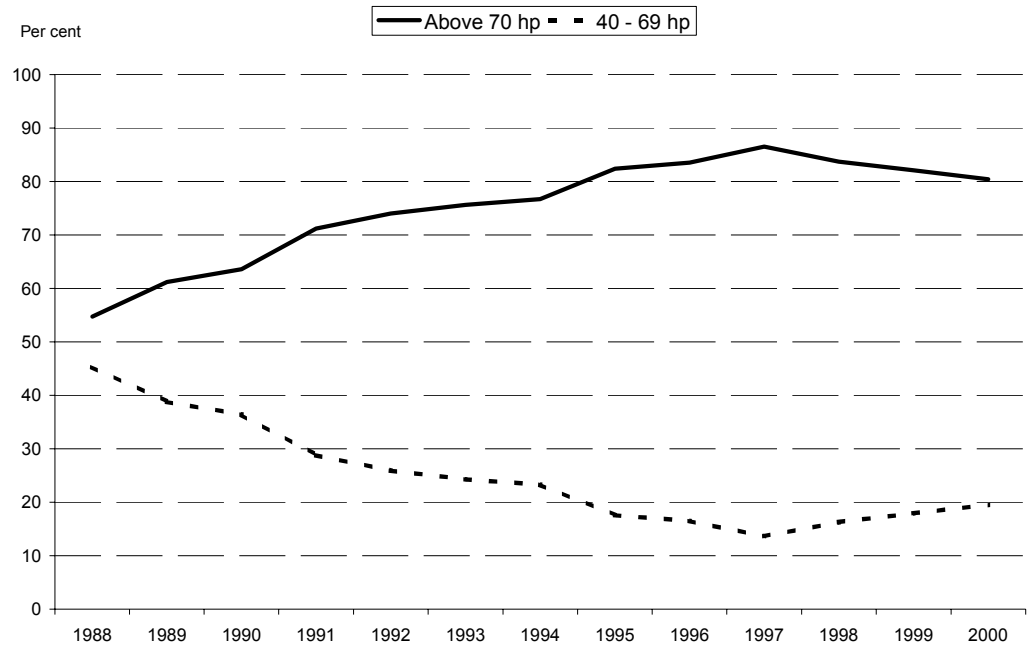
The Purchasing Power Parity (PPP) survey covers motor output, cylinder volume, number of gears, number of PTO speeds, rear tyre dimension, terms of sale and whether or not the tractor has four-wheel drive and drivers cabin.

2.4.1.4 Special aspects of tractors

Buyers want tailor-made units and there is a great deal of optional equipment available and an excess of characteristics that can be fitted according to each buyer's requirements. To examine prices one has to monitor quite a few characteristics.

According to the Norwegian Agricultural Authority (NAA) the most important development in tractors the last twenty-five years is their increase in motor output. Figures from external trade statistics support this statement. In 1988 40-69 hp tractors represented 45 per cent of all imported tractors above 40 hp. Similar figures in 2000 show that the smaller groups have declined to a mere 19.5 per cent.

Figure 2.2: Imports of tractors above 40 hp, 1998-2000



Source: External trade statistics, Statistics Norway.

2.4.2 Population and sample

2.4.2.1 External trade statistics

A sample consisting of six large importers (see table 2.8) will cover most of the imports of tractors.

2.4.2.2 Trade organisations

We located one trade organisation within this business sector – the Association for Importers of Tractors and Agricultural machinery. This organisation organises most of the importers. Some information about the market was gathered from this source. They were planning a central register for new tractors, but the work is not finished yet. For prices of tractors the organisation referred to the Norwegian Agricultural Authority (discussed in chapter 2.4.4).

2.4.3 Market analysis

2.4.3.1 Competitors

Using figures from the "Opplysningsrådet for Vegtrafikken" (Norwegian Road Federation - NRF) an overview of the quantity of first-time registered tractors and the companies that probably had imported the units was made. The links between the importers and their brands are sampled from a survey published in a Norwegian agriculture magazine.

Table 2.8: Importers and brands of tractors

Importer	Brand
AK Maskin	New Holland
Eik Maskin	Massey-Ferguson Fendt
Valtra	Valmet
Felleskjøpet Maskin	John Deere
Lantmannens Maskin	Case
Motokov	Lamborghini Hürlimann Same Zetor

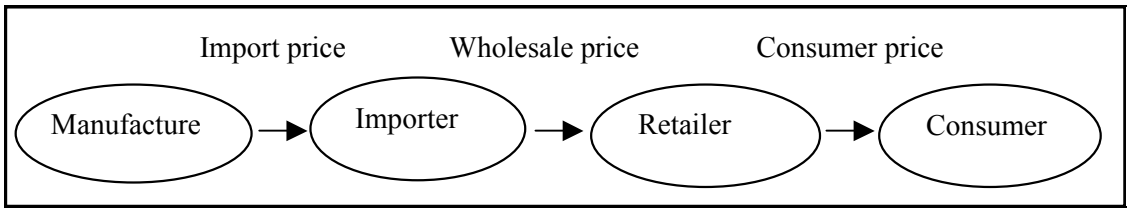
Source: Norsk Landbruk (1999).

Importers have introduced different pricing techniques at different times in order to achieve higher market shares. They normally return to their pricing strategy if new strategies are less successful than the previous ones. The surveyor needs a good relationship with the retailers in order to get the right impression of the actual prices. Most importers purchase tractors in Western Europe, which has fairly stable exchange rates against the NOK. Thus there are only minor price fluctuations associated with exchange rate variations.

2.4.3.2 Customers

The importers sell tractors directly to retailers. The relationship between an importer and its retailers is not the same for all brands. Some importers have their own retailers and others sell to independent retailers. These relationships might affect whether or not the prices between the importer and the retailer are actual or internal prices. This is summarised in figure 2.3 below.

Figure 2.3: Actors in the tractor market



2.4.3.3 Terms of sale

Usually all purchase contracts are sent to the factory abroad, and the tractors are delivered directly to the consumer. The importers are faced with constant prices from the factories during one year.[10] Even so some importers keep various tractors in stock, indicating that not all tractors are specially adjusted for the individual consumers.[11] The companies replace about one model each year. Most models are sold roughly four to five years before they are replaced.

Some tractor importers have their tractor portfolio available on the Internet. Here end users may choose or define which tractor they want and which optional equipment they need. And the consumer will at all times see the price he would have to pay for that tractor composition.

2.4.4 Previous attempts to quality-adjust tractor prices

Only the NSI publishes quality-adjusted tractor prices. There are also few research papers discussing quality-adjusted indices for tractors and the identification of relevant quality characteristics. The Office for

[10] This depends on the market – if some extraordinary event puts pressure on prices, the prices of tractors may be adjusted. This may for instance be large exchange rate fluctuation.
[11] According to the Norwegian Agricultural Authority.

National Statistics (ONS) in the UK is currently using option pricing to adjust for quality differences in capital goods, including tractors, in their producer price index.

2.4.4.1 The Norwegian Agricultural Authority's tractor index

The Norwegian Agricultural Authority (NAA) made its first tractor index in 1975. This index is created annually and chained when required. The sample consists of 20 tractors from six different manufacturers, which is assumed sufficient in order to avoid any errors due to strategic pricing.

The most important tractor improvement since the index first was created is the increase in average motor output that has doubled from 40-50 hp. This is mainly due to the four-wheel drive, cabins and other facilities, which increase the tractor's weight and thus its need for power. Heavier tractors need bigger tires as well. The NAA's findings show that tyre size has a significant influence on the tractor price and therefore needs attention.

The NAA classifies the surveyed tractors using the Customs Tariff and the external trade statistics' weights. Within each group the observations are weighted by sales data. The forms that are sent to the importers have only the model names and no technical details. The contact with the importer is limited to an enquiry every time a new model name reveals a quality change. The importer's estimated value of this quality change is used in order to make a judgmental adjustment of the index.

The NAA index attempts to measure the development of prices that end users actually pay. Price lists are occasionally received (list prices), which are adjusted for an average discount. This discount is normally given as a reduction in the price paid. Discounts vary geographically and between the makes depending on local competition. For example – one of the chains of dealers has been using a net pricing system while another has been giving around a twenty per cent discount on the list price. Discount levels also vary within the makes and over time.

The NAA has sampled data from a Norwegian agriculture magazine (Norsk Landbruk) that presents a tractor survey in one of its last issues every year. Some industry organisations and magazines issued by the importers have also been of use to the NAA.

2.4.4.2 Research papers

We have located only three studies on quality-adjustment of tractor prices, all applying the hedonic method. Fettig (1963) analysed the sale of tractors in the UK over the years 1950-1962. The number of models varied between 41 and 89. Fettig used a simple model where tractor prices are adjusted to the tractor's attached equipment and subsequently applied in a regression with belt horsepower and engine type (diesel or petrol) as explanatory variables. He believes the tractor's horsepower is correlated with other variables and thus picks up their effects. The diesel/petrol variable became less important for the latest models.

Pagoulatos et al. (1982) has made a more complicated model that includes brand dummies, power takeoff, drawbar performance and fuel economy. The authors concluded that power takeoff horsepower accounted for 95 to 98 per cent of the variation in list prices for tractors. There was little evidence to suggest that prices were related to either the drawbar performance or fuel efficiency. The authors believe the reason why fuel efficiency does not matter is that information concerning this is not readily available to the farmer.

Cooper (1993) discusses constant quality prices of agricultural tractors. The paper describes an application of hedonic regression to quality-adjust annual prices of fertilisers and tractors in the UK since 1945. The main problem was that not all the changes or qualitative improvements could be included in the regression due to multicollinearity. This problem was amended using option pricing or the manufacturers' cost estimates. Another problem was the lack of information regarding operating characteristics such as fuel economy.

2.4.5 Sources of tractor prices and quality characteristics

External trade statistics can give detailed customs reports for imported tractors provided that the importer has given details when declaring the tractors. An extract from their databases shows that this does not

happen regularly. The table has one entry for each customs clearance. Each record always includes weight, value and the number of tractors. However, the entries seldom include model names. Between one and 17 tractors are declared at the same time in the investigated data, so it is not always possible to see each individual tractor's price or weight. Data from external trade statistics cannot be used unless the tractor importers give detailed information more frequently. The individual tractor makes have web pages with technical details for each model or forms for ordering brochures. Historical technical data and list prices may be obtained from the annual survey in the Norwegian agriculture magazine "Norsk Landbruk".

2.4.6 Potential methods

The approaches of a hedonic regression method, a judgmental method, price overlap and model pricing have been considered to be the most appropriate methods concerning price measurement for tractors.

- **Hedonic method**

All tractors have some standard characteristics that account for most of their value, such as the motor output, two or four-wheel drive and type of optional equipment. The basic models have a tendency to longevity, but the number of observations may be on the low side when it comes to taking all relevant variables into the regression.

- **Judgmental method (expert panel)**

The NSI already has extensive direct contacts with the experts (importers) that may be extended to obtaining quantitative judgements of the change in value pertaining to the relevant characteristics of old and new observations.

- **Price overlap**

Overlap pricing is a method that could be appropriate if each company markets and provides data on only a few basic models in the imports.

- **Model pricing**

Model pricing may be possible if the dominating companies typically import tractors that are already fitted to the individual consumer's demand.

For more about these methods, see chapter 4.

2.4.7 Concluding remarks

After further studies of data from external trade statistics these data were seen unfit for our purpose due to lack of details in the material. Furthermore, we chose not to base the study on unreliable data from "Norsk Landbruk". Thus five of the importers will be requested to report about five tractors each, which will lead to a sample size of twenty-five tractors.

Tractors represent a complex bundle of characteristics so it will probably be difficult to specify all relevant characteristics and still keep a manageable model. Thus the first task will be to limit the number of characteristics to a few that are really important (or picks up the effect of many others).

The considered methods will be evaluated and tested further to see which one is most appropriate. The tractors' technical specifications will vary not only between models but each model may be available in several versions. This has to be accounted for explicitly if the importers are unable to report prices of standard tractors.

2.5 Lorries

2.5.1 Definition of a lorry

For the purpose of this study, a lorry means a large motor vehicle designed to carry heavy loads.

2.5.1.1 External trade statistics

The study deals with the imports of new lorries in the five commodity codes in table 2.9.

Table 2.9: Imports of lorries in 2000

Commodity code	Description	Value in NOK 1000	Quantity	Unit value
87.01.2001	Road-tractors for semi-trailers, new	30 793	82	375 521
87.04.2201	Motor vehicles for the transport of goods: Chassis with motor and driver's cabin, diesel or semi-diesel, 5-20 tonnes total weight, new	300 645	685	438 897
87.04.2202	Other vehicles for the transport of goods, diesel or semi-diesel, 5-20 tonnes total weight, new	1 047 133	2 264	462 515
87.04.2301	Chassis with motor and driver's cabin, diesel or semi-diesel, over 20 tonnes total weight, new	430 513	675	637 797
87.04.2302	Other vehicles for the transport of goods, diesel or semi-diesel, over 20 tonnes total weight, new	173 720	193	900 106

The majority of the lorries imported into Norway in 2000 were declared under the two codes of heading 87.04.22, vehicles designed to haul a total weight between five and 20 tonnes. The total weight means the gross vehicle weight (g.v.w.). The g.v.w. is the road weight specified by the manufacturer as being the maximum design weight capacity of the lorry, that is the maximum specified load, including the weight of driver and fuel. The data suffer to some extent from statistical noise due to 'weight class' being perceived to mean the vehicles' own weight at the point and time of declaration. The vehicle's own weight is obviously only one of the components of g.v.w. The distinctions between the codes in the nomenclature lead to disparate interpretations at the point of customs' clearance.[12]

2.5.1.2 Our definition

The original intention of this study was to limit the analysis of lorries to trucks for semi-trailers. However, from the findings reported in 2.5.1.1, it is evident that there are very few imports of such vehicles into Norway. Therefore the study from here on deals with the imports of vehicles in 87.04.2201 and .2301, new motor vehicles for the transport of goods of gross vehicle weight 5-20 and over 20 tonnes, respectively.

2.5.1.3 Characteristics

The vehicles in 87.04.2201 and .2301 are equipped in various ways before they are sold as lorries, tractor trucks or special vehicles in the home market. It is so far unknown how many of them that are used for each purpose.

[12] According to the Norwegian Directorate of Customs and Excise, lorries that do not appear to be complete belong in the positions for chassis with motor and driver's cabin. Lorries that appear to be complete are recorded in the positions for lorries for the transport of goods, diesel or semi-diesel.

Most of the imported lorries are customised - normally by Norwegian experts. This means that models with identical names in import may have different specifications and prices when delivered to the customer. A lorry identified by a particular make and model may for example have an automatic transmission or a manual transmission. The HS-system does not allow for separating in this case. Due to this the use of external trade price statistics for monthly comparisons are prohibitive and further information is required.

The new lorries' negative impact on the environment has been significantly reduced over the last twenty years. They are also less dangerous to other road-users. Though the hauliers might consider these improvements to give them a competitive advantage, they are also advantageous to the society in general. This makes it more complicated to value the quality improvements. Other characteristics like productivity and reliability may be even harder to get objective measures of.

Technical characteristics

In order to determine the set of technical variables that are influential to the price of a lorry, the criteria specified for the PPP survey and the most important criteria according to a representative importer of lorries are assembled. The variables marked with an asterisk are considered by the importer to be the main determinants for the price of a lorry.

- Gross vehicle weight
- Wheel base
- Engine capacity
- Power of engine*
- Engine power output
- Number of forward speeds
- Types of suspension, front and rear*
- Brake system*
- Type of cabin*

The technical specifications in the PPP coincide to a great extent with the characteristics assumed as price determinants from a representative importer's view. As for the haulage capacity – represented by the gross vehicle weight in the PPP specification – the importer suggests to use the characteristic of

- Number of wheel axles

A characteristic that is not mentioned in the PPP specification, but considered important by the importer is environmental standard.

The BLS survey for light trucks (BLS, 2000) attributes changes in quality to certain variables that are relevant for the set of vehicles considered in this project, as well.

- Changes that are made in order to comply with environmental legislation
- Changes that are made in order to comply with national safety standards
- Power train improvements
- Changes in level of standard equipment
- Changes in level of optional equipment

The first dot corresponds to Norway's obligation under the EEA[13] agreement with the EU. By 1 October 2001, each lorry has to comply with the EURO 3 environmental standard in order to be granted registration (Eurostat, 1999). One importer explained that they were already importing a few EURO 3 vehicles, among the prevalent EURO 2s, which are only complying with the present standard (Eurostat, 1991).

[13] European Economic Area.

2.5.1.4 Special aspects of lorries

The technical characteristics vary not only between the different makes of vehicles but also within the models of a make. The result is that each of the pertaining HS codes contains a mix of products. Moreover, the vehicles are typically imported in a semi-finished state. The classification at the customs' clearance depends on the interpretation of the criterion of whether the vehicle appears to be finished or not. The characteristics of environmental standard and packages of standard equipment are beyond the specification of the HS commodity classification, altogether.

Whereas the haulage capacity and efficiency used to be the dominant characteristics of a lorry, the safety, comfort and environmental aspects have gained in importance. Over time this is reflected in the upgrading of each make's and model's sets of standard and optional equipment.

The Norwegian importers of lorries are typically affiliates of the foreign producer. Within the external trade statistics, the values in transactions taking place between affiliated companies may be biased by transfer pricing. There seems to be some evidence in favour of the assumption that the import and retailing prices are changed once or twice a year.

2.5.2 Population and sample

2.5.2.1 External trade statistics

The import data for the commodity groups described in 2.5.1.1 have been investigated further in order to identify the importers responsible for the highest imports. For the year 2000 the eight largest importers covered nearly 92 per cent of the total number of imports of new lorries.

2.5.2.2 Trade organisations

There are Norwegian organisations for importers and hauliers and a Norwegian periodical with technical data for vehicles for the transport of goods or passengers (Last og Buss, 2000). The periodical is a valuable source of technical information, but does not contain information on actual prices of sale and purchase. The lorry owners' association is a source of information concerning the hauling industry.

2.5.3 Market analysis

2.5.3.1 Competitors

The Norwegian Road Federation publishes statistics on first time registered, heavy vehicles (see table 2.10). The table covers all heavy transport vehicles of goods, which is a wider range of vehicles than in table 2.9. The difference in concept between imports and first time registration plays a minor role, but the first time registrations also encompass e.g. light trucks.

Table 2.10: First time registrations of heavy transport vehicles in Norway in 2000

Manufacturer	Quantity	Percentage of total quantity
Volvo	1 188	18.7
Chevrolet	1 083	17.0
Mercedes-Benz	884	13.9
Scania	795	12.5
Ford	551	8.7
MAN	432	6.8
Iveco	418	6.6
Nissan	164	2.6
Peugeot	111	2.2
Tri-Star	142	1.8
Total	6 361	

Source: The Norwegian Road Federation: www.ofv.no/bilsalg.asp.

2.5.3.2 Customers

According to the Norwegian Lorry Owners' Federation ("Norges lastebileierforbund") most of the hauliers purchase new lorries from importers. This coincides with the findings in table 2.9. The importers import chassis with motor and cabin that they in Norway equip with what the haulier requests.

2.5.4 Previous attempts to quality-adjust prices of lorries

We have not found any research papers or previous attempts to quality-adjust the prices of lorries, except for the Bureau of Labor Statistics' (BLS) adjustments for light trucks. The BLS uses a cost-based approach in their CPI, PPI and IPP indices. The descriptive categories applied to adjust for quality can be thought of in terms of reliability, durability, safety, economy, manoeuvrability, speed, acceleration/deceleration, carrying capacity and comfort or convenience. The criteria include structural and engineering changes, except changes in style or appearance and physical changes in separate components that do not affect functionality or performance of the component. The values of quality changes for a sample of twenty models are assessed directly – in dollars and cents – in consultation with the truck producers. The weighting of the models' prices is based on revenue. If a model goes out of the market, it is dropped from the sample. A complete re-sampling is undertaken every five years.

The resource cost associated with an entirely new standard feature that meets the criteria for quality adjustment is applied as the value of the adjustment. When a change involves a modification or a replacement of an existing standard or recorded optional feature, the net difference in resource cost will be applied as the value. When a previously standard feature is made optional at extra cost, the feature will be added to the survey's truck product specification and its mark-up cost will be added.

2.5.5 Sources of prices and quality characteristics for lorries

The importers are the experts when it comes to decide which models of a certain make give the most accurate representation of the make's population. The importers may very well be the sole source, if any exists at all, of historical prices and characteristics. In order to reduce some of the burden on the importers, we have considered the following alternative information sources.

2.5.5.1 External trade statistics

Data from external trade statistics could have been used if the most important importers had given sufficient information when declaring. Each customs record always includes weight, value and number of vehicles. Lorries are usually declared in single entries including chassis number and model name. The information available allows identifying the model codes. This is useful information regarding which models are relevant to monitor, provided that the pertinent data fields are transmitted to the NSI.

2.5.5.2 Transport statistics

Statistics Norway collects monthly data on the retail price of lorries for the cost index for road goods transport. Data are collected from four importers, each giving the prices for ten models within specific positions of the HS chapter 84.13, and the following technical specifications:

- Chassis, make and type
- Motor
- Type of suspension, front
- Type of suspension, back
- Type of cabin
- Standard equipment

As these prices and characteristics do not suffice for the use in this project a joint effort is about to be launched to collect data for the dual purpose of the cost index and the PPI.

2.5.5.3 Branch publications

Branch publications like the Norwegian periodical "Last og Buss" contain recommended prices and some technical details. Such publications might be used to see whether or not a specific model is relevant to the study. However, such publications rarely cover all models.

2.5.5.4 Internet

Most manufacturers have web pages with technical details for each model. These technical data are for available models, and not necessarily the models that are actually sold in Norway. There are normally no prices for lorries or their optional equipment on web sites or in brochures.

2.5.6 Potential methods

The potential methods for lorries are, in the same way as for tractors, limited by the quality and the amount of sampled characteristics and prices, and the small country dimension (modest population and limited resources for data sampling). We have considered the following methods to be the most appropriate: The hedonic regression method, option or production cost adjustment and the judgmental method. For more about these methods than below, see chapter 4.

- **Hedonic method**

All lorries have some standard characteristics that account for most of their value, such as engine power, type of suspension, brake system, type of cabin, compliance with environmental and safety standards, contents of standard and optional equipment. The basic models have a tendency to longevity, but the number of observations may be on the low side when it comes to taking all relevant variables into the regression. There is typically a wide spread in the contents of the sets of standard and optional equipment between the makes of lorries.

- **Option cost adjustment**

Considering that a common feature of lorries is the moving of a piece of optional equipment to the set of standard equipment or vice versa, this method is relevant if such transitions are typically tantamount to a change in quality. The method measures prices to the consumer and may be biased when it comes to represent the price change at the point of border crossing for imports.

- **Production cost adjustment**

This method measures how much a characteristic costs to produce. When products are replaced this method may be used to adjust for the production cost of the new characteristics.

- **Judgmental method**

The NSI has direct contact with the experts (importers) and makes a quantitative judgment of the change in value between the old and new observation. This method may be useful because models are on the market for some time, and because they often are replaced with a product not very different. Prices change usually once or twice a year.

2.5.7 Concluding remarks

Based on the information in this chapter the preferred course of action for lorries is to extend the already existing survey on lorries in the division of transport and tourism into a joint survey. The collection of retail price needs to be supplemented by the collection of import price. The lorries tend to be imported in a basic state, the optional and ancillary equipment being mounted after the importation. The information presently asked for needs to be upgraded to include the characteristics that are assumed to be bearers of change in quality. Data for all months in 2000 and 2001 will be collected for testing and final choice between the potential methods.

Lorries represent a complex bundle of characteristics so it will probably be difficult to specify all relevant characteristics and still keep a manageable model. The first task is to limit the number of characteristics to a few that are most important while trying to avoid introducing biases for omitted variables.

2.6 Power utility equipments/Pumps

Most of the products produced in or imported to Norway within the group called power utility equipment are quite large units of machinery. Within the same eight-digit commodity classification in the Norwegian external trade statistics there are also far smaller units. For this reason, the unit prices within these groups show considerable variation. This is because the group definitions usually place no restrictions on size or capacity. The small, inexpensive products within the same commodity groups are sold in much larger quantities and are normally quite standardised.

The main challenge in measuring the price development for power utility equipment is their complexity and varying specifications. When these issues are combined with low volumes and/or a number of different products, which is often the case in small countries like Norway, they become particularly difficult to deal with. Some of the most expensive products are sold exclusively as packages, which include installation and service. This requires the manufacturer, or the statistician, to artificially separate the different cost components – the product, customising, installation, transport, service, etc. – from the total cost.

The degree of heterogeneity of power utility equipment makes an analysis almost unfeasible. The rest of this analysis therefore narrows the scope to one particular, important subset of power utility equipment - pumps. The preliminary results on power utility equipment as a whole can be found in appendix D.

A pump is a machine that is used to force a liquid or gas to flow in strong, regular movements in a particular direction. According to Karassik (1998) pumps are built in sizes ranging from tiny swimming pool pumps delivering a few gallons per minute, to very large pump turbines which deliver 116 m^3/s against 387 meter total head and absorb 410 MW when running in pump mode. The range of pressures is just as wide, starting with single stage cellar-pumps, which develop around 0.3 bars, and rising to the multistage pumps used for oil field water injection, which develop as much as 360 bar in a single casing.

2.6.1 Definition of a pump[14]

2.6.1.1 External trade statistics

Pumps are classified in HS-chapter 84.13:

84.13 Pumps for liquids, whether or not fitted with a measuring device; liquid elevators:
- Pumps fitted or designed to be fitted with a measuring device:
  - -- 84.13.1100 Pumps for dispensing fuel or lubricants, of the type used in filling stations or in garages.
  - -- 84.13.1900 Other
- 84.13.2000 Hand pumps, other than those of subheading nos. 84.13.1100 or 84.13.1900.
- 84.13.3000 Fuel, lubricating or cooling medium pumps for internal combustion piston engines.
- 84.13.4000 Concrete pumps.
- 84.13.5000 Other reciprocating positive displacement pumps.
- 84.13.6000 Other rotary positive displacement pumps.
- 84.13.7000 Other centrifugal pumps.
- Other pumps; liquid elevators:
  - -- 84.13.8100 Pumps.
  - -- 84.13.8200 Liquid elevators.
- Parts:
  - -- 84.13.9100 of pumps.
  - -- 84.13.9200 of liquid elevators.

The most important pumps measured by values in external trade statistics in 2000 were the categories 84.13.6000, 84.13.7000 and 84.13.8100, see table 2.11.

[14] Appendix D shows the different types of pumps.

Table 2.11: Imports of pumps: Selected commodities, 2000

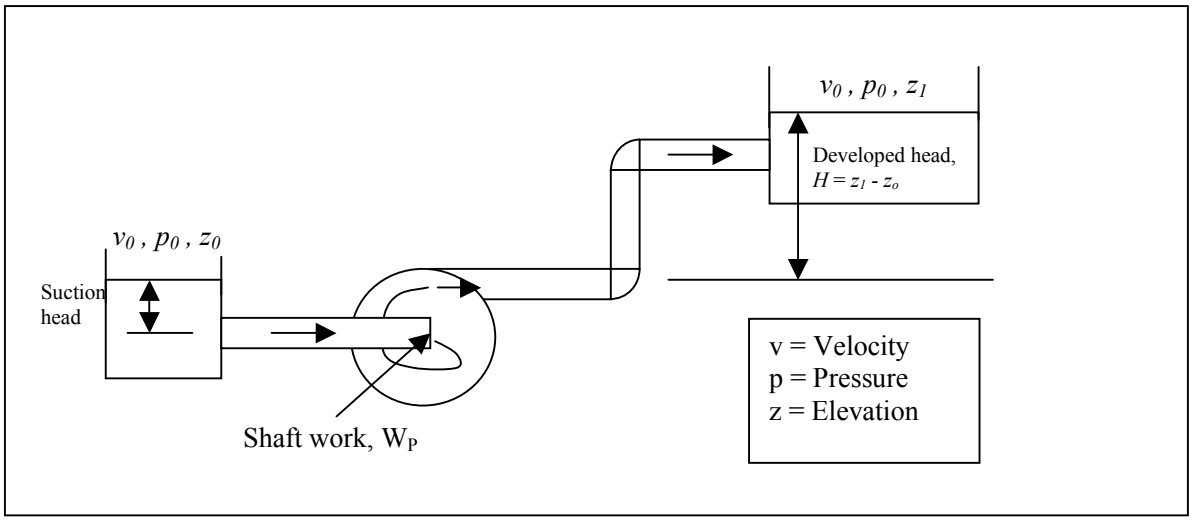
Commodity	Quantity (pieces)		Value (NOK millions)	
	Imports	Exports	Imports	Exports
84.13.6000 Rotation pumps other than those meant for fuel, lubricants, cooling agents and concrete	45 983	7 072	131.4	385.1
84.13.7000 Centrifugal pumps other than those meant for fuel, lubricants, cooling agents and concrete	38 064	11 833	105.4	392.2
84.13.8100 Other pumps; liquid elevators: pumps	97 775	3 939	160.9	51.2

The export value is far higher than the import value for rotation and centrifugal pumps, though the export volume is lower in terms of number of units. This relationship is opposite for the group other pumps and liquid elevators. The unit values are quite dispersed, which is to be expected since the commodity positions do not specify size limits. Moreover, misclassifications may increase the heterogeneity even further.

2.6.1.2 Technical characteristics

A pump increases the mechanical energy of a fluid by supplying the driving force required in order to make it flow from one point to another in a closed conduit or pipe. This mechanical energy may be used to increase the velocity, the elevation or the pressure of the fluid with a given density. Figure 2.4 represents a schematic pump system, its main building blocks and concepts and the direction of the transmission of the mechanical energy.

Figure 2.4: Draft of a pump system



Efficiency

The efficiency of a pump is the mechanical energy it supplies to the liquid divided by the shaft work delivered to the pump. In addition to flow, pressure, the pump's design and the liquid's density, the electric motor's efficiency is determining the pump's overall efficiency.

Head

The mechanical energy in joules[15] per kg, of fluid added to it by the pump is often expressed as the developed head in metres of fluid being pumped, when the fluid's velocity and pressure are held constant. If the pressure of the liquid in the pumps' inlet drops below its vapour pressure, voids or bubbles will develop. The bubbles will collapse when they reach the pressure side of the pump. The collapse may damage the pump and erode hard surfaces. This phenomenon, called cavitation, causes a drop in the output flow. An important pump characteristic is thus its minimum required net positive suction head.

Capacity

Thus some of the most obvious pump characteristics are the maximum head and efficiency. The discharge, flow rate or capacity for a pump with a given size depends on the head. Size is often expressed as the maximum flow rate. The manufacturer often expresses the capacity by characteristic curves (graph of flow versus head) for a liquid with a given density, normally water. The head will be the same for any liquid of the same viscosity. The pressure produced will be proportional to the density of the fluid.

Customisation

Pumps are quite often customised and not directly comparable to other pumps. Furthermore, the prices are then only given upon request and may depend on other factors in addition to the pump's characteristics. Nevertheless, some of the customised pumps are probably assembled from fairly standardised components, which may be easier to compare.

Type of energy transmission

According to Nelik (1999) pumps are divided into two fundamental types based on the manner in which they transmit energy into the pumped media – kinetic or positive displacement. A classification of the types considered within these pump groups, as defined by the Hydraulic Institute (HI), is shown in appendix D. The HI classifies pumps by type, not application. However, the user must ultimately deal with specific applications. As a general rule, kinetic pumps are used for *higher flows and lower pressures* (heads), while positive displacement types are used for *lower flows and higher pressures*.

2.6.1.3 Quality characteristics

According to Nelik (1999) some quality characteristics common for most of the pumps in addition to capacity, efficiency, minimum suction head and developed head already mentioned are:

- Vibration/noise
- Mean time between failures or mean time between repair
- Mean time between scheduled maintenance
- Economic service life
- Sealing type

These factors are hard to measure since they depend on load, operating environment and many other factors. Some of these characteristics are normally given in pump pamphlets. Some of the factors are interdependent.

2.6.1.4 A manufacturer's view of the characteristics

One of the largest pump manufacturers in Europe is the Danish enterprise, Grundfos. Grundfos describes their pumps with the following technical data in their brochures:

- Maximum flow
- Maximum head
- Liquid temperature range
- Maximum operating pressure

[15] A joule is a unit of energy or work.

Grundfos also describes their pumps' applications, features and benefits.

2.6.1.5 Characteristics according to the PPP

The PPP survey requires the following technical data:

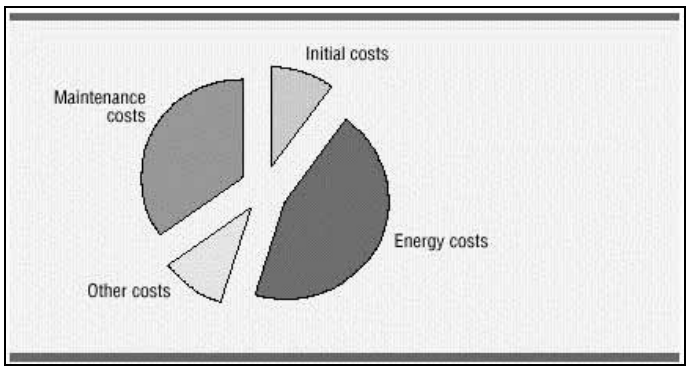
- Volume capacity (the same as "maximum flow" in the Grundfos' set of characteristics)
- Head
- Speed
- Suction diameter
- Number of stages
- Whether or not the pump and impeller are in stainless steel
- Whether or not the electrical supply is 415 V, 50 Hz, 3 phase
- Power of motor
- Whether or not coupling, mounting and base are included in the price
- Pump's weight

The PPP survey includes design or application characteristics needed to find similar pumps, and not necessarily characteristics that reveal improvements in quality over time.

2.6.1.6 Characteristics of quality improvements

The pump manufacturers are putting most of their research and development effort into reducing the pumps' life cycle costs, see figure 2.5. The energy and maintenance costs are the major cost components. According to Karassik (1998) the latest improvement is variable frequency motors. Altering the motor's frequency is a more energy efficient way of controlling the flow than to throttle it. Another improvement is to coat the wetted parts of the pump to reduce wear and tear. This is less costly than to use expensive materials all the way through.

Figure 2.5: Typical life cycle costs for a medium-sized industrial pump



Source: Hydraulic Institute

2.6.1.7 Ejectors

The external trade statistics' commodity position 84.13.8100 encompasses ejectors as well as pumps. Ejectors are jet pumps for accelerating and ejecting a fluid with increased velocity. Team Tec, which delivers ejectors, considers the following general information to be needed for offering ejectors:

- Stripping application
- Requested suction capacity
- Estimated suction lift (inclusive velocity pressure drop)
- Estimated discharge head (back pressure) inclusive velocity pressure drop
- Available pump for motivating the ejector – quantity and pressure
- Material

The ejector's material quality is of great consequence for its need for maintenance. Ejectors of cast iron or steel with internal coating have a shorter lifetime compared to ejectors made in corrosion resistant materials. The high velocity of the normally contaminated liquid causes wear and tear.

2.6.1.8 Special aspects of pumps

Some of the pumps with the highest import and export values are exclusively sold as packages that include installation and different kinds of services. This requires the manufacturer, or the statistician, to estimate the costs for each component such as installing, transporting and services from the total cost. Even standardised pumps – pumps that the manufacturers keep in stock – still have a range of characteristics that must be paid attention to.

All in all, pumps are quite a heterogeneous group of products. A large number of different pumps exist for different purposes. Since neither these purposes, nor the pump sizes, are reflected in the classification used by external trade statistics there will be large variations within the selected HS positions.

The importance of the different characteristics varies between different pump applications. For pumps in waterworks, for instance, the energy cost may be as high as 80 per cent of the total cost. Thus the pump's efficiency is crucial. At the other extreme, maintenance cost and the risk of unscheduled shut-downs are far more important than energy consumption in process applications, where the service is often severe and the cost of lost production is significantly greater than any other consideration.

2.6.2 Population and sample

In order to identify the most important manufacturers and importers, the import and export data from external trade statistics and production data from the manufacturing statistics were analysed. The web sites belonging to the most important firms have been investigated to see what kind of machines they actually manufacture or import. Some pump manufacturers' associations and other useful sources have also been identified.

2.6.2.1 External trade statistics' categories of pumps

- ***Rotary positive displacement pumps 84.13.6000.*** *The intake and discharge of the liquid in a rotary positive displacement pump is affected by suction and compression, which is produced by cams (lobes) or similar devices, rotated continuously on an axis. These devices make contact, at one or more points with the wall of the body of the pump, and form in this way the chambers in which the liquid is displaced* (WCO, 1996, p.1257).

Figure 2.6: Gear pump

Source: Assopompe[16]

Figure 2.7: Lobe pump

Source: Assopompe[16]

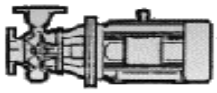
According to Geankoplis (1993) positive-displacement pumps (rotation pumps, gear pumps, piston pumps, etc.) can only be used for liquids containing dissolved substances. They can be used to very high pressures.

The unit prices and unit weights vary considerably between the firms in the import and export data for rotary displacement pumps, HS-code 84.13.6000. Another feature is that for exports there is one large firm while for imports there are several small firms.

[16] Associazione Italiana Produttori Pompe.

- ***Centrifugal pumps 84.13 .7000.*** *In these pumps, liquid taken in axially is set into rotation by the revolving blades of a rotor (impeller), the resulting centrifugal action forcing the liquid outwards to the periphery of an annular casing containing an outlet placed tangentially* (WCO, 1996, p.1258).

Figure 2.8: Single stage centrifugal pump



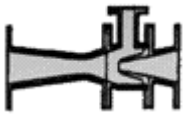
Source: Assopompe[16]

According to Geankoplis (1993) centrifugal pumps are pumping with a uniform pressure, without pulsation or shock, and can handle liquids containing large amounts of suspended solids. Their pressure is limited in their head, and they are used for lower pressures.

For this group there are also large variations in unit weights and unit prices. And again there is one large exporter and several small importers. The most important types of pumps are centrifugal pumps for water and drainpipes according to two representatives for the importers in Norway.

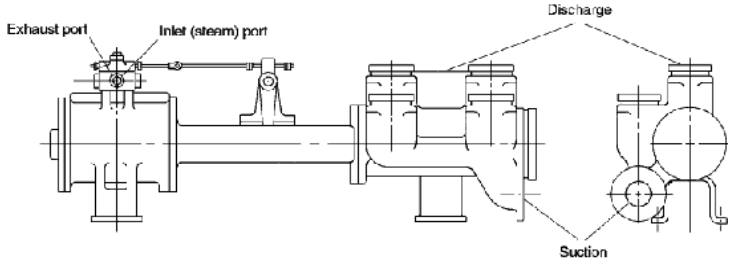
- ***Other pumps or liquid elevators; pumps 84.13.8100.*** *The following pumps fall in this group; electro-magnetic pumps, ejectors, emulsion pumps, pumps in which the steam or gas pressure acts directly on the surface of the liquid* (WCO, 1996, p.1258).

Figure 2.9: Ejector



Source: Assopompe[16]

Figure 2.10: Horizontal simplex direct acting (steam) pump



Source: Hydraulic Institute.

The situation regarding unit prices and unit weights is the same for this group as for the two previously mentioned. However, the distribution of the exporting and importing firms differs from the other groups. For imports, there are many small firms – the largest having a proportion of import value of less than three per cent. For exports the largest firm accounts for nearly 16 per cent of total value.

This discussion of the pumps in the external trade statistics leads to the conclusion that even the most detailed data can not provide any useful information about prices. The large dispersion may be explained by the fact that there is a plethora of makes and types of pumps – serving specific purposes – being recorded in each of the pertinent HS-codes.

Manufacturing statistics

Many manufacturers are producing a variety of products. The manufacturers are categorised in the statistics by the product that is most important for their turnover. Thus a large pump manufacturer that is an even larger compressor manufacturer will appear in the compressor PRODCOM code, not in the pump code.

2.6.2.2 Other information

All the firms that claim to be leading importers or manufacturers and exporters of any of the considered pumps have web pages. Some of the importing firms are Norwegian branches of foreign manufacturers so

import prices might be intra-enterprise transfer prices. However, the prices Norwegian manufacturers pay when importing from subcontractors are more likely to be real market prices.

2.6.2.3 Organisations

Pumps serve a wide range of functions in ships' and offshore machinery. Therefore an organisation called The Association of Norwegian Maritime Exporters (NME) has pump suppliers as members. A division within NME called the Institute for Mercantile Information (IMI) publishes a preferred makers list on CD ROM, with names and occasional pamphlets from the manufacturers of each product. A version of this database will be launched on the Internet with recommended prices meant for electronic commerce between companies' (B2B). The pumps in the IMI directory are mostly classified by their use e.g. bilge pumps, seawater pumps, sewage pumps, etc. This is different from external trade statistics that classifies the pumps by how they operate. How the pumps operate, however, is dependent on their purpose. Allweiler AS, Eptec AS and Hamworthy KSE A/S are listed in the IMI "centrifugal pump" category. However, there might be other suppliers of centrifugal pumps in other categories like sewage pumps or seawater pumps.

Selvig Publishing A/S publishes yearbooks within the areas of shipping, shipbuilding and offshore industry. The offshore yearbook, which is published in association with the Norwegian Trade Council, contains information on Norwegian suppliers and manufacturers of offshore products and services. Searching for pumps in their offshore index on their web page resulted in the following hits:

- Allweiler AS
- Eptec AS
- Framo Engineering AS
- Hitec ASA
- Kumera AS
- Kværner Eureka

The list of Selvig Publishing A/S, however, seems to be less comprehensive than the catalogue published by the IMI.

Association Européenne des Constructeurs des Pompes or Europump is a Pan-European organisation for the national associations of pump manufacturers in their respective countries. There is no Norwegian association in their member list. Europump says that they will be the recognised European source and forum for exchange of pump industry related information.[17]

The HI has in many ways the same interests as Europump. The institute provides detailed standards for pumps.[18]

2.6.3 Market analysis

Whether the pumps are sold directly from the manufacturer to the consumer depends on the value and complexity of the pump. The manufacturer always installs the large, customised and expensive pumps. Pumps for heat, water and sanitary installations installed by local plumbers are sold through wholesale merchants. Most of the imports go through established importers – few firms have the capacity to import for self-consumption.

2.6.3.1 Competitors

According to the United States Hydraulic Institute (HI) there are standards for pumps that can be used to identify duplicate performance, dimensionally interchangeable or pumps with identical performance and dimensions. This gives the consumer the freedom to choose from a range of suppliers internationally. Since the manufacturing statistics and the external trade statistics indicate that much of the production is exported, there is international competition. A representative for one of the importers says that they use list prices, and give various rebates depending on user group and consumer relationship. Most importers serve several niches. The consumers attempt to select the most economical, reliable and environmentally friendly pumping system for each application. The supplier normally assists in this selection. Allweiler, which is

[17] See the Internet - www.europump.org.
[18] See the Internet - www.pumps.org.

one of the largest importers, provides a PC-based pump selection program. This makes the consumers capable of analysing operating costs, which vary between applications.

2.6.3.2 Terms of sale

The terms of sale vary with the complexity of the pumps. An example of the most complex terms of sale is the Framo cargo pumping system, which includes professional assistance during project evaluation, technical support during engineering and supervision of installation and testing. Furthermore, worldwide service organisations take care of training, technical services, spare parts and repairs. However, some of the pumps supplied by ABS Pumps are so easy to install and connect that they can be ordered by filling in an online form.

2.6.3.3 Metal prices

Fluctuations in world market prices of steel and alloys may lead to changes in pump prices. This would affect prices both for imported pumps, and pumps manufactured in Norway and then exported.

2.6.4 Previous attempts to quality-adjust pump prices

There are no known attempts by any NSI to quality-adjust pump prices or any research papers on this topic.

2.6.5 Sources of prices and quality characteristics for pumps

The manufacturers and importers are the most obvious source of prices and quality characteristics. However, some quality characteristics for standardised pumps can be sampled from pamphlets and web sites. These characteristics may be the most important ones.

The pump manufacturer ABS Pumps has a form for online shopping on their web site. The prices can be displayed in a range of currencies, including NOK. Some technical information about the pumps can be obtained by clicking on their names. There are, of course, no information regarding how representative each pump is for the considered firm's total sales, but it is probably not unreasonable to believe that some of their most popular pumps are marketed this way.

The IMI is about to launch an Internet platform, meant for business-to-business (B2B) purposes, including pumps with prices and characteristics. This will probably have the same limitation as the ABS Pumps' site.

2.6.6 Potential methods

Pumps belong to a heterogeneous product group. Several different pumps exist for several different purposes – which is evident in figure E.1 to E.3 in appendix E. This makes it difficult to indicate which methods that may be superior to others. Also the small country dimension comes into play, with modest populations of firms and products and limited resources for data sampling. The most appropriate methods may be the hedonic method, the matched model method (even if this does not explicitly adjust for quality), the model pricing method and the specification method.

- **Hedonic method**

The hedonic method could be suitable if there is sufficient quantity of sampled data. This could be possible if the new IMI B2B platform contains producer prices as well as the sufficient technical data for each pump.

- **Matched model, model pricing and specification methods**

The matched model method might be feasible for smaller pumps. Model pricing and possibly the specification pricing may be the best, perhaps the only possible methods for larger pump systems. For more about these methods, see chapter 4.

2.6.7 Concluding remarks

The number of imported and exported pumps is quite large. A distinct trend in the external trade data is that large pumps contribute to a large part of the export value, and the export value is divided between a few large exporters. The imported pumps are on average smaller and the import value is divided among many smaller firms.

Pumps are quite heterogeneous products. A wide range of pumps exists for different applications that are not directly comparable. We have also seen that a wide range of characteristics is relevant in determining changes in price and quality. Due to complexity and costs in data collection the most feasible approach is most likely to focus on one of the pump categories. According to industry expert's centrifugal pumps are the most important. Hence, the first step in our analysis will be to scrutinise that group.

2.7 Paper machinery

A paper machine in the sense of an industrial plant is a huge and very complex piece of equipment. In Norway imports of such machines are very rare. During the last 30 to 40 years Norwegian establishments have purchased only twelve new machines. The price of one paper machine can reach the magnitude of more than NOK three billion (with utility equipment). The last purchase of a paper machine in Norway in this sense was carried out in the early nineties, when Sagbrugsforeningen bought their PM6.

2.7.1 Definition of a paper machine

The huge paper machines making up an industrial plant do not usually have a second-hand market. However, a frequent upgrading is necessary in order to improve the quality and increase the capacity. When doing so, the paper industry must purchase different kinds of machinery. In this analysis the focus will therefore be on all machinery used for processing and finishing pulp and paper. For Norway this will be the most correct way, or the only way, to deal with this kind of machinery.

2.7.1.1 External trade statistics

We have limited the investigation to the following categories in the HS:

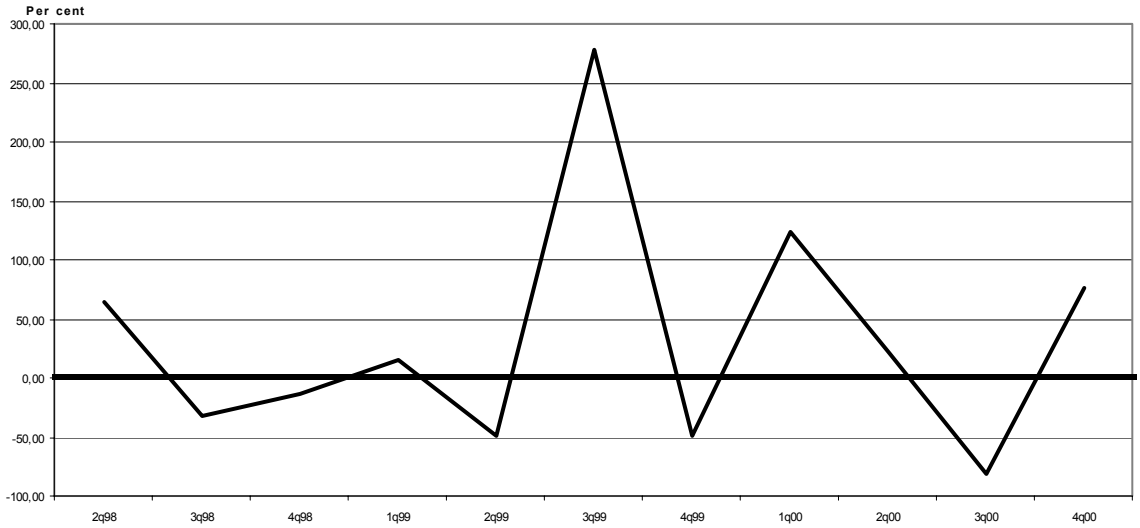
84.39.1000 - Machinery for making pulp of fibrous cellulose material

84.39.2000 - Machinery for making paper or paperboard

84.39.3000 - Machinery for finishing paper or paperboard

The first category is by value the most important, with an import of nearly NOK 100 million over the years 1998–2000. The external trade statistics also indicate that the chosen categories are far from uniform. There is a large dispersion within each group. This is verified by the WCO's descriptions of the commodity codes and by the price development of the chosen categories. This means that use of the external trade statistics´ unit value is not possible. Figure 2.11 illustrates this point:

Figure 2.11: Machinery for making pulp from fibrous cellulose material, imports 1998–2000



Source: External trade statistics, Statistics Norway.

Figure 2.11 picture the change in unit value[19] for imports from the previous quarter for machinery for making pulp from fibrous cellulose material. It gives a rather strong indication that the Norwegian import of goods of commodity code 8439.1000 is a mix of very heterogeneous machinery. Even when making quarterly figures, the changes may be several hundred per cent.

The national accounts figures for 1995 give the following picture of production and imports of machines for the paper industry:

Table 2.12: Paper machines by industry level and market (percentage of value).[20]

	Domestic market	Export market	Import market
NACE 3-digit	5.98	11.86	8.89
NACE 2-digit	1.18	2.84	2.52
Total	0.05	0.12	0.35

Table 2.12 shows that the import market only accounted for approximately 0.35 per cent of the Norwegian market in 1995 of the producer price population. In this group (CPA295510) all kinds of machines for the paper industry are included. According to our definition in 2.7.1.1 above this percentage would of course be lower.

2.7.1.2 Our definition

As mentioned earlier the focus is on paper machinery for making pulp of fibrous cellulose material or for making or finishing paper or paperboard. This machinery is often part of a larger unit – an industrial plant. An industrial plant is accordingly an alternative definition. Actually, the industry itself, according to our contacts, is using the "industrial plant" definition when the concept of paper machinery is explained.

2.7.1.3 Characteristics

One way of making price indices for capital goods is to take a closer look at the products' characteristics, using them to help explain the price variations. Eurostat (1999b) uses the following characteristics to describe paper machinery:

- Ratio of produced output of paper with the desired quality, to the input used (working hours, energy, pulp, and other raw materials).
- Production capacity.
- Ability for flexible production, to change the quality of the paper produced according to shifts in the market.
- Safety of working conditions (probability of accidents).
- Comfort of working conditions (little noise, pleasant temperature, and as little physical hardship as possible).
- Amount of pollution produced.
- Expected lifetime of the paper machine.

These characteristics are the most important ones for a complete industrial plant. For the analysis these characteristics will have to be further specified, due to the complexity of the machinery involved.

2.7.1.4 Special aspects of paper machines

As already mentioned the industry itself uses the term "industrial plant" when explaining the concept of paper machinery. The analysis has revealed that purchases of such plants are very rare. However, once installed, there is continuous upgrading of these plants. Investigation of the external trade statistics and contact with the industry indicated that the Norwegian, international trade in paper machinery encompasses a wide range of different machinery. The transactions being few (see table 2.13) and the equipment

[19] The monthly unit value is calculated as the ratio between monthly value and quantity. The quarterly unit value is the average of the respective monthly unit values.

[20] The value of machines in the paper industry in the PPI population.

imported being heterogeneous mean that the possibilities of measuring prices are weak. One explanation is the size of the industrial plant – such a plant may exist of a multitude of different units of machineries. The abrasion of these may be uneven, therefore making the imports somewhat erratic. When in addition the small country dimension is taken into consideration, the difficulties monitoring prices for paper machinery are obvious. Summed up, the economically important products within the group of paper machinery are almost of a unique goods' character.

2.7.2 Population and sample

2.7.2.1 External trade statistics

The establishments that employ paper machines import most of the selected items themselves. This means that the contacted establishments will have their main field of activity in other groups than the actual paper machine group (paper machinery is grouped under capital goods belonging to NACE 29). According to external trade statistics, there are six major establishments that import machinery belonging to the categories. All of these establishments are located in NACE 21. Table 2.13 shows imports during 2000.

Table 2.13: Paper machines – selected commodity positions, imports in 2000.

Commodity position	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
84.39.1000	1	2	2	1	4	2	0	0	4	0	2	4
84.39.2000	0	3	0	2	2	1	1	0	2	5	2	3
84.39.3000	0	11	12	1	4	5	5	0	17	4	15	4

Table 2.13 and figure 2.11 demonstrate clearly the problems of collecting prices for paper machinery:

1. There are usually very few observations per month.
2. The prices (external trade statistics) fluctuate a lot, indicating that there are large differences in the types of machinery imported (which is also obvious from the detailed descriptions behind the selected HS-categories).

2.7.2.2 Manufacturing statistics

The manufacturing statistics show that the production value in 1998 was approximately NOK 303 million for manufactures of machinery for paper and paperboard production (NACE 29.55). The PRODCOM code where paper machines can be found is 29.55.11.13. Here, the value was NOK 135 million.

According to the central register of establishments (BoF) there are more than 20 establishments within NACE 29.55, but most of them are very small. When extracting establishments with ten or more employees there are less than five units. Of these, the only interesting establishment is Kværner Pulping AS. The others are either too small as measured by turnover, or their classification may be wrong.

2.7.2.3 Trade organisations

There is one Norwegian trade organisation for the wood processing industry – "Treforedlingsindustriens bransjeforening" (The wood processing industry's trade organisation). This organisation consists of 25 establishments with approximately NOK twelve billion in turnover per year, of which 90 per cent are sold abroad. The exports are mainly paper and paper products. The organisation was unable to provide information of relevance to the project. The organisation suggested that the paper producing establishments be approached directly.

2.7.3 Market analysis

2.7.3.1 Competitors

There are just a few suppliers of paper machinery, especially when concerning machinery in the sense of industrial plant. Finland is one of the major suppliers in the European paper industry. Other important countries that deliver such plants are Germany and Italy. Two major producers were located on the Internet

– Valmet-Raisio and The Voith Group of Companies (Voith Sulzer). Establishments that were mentioned are located inter alia in the USA, the UK and France in addition to the above-mentioned countries. These suppliers delivered only parts for the industrial plant (that is – paper machinery according to our definition).

On the Internet Kværner Pulp & Paper (similar to Kværner Pulping AS) claimed to be a leading supplier of machines and systems to the chemical and recycled pulp industries, providing design, engineering, fabrication and project management services for fibre lines, recovery boilers and power boilers.

2.7.3.2 Consumers

The consumers of paper machines are broadly speaking establishments operating in the pulp and paper industry. These have to purchase equipment from the suppliers mainly located abroad. As mentioned earlier they are rarely purchasing paper machines according to the industrial plant definition. But they carry out upgrading of the existing industrial plant and thereby purchase paper machinery according to our definition.

2.7.3.3 Terms of sale

When producers of paper and paper products are investing in larger installations they call for tenders. For optimising and upgrading, there are often long-term contracts. For spare parts (the most important category under CPA 295510, but not covered in this analysis) the usual terms of sale are ordinary list prices or contracts/agreements.

2.7.3.4 Other

The international paper industry is characterised by rather powerful fluctuations in the economic cycle. By observing these fluctuations one would also get some indications of the price development in the making of paper machinery, according to contacts in the industry. The reason is mainly that low investment levels in the paper industry (as often is the case during depressions) sharpen the competition among the suppliers of the paper machinery when projects are carried out or opened for tenders.[21] Information is also received indicating there may be price discrimination in the industry.[22]

2.7.4 Previous attempts to quality-adjust paper machinery prices

We have not identified any research paper discussing attempts to quality-adjust prices for paper machinery. However, Statistics Finland uses a cost index involving wages, social security payments, raw materials, purchases invoiced and other costs (Eurostat, 1999b).

2.7.5 Sources of prices and quality characteristics

The manufacturing statistics and the external trade statistics indicate that ordinary price collection is useless in price measurements for paper machinery according to our definition. One possible source of prices, however, is the establishments producing and exporting paper and paper products. Another source is of course the Norwegian producer – Kværner Pulping AS.

2.7.6 Potential methods

A kind of price collecting may be accomplished if the negotiated prices for machinery and equipment used for optimising and upgrading can be obtained. These prices may be a good proxy for the price development in the industry. On the other hand, such prices are often regarded as very sensitive by the establishments. Another potential method is, although classified as a C-method, the input method used in Finland.

For paper machinery, the most appropriate methods are according to Eurostat (2001), model pricing and the specification pricing approaches. Appropriate quality adjustment methods can also be used directly where the machinery is not suited for a decomposition method. Yet another method – use of international prices – is also considered in Eurostat (2001).[23]

---

[21] However, from another contact in the industry we were told that there is poor connection between prices for paper machinery and prices for paper.

[22] This may affect the price development in Norway, especially if Norwegian producers of paper import from different countries.

[23] A project within Eurostat looks into the possibility for a centralised database composed of prices and characteristics for capital goods (Eurostat, 2000), notably computer equipment. For paper machinery (special purpose machinery) this could also be a good solution, depending on the magnitude of international competition in the industry.

2.7.7 Concluding remarks

This analysis leads to the conclusion that monitoring prices of paper machinery on a monthly basis, and even on a quarterly basis, will be very difficult due to great heterogeneity and few observations – with other words, uniqueness.

The analysis also provides an illustration of the large country – small country dimension. A large country may be able to use more refined methods, e.g. the specification method or model pricing. A large country may also have a sufficient number of paper machinery transactions to enable inclusion in an ordinary price collection. Eurostat (2001) states that data availability may be a major problem for special purpose machinery, of which paper machinery is a part. For Norway that is indeed true.

3 Data collection and description of data

3.1 Introduction

The first contact with the companies did not only involve prices, but was also a quest for information regarding the market and the market conditions. This information was gathered to make the discussions with the firms based on information rather than on our beliefs about the markets. Information about how often models were introduced, how often prices changed and if there was any other important information crucial for making a successful index were sought. Much of this information is given in the branch analyses.

This chapter will describe the work done when collecting data. A short description of the data sets that will be used when making the indices is given. This includes an overview over variables meant for a hedonic approach. This chapter will only include information about washing machines, lorries and computers. Limited resources have prevented us to go further with all of the chosen products. Further work on these products will start later in 2002.

3.2 Computers

3.2.1 Introduction

In this section the focus will be on data used to estimate the hedonic model. The data consist of prices and characteristics, and the goal is to make quality adjusted indices.

3.2.2 Data collection

The data collection started medio September 2000 with a letter of introduction and a request for data for September. The intention was to collect import and domestic market prices as well as data on some quality characteristics for a range of desktops and portables from January 2000. Establishing contact was the first goal, then collecting historical data. It soon became clear that it was difficult to get data back to January 2000. Only one reporting unit supplied historical data, but only back to May. The estimation of the hedonic model was therefore based on data only from the last quarter of 2000.

Historical data proved, as mentioned, to be very difficult to obtain. To establish historical series we investigated other possibilities, and ended up using indices from the USA. Other possibilities were investigated (see 2.2.4), among others indices from Sweden. The choice was based on:

- Market transparency.
  Series back to the early 90's indicates that computer indices from Sweden and USA have the same development.
- Sweden publishes one computer index whilst the USA publishes series for stationary and portable computers. From January 2001 series for stationary and portable are published in Norway.

When a country uses a foreign index it is usual to make an adjustment for the exchange rate. The result of trying different approaches for exchange rate adjustment (monthly, quarterly etc exchange rate), was that using the indices un-adjusted gave best fit against the Swedish index, and also against the Norwegian series.

Using un-adjusted indices are dependent on product – for some products there is likely to exist transparent markets, as is probably the case for computers. Then there is reason to believe that the price development would be fairly equal across boarders, at least over some time.

3.2.2.1 Sample

For the period October to December 2000 only twelve importers supplied data (see also 2.2.2).

3.2.2.2 Methods of reporting

The letter of introduction opened for different methods of reporting data. In the first contact after receiving a reply the advantages (to both parties) of sending data that are already electronically available were stressed. Surprisingly, only two of the reporting units took advantage of this opportunity. From these two data for the whole range of computers and computer-related products were obtained. The other reporting units are using an excel version of an ordinary form. Our initial fear that this would lead to the reporting units just copying the information from last month's form seems uncalled for. We have therefore not yet made use of the opportunities mentioned in 2.2.5.

3.2.3 Data

3.2.3.1 The variables

Dependent variables

Dependent variables are import price (IPRI) and price to the domestic market (DPRI).

Independent variables

The independent variables are chosen considering which variables are being used in other countries (particularly in Sweden).[24] The selected variables are shown in table 3.1.

Table 3.1: Independent variables for computers

Variable	Type	Definition
TYPE	Dichotomous	Portable (1) or desktop (0)
COUNTRY	Discrete	Country of origin
MEMORY	Continuous	Memory size, measured in MB
SPEED	Continuous	Processor speed, measured in MHz
HD	Continuous	Size of hard drive, measured in GB
CD/DVD	Discrete	CD/DVD/0
OPERA	Discrete	Operating system
FAB	Discrete	IBM, Compaq, etc.
PROC	Dichotomous	Intel (1) or AMD (0)
SUP	Dichotomous	Supplier (1) or importer (0)

Information obtained after the data collection started demanded that the dummy SUP was included. All the firms in the sample are represented in the import statistics of external trade. Even so, some of these firms argue that their imports go via the computer manufacturers' representative in Norway. If this is the case there is a risk of measuring as import prices both real import prices and prices that are strictly speaking domestic market prices. Because of the limited data material it is not possible to estimate a hedonic model for the "real" importers only. We have defined "importer" as a company that is only selling one brand, and where the brand's name equals the name of the company (Compaq, IBM, Cinet, REC, Dell, Evercom, ACER, FujitsuSiemens, Packard Bell and Hewlett Packard).

As mentioned earlier, the choice of variables is based mainly on the Swedish model. There might, of course, be other important variables – one respondent for instance claimed that the price depends strongly on which kind of graphic card, video card or soundcard that was installed. Even so the first attempt of quality adjusting computer prices will only treat the variables given in table 3.1 – new variables will be tested in future work with this product.

3.2.3.2 Description of the data set

The number of observations in the period October to December 2000 is 244. Two respondents have provided data on more than five computers each – their prices have more influence on the calculation than

[24] Contact with the respondents was also undertaken.

the other. Desktops form about 55 per cent of the sample, the rest are portables. More than 90 per cent have an Intel processor. One importer reported about 44 per cent of the price material in the hedonic regression. In table 3.2 descriptive statistics on the data set are presented.

Table 3.2: Descriptive statistics of the data set for computers

	Mean	Standard deviation	Minimum	Maximum
IPRI	12176	5433	3552	29288
DPRI	14444	6657	3700	35700
SPEED	710	135.3	400	1400
MEMORY	94	53.9	32	512
HD	13	8.0	4.8	75

The large gap between the lowest and highest price is due to the fact that both desktops and portables are included. According to one of the respondents a rule of thumb is that a portable costs three times as much as a desktop with the same technical specifications.

When it comes to variables such as CD/DVD and operating systems – there were frequent cases of non-responses. As we cannot afford to lose any observations, these variables are dismissed for now. Country of origin will neither be used in the estimations.

Summing up – the sample is rather small. Discussions with the responding experts reveal that important variables are excluded. Both of these problems will probably diminish after more information on price and characteristics are gathered.

3.3 Washing machines

3.3.1 Introduction

The goal is to start a continuous collection of prices and characteristics for the purpose of quality adjusting washing machine prices. In addition an attempt will be made to obtain a historical overview of washing machine prices with belonging characteristics. How far back the study will reach depends on the availability of data.

3.3.2 Data collection

3.3.2.1 External trade statistics

The data collection work started with an evaluation of data from external trade statistics. Unfortunately this source could not supply data on a product level since many consignments that are declared contain different washing machines or even different white goods. Thus data from external trade statistics could only be used to get an overview of the total import value and the major companies.

3.3.2.2 Importers

Each of the six importers referred to in chapter 2.3 was asked to deliver information on at least five units, using data base extraction if possible. After several contacts with some of the companies it became clear that collecting data previous to 2000 would be difficult. Not all companies had the possibility to do a sufficient extract from their databases. Furthermore, not all companies had the necessary information on expired models at hand and a decision was made that data previous to 2000 were more trouble than it was worth. From here on only data for 2000 and thereafter will be discussed.

As mentioned, historical data proved to be very difficult to obtain. Indices from the USA were used to establish historical series, just as for computers – see 3.2.2. The justification is the same as for computers – existing Norwegian series demonstrated great resemblance with un-adjusted series from the USA.

3.3.3 Methods of reporting

The prices for 2000 were collected both from database extracts and spreadsheets sent by e-mail. The companies, which reported by way of spreadsheets, were asked to give information at least on five of the models with a high import quantity. They were informed to change models as old ones loose market portion and new models appear, thereby always reporting on the same amount of units. Statistics Norway chose which model to use for the companies delivering database extracts.

The following specifications from the database extracts were required; unique description of model, month, import price and quantity imported. One problem was that the smaller companies had several gaps in the individual models' time series. A model could be absent for several months making it impossible to decide if it was out of production or if it would resurface later. The only way of getting this information would be to contact the companies. As this occurs quite often it does not seem easier for the company than using a questionnaire. Another source of errors in the files was that the average monthly import prices not always were based solely on the prices of goods that the company had imported to Norway. Some prices could originate from units sold to Elkjøp. These products are sent to Elkjøp's storehouse in Sweden and could end up all over the Nordic market. The import price of these products sold in Norway is picked up through Elkjøp's reports.

Collecting characteristics was more time-consuming than predicted. As the firms had been contacted repeatedly for information regarding price, databases and general information, much of the characteristics were collected from brochures and from the Internet. Several obstacles were met doing this. Brochures and the Internet did not always give information on models that had left the market during 2000 and not all characteristics were mentioned. Information about timer mechanism was not found explicitly in any advertisement or description of the products available for the public.

3.3.4 Data

3.3.4.1 The variables

Dependent variable

The dependent variable is the import price.

Independent variables

The starting point was all the variables gathered from brochures, given by importers and mentioned in the PPP survey. Because the number of programs, as asked for in the PPP survey, is hard to interpret – this quality characteristic is not included. A large number of programs can confuse the user and several programs may be very similar to each other, thereby being more or less redundant. The size (length*height*width) was rejected as some makes have more or less standard measurements. In addition this variable will depend on whether the machine is a front or top-loader, this was also the case with the door size. Importers also indicated that there were different qualities of extra functions like foam control and imbalance control system making these characteristics more than a yes or no option. The country in which the models were produced was rejected, as the make would cover this area better.

Mainly as a result of further contact with the companies and more accurate studies of the variables – only eleven variables were monitored when collecting information to use together with the importers' prices. These are reproduced in table 3.3.

Table 3.3: Variables for washing machines

Independent variable	Type	Description
FRTOP	Discrete	If the machine can be opened on top or in front.
CAP	Continuous	Capacity, kg. (dry clothes).
SPEED	Continuous	Maximum centrifugal speed.
ENCONS	Continuous	Energy consumption per wash in kilowatts per hour. Measures of cost for a cotton 60 degrees program.
DAMP	Continuous	Remaining dampness after centrifugation. Percentage wet weight.
ENEFF	Discrete	Classification variable that goes from A to G measuring an EU standard of energy efficiency.
DRYRAT	Discrete	Drying rating. Classification variable that goes from A to G measuring an EU standard of centrifugal quality.
WASRES	Discrete	Washing result. Classification variable that goes from A to G measuring an EU standard of the quality of the wash.
WACONS	Continuous	Water consumption in litres for a cotton 60 degrees program.
PRTIM	Continuous	Minutes used for a cotton 60 degrees program.
TIMER	Discrete	Three types of timers: 1 = Mechanical, 2 = Hybrid and 3 = Electronic.

The range of variables in this study differs from the ones chosen by Silver and Heravi (2000). This is due to the fact that this study focuses on import prices, not consumer prices. Moreover, the UK dataset was more comprehensive.

3.3.4.2 Description of the data set

The total number of collected observations for 2000 is 602 divided between 65 different models. The number of different models per month from each company varies from around five to around fifteen depending on the company's market portion.

Two of the six companies have close to no price change throughout the year, while two others only have few changes. There are 19 model changes during 2000. They have the following dispersion:

Table 3.4: Model changes for washing machines in 2000

Period	Changes	Period	Changes
January	-	July	2
February	1	August	2
March	-	September	1
April	2	October	-
May	6	November	-
June	4	December	1

A majority of the machines are front loaders, around 86 per cent. The rating on energy efficiency, washing result and drying rating range from A to G, but in our sample mostly A, B and C are used, something that can be interpreted as a general improvement of these characteristics. This could also reflect high demands for quality by the Norwegian consumers. In table 3.5 descriptive statistics are presented.

Table 3.5: Descriptive statistics of the data set for washing machines

Variable	Mean	Median	Standard deviation	Minimum	Maximum
Import price	2709	2663	815	1195	5693
CAP	4.90	5	0.41	4.50	6
SPEED	1199.83	1200	199.54	800	1600
ENCONS	1.01	1	0.08	0.86	1.2
DAMP	54.36	53	5.66	44	70
WACONS	54.24	54	7.39	39	72
PRTIM	121.1	120	5.31	110	130

• ENEFF A 36 units B 25 units C 4 units • WASRES A 45 units B 19 units C 1 units • TIMER Electronic 34 units Hybrid 18 units Mechanical 13 units	• DRYRAT A 1 unit B 49 units C 10 units D 5 units • FRTOP Front 56 units Top 9 units

The gap between the cheapest and the most expensive unit at any given time in 2000 is NOK 4498 as can be seen in table 3.5. This clearly indicates that there has to be a large difference in quality between the two machines. This is easily seen in all the continuous variables, which more or less all display sizeable differences between the top model and the unit with the lowest score.

3.4 Lorries

3.4.1 Introduction

The goal is to create an improved price index for lorries. Furthermore, work will be done to obtain a historical overview of lorry prices. In addition the current collection of prices will be upgraded to a joint data collection covering the purposes of both the division of external trade statistics and the division of transport and tourism statistics (TTS).

3.4.2 Data collection

Historical data back to 1998 already exist in the division of transport and tourism statistics. However, test-runs have proven these data to be inadequate for the purpose of producing quality-adjusted price indices. The inadequacy is largely due to the lack of additional information such as whether it is actually a new model that is reported, or just a change of the description of the model. There are also some difficulties associated with the characteristics that are monitored.

The TTS-data will be supplemented by import prices in addition to the domestic market prices already in the TTS-files. Furthermore, it is necessary to modernise and to some extent modify the existing data collection, to get more adequate data on the characteristics that are the bearers of information on quality improvement. For instance – the variable for environmental standard needs to be collected.

It seems to be some evidence in favour of the assumption that the prices are changed once or twice a year. Combined with the fact that a lorry may be on the market for several years, an important price

determining aspect is the composition of the standard equipment and the optional equipment. Price differences of NOK 200.000 merely due to this aspect are found. One possibility is to define lorries without any optional equipment using a set of standard equipments – a basic lorry. If the price development of optional equipment is similar to the price development of basic lorries, and the standard equipment stays constant over time (e.g. a year), it may be sufficient to measure prices of a basic lorry.

For historical purposes indices from the USA was used, just as for computers and washing machines – see 3.2.2 for computers. The justification is the same – existing Norwegian series demonstrated great resemblance with un-adjusted series from the USA.

4 Methods

In this chapter the different methods that have been and could be used to deal with quality changes in capital goods will be presented briefly. In section 4.2 therefore, focus will be on the theory and build-up of two of the methods tested in the analyses in chapter five, the hedonic method and monthly chaining and re-sampling.

4.1 Traditional methods for quality adjustment

The conventional approach to the compilation of a price index for a particular good or service is to follow the prices of a fixed sample of items over time. The price changes are averaged to obtain the price index for the product. The rationale behind the fixed sample procedure is to make sure that only pure price changes are measured. However, in practice the goods and services in the sample do not remain constant. Furthermore, there may be changes outside the sample, e.g. when new products are introduced.

Handling such quality problems is perhaps the most difficult aspects of producing a price index. In some cases the problem is minor since the replacement product is more or less identical to the old product. Then the assumption of a fixed sample of products can be said to still exist. But when the replacement product invokes new technology there is truly a problem, since the sample before and after consists of different sets of products. The distinction between a change of quality and a new product is nor a straightforward concept. Approximately we may say that a change of quality occurs when the area of use is the same and the utility value of the product is not radically changed. An example is if the performance of the processing unit of a computer increases slowly over time – this is a quality change since the likely area of use remains unchanged and the utility value is not radically changed.[25] If a portable computer replaces a stationary computer, the area of use may be unchanged, but the utility value might be radically changed.

In general – the classical problem of quality adjustment may be explained as follows. An item, call it A, in the price index for a certain product group disappears from the market. A new item, B, is chosen to replace it. How to measure the price change over time? Below, several methods that were developed to answer this question are examined briefly. The examinations are categorised depending on whether or not the so-called quality adjustment is explicit or not. We start with the latter case.

4.1.1 Methods which involve replacements without explicit quality adjustment

There are lots of methods that acknowledge the quality aspect, but try to get around it rather than treat it explicitly. One advantage with these methods is the simplicity, which makes some of these methods feasible for small countries (with shortage of resources).

4.1.1.1 Unadjusted price comparison[26]

This is a simple method in which the price difference between A and B is taken unadjusted into the index. So the estimated price change is simply the price of item B in the comparison period divided by the price of item A in the reference period. Thus it is assumed that there is no quality difference between A and B. Needless to say, this method is clearly not suitable for goods characterised by a rapid quality change. However, it may be worth mentioning that it is not necessarily so that the method imparts a positive bias to the rate of price change by the PPI. Some model alterations may represent a decline in performance quality or durability.

4.1.1.2 Link-to-show-no-price-change[27]

In this method, the items are simply called non-comparable and the price level is considered unchanged. Hence the measured price difference is fully attributed to the quality change. The method involves the

[25] In some cases this may not be entirely true. In the example a more powerful processing unit may enable the user to change the area of use or at least expand it, and the utility value may radically change. This distinction may be difficult, and the choice between new product and quality change will therefore often be approximate.
[26] Also called "Direct price comparison".
[27] Also called "Automatic linking".

opposite assumption from the direct comparison method – the price difference between the replacement product and the product to be replaced is assumed to be quality change. Where the direct comparison method implies that the entire price change between the old model and its replacement is inflation, the link-to-show-no-price-change method implies no inflation at all. It biases the index downward when prices are rising, and biases them upward when the true quality-adjusted prices are falling, regardless of whether quality is improving or deteriorating.

These two first "methods" can also be called "non-methods" since they totally ignore the quality dimension, however in two different ways. Under very special circumstances they may be acceptable, but it is fair to call them C-methods and they cannot be recommended.

Other methods try to deal with the quality problem in a little more sophisticated way, despite not directly facing it. These are often used methods in statistical agencies, and thus can sometimes be recommendable and are often treated as B-methods by Eurostat.

4.1.1.3 Price overlap[28]

The name of this method refers to the fact that in many cases there will be one or more periods where both item A and item B are on the market (i.e. they "overlap"). In this situation prices are available for both items at, say, time t. Price change up to t could be based on A and after t on B. It is then implicitly assumed that the price difference between A and B in period t is a measure of the value of the quality difference. Whether or not this is a reasonable assumption depends on the market situation of the product in question. In situations that are close to perfect competition, the price overlap method will give appropriate results. However, in certain circumstances, e.g. when new variants of the product are introduced frequently and prices change quickly, this method may not give good results. The main problem is that very different results may be obtained depending on when items are introduced into, or dropped out of, the price sample.

An N-period price overlap means that there are N consecutive periods of parallel pricing of both the old and the new product. The N-1 period's price change may then be based on either the old or the new product or on an average of the two. Below is an example of an N=1 period price overlap.

Table 4.1: Price overlap example

	Time	**t-1**	**t**	**t+1**
Commodity	Old	x(t-1)	x(t)	
	New		y(t)	y(t+1)

The price development up to period t is based on the development in the old product's prices – $\frac{x(t)}{x(t-1)}$.

From period t and onward the new product's price development is used – $\frac{y(t+1)}{y(t)}$.

This method ignores the quality problem by looking at the actual price change from t to t+1 for the replacement product. Using the computer example above – if a computer with double the speed of the processor unit replaces an older model, this method does not take into account this increase in performance. Actually, pushing things to extremes, if the new model has identical price to the old model, and there is no price change from t to t+1, one will not monitor any price change even though the product clearly has a relatively lower price (if the new model is better). Thus this method is not very suitable for handling quality changes, and of course not at all suitable for new or unique products.

4.1.1.4 Matched model method[29]

In the price index this method includes only the price changes of items that exist in the two periods compared, while disregarding all non-matching items. Thus, items A and B in the above example will both

[28] Sometimes also called "Overlapping".
[29] Also called "Implicit quality adjustment method" or "Imputed price change".

be dropped from the sample, and the price index is only based on those items for which no quality change occurred. The implicit assumption is that the price change of the matching items is representative for the price change of the non-matching items. Whether this is realistic depends on the extent of which price changes are introduced at times when new variants of products are introduced, which is the case in many markets.

4.1.1.5 Re-sampling[30]

The method means that in each time period a new sample of items is priced. Thus, up to period t the estimate of the price change is based on an old sample called X, and after t on a new sample called Y. As for a simple price overlap, re-sampling depends on the differences between average prices between X and Y to be genuine reflections of quality differences.

4.1.1.6 Monthly chaining and re-sampling

This method is a version of the re-sampling method and will be further discussed in section 4.2.2. The method involves observing the prices of all varieties (or some representative sample) of a product that are on the market each month. The price change is then computed from one month to the next as an average over those items that are in the sample both months. Price changes between months further apart are calculated by multiplying the month-to-month links. The difference between this method and the traditional ones is that one no longer tries to follow the same sample over time, but instead one looks at what is actually on the market in each period. New products are therefore included earlier than with a fixed basket. Preliminary testing seems to have shown that indices based on this method yield similar results as hedonic indices in some cases.

When it comes to large equipment products, and especially unique products, there are many otherwise usable methods that for different reasons cannot be used here. For these circumstances Eurostat recommends the following two methods.

4.1.1.7 Model pricing

A product (or a specific model) is specified in some detail and then the contributory elements are re-priced in successive time periods. An example might be construction, where a typical house can be specified and then all of the constituent elements (like roof, kitchen unit, etc) re-priced.

4.1.1.8 Specification pricing

This is where a real product is broken down into a number of key elements, which are priced, and then in successive periods, individual projects are examined and the key elements compared. This method differs from the "model pricing" above because no ideal models are actually specified. The Bureau of Labor Statistics uses this technique in their CPI and PPI. Ziemer and Kelly (1993) use the method in their study of military aircraft.

The obvious drawback with these two former methods are that they are very resource demanding. Yet another drawback is that for smaller countries they can prove to be almost impossible to implement due to too few observations. Therefore, despite the rather "passive" looks, the following method could be a possibility.

4.1.1.9 International prices

For some products there may be little imports for a particular country, even though the product is produced in large numbers in some other country. Then there might be available information on export prices for such products to other countries. Such data can for some products be used for the price estimation. Such a material can be gathered either directly from the importer or the exporter, or be built on price index information from other countries' import statistics. This procedure might be particular relevant when it comes to the so-called large equipment goods, like aeroplanes or paper machines, where the import is small and rather irregular. This would be more attractive if there are a few countries producing the product, so the country adopting the figures has the possibility to compare different figures since otherwise there might be too big differences between the countries that would make an "adoption" doubtful. A special version of

[30] This method could also be labelled "Aggregate overlap pricing".

using international prices would be if some countries worked together in creating an index common for all of them. However resource demanding, this could be a possibility if the product is of "global art" and can be assumed to be about the same in the participating countries (compare with the ongoing Eurostat project on computers mentioned earlier). The method of using international prices in some form is especially useful for smaller countries, particularly when it comes to large equipment goods, where it due to low imports might be almost the only possible way if the quality aspects of the goods are to be treated at all.

Before finishing this section, there are a few other methods that from time to time are used under rather special circumstances.

4.1.1.10 Imputation method

A lot of different imputation techniques exist. One example is imputation by the donor principle. This method chooses the price change of a random product from the same industry. This way the actual dispersion in the received prices is maintained. Another is when an average price change is imputed from a higher aggregate to which the observation series belongs, e.g. the price change for bike wheels can be imputed from the price change for bikes in total.

4.1.1.11 Complementary products

A special case arises where one or more products are used together in fixed proportions as inputs used to produce what is consumed. Washing a load of clothes for example – requires a washing machine, detergent, electricity and water. The amounts required for any given washing machine are technically determined rather than being open to consumer choice; they are among its characteristics. An example can be a new model of a washing machine with lower water consumption that replaces an old model. The difference between the prices is then quality-adjusted by deducting the water cost saving for a typical household's annual use of a washing machine.[31]

4.1.1.12 The twin method

This method is used when product prices can be observed, but where imports to the country in question are very seldom. The method counts on that in practice there are many common products produced, but that it normally takes some time between the productions of each good. If price observations exist for such a product for two or more time periods, these could possibly be used in the estimation of the true price development of the product. For periods where prices cannot be observed an extrapolation of the price change must be made. The method uses available time series for the prices to develop estimators for price change in periods where such information is missing. New observations are used to quality check the estimators in between for the price change and for the development of the estimation model. The concept in this method is a little bit like the international prices, except the comparison is between goods that are about the same – instead of countries.

4.1.2 Methods that involve replacements combined with explicit quality adjustment

As seen in the previous section, however sometimes practically useful, the methods there tried to disregard the quality development of the products, despite in most cases, trying to deal with it implicitly. However, there are a few methods that more explicitly try to catch the quality aspects and to include this dimension in the index calculations. Even though maybe the most known method - the hedonic method - will be presented in section 4.2.1, there are still other methods available.

4.1.2.1 Quantity augmenting[32]

When there is a forced replacement of one product by another, which is essentially similar except only for pack size, an obvious procedure is to adjust the price of the one or the other proportionately to the size difference. Unfortunately, there are many cases where price does not vary proportionately with quantity. The price index is generally downward biased by quantity augmenting.

4.1.2.2 Option cost adjustment

This method values an extra characteristic, now included in the price of a composite product, at its actual price as an optional extra in the previous period or as a certain portion of that price. Thus, if variant B

[31] See Clements, Allen and Travers (1989).
[32] Sometimes called "Package size adjustment".

includes a CD-ROM drive, then its price can be reduced by the price of that drive to arrive at an estimate for the price of variant A, which did not have the CD-ROM, in period t. Clearly, this method is only possible when the quality difference can be described in this way, and when a separate price for the option exists. Note that this method uses prices to the consumer and not production costs.

4.1.2.3 Production cost adjustment

In some cases, a separate price will not exist for the new option. In such cases the producer is asked how much an extra characteristic costs to produce. More generally, producers may be asked for data on the difference in production costs between variant A and B. Note that in this method costs are used instead of prices, so that the user's preferences are not taken into account. The method can be improved in this respect by including the producer's profit margin.

4.1.2.4 The hedonic method

The value of a characteristic is given by estimated coefficients in a multiple regression equation. Differences in the content of characteristics between the new and the old observation are multiplied by these values to provide a total adjustment to either the reference or the comparison price. A broader description of the methodology behind this method will be given in section 4.2.1.

4.1.2.5 Judgmental adjustment

Experts, commodity specialists, price collectors or other experts are asked to give an estimate of the value of the quality difference between variant A and B. Despite the subjective part, the method is an important and useful practical method for smaller countries, especially for complex products and where the quality dimension is not so easily recognised and estimated.

4.2 Methods used in this report

One wise man once said, "There are as many different methods as there are statisticians in the world". However an exaggeration, we saw in the last section that there are indeed quite a few methods even though they are only some examples of the various kinds of methods that could be found in the literature. However, we also saw in the last section that quite a few of these methods, at least in general, can be said to be less recommendable. Yet some other listed methods are less useful when it comes to dealing with capital goods. We also mentioned some methods that, however theoretically possible, are less useful in practice for small countries like Norway. So we have literally a handful of methods that could be suitable for our needs. A couple of these methods are, however, due to data availability, not possible for us to test. Among those still on the list there are one or two that definitely are interesting, but due to shortage of resources these have not yet been properly tested. But in future work, the specification pricing will be tried for large equipment goods not yet empirically investigated. So in this status report, there are only two actual methods that we test – one from each category in section 4.1 – the hedonic method and monthly chaining and re-sampling. For comparative purposes, we also try some other less recommended alternatives. In the following we present the methodology behind the two main methods, and we start with the hedonic method.

4.2.1 The hedonic method[33]

The technique behind the so-called hedonic method dates back to Waugh (1928; 1929) and Court (1939). These early pioneering works did however not get many followers and it was more of a technique than a theory in those days. It was not before the 1960s and especially the 1970s that things started to happen. First, Griliches (1967) did some interesting work about cars. Then "The new consumer demand" and Lancaster (1971) introduced some new perspectives, and finally Rosen (1974) wrote his seminal paper. The paper by Rosen was the beginning of an intense theoretical debate about the hedonic method, a debate that still continues, even though it has shifted direction. Rosen's main contribution was that he established that the interaction between consumers and producers on a market with perfect competition for a differentiated product decides the appearance of the hedonic equilibrium equation. Except for this model Rosen's paper contained proposals for empirical estimations of demand and supply parameters for situations where no

[33] This section is partly based on Gordon (1990).

explicit solution to the hedonic price function is available.[34] So, Rosen (1974) gave developing contributions to a uniform treatment for analyses of implicit markets.

The hedonic literature of today is mainly dominated by housing studies, index calculations and studies of labour supply. The use of the hedonic method has normally one of the following aims:

1) Explaining price divergences between goods in a group of goods.
2) Establishing quality-adjusted price indices.
3) Establishing the market value for a particular characteristic.
4) Estimations of supply and demand functions for products or characteristics.

Apart from the very first study by Waugh, works on index construction and calculation also dominated the early hedonic work. The hedonic method is also very well suited for adjusting prices on goods for quality differences. There are however two different approaches when dealing with this in the context of price indices. In the following we give a short theoretical description of these two approaches, and we start with the so-called hedonic function.

The hedonic hypothesis says that the utility from consuming a particular good is given by the characteristics of that good. So, it is assumed that it is the characteristics rather than the good itself, that give rise to utility for the consumer.

The hedonic function is very central here, describing a relation between prices for a variant of a heterogeneous good, or service, and the quantities of characteristics contained in it. The function got several different names in the literature, like "hedonic function", "hedonic quality function" or "hedonic price function" and they all refer to a function of the form

$$P = h(c) \tag{4.1}$$

where the depending variable P is a vector of prices on different variants of some good and has n elements. (c) is an m*n matrix with characteristics where each column refers to values on a selection of attributes which affect the price of the good. These attributes have different values for each variant of the good.

What the hedonic regression approach means, is that it assumes that the price of a product observed at a given time is a function of its quality characteristics (c), and it estimates the implicit prices of such characteristics by regressing the prices of different variants of the product on their differing embodied quantities of characteristics.

The empirical problem is the estimation of the implicit prices of characteristics (c_{ij}) in which the dependent variable is a vector of observations on prices on n different variants at a given time, and each of the m independent variables is a vector of data for a quality attribute for the different variants.[35] The regression is often specified in the semi-logarithmic form:

$$\log p_i = a_0 + \sum_{j=1}^{m} b_j x_{ij} + u_i, \qquad i = 1,...,n. \tag{4.2}$$

The regression coefficients (b_j) from (4.2) are combined with the data on changes in quality attributes (dx_{ij}) to yield the estimated change in quality, a calculation that implicitly assumes that all quality changes can be treated as variations in the quality of the x_{ij}, and any change in the quantity of a particular product attribute can be converted into an equivalent amount of weights. Then the change in a quality-adjusted price index for the product can be calculated by subtracting for each model the change in its quality index (i.e. the

[34] However, this has been much debated in the literature – see e.g. Brown and Rosen (1982), Bartik (1987), Bartik and Smith (1987), Epple (1987) and Palmquist (1991).

[35] The partial regression coefficients of p_i and x_{ij} are precisely equal to Mp_i/Mx_{ij} only if a linear relation is postulated between the p_i and x_{ij}. If the variables are in semilog form, the coefficients stand for the percentage change in price with respect to a unit change in each quality attribute.

change in each quality characteristic multiplied by its estimated implicit price) from the change in its actual transaction price or unit value.

An alternative approach to the estimation of a quality-adjusted price change is to estimate the coefficients on one or more time dummy variables (D_t) in cross-sectional regressions for two or more years:

$$\log p_{it} = a_0 + \sum_{t=1}^{N} d_t D_t + \sum_{j=1}^{m} b_j x_{ijt} + u_{it}, \quad i = 1,...,n; t = 0,...,N. \tag{4.3}$$

An aggregate index of price change is then obtained either from the series of d_t coefficients obtained in one regression like (4.3) run on data for a number of years, or from a string of d_t coefficients obtained from a series of "adjacent year" regressions on data for successive pairs of years. To the extent that the prices for quality characteristics are changing over time, the latter two-year technique allows the regression coefficients on the x_{ijt} to change frequently and is preferable.

There is no difference in principle between the two methods of estimating price change, deflation by a quality index and estimation of coefficients on time dummy variables. Results differ only to the extent that the time period for which the b_j implicit price weights are estimated in (4.2) – differs from the time period in the adjacent year regression. Most studies have in practice chosen the dummy variable approach, simply because it conveniently allows the "true" rate of price change to be read directly from the computer printout without any intermediate transformations. As already Griliches (1967) pointed out, however, changing samples of variants in a regression like (4.3) for two adjacent years will cause some of the sample variation to be picked up in the time dummy coefficients, unless the sum ($\sum u_{it}$) of the "model effects" (the effect of left out qualities) for both groups of models is identical.

4.2.2 Monthly chaining and re-sampling[36]

This method only compares identical commodities in each period. Actually, the assumption of a fixed sample is rejected since each period has its own sample. Each period, all products having a price in the present and the previous period are selected (re-sampling). The price change is then computed. Then a link for each month is established. An index is calculated by multiplying the month-to-month links (chaining).

With this method the actual quality problem is not taken care of. If a new product replaces an old, then that new product will not be a part of the index calculation before the next period, unless there is a price observation for the previous period. However, this method will often include new products earlier than traditional methods. Tests have shown that indices based on this method often yield similar results as hedonic indices (Eurostat, 2000). However, in the transition period between economic depression and expansion, differences may occur, dependent on how the mark-up in the establishments is set.

Let us say there are four commodities, A, B, C and D, with prices for five periods, as shown in table 4.2.

Table 4.2: Illustration of monthly chaining and re-sampling

	Time				
Commodity	**0**	**1**	**2**	**3**	**4**
A				A_3	← A_4
B	B_0	← B_1	← B_2	← B_3	
C	C_0	← C_1		C_3	← C_4
D		D_1	← D_2	← D_3	← D_4

Table 4.2 illustrates how this method only compares commodities that actually have a price in at least two subsequent periods. This method does thus not explicitly deal with the quality problem – the method ignores the problem attached to new products. The arrows in the table indicate for which period the

[36] Chapter 4.2.2 is based upon Silver and Heravi (2000).

commodity's price is actually included in the index calculation. For instance, commodity C has price observations in period 0 and 1. In period 2 C disappears from the market (no sales/no price observation), but in period 3 and 4 it is back. In the index calculation commodity C will contribute with the change from time 0 to 1, and with the change from 3 to 4. C is not a part of the index in time 2 and 3. This way, the index will consist of commodity B and C in period 1, B and D in period 2 and 3, and commodity A, C and D in the last period.

When producing these indices, an arithmetic mean is calculated from the changes in the products existing in both periods. First a short-term index is produced, where the previous period is set to 100. Then the changes are chained, making an index with reference period equal to the first month with observations. In this preliminary run-through the geometric mean is not used. This is recommended due to the bias one may have from the arithmetic mean, which seems to assign larger weight to higher price levels. A geometric mean will be included in the final report.

The monthly chaining and re-sampling method works best with large samples. One problem is loss of information due to the requirement of prices in at least two subsequent periods. In the previous example no use is made for D_1 in time (0,1), nor A_3 or C_3 in time (2,3). There is of course a possibility to use imputation for commodities missing a price observation using for instance the change of a higher aggregate to indicate the price development. Silver and Heravi (2000) discuss this problem when the lack of prices is at the end of the time period, or at the very beginning. These missing prices often indicate either the start or the end of a product. When a product is introduced in the market, it is reasonable to believe that its market portion is rather small. The same allegation may be used when a product disappears from the market for good. If one uses a weighted index the loss of information will be relatively low due to the market portion of these products.[37] If the data sample is large the loss of information may thus be considered insignificant.

[37] There are of course problems with this allegation if enterprises are dumping the price for the diminishing product, with that the product taking some higher market portion. When introducing a product the price is often high and falling in the subsequent periods. Silver and Heravi (2000) refer to inter alia works by Hicks, which suggest setting a "virtual" price before the introduction that makes the demand equal to zero. The change will then be used to estimate the gain in welfare.

5 Analyses and results

This chapter summarises some of the results so far. For statistical works like this all results will be temporary in the sense that there will always be a need or room for improvements - as a result of changing preconditions or changing economic environments (products, technologies, etc.). To some extent this is especially a problem as concerns capital goods bearing in mind the increasing pace of innovation. Building a system of quality adjusted price indicators requires a group of experts continuously monitoring products and changes.

5.1 Computers

Based on the dataset described in 3.2, a hedonic model was estimated. This model has then been used in order to quality-adjust computer prices in the producer price index and the price index of first-hand domestic sales as of January 2001. In this section the estimations are described and some indices are presented.

5.1.1 Estimations

The data were tested for different functional forms, which variables to include, and whether or not the price difference between portables and desktops may be checked using a dummy. We also tested if it was necessary to have two models, one for import price and one for domestic market price. First, a look at the correlation between some important independent variables seems reasonable (see table 3.1 for a description of the variables):

Table 5.1: Correlation matrix for computers

	PROC	TYPE	SPEED	MEMORY	HD	SUP	IPRI	DPRI
PROC	1.00							
TYPE	0.23	1.00						
SPEED	-0.23	-0.55	1.00					
MEMORY	-0.20	-0.32	0.51	1.00				
HD	-0.34	-0.40	0.67	0.67	1.00			
SUP	-0.07	0.01	-0.20	-0.05	-0.14	1.00		
IPRI	0.11	0.68	0.02	0.14	0.11	0.16	1.00	
DPRI	0.09	0.62	0.12	0.23	0.17	-0.07	0.91	1.00

TYPE, i.e. desktop/portable, is negatively correlated with the variables measuring capacity and performance. This means that, regardless of price, desktops generally score higher than portables on these variables. This comes as no surprise. PROC is also negatively correlated with SPEED, MEMORY and HD, suggesting that computers with "Intel inside" generally perform poorer than computers with AMD-processors. This seems improbable, but the issue will be further explored in 5.1.1.1. An assumption that is supported by the data is the positive correlations between SPEED, MEMORY and HD. IPRI is the import price, while DPRI is the domestic price (transaction between domestic provider and domestic buyer).

5.1.1.1 Model and functional form

Two functional forms were tested – linear and log-linear. In these tests a log-linear form gave the best fit. Since this form is quite common and has some appealing characteristics, the log-linear form is the one chosen. As mentioned in 4.2.1, this implies that the estimated parameters can be interpreted as elasticities. Table 1 in appendix F shows the results of the estimation with all the variables from table 5.1 and dummies for the different months. Two model specifications are estimated, one with import price and one with domestic market price. The first thing worth noticing is that all the coefficients have the expected sign (see appendix F). Further, the coefficients estimated for the expected important independent variables are significantly different from zero in both models. The estimated coefficients for the monthly dummies show that the price – holding everything else constant – has declined from October to November, and from

November to December. As the dummy for October is also significant, the dummies for month will be kept. The dummy for importer/retailer (SUP) is also significant, and will be included in the final model. PROC is not significant and is consequently excluded.

The dummy for TYPE, i.e. desktop/portable is highly significant. Therefore separate specifications for desktops and portables will be estimated. Large differences in the estimated coefficients will then suggest that these two kinds of computers really should be treated as two different products. This is done in table 2 for desktops, and table 3 for portables, both in appendix F. As would be expected, large differences are found in the two specifications.

The last thing that was done was to test whether the same coefficients for *SPEED, MEMORY* and *HD* could be used for import price as for domestic market price. These tests are shown in table 4 for desktops, and in table 5 for portables (appendix F). For desktops the hypothesis of equal coefficients was not rejected, while it was rejected for portables. This means that one set of coefficients for desktops, and two sets for portables, will be used.

5.1.2 Models

For desktops the chosen models for the domestic price (DPRI) and the import price (IPRI) are:

$$\ln DPRI = -0.626 + 1.212 \ln SPEED + 0.323 \ln MEMORY + 0.087 \ln HD + 0.053 SUP$$
$$\ln IPRI = -0.911 + 1.212 \ln SPEED + 0.323 \ln MEMORY + 0.087 \ln HD + 0.261 SUP$$

For desktops the coefficients for the different independent variables were so similar for the import market and the domestic market that it was decided to keep them identical. If this hypothesis is correct the estimation of the coefficients will be more accurate. This implies that the price difference between the two markets is a fixed mark-up.

For portables the selected models the domestic price (DPRI) and the import price (IPRI) are:

$$\ln DPRI = 2.562 + 0.779 \ln SPEED + 0.220 \ln MEMORY + 0.367 \ln HD + 0.082 SUP$$
$$\ln IPRI = 3.173 + 0.710 \ln SPEED + 0.139 \ln MEMORY + 0.335 \ln HD + 0.260 SUP$$

For portables the difference between the estimated coefficients was too great to claim that there existed a fixed mark-up and that the two markets have different equations.

5.1.3 Indices

Hedonic indices for computers are included in the price index of first-hand domestic sales beginning January 2001. In this section these index series will be presented and compared with two other index series based on the same data.

5.1.3.1 Hedonic indices

Between four and eight computers are monitored from each firm. A computer is always replaced with one from the same company, thus avoiding the problem of differences in price between importers and retailers. Substitutions between desktops and portables will also be avoided.

In cases of model substitution the estimated coefficients are used to quality-adjust prices. This is done in the following way:

Consider a desktop computer, which from one month to the next increases its speed from 733 to 800 MHz. The price, the base price and the quality characteristics for the two periods are given below:

Month	SPEED	MEMORY	HD	Base price	Price	Index
January	733	64	10.2	7452	6575	88.2
February	800	64	10.2	?	6575	?

A regular price index calculation, disregarding the quality change, would give no price change, as the reported price is the same in both months. However, the performance is clearly improved, so we would

expect that – corrected for quality change – the index for this particular computer would decline. The estimated coefficients from the hedonic regression are therefore used to compute a new base price using this formula:

$$Basis_{Feb} = Basis_{Jan} e^{\left[Coeff_{SPEED} * \ln\left(\frac{SPEED_{Feb}}{SPEED_{Jan}} \right) \right]} = 7452 e^{\left[1.212 * \ln\left(\frac{800}{733} \right) \right]} = 8285$$

The quality-corrected index for February is: $\frac{6575 * 100}{8285} = 79.4$

This way the hedonic method produces a decline in the price index of more than six per cent, even though the price itself has not changed. After treating all the computers with quality changes this way, the computer indices are computed using a geometric mean. The resulting indices are presented in table 5.2.

Table 5.2: Indices for computers based on hedonic quality adjustment

	Portable computers		Desktops	
	Domestic market	**Import market**	**Domestic market**	**Import market**
Dec. 2000	100.0	100.0	100.0	100.0
Jan. 2001	97.0	95.2	97.2	98.8
Feb. 2001	89.1	86.7	87.1	86.7
Mar. 2001	83.2	82.3	84.6	84.9
Apr. 2001	74.9	74.9	79.3	78.2
May 2001	71.9	73.3	73.8	72.5

Table 5.2 implies that the (quality-adjusted) computer prices have fallen between 26 and 28 per cent from December 2000 to May 2001, and that the prices have declined every month. Although this decline might seem extremely high, we know that the producer costs of important inputs (microchips) have declined substantially during this year. The price competition has also been strong among the retailers. Only through seeing the development over a longer time span, and perhaps through comparisons with indices estimated with other methods, it will be possible to say more about how reasonable this development is.

5.1.3.2 Monthly chaining and re-sampling

Here, only price changes on matching models are used, meaning that the problem of quality change is not treated explicitly. The results are presented in table 5.3.

Table 5.3: Indices for computers based on monthly chaining and re-sampling

	Portable computers		Desktops	
	Domestic market	**Import market**	**Domestic market**	**Import market**
Dec. 2000	100.0	100.0	100.0	100.0
Jan. 2001	98.8	98.0	98.4	98.8
Feb. 2001	93.2	92.5	93.6	93.5
Mar. 2001	90.4	92.0	92.0	92.3
Apr. 2001	84.7	89.2	90.0	90.0
May 2001	81.8	87.4	87.8	88.0

We see the same unambiguous downward trend as in the preceding table. According to the index computed with the MCR method the computer prices have decreased between twelve and 18 per cent from December 2000 to May 2001. This is less than the case with the index based on hedonic quality adjustment, but still a considerable decline.

5.1.4 Preliminary remarks

The preliminary comparison of the different methods has shown the effect of adjusting computer prices for quality changes. The need for, and importance of, further quality adjustment are underlined by the hedonic approach. The large decline in the hedonic indices as compared to the ones based on monthly chaining and re-sampling suggests that the quality change is considerable. This might be because the technological change has been very rapid the last six months, or it might also be that the estimated coefficients over-estimate the value of the technological change.[38]

When using the hedonic approach on computers it is important to be aware of the following:

- The interpretation of quality. The advantage to the consumer is not given when technical performance is increased. New software demands higher performance – for a user, which only needs basic word processing, the old machine with the previous software may be sufficient. Given this, technical attributes may be misleading as many different consumers with different demands to performance buy the machines.
- The interpretation of the price development is influenced by the rapid product development making products obsolete and sold cheap after only a short time on the market. This may cause problems with the interpretations.
- The rapid development of the technical performance causes the coefficients to change frequently. Constant coefficients may therefore give incorrect results. The statistical model should be re-estimated frequently due to a continuous technological development. The time between launching of new computer models decreases while the performance of these models just increases and becomes greater.
- New characteristics are also typical in the computer markets. This may also cause problems when new models contain characteristics that did not exist at the time the model was estimated and therefore could not be observed in previous periods. This will e.g. give the impression that two models are the same even though the latest model introduced might include a new characteristic that affect the quality of the product and also its price. The introduction of DVD players is one example of this phenomenon.
- Finally, the whole development seems to be much faster than before. New models are introduced more frequently and the quality improvement seems to be more extensive. An example is the processor unit, which has doubled in less than a year and may be as high as two GB (November 2001).

Still, in spite of the above-mentioned problems – the preliminary results suggest that hedonic indices for computers are applicable also for small countries. But nonetheless, more testing has to be done. Some suggestions for further investigations:

- Re-estimate the parameters regularly, as these changes over time.
- Check for parameter stability. This can be done by estimating the parameters using data from different three-month periods and comparing the results.
- Compare the parameters and estimated indices with those from other countries.
- Investigate other explanatory variables (software, weight (for portables), CPU performance[39]).

5.2 Washing machines

Based on the data described in 3.3.4, a hedonic model is estimated using import prices. As a comparison to this an index using the overlap method is computed.

5.2.1 Estimations

The data were tested for different functional forms and which variables to include in the final model. As an onset to this run-through, the correlation between some important independent variables was investigated. This is done to uncover any covariance between the variables.

[38] Of course, a combination of these two may be the explanation.
[39] Statistics Canada uses a CPU performance score obtained from the web site www.cpuscorecard.com.

Table 5.4: Correlation matrix for washing machines[40]

	CAP	ENCONS	DAMP	WACON	PRTIM	MIELE
CAP	1.000					
ENCON	-0.333	1.000				
DAMP	-0.312	0.428	1.000			
WACON	-0.266	0.623	0.550	1.000		
PRTIM	-0.195	-0.095	0.155	-0.016	1.000	
MIELE	0.068	-0.219	-0.208	-0.153	-0.180	1.000
FRTOP	-0.124	-0.137	0.247	0.240	-0.047	0.179
ENEFF	0.602	-0.828	-0.621	-0.710	-0.100	0.281
DRYRAT	0.310	-0.397	-0.951	-0.444	-0.197	0.242
WASRES	0.657	-0.478	-0.578	-0.539	-0.057	0.223
TIMER	0.485	-0.370	-0.510	-0.472	0.076	0.279
lnPRICE	0.423	-0.579	-0.729	-0.541	-0.155	0.567
lnSPEED	0.240	-0.444	-0.957	-0.555	-0.068	0.199

	FRTOP	ENEFF	DRYRAT	WASRES	TIMER	lnPRICE	lnSPEED
FRTOP	1.000						
ENEFF	-0.024	1.000					
DRYRAT	-0.176	0.580	1.000				
WASRES	-0.075	0.750	0.545	1.000			
TIMER	-0.160	0.615	0.450	0.695	1.000		
lnPRICE	0.118	0.734	0.700	0.676	0.619	1.000	
lnSPEED	-0.212	0.575	0.921	0.546	0.454	0.705	1.000

The dummy variable FRTOP was given the value '1' if the machine is a top loader. Score A for energy efficiency, water consumption and drying rating was given the value 5, while B was given 4 and so on. Regarding the timer, the electronic version was given the value '2', the hybrid '1' and the mechanical '0'. Further analysis returned Miele as a highly significant brand dummy and accordingly this variable was included in the model even though a brand dummy does not reflect quality in itself. Miele is among the most expensive units sold in Norway and marketed their units as high quality products.

Several of the potential independent variables cover the same area of quality:

- There is high correlation between (log of) spin speed and drying rating (92%). Every class (A–D) more or less corresponds with a spin speed interval (800-1600). Both measurements of drying efficiency correlate highly with price (70%) and remaining dampness (95%).
- Energy consumption and energy efficiency have high negative correlations (83%).

All variables with the wrong sign or classified as not significant were removed from the model. Spin speed, program time, drying rating and energy efficiency were among the rejected variables.

5.2.2 Model

The final model is a log-linear model and has an adjusted R^2 of 84.6 per cent and standard deviation in the errors (sigma) of 11.5 per cent (the estimated model also included monthly dummies to check for quality-adjusted price changes in the estimation period). The result of the regression analysis is given in appendix H. A linear specification was also tested, but did not describe the price movement as well as the reported model.

[40] For the definitions of the variables - see section 2.3.

$$\ln PRICE = 8.973 + 0.068\,CAP - 0.378\,ENCONS - 2.423\,DAMP - 0.003\,WACONS + 0.360\,MIELE + 0.195\,FRTOP + 0.064\,WASRES + 0.048 TIMER$$

According to the model:

- Larger capacity means higher price
- Greater energy consumption means lower price
- A higher degree of residue dampness means lower price
- Larger water consumption means lower price
- A Miele machine is more expensive than an average machine
- A top loader is more expensive than a front loader
- A better washing result means higher price
- The better the timer the more expensive the machine (mechanical=0, hybrid=1, electronic=2)

Price change is not estimated by using the entire equation on the new washing machines. The price change is estimated only by adjusting for the characteristics that are different between the expired model and the substituting model (see previous example in section 5.1.3.1).

5.2.3 Indices

A decision was made to maintain a constant number of observations per company each month. This meant removing ten models with only few observations when calculating the index. The result was a data material of fifty products each month. These units were among those that were used in the regression analysis. No weighting is used, but larger importers contribute with a larger number of units. Each company is represented with between four and 13 washing machines, maintaining the same number of units from each firm for all months covered. This means that when one model disappears another model is introduced into the sample. The following indices were composed by quality-adjusting prices using the model described in 5.2.2:

Table 5.5: Hedonic index for washing machines 2000

Month	Index value	Month	Index value
Jan.	100.00	July	97.00
Feb.	99.32	Aug.	96.85
Mar.	98.83	Sep.	96.42
Apr.	98.19	Oct.	95.98
May	98.68	Nov.	95.65
June	98.12	Dec.	95.87

As is seen from the table, the price index decline every month except in May. Needless to say, this is not the common pattern when prices are concerned, even though the price decline is much less than were the case for computers. Further studies of the development showed that the decline in July originated a great deal from one particular model change from a unit from Siemens to an Artison machine. If this change is removed by using link-to-show-no-price-change in the case of this particular model change – the development from June to July went from -1.14 to -0.36 per cent. A similar event causes much of the price development between November and December. In this case the change is from a Zanussi to an AEG machine. If the same procedure as proposed for July is followed, the development in December goes from a 0.23 per cent rise to a 0.34 per cent decline. By removing the changes in the manner mentioned above the adjusted index varies from the original one by as much as 0.77 percentage points most of the second half of 2000, see table 5.6.

Table 5.6: Adjusted hedonic index for washing machines 2000

Month	Index values	Month	Index values
Jan.	100.00	July	97.77
Feb.	99.32	Aug.	97.62
Mar.	98.83	Sep.	97.19
Apr.	98.19	Oct.	96.74
May	98.68	Nov.	96.41
June	98.12	Dec.	96.08

The above does not only show how vulnerable the data set may be due to the small amount of units, but also gives an indication that a comparison of models from different producers may give unwanted effects.

5.2.4 Other methods

Other methods that are relevant in the case of washing machines are monthly chaining and re-sampling (MCR) and price overlap. Due to the small sample used – the overlap method is seen as a better method for comparison rather than the MCR technique. Table 5.7 shows the development in the MCR and overlap solutions.

Table 5.7: Indices for washing machines 2000

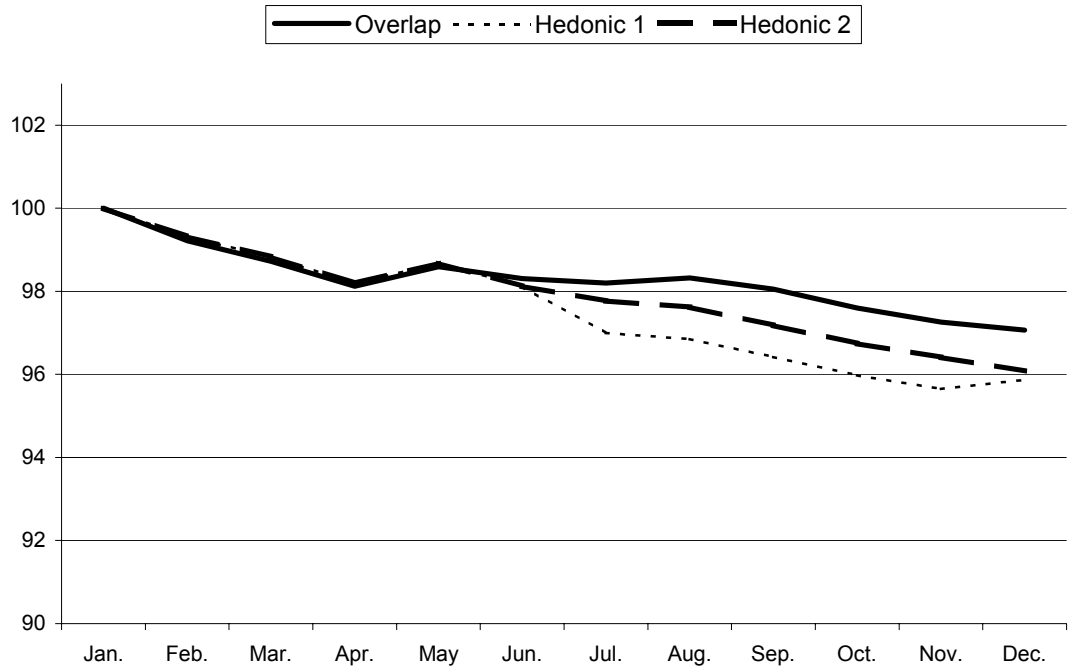
	MCR	Overlap
Jan.	100.00	100.00
Feb.	99.21	99.22
Mar.	98.74	98.72
Apr.	98.12	98.12
May	98.71	98.59
June	98.54	98.31
July	98.44	98.20
Aug.	98.46	98.32
Sep.	98.20	98.05
Oct.	97.82	97.60
Nov.	97.62	97.26
Dec.	97.24	97.07

The price overlap method will give very similar results as link-to-show-no-price-change. This is due to many prices remaining flat over time. In all model changes except one from November to December the price overlap method gave a result equal or close to equal to no change in price. Link-to-show-no-change showed a 0.3 per cent fall from November to December, while price overlap shows a 0.2 per cent decline.

5.2.5 A comparison between price overlap and the hedonic method

A comparison is made between the hedonic index and the index based on the overlap technique. As can be seen from figure 5.3 the development of the adjusted hedonic index, where the comparison between models from different producers is removed (Hedonic 2), is closer to the index based on price overlap than the original hedonic index (Hedonic 1). This reinforces the assumption that comparing models from different producers may cause unwanted effects.

Figure 5.1: Washing machines, different indices for import prices



As the graph shows the hedonic method reflects what is assumed to be the quality impact more than is the case with the overlap method. Provided that this assumption is correct a traditional way of making a price index for washing machines will have missed the actual decline by about one per cent.

5.2.6 Preliminary remarks

The results from using the hedonic approach are promising – though further analysis is required. The limitation in the data set reflects both the size of the population and the resources available in Statistics Norway. A condition for using a hedonic solution is a continuous easy access to the necessary prices and characteristics. The study will therefore continue and some of the things that will be focused on are the following:

- Analysis of the sample of products and the hedonic solution to uncover weaknesses;
  - how sensitive is the sample to changes in a single unit's price?
  - are there any missing variables?
- Re-estimate the hedonic model using figures from 2001 and study the parameters' stability.

6 Conclusions and prospects

6.1 Introducing new methods in the PPI system

6.1.1 Background

The producer price system (see section 1.2 and appendix A) is an important part of a system for short-term indicators made for monitoring the national economy. The national accounts use the PPI as a deflator. Another important use of the PPI is in different kinds of contracts. Here, the main area of use is regulating contracts due to price development during the contract time.[41] When regarding the national accounts' data as a foundation for the formulation and monitoring of economic policy, and the value of contracts using the PPI, the importance of the PPI becomes clear.

The Norwegian indicators from the producer price system are chained price indices of the Laspeyres type with annual links. Each link makes a price comparison with the price in December the previous year. The idea of a Laspeyres index is to monitor the same commodities over time – a so-called basket of commodities. This means also that the quality should be constant. The weights are updated each December, and are effective from the January index. The natural place to introduce new calculating methods and/or new information is thus in the January index, when the PPI starts a new cycle.

6.1.2 Introducing new methods of calculation in the historical PPI system

The Norwegian producer price system was revised in January 2001. In connection with a general improvement of price statistics, considerable attempts were made to improve the basis of the data for the index – also covering the period 1995 to 2000. To make these improvements available for users, a commodity price index for the industrial sectors[42] (VPPI) was made.[43]

One of the main reasons to make this new index is to be able to implement the new methods of calculation on historical data. The new index is based on the same principles and methods as the ordinary PPI, but as opposed to the PPI, the new index will be subject to revisions in later periods – revisions that also will affect published series. This means that the index will use historical price information to re-calculate the indices. To use new, historical price information in the VPPI will of course be of great value, for instance for the national accounts and analysts. After implementing new series based on this project the index will be more suitable for analysis of the historical price development.

Other indices may also take advantage of the project. The way the different commodities and their markets are analysed reveals information that may be of great value for other indices. The general surge in the quality of the PPI descending from the project should be utilised in the CPI estimation process as well as in the estimation of volume indices in external trade statistics. One example is the latter – here the problem of capital goods is well known, with indices that from one quarter to the next may consist of totally different products and/or quality.

The PPI system uses the price indices for computers and washing machines as described in this report. Indices from the BLS are used for historical purposes and are linked to the Norwegian computer index in December 2000 and to the Norwegian washing machine index in December 1999. The VPPI were recalculated in order to incorporate these new historical price indices.

6.2 Concluding remarks

The importance of this project has been mentioned several places throughout this report. The quality aspect will definitely be the subject for more focus on other areas at Statistics Norway, as it will in other countries

[41] A Dutch investigation estimated that the use of such PPI-based escalation clauses represented a worth of approximate five per cent of the Dutch GDP (Eurostat, 1998b).
[42] Oil and gas extraction, manufacturing, mining and quarrying and electricity, gas and steam supply.
[43] For more about this index – see http://www.ssb.no/vppi_en.

as well. Moreover, the work will continue in cooperation with Eurostat. This study has so far investigated just a few capital goods. However, lots of empirical investigations and tests remain to be done, as seen in chapter 5. In this respect it is worth repeating that the presented results are to be considered as preliminary.

One important conclusion is that highly specialised methods, like the hedonic approach, are achievable even for small countries like Norway. Access to statistical methods' specialists is crucial to the success when establishing advanced methods. The cooperation with the research department at Statistics Norway has been of great value – they have participated in meetings, been available for discussions, and helped investigating, and using, the hedonic method. Other countries may develop such cooperation with e.g. universities, or other expert institutions.

For historical purposes the use of indices from other countries may be the only solution, or at least the most cost effective one. For some products the market is quite transparent, making the price development rather equal across borders. This seems to be the case with e.g. computers – where time series from the BLS and Statistics Sweden showed a similar development. Also the series compiled using the limited Norwegian data revealed results very parallel to the ones from the BLS and Statistics Sweden.

The data collection was much more time consuming than expected. This is not only relevant for future studies similar to this, but also relevant when policy implications for statistical production are discussed. Some of the presented methods are quite data demanding and if the data have to be more or less manually collected from the firms, then the costs might exceed the benefits. In such cases other methods like for example an expert panel, may be the solution.

The general development often involves more electronics and new technologies in the products. Normally, this makes index calculations more difficult. Another challenge for the statisticians may be that the corporate structure seems to change more frequently than before. An example is enterprises having companies in several countries – the import (or export) price may be difficult to obtain due to transfer pricing. In Statistics Norway more products will therefore undergo a similar scrutiny as those in this report, trying to reveal information that is essential when collecting prices.

6.3 Future work

In the immediate future the work will be continued in the following way:

- Collection of data for all products, with a special aim at historical prices.
- The time series are to be extended covering more recent information. In general the experience gained from studies of extended time series is important when deciding the cost-benefit of using more costly methods.
- Testing, and analysing alternative methods.
- Analyses of the sample of products and the hedonic solution to uncover weaknesses.
  - How sensitive is the sample to changes in a single unit's price?
  - Are there any missing variables?
- Re-estimate the hedonic model using more recent data including figures from 2001. Study the stability of parameters using different reference period data when estimating the coefficients. Further studies are also required for deciding the frequency in updating the coefficients.
- Compare the parameters and estimated indices with those from other countries.

Throughout 2002 several papers will be published. During 2003 the project will be concluded by a final report comprising all commodity groups.

References

Bartik, T.J. (1987), The estimation of demand parameters in hedonic price models*, Journal of Political Economy*, vol.95, 81-89.

Bartik, T.J. and Smith, V.K. (1987), Urban amenities and public policy, in Mills, E.S. (ed.), *Handbook of Regional and Urban Economics*, vol.2, Elsevier Science Publishers, North-Holland, 1207-1254.

Berndt, E.R. (1991), The measurement of quality change: Constructing an hedonic price index for computers using multiple regression methods, in Berndt, E.*, The Practice of Econometrics, Classic and Contemporary*, Reading, Mass., 102-149.

Berndt, E.R, Griliches, Z. and Rappaport, N. (1993), Econometric estimates of prices indexes for personal computers in the 1990s, *NBER working paper series,* no.4549, Cambridge, Mass.

Berndt, E.R. and Rappaport, N.J. (2001), Price and quality of desktop and mobile personal computers: A quarter-century historical overview, *American Economic Review*, Papers and Proceedings of the One Hundred Thirteenth Annual Meeting of the American Economic Association, New Orleans, LA, 5-7 January, 268-273.

BLS (2000), Report on quality changes for 2001 model vehicles, News, Bureau of Labor Statistics, 9th November 2000.

Boskin, M.J., Dullberger, E.R., Gordon, R.J., Griliches, Z. and Jorgensen, D.W. (1996), *Report by the United States Advisory Board to Study the Consumer Price Index*.

Brown, J.N. and Rosen, H.S. (1982), On the estimation of structural hedonic price models, *Econometrica*, vol.50, 765-768.

Clements, L.C., Allen, D.N. and Travers, T.C. (1989), Pricing of new vehicles in the Australian consumer price index: Adjusting for quality change, in Turvey, R. (ed.), *Consumer Price Indices: An ILO Manual*, International Labour Office, 163-165.

Cooper, D, Rayner, A.J. and Greenaway, D. (1993), Constant-quality price indices for agricultural inputs: Tractors and fertilisers revisited, *Journal of Agricultural Economics,* vol.44, no.1, 67-81.

Court, A.T. (1939), *The Dynamics of Automobile Demand*, General Motors Corporation, New York.

ECB (2000), Statistical requirements of the European Central Bank in the field of general economic statistics, *ECB*.

Epple, D. (1987), Hedonic prices and implicit markets: Estimating demand and supply functions for differentiated products, *Journal of Political Economy*, vol.95, no.1, 59-80.

Eurostat (1998a), Methodology of industrial short-term statistics. Rules and recommendations, European commission, OJ L 162.

Eurostat (1998b), Methodological aspects of producer prices on the export market, European commission.

Eurostat (1998c), Council regulation (EC) no.1165/98 of May 1998 concerning short-term statistics.

Eurostat (1999a), Volume measures for computers and software - Report of the task force, *Eurostat* CN 408.

Eurostat (1999b), Task force on prices and volumes for large equipment, Final Report, *Eurostat*.

Eurostat (2000), Hedonic price indices for computers - feasibility study report, *Eurostat* CN 442.

Eurostat (2001), Handbook on price and volume measures in national accounts, Methods and Nomenclatures, *Eurostat*.

Fettig, L. (1963), Adjusting farm tractor prices for quality changes, 1950-1962, *Journal of Farm Economics,* vol.45, 599-611.

Financial Times (2000a), "Back to basics for a washtub revolution", 8th November, 16.

Financial Times (2000b), "America's hedonism leaves Germany cold", 4th September, 15.

Geankoplis, C.J. (1993), *Transport Processes and Unit Operations*, 3rd ed., Prentice-Hall.

Gordon, R.J. (1990), *The Measurement of Durable Goods Prices*, National Bureau of Economic Research, University of Chicago Press.

Griliches, Z. (1967), Hedonic price indexes revisited: Some notes on the state of the art, *Proceedings of the American Statistical Association*, 324-332.

Griliches, Z., Hamermesh, D.S. and Students (1994), Hedonic price indexes for personal computers - Intertemporal and interspatial comparisons, *Economics Letters*, vol.44, 353-357.

Kapital Data (2000), no.8.

Karassik, I.J. (1998), *Centrifugal Pumps*, 2nd ed., Chapman and Hall, New York.

Lancaster, K.J. (1971), *Consumer Demand: A New Approach*, Columbia University Press, New York.

Last og Buss (2000), Bilteknisk oppslagstidsskrift, Forlaget Last og Buss.
Lunde, L.A., Røgeberg, S.L. and Sandberg L. (2000), Price Indices for Capital Goods - Part 1. A Descriptive Study, Report 2000/4, *Statistics Norway*.
Moch, D. (2001), Price Indices for Information and Communication Technology Industries - An Application to the German PC Market, *Zentrum für Europäische Wirtschaftsforschung* (ZEW), Mannheim.
Nelik, L. (1999), *Centrifugal and Rotary Pumps, Fundamentals with Applications*, Boca Raton, Fla., CRC Press.
Nelson, R.A., Tanguay, T.L. and Patterson, C.D. (1994), A quality-adjusted price index for personal computers, *Journal of Business and Economic Statistics*, vol.12, no.1, 23-31.
Norsk Landbruk (1999), no.22, 58-67.
OECD (2000), Handbook on quality adjustment of price indexes for information and communication technology products, Working Party on Statistics, *OECD* official document, JT00100426.
Ohta, M. (1975), Production technologies of the USA boiler and turbo generator industries and hedonic price indexes for their products: A cost-function approach, *Journal of Political Economy*, vol.83, no.1, 1-26.
Pagoulatos, A., Debertin, D.L. and Johnson, W.L. (1982), An econometric analysis of qualitative choice among performance characteristics of agricultural tractors, *Southern Journal of Agricultural Economics,* vol.14, no.2, 83-89.
Palmquist, R.B. (1991), Hedonic methods, in Braden, J.B. and Kolstad, C.D. (eds.), *Measuring the Demand for Environmental Quality*, Elsevier Science Publishers B.V., North-Holland, 77-120.
Rosen, S. (1974), Hedonic prices and implicit markets: Product differentiation in pure competition, *Journal of Political Economy*, vol.82, 34-55.
Shiratsuka, S. (1995), Effects of quality changes on the price index: A hedonic approach to the estimation of a quality adjusted price index for personal computers in Japan, *Monetary and Economic Studies*, vol.13, no.1, 17-52.
Silver, M. and Heravi, S. (2000), The measurement of quality-adjusted price changes, Presentation at the National Bureau of Economic Research, Conference on Research in Income and Wealth, Washington DC, September 2000.
Statistisk sentralbyrå (1982), Engrosprisstatistikk, Engrosprisindeks, produsentprisindeks, Rapporter 82/29, *Statistics Norway*.
Statistisk sentralbyrå (2001), Commodity List External Trade 2001, NOS C 643, *Statistics Norway.*
Thunes, O.M. (1998), En hedonisk prisanalyse av det norske pc-markedet, utredning i fordypningsområdet: Regnskap og økonomisk styring, NHH, Bergen.
Waugh, F.V. (1928), Quality factors influencing vegetable prices, *Journal of Farm Economics*, vol.10, no.2, 185-196.
Waugh, F.V. (1929), *Quality as a Determinant of Vegetable Prices: A Statistical Study of Quality Factors Influencing Vegetable Prices in the Boston Wholesale Market*, Colombia University Press, New York, reprinted by AMS Press Inc., New York 1968.
WCO (1996), Harmonized Commodity Description and Coding System, Explanatory notes, Second edition, *World Custom Organisation*.
Ziemer, R.C. and Kelly, P.A. (1993), The deflation of military aircraft, Price Measurements and Their Uses, Studies in Income and Wealth, NBER, vol.57, 307-331.

Appendix A: PPI – about the index

1. Administrative information

1.1. Name
Producer price index.

1.2. Subject group
08.02.20 Prices, Price Indices and Economic Indicators, producer price index (PPI).

1.3. Frequency
Monthly.

1.4. Regional level
National level only.

1.5. Responsible division, person
Division for external trade statistics (270), the producer price group, Ronny Haugan.

1.6. Collection authority
The Statistics Act (1989) §2-2 and 2-3.

1.7. EU regulation
Council regulation (EC) no. 1165/98 of May 1998 concerning short-term statistics (Eurostat, 1998c).

2. Background and purpose

2.1. Purpose and history
The PPI is an important part of a system for short-term indicators made for monitoring the national economy. The purpose of the index is to measure the development of the producers' prices for sales in the Norwegian market and sales for exports. The PPI was first published in 1977.

As of the January 2001 index, a modernised and improved routine for estimating the PPI is being used. A new standard for classification – SIC94 (Standard Industrial Classification) – is also adopted. Furthermore, some small changes in the routines for data collection have been undertaken: The news is that for exports unit price data from the external trade statistics are in some cases being used. This is of course done only in those rare cases where these prices are deemed good indicators for measuring the development in import prices.

For more information on these changes see *Revision* (at our web site www.ssb.no/ppi).

2.2. Users and applications
The statistics are used by the public sector (ministries, Central Bank of Norway, etc.) and the finance and analyst sectors. The index is also used for regulating different kinds of contracts. Furthermore, the national accounts (NA) within Statistics Norway is an important user of the PPI. Here the index is mainly used as a deflator.
.

3. Statistics production

3.1. Population
All commodities produced by companies within oil and gas extraction (NACE11, see 4.3 for explanation), mining (10, 13-14), industry (15-37) and energy supply (40). The following industries are not covered: mining of uranium and thorium ores (12), publishing (22.1), processing of nuclear fuel (23.3), manufacturing of weapons and ammunition (29.6), building and repairs of ships and boats (35.1) and manufacturing of aeroplanes and spacecraft.

The commodities are mainly from establishments belonging to these industries, and the establishments are sampled from Statistics Norway's Business Register. Parts of the primary industries and wholesalers are also included in order to cover first-hand domestic transactions. The population does not include establishments with ten or fewer employees.

3.2. Data sources
Prices are mainly collected using questionnaires to the establishments specified above. In addition data are collected from various sales organisations, the division of external trade statistics, the quarterly electric energy prices, and in some cases from international sources (spot prices).

3.3. Sampling
The sample consists of about 630 commodity groups (CPA-products, see 4.3). These groups are split into various HS-products (see 4.3). CPA-products are selected in cooperation with the national accounts and cover important commodities in national accounts. The HS-products are selected using data from external trade statistics, and cover the chosen CPA-commodities. The range of CPA-commodities and HS-products is adjusted according to changes in the national accounts and external trade statistics – even so, the annual changes are modest. The changes are carried out to introduce new products into the sample. A selection of establishments is used in the monthly price collection. In cooperation with these companies a range of goods is chosen to cover the selected HS-products (and CPA-commodities). The sample consists of about 800 establishments and roughly 2800 products. Companies with 100 employees or more are to be included in the sample on a permanent basis (cut-off principle). The sample is supplemented continuously when bankruptcy, closedowns and so on occur.

3.4. Collection of data
The survey is mainly based on questionnaires that are sent out the 10th every month and are to be returned around the 18th. Prices are also collected via e-mail. Figures from external trade statistics are used if they are found to be an adequate indicator for the price development of a good. The quarterly electric energy prices and spot price information from NordPool are combined in an effort to monitor the price of electricity. In addition some prices are collected from international commodity exchanges.

3.5. Reporting and record-keeping burden
A reporting establishment spends on average 90 minutes per year filling in questionnaires. The total time used for the entire sample represents 1200 hours of work or 150 man-days.

3.6. Quality control and revision
Most of the questionnaires are optically read. All forms go through a manual check where administrative marks are checked. Afterwards a computerised control checks for punching errors, duplicates and observations with large price changes from the previous month. Thereafter all observations are arranged after the intensity of their price change. This is done to prevent extreme changes affecting the imputation routines (see below). Checks are also made on HS-products, CPA-commodity groups, and finally on the figures published. Checks are made on each market. The establishments are only contacted if one or more of their commodities show large changes in price and no explanation is given on the questionnaire.

Non-response: Non-response is imputed mechanically based on the donor method. This method chooses the price change of a random product from the same industry. This way we maintain the actual dispersion in the received prices. In cases of total non-response the establishment is contacted, and is only imputed if prices still cannot be obtained. In this process priority is given to important companies, i.e. companies whose products have a large influence on aggregated levels.

Other checks: Aggregated series are checked in several ways. Data are compared with turnover data, the production index and other price statistics by charts and tables. Important changes or errors in aggregated time series, extreme values, etc. are identified using the X12ARIMA. The checks are followed up with a new evaluation of data at sector/micro levels.

3.7. Analysis
On the micro level a geometric average is used on products within the same HS-product (see 4.3). The index is calculated using a chained Laspeyres formula. For the PPI total indices on the HS-level, domestic market and exports are weighted together. Weights are updated annually. On detailed levels the weights are based on the national accounts' latest final figures. To keep the weight as current as possible aggregated levels are adjusted by using the quarterly results from the national accounts. This way weights always relate to the year previous to each index period (calendar year). The reference year is 2000 (2000=100). Only the total index is seasonally adjusted. The method used is X12ARIMA.

4. Concepts, variables and classifications

4.1. Definition of the main concepts
A chained Laspeyres formula is used in the production of the index. A Laspeyres formula is characterised by constant weights for a given time period. A chained Laspeyres index is an index made up by several Laspeyres indices with various weights. In the producer price index weights are changed once a year.

Norwegian market is a joint description for all sales to purchasers in Norway.

Export markets are all other purchasers.

Imputed value is the estimated value where observations are missing.

4.2. Definitions of the main variables
Price for sales in the Norwegian market and for exports: The price is defined ab factory (ex works), i.e. sales price at the factory gate inclusive any invoiced cost of package and transport by the establishments' own employees and equipment. All prices shall be reported exclusive all taxes and shall be as of the 15th every month. For exports we want the fob-price (free on board).

4.3. Standard classifications
HS - Harmonised System - an international custom and statistical nomenclature.
CPA - Statistical classification of products by activity – the EU standard for products grouped according to main activity – used for the national accounts only (see 6.2).
SIC94 - Standard Industrial Classification – Norwegian adjustment of NACE Rev.1.
NACE - Nomenclature Générale des Activités economiques dans les Communautés Européenes – Eurostat's industrial classification. This standard is based on ISIC – Rev.3 (International Standard of Industrial Classification of all Economic Activities) – the UN's international industrial classification.

5. Sources of error and uncertainty

5.1. Collection and processing errors
A correct answer to the questionnaire requires that the respondent has understood the definitions of the main variables. To reduce the effects of possible errors in the collection each product is specified in text on the questionnaire, as well as the recommended unit/quantity. Furthermore, the respondent is encouraged to put the establishment's own product description and/or product code on the questionnaire. The price reported the previous month is also pre-printed. In addition, a guideline containing important definitions is provided. This system should give a good outline of the situation for the respondent, but still errors may occur.

Sometimes the respondents report the same price over longer periods of time. In many cases this is correct because of costs due to changing prices (menu costs). However, in some cases this may reflect errors due to lack of motivation by the respondents. In extreme cases of constant prices the respondents are contacted.

In the cases where the reporting establishment's selected product is out of production or sold out, and the respondent is reporting a different product, the change shall be explained on the form. If this is not done, changes in products may be registered as price changes. Normally, these kinds of errors are identified.

The forms are optically read, automatically verified, and the data are stored electronically. The routine for optical reading has turned out to be very reliable in other statistical areas. It is also part of the routine to produce electronic images of the forms. This makes it easier for the auditor to compare the optically read data with the information given on the form.

5.2. Sampling errors

In order to secure a high level of accuracy at a low cost – emphasis has been put on covering large units within the population – where these are dominating.

Variance: Is not calculated.

Skewness: The products in the population are revised once a year in order to get new products. The sample of products in each establishment is selected in a joint effort between the establishment and Statistics Norway. The respondent is asked to continuously update the sample. This means replacing all discontinued products, products that for some other reasons are less important for the establishment's turnover, and products where the price development no longer represents the overall price development for the establishment. If the respondent for some reason does not update the product sample, this may represent a source for skewness. No calculations of the sample skewness have been made, but by experience these kinds of errors may go in both directions. Extreme cases are normally identified through checks. Also, contacting the establishments reduces effects from these kinds of errors/skewnesses.

Furthermore, commodity-group levels are checked in connection with the annual weight changes. Here all commodity groups (with weights) are checked against the sample. In commodity groups with poor coverage efforts will be made in order to improve the coverage.

Replacing units that are omitted continuously revolves the sample of establishments. A source of skewness may be a relatively high number of large units (establishments) in the sample. If many small units are present within an industry, with a price development different from the large units, this might cause skewness.

Non-response: At the deadline the response percentage varies between 85 and 90. After the reminder and before publishing the percentage rises to about 95 per cent. In cases of total non-response, the establishments are contacted and imputed if the questionnaire fails to appear. Here, important respondents are given priority.

5.3. Non-sampling errors

We experience that some of the units (normally small) in the population is misplaced as regards industrial code and commodity code. This is due to changes in the classification, and/or insufficient or misleading information at a certain time. Information about the commodities in the sample and in the population is improving over time. No attempts have been made to estimate the extent and significance of these types of errors, but it is assumed to be small.

The quality of the products will also change over time. This might lead to an overestimation or underestimation of the price development. In the cases where we know there has been a change in quality, this is adjusted by ordinary methods of quality adjustment.

For computers a so-called hedonic method is put to use in order to deal with the frequent quality changes within this commodity group. This method is based on the assumption that the price of a commodity is decided by its quality characteristics. It is therefore essential to establish a descriptive relationship between price and quality characteristics, i.e. price as a function of these characteristics.

As mentioned before, sometimes prices are constant over a longer period of time. This might be because the respondents report list prices instead of transaction prices. In cases where for instance demand or the competitive conditions change – thereby changing the level of discount – the development in the index may over- or under-estimate the price development.

Effects from changes in relative prices may represent another non-sampling error. The relative price between different products changes over time, often because of changes in demand. This may affect the producer's/importer's prices and price developments. To intercept such substitution effects, the weights, and the sample of products should therefore frequently be revised. The size of this skewness is not estimated, but as both the sample of products and the weights are subject to an annual revision, this skewness is assumed to be very small. The product sample is mentioned in 5.1.

6. Comparability and correlation

6.1. Comparability over time and place

The PPI was produced for the first time in 1977, and published series exist down to a 2-digit ISIC level from January 1977 to December 2000. The revision in 2001 implies a break in these series. Series grouped according to NACE exist as of January 2001 on a 2-digit level, and some 3-digit levels. The series are published for the domestic market alone, as well as for the domestic market and exports together.

6.2. Correlation with other statistics

The results from the PPI are transferred to the national accounts. These are CPA home market indices that are otherwise not published. The building cost index and the quarterly wholesale price index use some data from the PPI.

The PPI is closely related to the Commodity Price Index for the Industrial Sectors. The main distinction is that the latter will be subject to revision as more information is obtained. This index will therefore not be suitable for regulation of contracts or for similar uses.

7. Availability

7.1. Internet address

http://www.ssb.no/english/subjects/08/02/20/ppi_en or http://www.ssb.no/ppi_en.

7.2. Languages

Norwegian and English.

7.3. Publications

The statistics are published electronically (tables and figures) at the Statistics Norway web site. Results are also available in the Monthly Bulletin of Statistics (the Internet). Additionally, selected results are published on paper in the Statistical Yearbook, Economic Outlook and Economic Analyses.

7.4. Storing and uses for basic material

Data concerning establishments, products and prices are saved in Oracle databases.

7.5. Other documentation

Engrosprisstatistikk, Rapporter 82/89 (Statistisk sentralbyrå, 1982). A revised documentation is in the process of being prepared.

Appendix B: Definitions

A lot of abbreviations and professional expressions will be used throughout this report. The most frequently used are listed in table B.1 to avoid confusion and also to spare the reader from too many repetitions.

Table B.1: Some frequently used abbreviations throughout this report

BLS	US Bureau of Labor Statistics.
CPA	Statistical classification of products by activity in the European Community – the EU standard for products grouped according to main activity.
CPI	Consumer Price Index.
EFTA	European Free Trade Area.
EU	European Union.
HS	The Harmonised System – an international custom and statistical nomenclature. When the HS is used in this report it is in the meaning of the national, eight-digit figure. The first six digits are equal to the international standard, while the two latter is a division for national purposes.
IPP	International Price Programmes.
MCR	Monthly chaining and re-sampling.
NAA	Norwegian Agricultural Authority.
NACE	Nomenclature Générale des Activités economiques dans les Communautés Européenes – Eurostat's industrial classification. This standard is based on ISIC Rev. 3 (International Standard of Industrial Classification of all Economic Activities) - the UN's international industrial classification.
NRF	Norwegian Road Federation.
NSI	National Statistical Institute.
OECD	Organisation of Economic Cooperation and Development.
PPI	Producer Price Index.
PPP	Purchasing Power Parity.
PRODCOM	PRODuction COMmunautaire: The EU production statistics for Mining and Quarrying, Manufacturing, and Electricity, Gas and Water Supply, i.e. Sections C, D and E of the Statistical Classification of Economic Activities in the European Community (NACE).
SCB	Statistics Sweden.
VPPI	Commodity price index for the industrial sectors – an index based on the same principles as the PPI.
WCO	World Customs Organisation.

Appendix C: Computers and computer parts in the HS

HS		Description	Value of imports 2000 (in NOK millions)
8471		Automatic data processing machines and units thereof; magnetic or optical readers, machines for transcribing data onto data media in coded form and machines for processing such data, not elsewhere specified or included:	9120
	1000	- Analogue or hybrid automatic data processing machines	251
	3000	- Portable digital automatic data processing machines weighing not more than 10 kg., consisting of at least a central processing unit, a keyboard and a display	1554
		- Other digital automatic data processing machines:	215
	4100	-- Comprising in the same housing at least a central processing unit and an input and output unit, whether or not combined	
	4900	-- Other, presented in the form of systems	1006
	5000	- Digital processing units other than those of subheading nos. 84.71.4100 and 84.71.4900, whether or not containing in the same housing one or two of the following types of unit: storage units, input units, output units	2130
		- Input or output units, whether or not containing storage units in the same housing:	
		-- Writers:	
	6001	--- Matrix writers	33
	6002	--- Laser writers	54
	6003	--- Other	555
		-- Other:	
	6004	--- X-y coordinate input devices, weight at the most 1kg. (incl. mouse, light pen, joystick and trackball): keyboard	116
	6005	--- Data monitors	833
	6008	--- Other	608
	7000	- Storage units	1085
	8000	- Other units of automatic data processing machines	419
		- Other:	
	9001	-- Scanners	82
	9009	-- Other	179

Source: HS

Appendix D: Power utility equipment

Definition of power utility equipment
Most of the products produced in or imported to Norway within the group called power utility equipment are quite large units of machinery. Within the same eight-digit commodity classification in the Norwegian external trade statistics there are also far smaller units. For this reason, the unit prices within these groups show considerable variation. This is because the group definitions, with the exception of 84.11.8290, place no restrictions on size or capacity. The small, inexpensive products within the same commodity groups are sold in much larger quantities and are normally quite standardised. They are not considered in the following analysis.

The following external trade products will be considered:
84.11 Turbo-jets, turbo-propellers and other gas turbines:
- Other gas turbines:
- - Of a power exceeding 5 000 kW:
84.11.8290 Other (not meant for aircraft)

84.12 Other engines and motors:
- Hydraulic power engines and motors:
84.12.2100 Linear acting (cylinders)
84.12.2900 Other

84.13 Pumps for liquids, whether or not fitted with a measuring device; liquid elevators:
84.13.6000 Other rotary positive displacement pumps
84.13.7000 Other centrifugal pumps
- Other pumps; liquid elevators:
84.13.8100 Pumps

84.14 Air or vacuum pumps, air or other gas compressors and fans; ventilating or recycling hoods incorporating a fan, whether or not fitted with filters:
- Compressors of a kind used in refrigerating equipment:
84.14.3009 Other (than "sealed units")

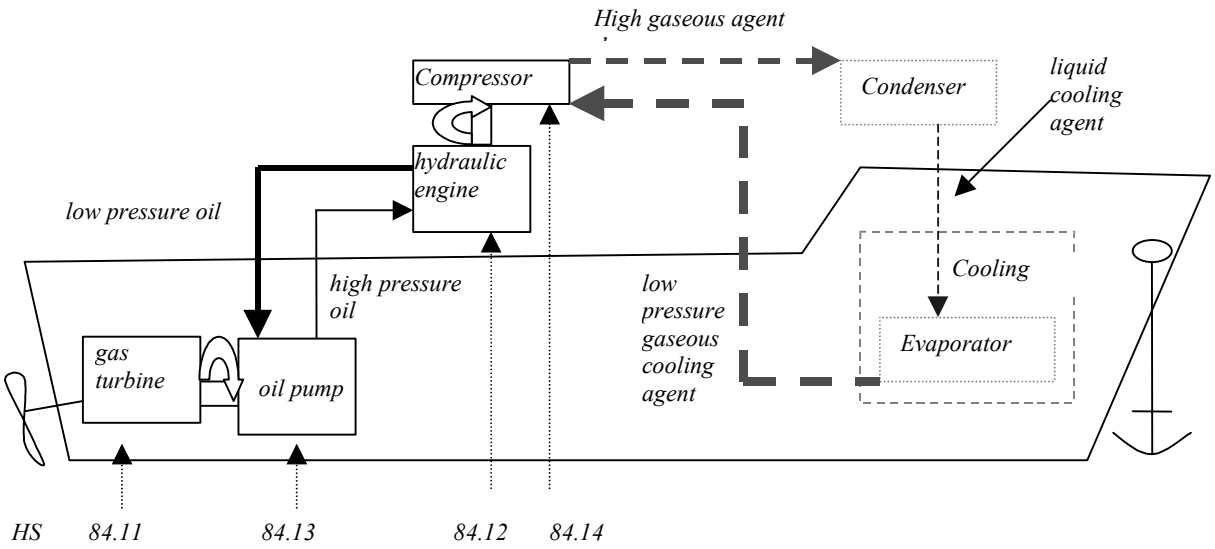
Common for all these groups in the external trade statistics is that the unit prices vary considerably. For one group, the price for exports was up to NOK 3 million and 2.4 million for imports. The minimum unit prices were below NOK 100 for both. This indicates that the commodities are quite heterogeneous.

Characteristics
Some of the products within the groups above are customised. For this reason, it may be difficult to compare the prices directly. Nevertheless, some of these customised products are assembled from fairly standardised components, which are easier to compare.

Some of the quality characteristics common to most groups of power utility equipment are capacity, efficiency, noise, vibration, required maintenance, reliability and sealing qualities. These depend on load and operating environment among other things.

Units of power utility equipment may be combined in many different ways, for example as illustrated in figure D.1. Gas turbines may be delivered with a generator, a pump, a compressor, or simply fitted with a mechanical drive. Hydraulic motors are always used to power something, e.g. a winch or a pump. However, a hydraulic motor does not belong in the same HS class as a winch or a pump. Pumps and compressors normally require mechanical power, which can be supplied by e.g. an electric or hydraulic motor. Units with an integral power unit and those without one belong in the same HS classes. These complications may, to some extent, explain the difficulties one encounters in the classification of imported and exported goods.

Figure D.1: An example of power utility equipment applied in a cooling ship



Special aspects of power utility equipments
The main challenge in measuring the price development for these products is their complexity and varying specifications. When these issues are combined with low volumes and/or a number of different products, which is often the case in small countries like Norway, they become particularly difficult to deal with. Some of the most expensive products are sold exclusively as packages, which include installation and service. This requires the manufacturer, or the statistician, to artificially separate the different cost components – the product, customising, installation, transport, service, etc. – from the total cost.

Population and sample

Some of the importing firms are Norwegian subsidiaries of foreign manufacturers, and may thus apply a policy of internal pricing (transfer pricing). The prices Norwegian manufacturers pay when importing from their subcontractors are more likely to be real market prices. The unit values and weights vary considerably between the firms with the highest import values, suggesting that they are not competing in the same market. The firms' web pages have sources of information as to what kind of machines they actually manufacture or import.

The HS products
This section consists of six products numbered from (i) to (vi). Information from the Internet is presented for each product together with product information from the WCO (WCO, 1996).

(i) Gas turbines exceeding 5000 kW other than turbo-jets and turbo-propellers (84.11.8290)
This group includes industrial turbine units which are either specifically designed for industrial use or adapt turbo-jets or turbo propeller units for uses other than providing motive power for aircraft. The gas turbines are used for marine craft and locomotives, for electrical power generation and for mechanical drives in the oil and gas, pipeline and petrochemical industries.[44]

[44] According to the WCO (1996) there are two types of designs: (i) The single-shaft gas turbine unit, in which the compressor and turbine are built on a single shaft, the turbine providing power to rotate the compressor and to drive rotating machinery through a coupling. This type of drive is most effective for constant speed applications such as electrical power generation. (ii) The two-shaft gas turbine unit, in which the compressor, combustion system and compressor turbine are accommodated in one unit generally called a gas generator, whilst a second turbine on a separate shaft receives the heated and pressurised gas from the exhaust of the gas generator. This second turbine, known as the power turbine, is coupled to a driven unit, such as a compressor or pump. Two-shaft gas turbines are normally applied where load demand variations require a range of power and rotational speed from the gas turbine.

The quantities and values in the Norwegian external trade statistics indicate there are but a few firms in the turbine branch. Furthermore, the import and export data do not tell enough about the turbines, i.e. whether plain turbines are imported and turbine packages exported. Searching the Internet for gas turbines, we found that Dresser Rand packs and General Electric produces gas turbines in Norway.

S&S Energy Products (GE) provides power generation packages ranging from two to 50 MW for utility power, private power, and mobile power for simple cycle cogeneration and combined cycle applications. Technical data for these turbines applied with 60 Hz and 50 Hz generators or mechanical drive are provided at their web page. We can thus expect the turbine packages to be quite standardised.

Dresser Rand claims to be a recognised leader in gas turbine packaging. They have vast experience in packaging aero derivative gas turbines from General Electric and Rolls Royce in the power range from 14 to 43 MW. They also provide some technical details for their models. Neither Dresser Rand nor General Electric tells, at their web sites, which of their turbines or power packages they produce or equip in Norway.

(ii) Hydraulic power engines and motors (84.12)
According to the WCO (1996) this HS chapter includes:

- Engines producing mechanical power by utilising the energy of the waves or sea swell.
- Water column machines operating by the pressure of water of pistons.
- Hydraulic cylinders.
- Hydraulic valve actuators, presented separately, consisting of a metal casing containing a piston which by means of a pin perpendicular to the piston rod, converts the linear motion caused by the action of a liquid under pressure into a rotary motion. This can be used to operate a plug value or other appliances with rotating mechanism.
- Hydraulic servomotors that perform the role of final or intermediate actuators in feedback control systems or regulating systems.
- Hydraulic systems consisting of a hydraulic power unit, hydraulic cylinders and the pipes or hoses needed to connect the cylinders to the power unit.
- "Hydraulic" jet engines ("hydro jets") for motorboats.

(iia) Hydraulic cylinder power engines (84.12.2100)
Hydraulic cylinder engines typically consist of a brass or steel barrel and a piston operated by oil (or other liquid) under pressure applied on one side (single-acting) or on both sides (double-acting) of the piston, the energy of the liquid under pressure being converted into a linear motion. These cylinders are used on machine tools, construction machinery, steering mechanisms, etc.

Thus even the more precisely defined of the two sub groups, cylinder and other power engines, is quite a wide category consisting of predominantly heterogeneous products.

A division within the association of Norwegian Maritime Exporters (NME) – the Institute for Mercantile Information (IMI) – publishes a preferred makers' list on CD ROM, with names and occasional pamphlets from the manufacturers of each product. Sylinderteknikk A/S is listed as supplier of hydraulic cylinders here.

Searching the Internet for firms importing cylinder power engines the following pieces of information were found:

- Hydralift ASA offers an advanced package of drilling products and supplies a wide range of cranes for offshore load handling operations. These products are equipped with hydraulic cylinders.

- Rapp Hydema designs and manufactures advanced hydraulic deck machinery for the global fishing fleet. Some of these products are powered using hydraulic engines.

- Sylinderteknikk AS supplies small and standardised hydraulic cylinders. They provide Autocad files for their products.

- The Kverneland Group is the largest specialised producer and distributor of agricultural implements in the world. Hydraulic engines are important parts of agricultural machinery as well.

Thus the products of the largest firms are completely different.

According to the external trade statistics the total export value of hydraulic power engines is far smaller than the import value. It shows the same wide variation in unit prices and weights as the imports. The largest firms' web sites show what products they actually manufacture.

- Bauer Hydraulics (Brodr. Bauer-Nilsen AS) provides a range of products, including high-torque slow speed hydraulic motors for the shipbuilding sector as well as for offshore and land-based industry. Their hydraulic motor program consists of standardised models with detailed descriptions at their web page.

- Berendsen PMC is the world's leading independent supplier of industrial hydraulic systems, power packs, cylinders, components and control technology.

- Luk produces hydraulic power steering parts.

- Scandia Trading provides hydraulic equipment. Their product range consists of gears, cranes, winches, power packs and any other type of deck machinery.

It is clear that products from these firms, which are exporting linear hydraulic power engines, are about as diverse as the products of the importing firms.

(iib) Other power engines (84.12.2900)

- (Aker) Maritime Hydraulics is one of the leading manufacturers of oilfield drilling and exploration equipment, where hydraulic motors are important components.
- Frank Mohn imports hydraulic engines to power some of its pumps.
- Lautom AS imports hydraulic equipment that they customise for their consumer's needs.
- Mannesmann Rexroth Norway imports hydraulic cylinders from its parent company in Germany.
- Rapp Hydema imports hydraulic motors for powering the hydraulic deck machinery and drive units they supply to the fishing fleet.
- Rolls Royce Marine (Brattvåg) develops winch systems based on low-pressure hydraulic technology.

(iii) Other rotary positive displacement pumps than hand pumps, fuel, lubricating or cooling medium pumps for internal combustion engines and concrete pumps (84.13.6000)

The intake and discharge of the liquid in a rotary positive displacement pump are affected by suction and compression, which are produced by cams (lobes) or similar devices, rotated continuously on an axis. These devices make contact, at one or more points with the wall of the body of the pump, and form in this way the chambers in which the liquid is displaced (WCO, 1996).

IMI lists a long range of pump suppliers categorised by the purpose of the pumps.

- Allweiler AG is one of the leading pump manufacturers, and exports rotation as well as centrifugal pumps from Germany to their subsidiary company in Norway.

- Frank Mohn exports rotation and centrifugal pumps. On their web site they claim to be the leading manufacturer and supplier of submerged pumps for the world tanker and offshore markets. A Framo cargo pumping system includes professional assistance during project evaluation, technical support during engineering and supervision of installation and testing.

- ITT Flygt claims to be the world leader of submersible pumps, mixers and accessories. They import rotation pumps for wastewater handling.

The pumps imported by Allweiler and Flygt seem to be fairly standardised. However, Frank Mohn supplies entire systems, which are totally customised and require to be installed by the manufacturer.

(iv) Centrifugal pumps (84.13.7000)
In these pumps, liquid taken in axially is set into rotation by the revolving blades of a rotor (impeller), the resulting centrifugal action forcing the liquid outwards to the periphery of an annular casing containing an outlet placed tangentially (WCO, 1996). According to Geankoplis (1993) these pumps can be used for fluids with suspended solids and pumps with a uniform pressure.

Allweiler AS, Eptec AS and Hamworthy KSE A/S are listed in IMI's "Centrifugal pump" category. However, there might be other suppliers of centrifugal pumps in other categories like sewage pumps or seawater pumps. The manufacturers with web sites were checked under the previous pump categories (see above).

(v) Other pumps and liquid elevators; pumps (84.13.8100)
The following pumps fall in this group: Electro-magnetic pumps, ejectors, emulsion pumps, pumps in which the steam or gas pressure acts directly on the surface of the liquid. The firms listed in IMI might have pumps that belong to this category, but the IMI has no such category. The pumps and liquid elevators show the same wide distribution of unit prices and weights as the other groups. However, the external trade data show that the individual firms' market portions are far smaller.

(vi) Compressors of a kind used in refrigerating equipment (84.14.3009)
In general, air pumps, vacuum pumps and compressors function on the same principles and are by and large of similar construction as the liquid pumps (WCO, 1996). Simex - Norsk Kjøleindustri A/S, Skogland AS, Kuldeteknikk and York Kulde A/S are listed in IMI's cooling compressor category. The web pages belonging to the firms with the highest import and export values give the picture:

- Frigoterm imports cooling compressors for cooling lorries.
- Norcool is Europe's leading supplier of glass door and ice-cold merchandises. They are also Scandinavia's leading suppliers of Cold Rooms and Cold Room Units. Their compressors are however smaller than those included in our survey.
- Sperre produces compressors meant for ships and can deliver any part at any place within 48 hours. Thus they supply standardised compressors. There are detailed technical descriptions at their web page.
- York Kulde imports cooling compressors for heat pumps and air conditioners.

Each importer and exporter seems to be targeting a specific segment of the market.

Market analysis

A comparison of the unit prices and unit weights from the external trade statistics for the firms with the highest export values within each HS group indicates that the exporting firms are providing specialised products. If these firms have the same position in the domestic market as in the export market, they can be considered to have some market power.

The unit weights and unit prices for imported goods are quite wide spread between the different firms within each HS group. Thus they could be expected to have some market power for the same reason as the exporting firms.

Previous attempts to quality-adjust prices of power utility equipment

No attempts to quality-adjust pumps were found – nor any research papers. We have only located one scientific study covering other power utility equipment. Ohta (1975) has tried to make a hedonic price index for boilers and turbo generators purchased by the USA steam electric power industry. Otha applies a cost function, assuming that the consumers do not determine the prices, i.e. mark-up pricing. The model is separated into a price index and a quality index. The duopolistic or oligopolistic structure of the industry makes it possible to estimate the cost function directly.

Ohta (1975) compiled an input price index from a sample of 119 boilers and 144 turbo generators. The input was classified into the three groups – labour, materials and capital. The input price indices were estimated from published industrial surveys and the producers' annual reports. There was no particularly strong evidence against the cost minimisation hypothesis and the input-output reparability of the production technology. Hedonic price indices were calculated and compared with the input-cost method. The former increased more over time.

Sources of prices and quality characteristics

There are a few alternative information sources, except going directly to the producers and importers of power utility equipment.

Trade organisations

The association of Norwegian Maritime Exporters (NME) covers more than 120 manufacturers of ships' gear and equipment for aquaculture and fishing. They provide databases on CD-ROM with the suppliers' own pamphlets and technical drafts. A version of this database will later be present on the Internet with recommended prices for B2B purposes. Hydraulikk-Pneumatikk Foreningen (HPF) is a trade organisation for suppliers of hydraulic or pneumatic solutions. They provide lists of suppliers, products and brands available in the Norwegian market.

Sources at Statistics Norway

The Division for Energy and Industrial Production Statistics at Statistics Norway provides manufacturing figures including wage costs and raw material costs for producers, which could be useful if one has to use a cost function approach. The manufacturing statistics also provide information regarding the production of the possible power utility equipment that could be used to identify which firms to include in the survey. Further investigation into the detailed data of the external trade statistics may also give useful information.

Internet and brochures

Some of the manufacturers have detailed presentations of their products including technical information. Each firm's annual cost of capital might be found in their annual reports, which would be helpful if a cost function approach is to be tested.

Potential methods

Some of the products are specially made for each consumer. These unique products may consist of more or less standardised units. The price development for the full product could, however, be different from the price development for the standardised components. For example, if the price of customising and installation of the product contributes considerably to the total cost and shows a different development, measuring component prices will bias the index.

There are a few suitable methods available for quality-adjusting the complex, but standardised components. A hedonic regression would probably require more observations of prices and characteristics than we hope to get. The judgmental or option price methods require the respondents or the statistician to estimate prices of components in addition to values of potential changes in quality. If this was considered inadequate in terms of burdens on the respondents and quality of the results, none of the preferred methods mentioned above may be possible. A cost function approach, like the input price index suggested by Ohta (1975), could be required to estimate the price development.

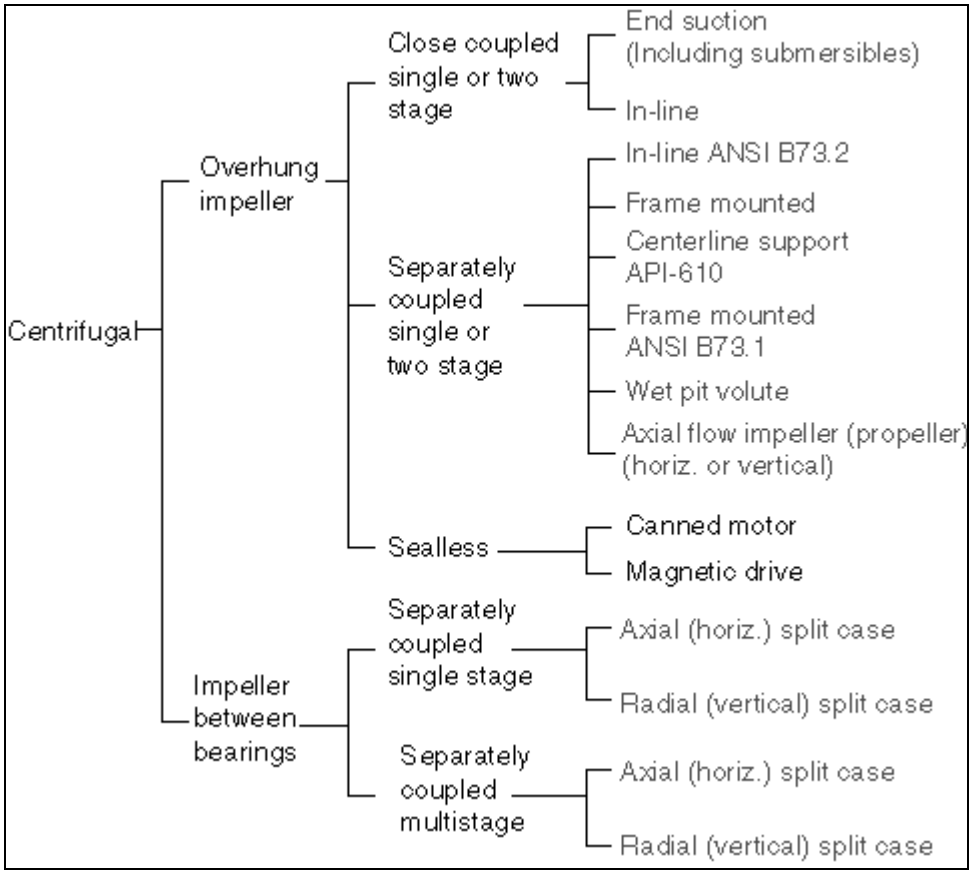
There are two turbine producers and exporters in Norway, Dresser Rand AS and Kværner Energy. Moreover, the manufacturers in most of the other considered HS groups supply products that are not direct substitutes – thus we may expect that none of the markets are fully competitive. Hence the assumption that the prices depend on the production costs might be valid. However, the export prices may be real market prices, so a cost function approach would only give a fair approximation. The manufacturers' raw material and wage costs might be obtained by means of data already within Statistics Norway or from the Federation of Norwegian Manufacturing Industries. Each firm's annual cost of capital can be obtained from its annual report.

Concluding remarks

This study has shown that the group power utility equipment is very heterogeneous. In addition – the product within a more specified HS group also seems to be heterogeneous. When taking into consideration that Norway is a small country, this means that the possibilities of producing reliable indices are limited. In an attempt to go deeper into power utility equipment a decision was made to concentrate on pumps – see 2.6. This analysis demonstrated that the number of imported and exported pumps is quite large. A distinct trend in the external trade data is that large pumps contribute to a large part of the export value, and the export value is divided between a few large exporters. The imported pumps are on average smaller and the import value is dispersed among many smaller firms.

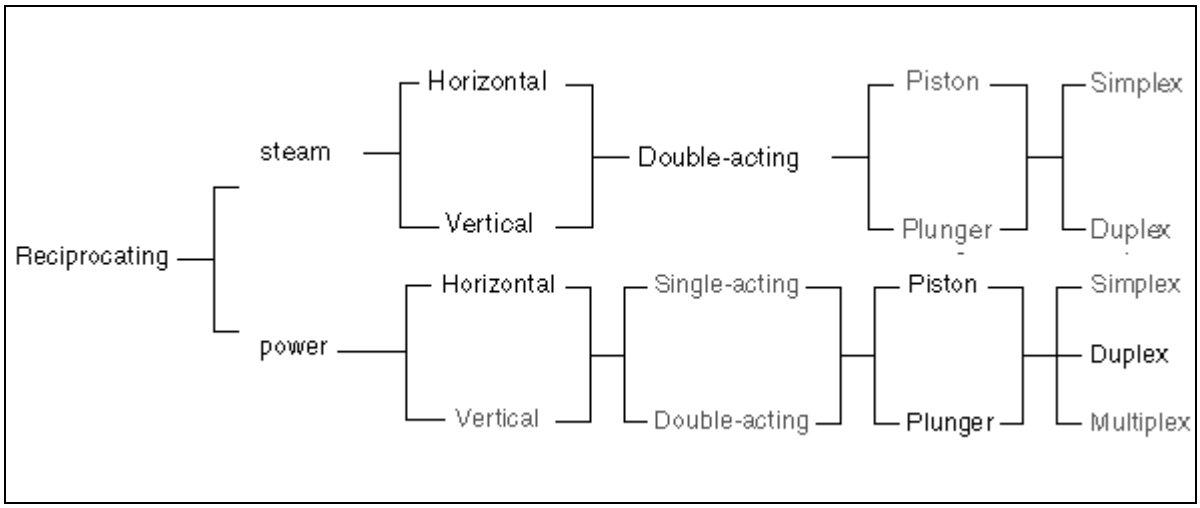
Appendix E: Pump types

Figure E.1: Types of centrifugal pumps



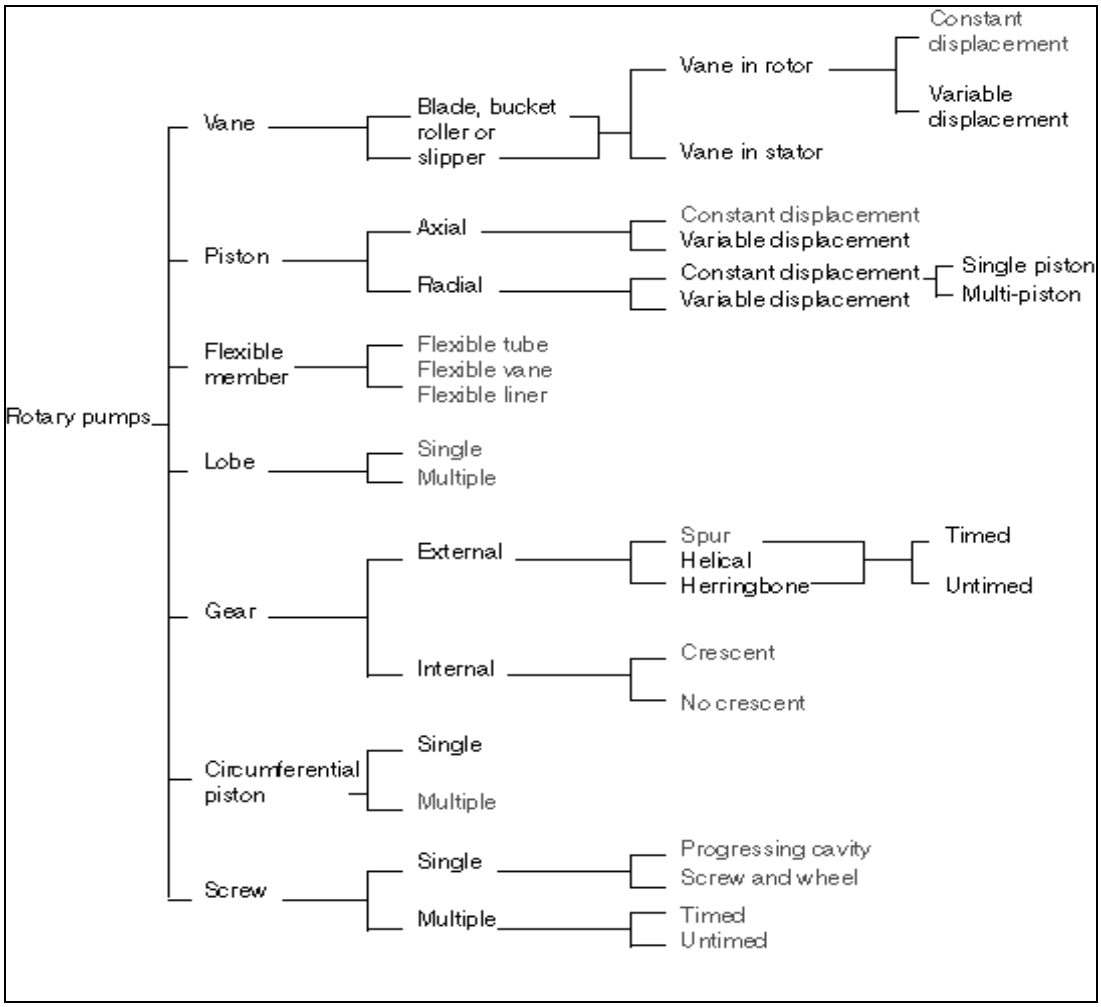
Source: Hydraulic Institute.

Figure E.2: Types of reciprocating pumps



Source: Hydraulic Institute.

Figure E.3: Types of rotary pumps



Source: Hydraulic Institute.

Appendix F: Estimation results for computers

Estimating the unrestricted reduced form by OLS, t-values are in parenthesis.

Variable	**Table 1** All models, N=242		**Table 2** Desktops, N=133		**Table 3** Portables, N=109	
	Import price	Domestic price	Import price	Domestic price	Import price	Domestic price
Constant	0.103 (0.177)	-0.278 (-0.411)	-0.926 (-1.399)	-1.222 (-1.470)	3.173 (3.225)	2.562 (2.410)
lnSPEED	1.065 (10.895)	1.138 (10.054)	1.214 (10.821)	1.291 (9.165)	0.710 (4.362)	0.780 (4.432)
lnMEMORY	0.262 (7.994)	0.310 (8.208)	0.320 (8.589	0.359 (7.680)	0.139 (2.480)	0.220 (3.638)
lnHD	0.177 (5.370)	0.170 (4.422)	0.090 (2.348)	0.051 (1.053)	0.335 (6.192)	0.367 (6.278)
SUP	0.254 (11.320)	0.572 (2.189)	0.260 (9.200)	0.052 (1.464)	0.260 (7.694)	0.082 (2.261)
DOctober	0.072 (2.528)	0.872 (2.636)	0.044 (0.694)	0.077 (1.747)	0.126 (2.886)	0.130 (2.751)
DNovember	0.018 (0.735)	0.030 (1.036)	0.047 (1.260)	0.066 (1.702)	-0.018 (-0.492)	-0.013 (-0.320)
PROC	0.008 (1.016)	0.005 (0.565)	0.005 (1.518)	0.002 (0.200)	0.442 (2.595)	0.440 (2.385)
TYPE	1.027 (37.888)	1.021 (32.601)				
R^2 adjusted	0.865	0.824	0.821	0.744	0.665	0.678
Standard error of regression	0.167	0.193	0.152	0.190	0.165	0.179

Estimating the model by CFIML[45], t-values are in parenthesis.

Variable	**Table 4** Desktops, N=133		**Table 5** Portables N=109	
	Import price	Domestic price	Import price	Domestic price
Constant	-0.911 (-33.250)	-0.626 (-0.955)	3.277 (95.939)	3.541 (3.675)
lnSPEED	1.212 (10.914)	1.212 (10.914)	0.742 (4.600)	0.742 (4.600)
lnMEMORY	0.323 (8.793)	0.323 (8.793)	0.160 (2.888)	0.160 (2.888)
lnHD	0.087 (2.308)	0.087 (2.308)	0.353 (6.609)	0.353 (6.609)
SUP	0.261 (9.306)	0.053 (1.542)	0.257 (7.517)	0.062 (1.692)
DOctober	0.042 (1.218)	0.073 (1.705)	0.116 (2.635)	0.099 (2.092)
DNovember	0.045 (1.471)	0.063 (-1.658)	-0.016 (-0.437)	-0.016 (-0.386)
Standard error of regression	0.165	0.189	0.169	0.183
	LR test of restrictions: Chi-square (3)=4.249		**LR test of restrictions:** Chi-square (3)=11.973 (**)[46]	

See section 5.1.1.1 for an explanation of the variables.

[45] Constrained Full Information Maximum Likelihood. When estimating individual equations the FIML coincide with the OLS. On the other hand, when estimating several equations the OLS cannot be used, and the FIML are used instead.

[46] ** means rejected at the one per cent level of significance.

Appendix G: Computers in the Swedish import price index

Since 1991 the Statistics Sweden (SCB) has employed the hedonic method to quality-adjust computer prices. Their approach has been considerably less ambitious than that of the USA, where more than one man-labour year is being used making indices for PCs, other computers and accessories. Since most countries are more like Sweden than the USA when it comes to resources available in the PPI-area, we find it useful to make a short presentation of the Swedish computer index.

Definition of the product
Hedonic indices are made for PCs (desktops and portables) only. A desktop is defined as "a processing unit plus hard disk but without display and keyboard". For portable computers monitor and keyboard are of course included. Already, a simplification is made compared to the USA.

Sample
16 importers are selected. They report on an extended form each month, which – in addition to price – also includes other variables. The reporting units are asked to choose the three most sold models that month. This gives a sample of 48 models (both desktops and portables) each month.

Variables
- Import price measured in SEK.
- Clock frequency measured in MHz.
- Size of hard disk measured in MB.
- Memory size (RAM) measured in MB.
- Dummy for portable/desktop.
- Access time measured in milliseconds. (Many respondents failed to report on this variable, so it was not included in the final model.)
- Weight, which is the reporting unit's weight, based on turnover.

Model
The Americans found that a linear model – where one unit's increase in one of the independent variables increases the price with X dollar – gave the best fit. In Sweden, a log-log model performed better. This implies that one unit's increase in one of the independent variables causes a different change in price – depending on the initial price level.

A weighted least-squares (WLS) is being used, where the weights are based on turnover. The reason why the USA uses WLS is that "it seems reasonable to give importers with a large market portion a larger influence on the regression". A WLS is normally being used to reduce the problem of heteroscedasticity, and this is another argument used by the Swedes: Some of the smaller importers have reported "strange" price developments. By giving these units less weight the variance is reduced, and the t-values increase.

Results
The model is estimated using data for one month, which is also the chaining month. Hence, the regression contains 48 observations and four independent variables. A R^2 of more than 0.8 was obtained, and all the variables were significant. The implicit prices on the different technical characteristics are being used for the rest of the year to quality-adjust the prices in cases of product substitution.

Other kinds of indices
A comparison was made between the official hedonic index from December 1990 to December 1991 and two other indices – one based on direct comparison, and one based on link-to-show-no-price-change. All three showed a price decline, but the hedonic index gave the largest decline.

A model with dummies for the different importers was also tried, in order to correct for possible brand effects. Because of the small sample this was not done in the official index, but the tests gave higher t-values and an increased R^2.

Concluding remarks
The Swedes are satisfied with what they have done given scarce resources. They have also explained that the computer index is not extremely resource demanding, and that they have not encountered any major problems in collecting the necessary data.

Appendix H: Estimation results for washing machines

	All variables		Our specification	
	Coefficient	Standard Deviation	Coefficient	Standard Deviation
Constant	7.432	0.975	8.973	0.131
lnSpin speed	0.239	0.104	-	-
Capacity	0.069	0.018	0.068	0.016
Energy consumption	-0.319	0.142	-0.378	0.089
Remaining dampness	-2.431	0.417	-2.423	0.114
Water consumption	-0.002	0.001	-0.003	0.001
Program time	-0.001	0.001	-	-
Miele-dummy	0.362	0.020	0.360	0.019
Toploader-dummy	0.195	0.018	0.195	0.018
Energy efficiency	0.018	0.026	-	-
Drying efficiency	-0.062	0.024	-	-
Washing result	0.059	0.018	0.064	0.017
Timer mechanism	0.049	0.009	0.048	0.008
DJan	0.055	0.023	0.056	0.024
DFeb	0.046	0.023	0.048	0.023
DMar	0.038	0.023	0.040	0.023
DApr	0.034	0.023	0.036	0.023
DMay	0.024	0.023	0.025	0.023
DJune	0.021	0.023	0.022	0.023
DJuly	0.019	0.023	0.020	0.023
DAug	0.018	0.023	0.018	0.023
DSep	0.013	0.024	0.013	0.023
DOct	0.013	0.024	0.014	0.024
DNov	0.006	0.023	0.006	0.023
R^2 adjusted	0.848		0.846	
Standard error of regression	0.114		0.115	

See section 5.2.1 for an explanation of the variables.

Recent publications in the series Documents

2000/6 K.E. Rosendahl: Industrial Benefits and Costs of Greenhouse Gas Abatement Strategies: Applications of E3ME: Modelling external secondary benefits in the E3ME model

2000/7 G.A. Ellingsen, K.E. Rosendahl and A. Bruvoll: Industrial Benefits and Costs of Greenhouse Gas Abatement Strategies: Applications of E3ME: Inclusion of 6 greenhouse gases and other pollutants into the E3ME model

2000/8 R. Ragnarsøn and L. Solheim: Industry Statistics in Mozambique: Major Findings and Recommendations

2000/9 R. Johannessen: The Consumer Price Index of Mozambique: A Short Term Mission 13-31 March 2000

2000/10 B.K. Wold: Planned Co-operation with Instituto Nacional de Estatística (INE), Mozambique: Report from Short Term Identification Mission 27th March to 3rd April, 2000 Requested by NORAD/Oslo

2000/11 P. Boug: Modelling Energy Demand in Germany: A Cointegration Approach

2000/12 E. Engelien and P. Schøning: Land use statistics for urban settlements

2000/13 M. Rønsen: Impacts on Women's Work and Child Care Choices of Cash-for-Care Programs

2000/14 H.C. Bjørnland: VAR Models in Macro-economic Research

2000/15 T.L. Andersen: Short-term Statistics in Mozambique: A short-term mission 19 June - 6 July 2000

2000/16 J. Thori Lind: The Use of Household Welfare Functions to Estimate Equivalence Scales

2001/1 T. Bye, R Choudhury, M. Harlarson and P. Hardarson: The ISM model: A CGE model for the Icelandic Economy

2001/2 K.Ø. Sørensen, J.L. Hass, H. Sjølie, P. Tønjum and K. Erlandsen: Norwegian Economic and Environment Accounts (NOREEA) Phase 2

2001/3 G. Haakonsen, K. Rypdal, P. Schøning and S.E. Stave: Towards a National Indicator for Noise Exposure and Annoyance: Part I: Building a Model for Traffic Noise Emissions and Exposure

2001/4 T. Åvitsland: User Costs of Real Capital

2001/5 H.V. Sæbø: Strategic planning and management in Institutio Nacional de Estatística, Mozambique: Short Term Mission Report, November 2 - 9, 2000

2001/6 H.V. Sæbø, J. Byfuglien and R. Johannessen: Quality issues in Statistics Norway

2001/7 J. Byfuglien: Comparability of income data: Project report

2001/8 A.S. Abrahamsen,.M.Q. Andersen and R.Ragnarsøn: Project: Quality of Manufacturing Statistics and Evaluation of Methods for Producing Preliminary and Final Figures. Final Report

2001/9 T. Skoglund: Employment in the Norwegian National Accounts

2001/10 O.C. Moen: Nordic Economic Growth in Light of New TheoryL: Overoptimism about R&D and Human Capital?

2001/11 H.V. Sæbø: Strategic Planning and Management in Instituto Nacional de Estatistica, Mozambique: Short Term Mission Report, August 27 - September 6, 2001

2001/12 B. Hoem: Environmental Pressure Information System (EPIS) for the household sector in Norway

2001/13 H. Brunborg, I. Bowler, A.Y. Choudhury and M. Nasreen: Appraisal of the Birth and Death Registration Project in Bangladesh

2001/14 K. Rypdal: CO_2 Emission Estimates for Norway. Methodological Difficulties

2001/15 E. Røed Larsen: Bridging the Gap between Micro and Macro: Interdependence, Contagious Beliefs and Consumer Confidence

2001/16 L. Rogstad: GIS-projects in Statistics Norway 2000/2001

2002/1 B. Hoem, K. Erlandsen og T. Smith: Comparisions between two Calculation Methods: LCA using EPIS-data and Input-Output Analysis using Norway' s NAMEA-Air Data

2002/2 R. Bjørnstad: The Major Debates in Macroeconomic Thought - a Historical Outline

2002/3 J. L. Hass and T. Smith: Methodology Work for Environmental Protection Investment and Current Expenditures in the Manufacturing Industry. Final Report to Eurostat.

2002/4 R. Bjørnstad, Å. Cappelen, I. Holm and T. Skjerpen: Past and Future Changes in the Structure of Wages and Skills

2002/5 P. Boug, Å. Cappelen and A. Rygh Swensen: Expectations and Regime Robustness in Price Formation: Evidence from VAR Models and Recursive Methods