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Price index for new multi-dwellings

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Preface

This report documents the background, development and methodologies used in the price index for new multi-dwellings.

The project was granted financial contribution from Eurostat.

Statistisk sentralbyrå, 13. desember 2016

Per Morten Holt

Abstract

Within the frames of the project of establishing a price index for new multi-dwellings, a survey for the collection of data has was conducted. Data have been collected from 2011, with a "test" quarter in 2010. Based on the data material, we have constructed a price model that adjust for quality differences, for small houses (semi-detached houses, row houses etc.) and dwellings in blocks of flats. The model adjusts for area, ownership, price zones, garage, floor for flats and some important interactions. The results show that there has been an increase in the prices for new multi-dwellings of 27 per cent in the period from the 1st quarter of 2011 to the 4th quarter of 2015. In the initial phases data for detached houses were collected in order to explore the possibilities to include them in the survey, but it turned out that they were highly underrepresented in the data material. However, the already existing output price index for new detached houses has been used to obtain a separate index for detached houses. An outline of the methodology for the aggregated index for new dwellings is given.

Contents

1. Introduction

There is much interest and demand for housing statistics in general and housing price statistics in particular. Developments in house prices will be of interest to households, analysts and policymakers among others. Buying a house is often the most important transaction done by the households, and its largest asset. This makes house prices central elements in several analyses.

Statistics Norway already produces a wide variety of statistics for the housing area. There is however an aim to create an even more complete overview. A house price index for used dwellings has been published since 1991. As there can be different price evolutions for newly built and existing dwellings it will be desirable to compile a price index for new dwellings as well.

To obtain a more complete picture for developments in house prices, a project on developing a total price index for new dwellings has been undertaken. It will consist of two sub-indices; a price index for new detached houses, which Statistics Norway already calculates and which have been published since 1989 and a price index for new multi-dwellings. In this report the development and results for the price index for new multi-dwellings are documented. A brief summary of the price index for new detached houses and the approach for a total price index for new dwellings is given. Furthermore a short description of the aggregation for a total house price index is outlined.

Eurostat regulation 93/2013 establishes owner-occupied housing price indices (OOH) with a view to improve the relevance and comparability of harmonised indices of consumer prices (HICP). In order to compile owner-occupied housing indices, it is necessary to produce house price indices. House price indices are also important indicators in their own right.

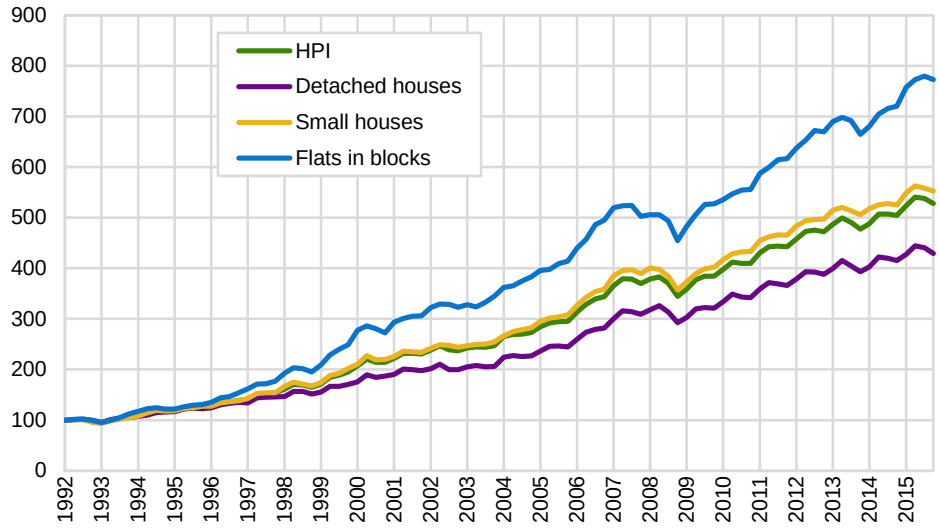
The project of developing an index for new dwellings was granted financial contribution by Eurostat.

2. Norwegian housing market

The Norwegian housing market is dominated by owner-occupiers. According to the Population and Housing Census 2011, 77 per cent of occupied dwellings are owner-occupied or in co-operative ownership, while 23 per cent are rented.

Looking at the Norwegian house price index for existing dwellings, we see that the housing prices for second hand dwellings in Norway have increased tremendously since the early nineties. Norway faced a recession corresponding with a major decrease in housing prices from 1988 to 1993, but from then on there has been a strong growth. From 1992 to 2015 the housing prices has increased by approximately 440 per cent. We can see in figure 2.1 that the index declined in 2008, simultaneously with the international financial crisis, but that the prices have had a steady rise since then.

Figure 2.1 House price index for existing dwellings, 1992-2015. 1992=100

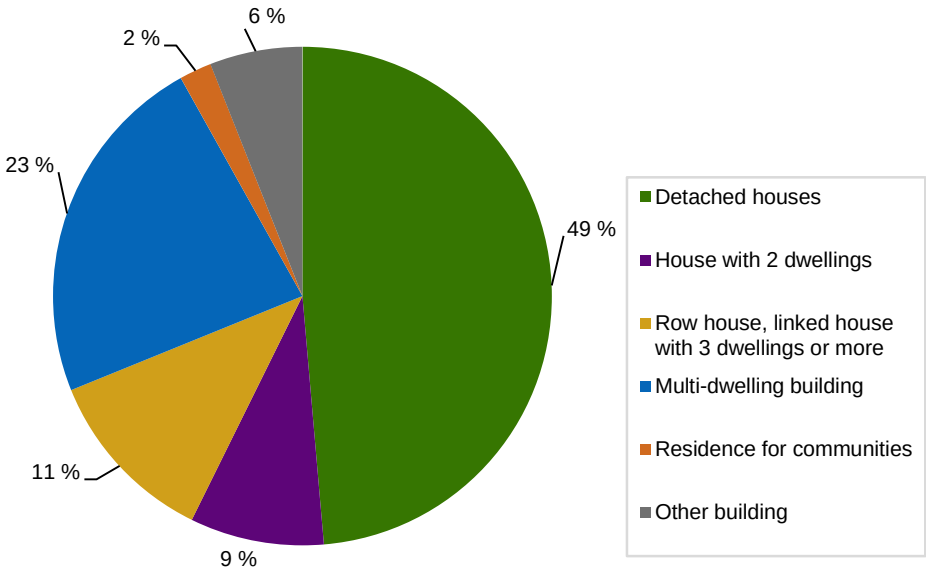


Source: Statistics Norway.

Over the last 20 years flats in blocks have had the strongest increase, with approximately 670 per cent. In comparison, small houses and detached houses have increased with approximately 460 per cent and 340 per cent respectively.

According to Statistics Norway's Building stock statistics, there are 2.48 million dwellings in Norway. About 50 per cent, 1.2 million are detached houses (figure 2.2). Small houses, e.g. semi-detached houses, row houses, linked houses and houses with 3 or 4 dwellings, accounts for 21 per cent of the dwelling stock, while flats in multi-dwelling buildings have a share of 23 per cent.

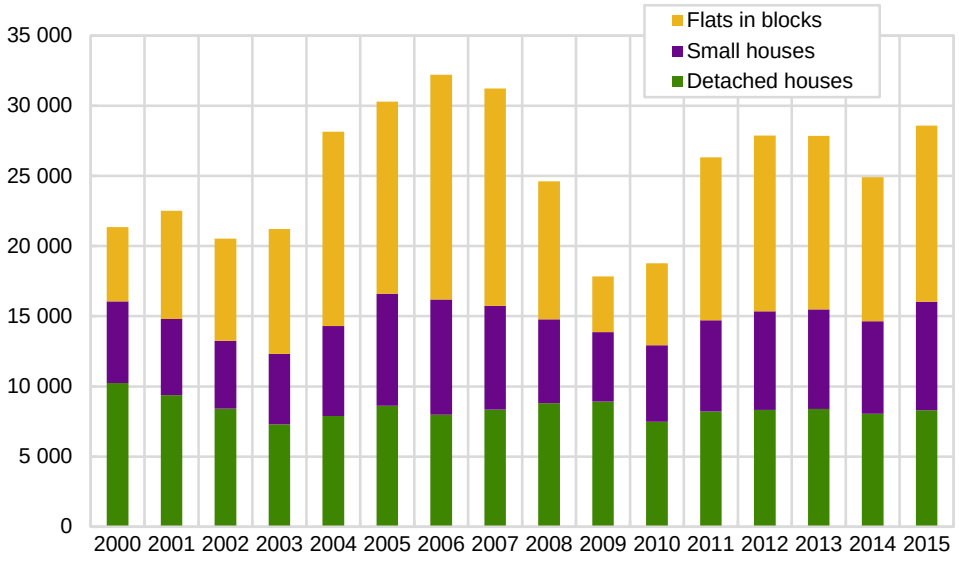
Figure 2.2 Dwelling stock in Norway. 1. January 2016



Source: Statistics Norway.

When it comes to new dwellings, the statistics show that there were approximately 28 500 building permits in Norway in 2015. Detached houses accounted for 27 per cent, while small houses, flats and others accounted for 25, 40 and 9 per cent respectively. Figure 2.3 illustrates how the building permits have developed during the last fifteen years. The building activity escalated in 2004. The increase was especially noticeable in the blocks of flats market. In the period 2004-2007 an annual average of 30 000 new dwellings were started, and nearly 50 per cent of these were in blocks of flats. In 2008 and furthermore in 2009 a decreasing trend followed, and the building activity within the block-segment dropped considerably. In 2010 the construction of blocks increased with a further increase in 2011. There has been a quite stable building activity from 2011 to 2015, and the distribution between detached houses, small houses and blocks of flats has also been quite the same, although there was a decrease in 2014, especially in the block market.

Figure 2.3 Number of new dwelling permits in Norway, 2000-2015



Source: Statistics Norway.

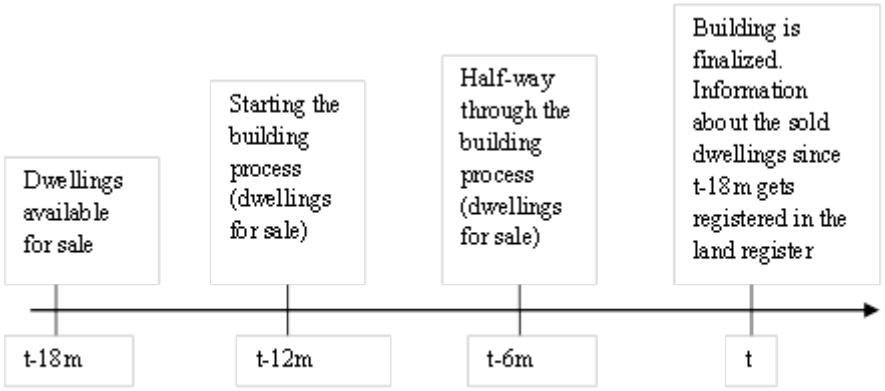
3. Data Sources

3.1. Direct vs indirect data collection

Collection of data has been a challenge in this project. First a decision whether to use administrative or direct data sources had to be made.

A main reason for choosing direct sources is the time lag in registers. As illustrated in figure 3.1, the transaction of a new dwelling can take place 18 months before the dwelling is registered in the land register. In addition the registers lack some central information needed for quality adjustments in calculations of indices.

Figure 3.1 Process of building and selling a dwelling



Source: Statistics Norway.

Statistics Norway undertook a preparatory study in the first phases of the project of the development of the index. The goal of this preparatory study was to clarify what reporting possibilities the companies had and what variables they could deliver. The preparatory study also increased our knowledge about the construction industry in general and gave us useful input for the sampling process.

In the initial phase of the project we attended a market forum hosted by the trade organisation. At this forum we were given the opportunity to present our project for the largest house producers in the country. We were given the impression that, with minor preparation, it would be possible for the companies to extract the information needed from their own accounting- and sales system. It was decided that we would maintain the cooperation with trade organisation, concerning exchanging information and experiences.

For price information of new dwellings it was then decided to collect information directly from the contractors.

3.2. Population

The aim of the survey is to collect information about the prices for new dwellings in Norway, d.e. the price the consumer pay for a new dwelling. The unit of the survey is therefore the sale of new dwellings, and the population can be defined as all sales of new dwellings in a limited time period. We don't know the exact population of sales of new dwellings in Norway. Number of building permits, from the construction statistics gives an indication of how many there can be. Still – not all dwellings are sold in the specific time period.

We chose to use the sellers as the main data source. It is difficult to define the exact population of enterprises that sell new dwellings. The enterprises belong to

different NACE codes; property developers, contractors or even finance institutions. Furthermore, several enterprises may cooperate in the development of the same residential area.

The most obvious industries to find the sellers of new dwellings are in following NACE codes:
41.10 Development of building projects
    41.101 House building cooperative
    41.109 Other development and sale of real estate
41.20 Construction of residential and non-residential buildings

When looking at the companies with the highest turnover in NACE 41.109, we see that the industry is quite complex. In addition to the largest contractors, it also consists of residential development projects of a more temporary character, established for the development of a specific area. Often these projects involve several enterprises cooperating. The projects with the highest turnover in this NACE group are normally completed or sold out at the time of the data collection and therefore irrelevant as a source for the survey.

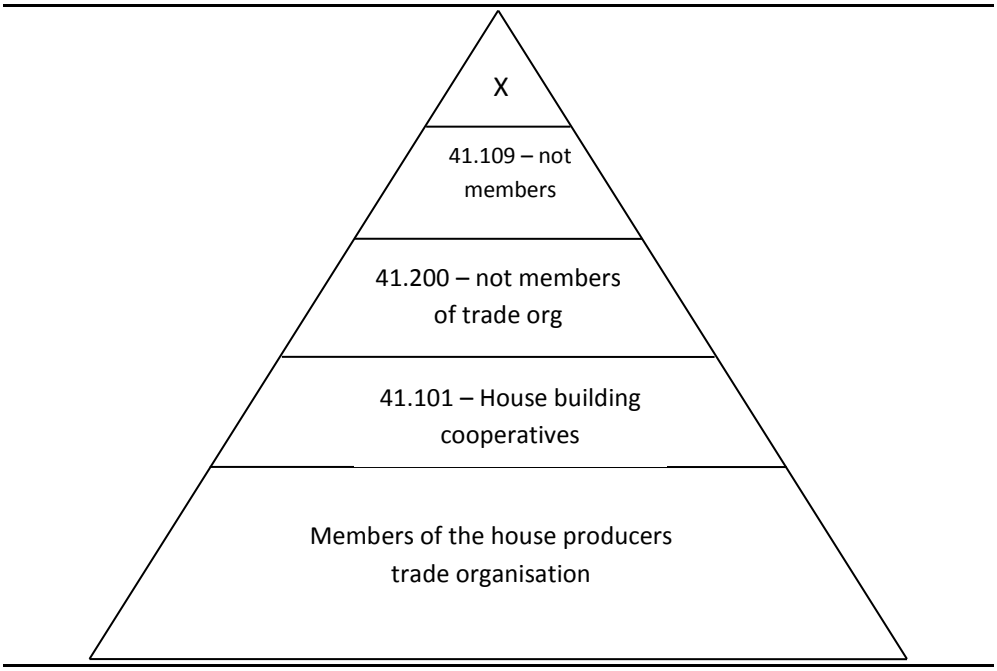
NACE 41.101, consist of the housing cooperatives that develop and sell new dwellings. Some of the large housing projects in Norway are run by regional or national housing cooperatives. In some cases they cooperate with the large contractors, which are covered in NACE 41.109, in other cases they use smaller subcontractors. Due to the latter cases, it is crucial to include the largest housing cooperatives among the respondents of the survey.

NACE 41.20 Construction of residential and non-residential buildings consists mainly of construction enterprises. It is difficult to identify the ones that are involved in the sales process as well.

The considerations above lead to a more pragmatic approach for defining the population of enterprises for the survey. Most of the large house builder companies in Norway are members of a trade organisation called Boligprodusentenes forening (BF). The organisation represents 75 per cent of the contractors in Norway, and among its members we find many of the large enterprises in NACE 41.109 and the contractors behind the project related enterprises.

Most of the members of BF have NACE code 41.109 and 41.200. Others are coded 71.112 Architectural design services for buildings, 71.121 Civil engineering activities and 16.231 Manufacture of wooden prefabricated buildings. This strengthens the conclusion that it is difficult to define the data sources strictly based on the industrial classification. A better starting point is the members of BF, with some additions from NACE 41.101 House building cooperative and the ones that are not members of the trade organisation in 41.109 and 41.200 (figure 3.2).

Figure 3.2 The population of enterprises selling new dwellings



Source: Statistics Norway.

3.3. Sample

As illustrated in figure 3.2 the potential respondents can be divided into different layers. The majority is found in the bottom layer while additions are represented by the other layers in the triangle. During the preparatory study it was revealed that it might be difficult for the small actors to deliver data according to the specifications. Several of the enterprises are organised in chains where the central chain offices don't have the information we acquire, and the enterprises are too small to deliver these data. In addition, the enterprises with few sales of new dwellings will have minor effect on the index. The sampling will therefore follow a cut-off principle, where the idea is to spare the small actors. However, it is important to ensure a sufficient geographical coverage of the sample.

The cut-off level differs among the different layers as seen in table 3.1. The criteria used at the different layers are chosen in cooperation with the trade organisation.

Table 3.1 Sample criteria

Population layers	Sample criterion
Members of the trade organisation (BF)	Estimated annual sale of more than 100 dwellings
Enterprises in NACE 41.101 that are selling new dwellings	The 15 largest coops (more than 30 mill NOK in turnover)
Enterprises in NACE 41.109 that are selling new dwellings and not covered by BF	Active enterprises with more than 100 mill NOK in turnover
Enterprises in NACE 41.200 selling new dwellings and not covered by BF	Enterprises with more than 450 mill NOK in turnover

Source: Statistics Norway.

According to this plan, the total sample consisted of 51 enterprises by set off. It should theoretically give a good coverage when it comes to type of dwellings and the geographical spread. Some of the initial enterprises have been deleted from the sample. This is because they are not involved in the sale of the dwellings or because they only sell detached houses. Some enterprises have been replaced with others that can provide the data we ask for. Some new enterprises have been included in the sample over time. For the 4th quarter of 2015, 49 enterprises provided data. We are planning to have an annual update of the sample, to ensure that we have a representative sample over time.

3.4. Data collection

The data is collected by electronic reporting. This is done in accordance with wishes from the industry itself. The public authorities in Norway offers a common web portal for public reporting, called Altinn[1]. In Altinn we use an enclosure solution. This means that respondents will get a username and a password for logging in to Altinn. When they are logged in, they upload a new file for the actual quarter. After uploading the file, they can press send – and the file will enter our database system. This is a very safe method for data transmission, with regards to sensitivity and confidentiality of data.

In order to treat the data files in an efficient and good way the variables and their values should follow a determined order. The respondents get information about the set-up of the files, the definitions of the variables and what should be included in the values, from the internet: http://www.ssb.no/a/innrapportering/bolig/.

They are asked to report, for each dwelling sold in the relevant quarter, the following data;

- the transaction price
- common debt if a housing cooperative
- dwelling type
- land number (cadastre id)
- municipality
- utility floor space
- ownership
- number of floors in the building – for flats in blocks
- in which floor the dwelling is situated – for flats in blocks
- if a garage is included in the price
- the name of the project

There are no physical restrictions when it comes to the format of the files. However, the respondents are asked to report the data on an Excel file-format. There is a pre-defined spreadsheet with descriptions available, but the respondents can in principle deliver in any format they want. This has caused a quite time-consuming preparation of data, with special treatment of each file. As much as possible of the data processing is done automatically in SAS EG. We are working to further simplify the data preparations.

3.5. Supplementary data collection

In addition to the above mentioned data collection, we have the possibility to supply the data set with data from the data source we use in the House price index for existing dwellings. These data are provided by the Association of real estate agencies. The dwellings in their data base are mainly used, but in some cases they are new. The dwelling is defined as new if it is built the same year that it is sold. In order to avoid duplicates, only observations in municipalities with no observations in the sample are used. The share of the total observations that come from the real estate business is up to approximately 5 per cent.

3.6. Sampling errors

As the definition of the population and the construction of a sample have proven difficult, it may lead to some sample skewness. There is a possibility the dwellings included in the index are not necessarily representative for all new multi-dwellings.

[1] More than 400 forms and services from Norwegian government agencies are currently available through Altinn.

In our data there are a relatively small number of observations for small houses. The coverage as compared to the building statistics is quite low, approximately 15 per cent per year. The low number of observations for small houses may not be representative for the total of new small houses that are sold. For flats in blocks the number of observations is higher, the coverage varies between 25 and 50 per cent per year. There is a quite large variation, so even for flats in blocks the sample may not be representative.

4. The hedonic method

4.1. Introduction

A number of different methods can be used in the calculation of a price index. In order to comply with the OOH-regulation, we follow the framework given by the manual on owner-occupied housing price indices (EU 2013). The manual gives an overview of index approaches, whereas the "Handbook on Residential Property Prices Indices (RPPIs) (EU 2013) gives a more detailed description of the methods.

A strategy of adjusting for quality factors by using hedonic regression methods seems like a reasonable approach when compiling a price index for new multi-dwelling. The hedonic regression method recognizes the fact that heterogeneous goods, such as dwellings, can be described by their characteristics. We have also aimed to coordinate model selection for the price index for new multi-dwellings with the price index for new detached houses.

4.2. Theoretical background

Statistics Norway uses the hedonic method in the compilation of several indices within the housing and construction sector, among them the house price index. The method is based on prices set by the market and regression analysis, which describe the relationship between the price of an object (dwelling, house, etc.) and the quality (or price-determining) characteristics of the object. This relationship is often represented by a multiple linear regression with the price as the dependent variable and relevant quality characteristics as the explanatory variables.

A theoretical basis for the study of product markets with differentiated products is presented by Rosen (1974). With Rosen's model as a starting-point, it can be argued that the market price of an object can be described as a function of the associated characteristics. A hedonic price function allows one to quantify how the price is expected to change as characteristics vary. This is sometimes referred to as quality adjustment. However, the word quality here should not be interpreted according to its everyday usage, as some kind of a benefit-cost trade-off. The idea is simply to find a means to avoid comparing the prices of different objects directly, since e.g. each house is sold only once as a new house.

Having constructed a hedonic price function, it is possible to calculate an implicit (or expected or theoretical) price of an object that is specified in terms of the relevant characteristics, whether it is real or imaginary. This makes it possible to construct price indices for the relevant objects in various ways. Two important questions arise when it comes to the hedonic price function: which characteristics should be included, and which form of function should be chosen.

There are no clearly defined theories that can be employed in the choice of characteristics to be assigned. On the basis of empirical research carried out elsewhere, however, it seems reasonable to divide these into three groups. Firstly the characteristics which can be linked to the house itself, such as living area, age, number of bathrooms, etc. The two other relevant factors are the physical and

social surroundings, although Griliches (1971) warns against the use of such characteristics as being not so much a characteristic of the building as of the market. In empirical studies, however, such factors do have a significant influence on the price. In order to be able to compare prices of comparable houses, it may be argued that, insofar as different physical and social environment affects the prices of two otherwise identical houses, adjustment for the relevant factors may be necessary.

Choosing the form of function is also an empirical question. Wigren (1986) assumes that the connection between the prices of house *i* during a period of time *t*, p_i^t, and the house's qualitative characteristics can be expressed stochastically as

$$p_i^t = f(x_{i1}^t, ...x_{ik}^t, \varepsilon_i^t) \qquad i = 1, ..., \mathrm{n} \tag{4.1}$$

Where p_i^t is the price of object *i* in period *t*, x_{ik}^t are the explanatory variables $(\mathrm{k} = 1, ..., \mathrm{K})$ for object *i* in period *t*, ε_i^t is the random error term and *n* is the number of objects.

Rosen and Wigren are both of the opinion that the price equation is multiplicative. It should furthermore have second order derivatives. By choosing a specific equation form one is able to estimate the partial derivatives, i.e. the hedonic prices. Empirical studies in Sweden and the United States show that a logarithmical form of the price equation gives the best fit in a multiple regressions. The regression analysis determines the significance of the variables and estimates their coefficients.

4.3. Hedonic function and regression model

The index for new multi-dwellings will be calculated by using a hedonic model. We use the transaction price as the dependent variable. We choose a log-linear function form in the regression analysis. There are two types of explanatory variables, numeric variables and classification variables.

The hedonic function can be written as follows:

$$\ln \mathrm{p}_i^t = \beta_0^t + \beta_1^t x_{i1}^t + \beta_2^t x_{i2}^t + ... + \beta_k^t x_{ik}^t + \varepsilon_i^t \tag{4.2}$$

Where $\ln p_i^t$ is the natural logarithm of the dwelling price for dwelling i in period and x_{ik}^t are the independent variables for dwelling *i* in period *t*. The regression coefficients $\beta_1^t \ldots . \beta_k^t$ can be expressed as the theoretical price of the respective characteristics. The coefficient β_0, is the baseline value per dwelling, irrespective of changes in the characteristics. The regression error ε_i^t is a stochastic variable with expectation zero.

Alternatively, the function can be written as follows:

$$p_i^t = \exp(\beta_0^t) \exp\left(\beta_1^t x_{i1}^t\right) \ldots . \exp\left(\beta_k^t x_{ik}^t\right) \exp(\varepsilon_i^t) \tag{4.3}$$

Where p_i^t is the price of the dwelling, $x_{i1}^t ....x_{ik}^t$ are the explanatory variables, and $\beta_1^t \ldots . \beta_k^t$ are the price coefficients.

In our model for multi-dwellings the variable of floor space will be transformed by using the natural logarithm of floor space and 4.3 can be written as

(4.4) $$p_i^t = \exp(\beta_0^t)\,(x_{i1}^t)^{\beta_1^t}\exp\left(\beta_2^t x_{i2}^t\right) \ldots . \exp\left(\beta_k^t x_{ik}^t\right)\exp(\varepsilon_i^t)$$

where x_{i1}^t is the floor space variable and β_1^t is it's price coefficient.

5. Index calculation

5.1. Index formula

The price-index is defined as a relation between the price of two dwellings equal in characteristics in period t and the base period 0 respectively. If both dwellings have a vector of quality attributes equal to x_1 ... x_k the theoretical price index can be written as (Lillegård, 1994):

(5.1) $$I_{0,t} = \frac{\exp(\beta_0^t)\exp(\beta_1^t x_1)\ldots\exp(\beta_k^t x_k)}{\exp(\beta_0^0)\exp(\beta_1^0 x_1)\ldots\exp(\beta_k^0 x_k)}$$

In the index formula the error terms are absent. The expression is said to be theoretical because the coefficients are unknown in reality and need to be estimated. This means that we cannot observe directly the relation between anticipated prices. One may choose the values of x_1 ... x_k to stand for a kind of representative house. For instance, these may be the median or mean values of all the observed objects. Notice that, on the one hand, the median of the observed prices is usually smaller than the mean when it comes to house prices, on the other hand, the theoretical price of a house with median (or mean) characteristics will be different form the median (or mean) of the observed prices. However, as long as the price variation is the same for both time points, which is not an unreasonable assumption, the relation between the medians will be equal to the relation between the mean prices (Goldberger, 1968). If we furthermore assume that the price coefficients are constant for a short period of time, we can reduce the price index to a simplified form:

(5.2) $$I_{0,t} = \frac{\exp(\beta_0^t)}{\exp(\beta_0^0)}$$

Then we are left with the constants, which includes the time dummies. Constants are easy to estimate in a linear regression. If we take the mean value on both sides of the equal sign in equation (4.2) and then transpose, the constants can be written as follows:

(5.3) $$\beta_0 = \overline{lnp} - \beta_1\overline{lnx_1} - \sum_{i=2}^{k}\beta_i\,\overline{x_i}$$

Then the constants are estimated in both the period t and the base period, and we will obtain the following calculated price index, which involves the regression errors:

(5.4) $$\hat{P}_{0,t} = \frac{\exp(\overline{ln\,p^t} - b_1\overline{lnx_1^t} - \sum_{i=2}^{k} b_i^t\overline{x_i^t})}{\exp(\overline{lnp^0} - b_1\overline{lnx_1^0} - \sum_{i=2}^{k} b_i^0\overline{x_i^0})}$$

where

$\overline{\ln p^0}$, $\overline{\ln p^t}$ are the mean values of the natural logarithm of the house price in the base period and in the period *t*.

b_1 is the price coefficient for the natural logarithm of the useful floor space.

b_{ik} is the price coefficients for the other explanatory variables *k*.

$\overline{x_1^0}, \overline{x_k^0}$ $\overline{x_1^t}, \overline{x_k^t}$ are the mean values of useful floor space and the other explanatory variables *k* in base period and in period t respectively.

5.2. Annual chained index

The price index for multi-dwellings is calculated as an annually chained index. The change in base period is calculated once a year with the previous year as the new base period. Observations from the last two years are used in the regression analysis and are thought to give enough observations to ensure stability in the estimates of the price coefficients. The price coefficients are held constant over a year. The formula for the chained index for the period t, denoted by $P_{chained}^t$, is given by:

(5.5) $$P_{chained}^t = P_{chained}^s P^{s,t}$$

Where *t* is the current period, *s* the basis price period which is updated once a year, and $P^{s,t}$ is the index from *s* to *t* calculated as described above.

6. Terms, variables and classifications

In the following an overview of important terms and classifications used in the index is given.

6.1. Dwelling identification

In the initial phase it was decided to try to avoid getting duplicates in our data material. Therefore it was mandatory with some kind of unit identification which separates the dwellings from each other. When contractors plan to build a new dwelling, they have to apply the state/municipality for a building permission. When this permission is consented, the dwelling will be given a land number and holding number which is unique for that specific building. If there are several dwellings in the building, each dwelling will be given a residential number. However, in the early stages of the building process, these identification numbers are not always assigned. Sometimes the entrepreneurs use a temporary ID-number to distinguish between the dwellings. This complicated the process of removing duplicates. It also made it difficult to merge the data set with other data sets, for instance the Cadastre, in order to include additional information about the dwellings.

6.2. Price

Indices shall be based on actual final transaction prices that are paid by the households for the purposes of purchasing a dwelling for their own use or occupation according to the owner occupied house indices. Accordingly this means that the VAT and other taxes have to be included in the price concept. For

dwellings in housing co-operatives[2] the deposit and joint debt are both included in the sales price. This method is in line with the suggestions made in the paper: "The treatment of housing co-operatives in the HPI/OOHPI" (Coordination team).

The land price is included in the price concept.

6.3. Land value

Very few of the companies that participated in the preparatory study reported that they were capable of separating the land value from the transaction price. In their systems this kind of information was not available. Thus, the dwelling prices are inclusive land costs.

6.4. Dwelling types

In this survey we distinguish between two main dwelling types. These are small houses and flats in blocks. The residential building types which are included in the two types of dwellings are listed below:

- Small houses: Semi-detached houses, row houses, linked houses (including atrium houses), terraced houses and houses with 3 or 4 dwelling units.
- Flats in blocks: flats in multi-dwelling buildings with 2 floors and more and with not less than 5 dwelling units and linked multi-dwelling buildings.

As mentioned in the introduction, detached houses are treated separately in this project.

6.5. Dwelling size – floor space

Floor space is an important quality characteristic in dwellings that highly correlate with the respective sales price. In the Norwegian housing market it is common, among different parts of the industry, to use *utility floor space* and *useful floor space* as measures. In our land register only utility floor space is available. Utility floor space covers area measured within the outer walls, including all type of rooms, storage rooms as well. Thereby utility floor space is chosen to use in this index, whereas the house price index for existing dwellings use useful floor space, in accordance with the practice in the real estate industry.

6.6. Price zones

In proportion to population, Norway is a country with relatively large area. This indicates that trends in house prices tend to vary from one region in Norway to another. The prices in the capital area (Oslo) will obviously be more sensitive to market trends, than the house prices in more rural parts of Norway. To adjust for these variations the country has been divided into several price zones. These price zones are based on average price per square metre and a priori knowledge about regional differences. The number of observations also played an important role in this classification.

After testing several classifications we ended up with the following price zones:

- Oslo and Bærum (neighbouring municipality to Oslo)
- Most central municipalities in Akershus (excluding Bærum), (Ski, Frogn, Nesodden, Oppegård, Asker, Rælingen, Lørenskog, Skedsmo, Nittedal, Ullensaker)

[2] A housing cooperative is forms of ownership in which a non-profit corporation owns the entire apartment building or development and residents own shares in the corporation that correspond to their apartment and a percentage of common areas.

- The largest cities (excluding Oslo) and their neighbouring municipalities (Bergen including Os, Trondheim including Melhus, Stavanger including Sandnes, Sola, Randaberg, and Tromsø)
- The rest of Norway

6.7. Ownership

Ownership is divided into two categories; freeholders and those parts of housing co-operatives. Housing co-operative is forms of ownership in which a non-profit corporation owns residential buildings and residents own shares in the corporation that correspond to their dwelling and a percentage of common areas. According to the Norwegian population and housing census from 2011 about 18 per cent of the owned dwelling stock in Norway is housing cooperatives. For blocks of flats the share of co-operatives is approximately 60 per cent, which is a decrease from 2001 of about ten per cent.

6.8. Garage

Whether a garage is included in the sales price for the dwelling or not is reported. It is supposed that when a garage is included in the price the total price tend to increase.

6.9. Floor

The number of floors in the building is asked to be reported for flats in blocks along with the floor the flat is situated on. The flats on the top floor and higher floors are expected to be more expensive than those situated on the ground floor level.

7. Results

7.1. Data description

Sales prices for small houses and flats in multi-dwellings have been collected since the fourth quarter of 2010. The first quarter has been considered to be a trial quarter, so these data are not included in the further calculations.

Table 7.1 describes number of observations per year and quarter and the distribution of dwelling types. The number of dwellings in our material varies between 688 (4th quarter of 2013) at its lowest and 1778 (1st quarter of 2015) at its highest. As can be seen in the table, there is a heavy overweight of flats in the material. The share of flats varies between 71.2 and 87.5 per cent. In comparison, the distribution of multi-dwellings from the building statistics is 37.5 per cent for small houses and 62.5 per cent for flats respectively. The distribution from the building statistics is calculated as the mean of building permits and buildings completed from 2015.

The total coverage in our material, calculated as the observations in the survey divided by the mean of building permits and buildings completed as in the building statistics, is between 12.4 per cent at the lowest and 45.2 at its highest. For flats in blocks the coverage varies between 13.7 and 65.6 per cent whereas for small houses it varies between 9.9 and 23.8 per cent.

Table 7.1 Number of observations per quarter and year

Year	Quarter	Number of observations	Coverage %	Flats in blocks	Coverage %	Small houses	Coverage %
	1	1 575	39.4	1 273	51.8	302	19.6
	2	1 458	45.2	1 199	65.6	259	18.6
2011	3	951	31.8	771	47.2	180	13.2
	4	1 317	30.2	1 126	41.5	191	11.6
	2011	5 301	36.4	4 369	50.6	932	15.7
	1	1 400	40.1	1 161	55.4	239	17.1
	2	1 574	35.4	1 307	45.4	267	17.1
2012	3	1 419	27.8	1 168	33.7	251	15.2
	4	1 266	24.6	1 037	33.6	229	11.1
	2012	5 659	31.1	4 673	40.5	986	14.8
	1	1 403	29.3	1 044	31.8	359	23.8
	2	1 085	26.6	788	33.7	297	17.0
2013	3	893	21.6	704	28.6	189	11.4
	4	688	12.4	503	13.7	184	9.9
	2013	4 069	21.9	3 039	25.7	1 029	15.2
	1	887	22.7	621	25.4	266	18.3
	2	1 115	23.9	848	28.9	267	15.3
2014	3	1 303	34.0	997	42.4	306	20.7
	4	1 167	23.8	947	30.3	220	12.4
	2014	4 472	25.8	3 413	31.3	1 059	16.4
	1	1 778	43.9	1 486	60.8	292	18.1
	2	1 710	32.7	1 410	40.2	300	17.4
2015	3	1 383	34.2	1 086	44.5	297	18.6
	4	1 666	30.4	1 459	43.4	207	9.8
	2015	6 537	34.9	5 441	46.5	1 096	15.6

Source: Statistics Norway.

Sales prices and area

The mean total-prices for new multi-dwellings tend to have increased during the period from 2011 to 2015. As can be seen in table 7.2 the price per square meter for flats in blocks has increased from a mean price of 42 999 in 2011 to 55 476 in 2015. The development in prices for small houses is somewhat more unstable, which may be due to the relatively small number of observations we have in our material.

Table 7.2 Mean total-price, price per square metre and area per quarter and house type

		Flats			Small Houses		
		Mean			Mean		
Year	Quarter	Total price	Price per square meter	Area	Total price	Price per square meter	Area
2011	1	3 046 691	42 074	73	3 249 435	28 455	113
	2	3 102 224	41 995	74	3 220 903	29 663	109
	3	3 032 564	41 936	73	3 119 635	29 651	105
	4	3 275 855	45 840	72	3 718 773	31 452	118
	2011	3 118 499	42 999	73	3 312 621	29 636	112
2012	1	3 257 116	45 838	72	3 295 908	30 439	110
	2	3 601 403	47 636	75	3 324 554	30 301	110
	3	3 367 891	46 615	72	3 538 641	32 178	112
	4	3 623 154	49 334	73	3 697 110	31 184	122
	2012	3 462 327	47 311	73	3 458 636	31 017	113
2013	1	3 726 143	51 257	73	3 331 979	30 828	110
	2	3 573 190	48 744	74	3 471 258	31 751	110
	3	3 695 848	50 307	74	3 326 413	32 040	105
	4	3 553 649	47 492	75	3 311 871	30 228	113
	2013	3 650 908	49 761	74	3 367 561	31 210	110
2014	1	3 550 302	47 972	74	3 347 040	28 076	121
	2	3 671 608	51 096	72	3 471 258	30 361	109
	3	3 679 405	51 343	72	3 324 750	31 306	106
	4	3 763 061	53 515	70	3 346 278	34 550	114
	2014	3 677 277	51 273	72	3 322 333	30 952	112
2015	1	3 806 566	54 057	71	3 467 724	31 847	108
	2	4 004 933	55 241	72	3 061 770	30 059	103
	3	3 941 065	56 788	69	3 103 904	30 826	103
	4	3 808 737	56 172	68	3 219 388	30 233	110
	2015	3 885 443	55 476	70	3 211 113	30 779	106

Source: Statistics Norway.

Price zones

There is a clear overweight of observations of flats in Oslo and Bærum in our material as described in table 7.3. Blocks will typically mostly be built in the more central areas of the country. For small houses “the rest of Norway” contains most observations. Small houses are built in more rural areas.

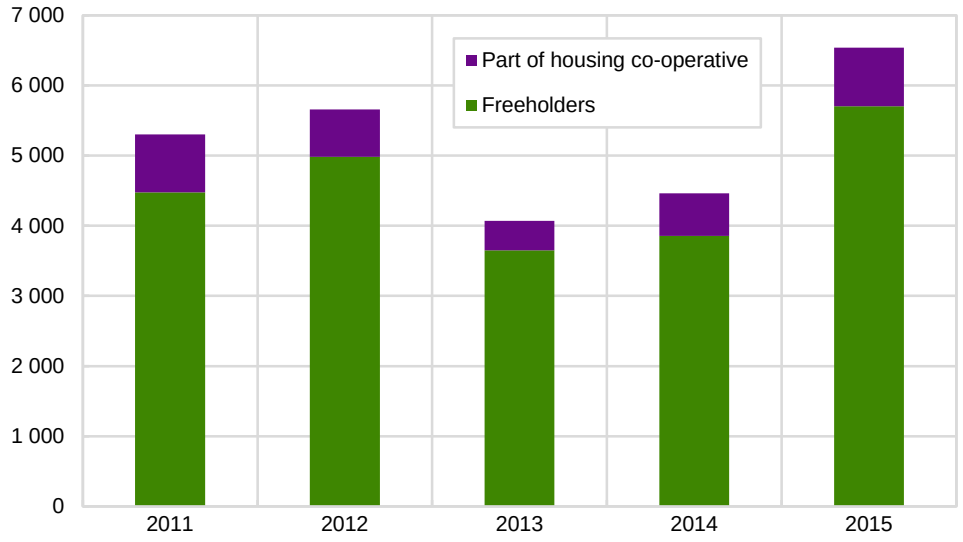
Table 7.3 Number of observations in price zones per year, by house type

	Flats				Small houses			
Year	Oslo and Bærum	Cities and surroundings	Central eastern Norway	The rest of Norway	Oslo and Bærum	Cities and surroundings	Central eastern Norway	The rest of Norway
2011	2 314	723	435	897	132	209	111	480
2012	2 314	1 101	527	731	92	275	104	515
2013	1 097	828	484	631	56	246	87	640
2014	1 178	1 061	505	668	75	229	90	657
2015	2 391	1 099	984	967	71	166	84	775

Ownership

Most of the observations are freeholders as seen in figure 7.1. For flats in blocks the share of freeholders varies between 82 and 87 per cent per year. For small houses the share of freeholders varies between 91 and 95 per cent per year.

Figure 7.1 Ownership per year

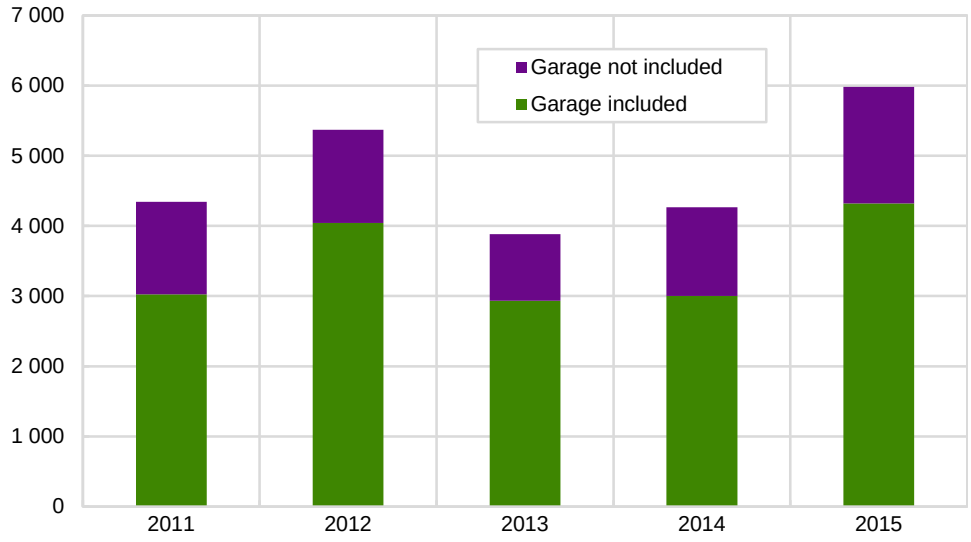


Source: Statistics Norway.

Garage

Most of the dwellings in our material include a garage in the price, between 70-75 per cent approximately.

Figure 7.2 Garage included in the price



Source: Statistics Norway.

Floor

The variables concerning the floor of the flats in blocks, has proven difficult to use. The idea was that the top dwelling/pent house of the block is especially expensive and should be used as an independent variable in the regression. Likewise, the ground floor flats tend to be less expensive. In order to identify the top flats, two variables must be reported; how many floors there are in the building, and the floor of the specific flat. Some of the top apartments contain two floors, and if the entrance is in the lower one, it will not be identified. The flats situated on the ground floor are easier to identify. So far we have used a simple categorization with the ground floor as one category, and all others in another. Approximately 20 per cent of the flats are on ground floor level.

7.2. Model testing

We have used standard model building strategies and diagnostics for linear regression in model decision.

As the price developments for flats in blocks and small houses tend to be somewhat different, separate models for the two dwelling types were tested out initially. However, the index for small houses showed some instability. This may be due to the relatively small data material for small houses. Furthermore when weighted together to a total index the index for small houses tended to get too much weight in the totals.

One model for both house types was then selected, with house type as a variable in the model together with relevant interactions for house type.

A model using total price as dependent variable was tested, and due to patterns in the variance a logarithmic transformation was carried out.

Using the square meter price as a dependent variable was also tested, but it was concluded that total price gave a better model.

7.3. Regression results

The linear regression analyses for developing a model for a price index for multi-dwellings, are based on data from 1st quarter of 2011 to 4th quarter 2015. The dwellings are divided into two categories; small houses and flats in blocks. A total regression model is fitted for the two categories, as the number of observations of small houses is relatively small, and initial model testing concluded that one model was preferable.

Data are undertaken revision.

The following variables are used in the final regression model:

Numeric variables:

- The natural logarithm of utility floor space

Classification variables:

- Dwelling type
- Price zone
- Garage
- Owner type (freeholder or cooperatives)
- Year of price measurement

In addition important interactions for dwelling type and other characteristics are entered into the model.

The numeric independent variable floor space is transformed into a logarithmic scale in the regression model. Observations from a period of five years are used in the regression analysis when obtaining a final model for the hedonic price function. The price coefficients are assumed to be constant for that period of time. In order to achieve the best possible estimate for the coefficients, the regression equations contain yearly classification variables. This prevents price changes due to the passing of time being explained by attributes of the house. The coefficients for the time variables are not used in the calculation of the index. In the further calculations of the index a period of two years will be used in the regression analysis.

Table 7.4 Regression model with the logarithm of the total price as dependent variable

Variable	Parameter estimate	Standard error	t-value	P-value
Intercept	10.50476	0.01972	532.68	<.0001
Ln utility floor space	0.95046	0.00460	206.44	<.0001
Dwelling type - small house	1.16747	0.04845	24.10	<.0001
Ownership - Part of housing co-operative	-0.03620	0.00379	-9.56	<.0001
Price zone - Oslo/Bærum	0.35047	0.00390	89.90	<.0001
Price zone - Cities	0.23531	0.00439	53.62	<.0001
Price zone - central eastern Norway	0.15195	0.00499	30.45	<.0001
Garage - Yes	0.03810	0.00323	11.78	<.0001
Floor flat - >1	0.10859	0.00352	30.83	<.0001
Year 2012	0.08707	0.00424	20.52	<.0001
Year 2013	0.16794	0.00478	35.13	<.0001
Year 2014	0.20244	0.00462	43.78	<.0001
Year 2015	0.26104	0.00410	63.71	<.0001
Ln utility floor space * small house	-0.30913	0.01061	-29.13	<.0001
Price zone - Oslo/Bærum * small house	0.12377	0.01154	10.72	<.0001
Price zone - Cities * small house	0.10357	0.00843	12.29	<.0001
Price zone - Central eastern Norway * smaahus	0.11854	0.01131	10.48	<.0001
Garage - Yes * small house	0.15468	0.00685	22.57	<.0001
Year 2012 * small house	-0.07980	0.01022	-7.81	<.0001
Year 2013 * small house	-0.12794	0.01039	-12.31	<.0001
Year 2014 * small house	-0.20413	0.01025	-19.91	<.0001
Year 2015 * small house	-0.22251	0.01004	-22.15	<.0001
R-square	0.7428			
Adjusted R-square	0.7426			
Number of observations	26007			

Source: Statistics Norway.

Positive parameter estimates means that the characteristic contribute to increase the price of the dwelling. As can be seen in table 7.4 utility floor space is the far most statistically important variable in the model. Interactions for house type and floor space, price zones, garage and year is included in the model to adjust for the differences between flats in blocks and small houses.

The final set of variables included in the model is selected on the basis of the coefficients, standard errors and t-values.

The fit of the model is tested, see Appendix A.

7.4. Index results

We have calculated a total index for small houses and flats in blocks. Table 7.5 shows the price index for new multi-dwellings from the first quarter of 2011 to the fourth quarter of 2015.

Table 7.5 Price index for new multi-dwellings, 1st quarter 2011 – 4th quarter 2015. 2015=100

Year	Quarter	Index	Change from the last quarter	Change from the same quarter the year before
2011	1	79.9		
	2	79.6	-0.4	
	3	79.3	-0.4	
	4	84.9	7.1	
2012	1	84.6	-0.4	5.9
	2	88.5	4.6	11.2
	3	85.9	-2.9	8.3
	4	90.5	5.4	6.6
2013	1	93.2	3.0	3.0
	2	93.0	-0.2	-0.2
	3	93.6	0.6	0.6
	4	90.5	-3.3	-3.3
2014	1	90.0	-0.6	-0.6
	2	94.6	5.1	5.1
	3	94.5	-0.1	-0.1
	4	95.7	1.3	1.3
2015	1	98.6	3.0	3.0
	2	98.9	0.3	0.3
	3	101.1	2.2	2.2
	4	101.4	0.3	0.3

Source: Statistics Norway.

From the first quarter of 2011 to the fourth quarter of 2015 there has been an increase in the prices of new multi-dwellings on 26.9 per cent.

8. House price indices

The house price index for multi-dwellings can be seen as a part of a hierarchical system of house price indices. A price index for new dwellings will be compiled by the price index for new multi-dwelling houses and the price index for new detached houses. Furthermore, a price index for all houses, both new and existing, will be compiled.

8.1. Price index for new detached houses

Over the last years about a third of newly built houses in Norway are detached houses. The contractors in this marked are often small firms and, as confirmed in the initial phases of this project, it is difficult to collect data for detached houses. On the other hand Statistics Norway has been compiling a quarterly output price index for new detached houses since 1989. By this reason we choose to use data from this index which include detailed information about the house standard. The output index is an approximation of a selling price index as VAT and profit margins are included in the price. Land prices are excluded in this output price index. This is not consistent with the approach for our new index for multi-dwellings and our house price index for existing dwellings, which includes land[3]. The model for new detached houses was revised in 2015, and will be documented in a separate report expected published early 2017.

Prices of new detached houses and new multi-dwellings are collected at different stages in the building process. New detached houses are measured after the completion registered in the Cadastre, while new multi-dwellings are measured at the point of sale.

[3] According to OOH the perfect index should exclude land, but for harmonization reasons land has to be included.

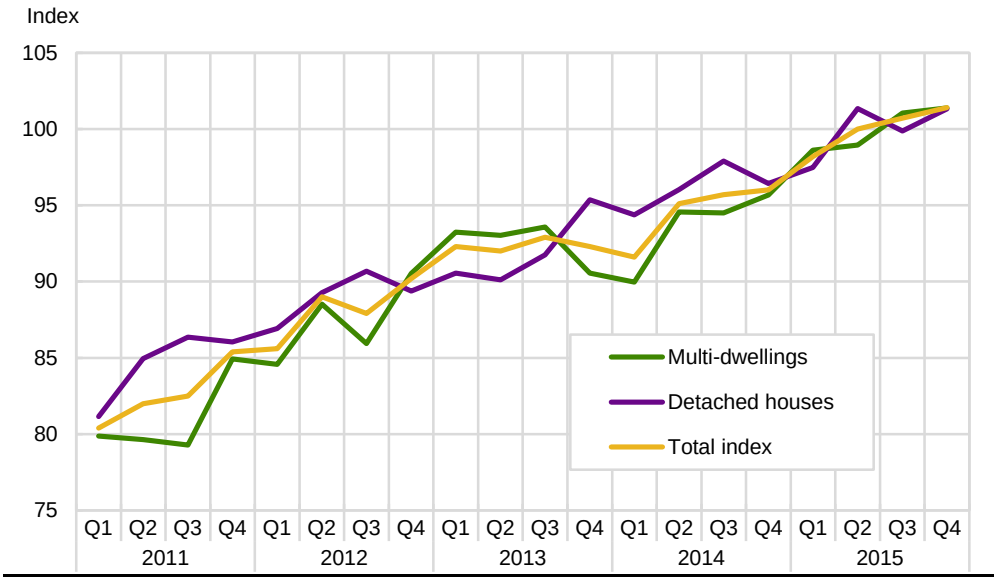
However, there has been a quite similar increase in the price index for new detached houses from the first quarter of 2011 to the fourth quarter of 2015. The prices for new detached houses increased by 24.8 per cent in the period, while the corresponding figure for new multi-dwelling houses was 26.9 per cent.

8.2. Price index for new dwellings

In order to develop an index for new dwellings in the household market, the price indices for detached houses and multi-dwelling houses will be aggregated.

The weights of the different dwelling types are calculated as the number of dwellings multiplied by the value. For the number of dwellings we use the mean of building permits and completed dwellings, as we assume that the sales take place somewhere in between these two points in time.

Figure 8.1 Price index for new dwellings 2015=100



Source: Statistics Norway.

8.3. Price index for dwellings

A total price index for houses will be estimated by an aggregate of the price index for new houses and the price index for existing houses.

9. Dissemination

The price index for new multi-dwellings was published at Statistics Norway's home page, www.ssb.no for the first time the 3rd quarter of 2015, with an index series from 1st quarter of 2011. The index will be forwarded to Eurostat within 85 days after the end of each quarter in accordance with the OOH-regulation.

For the 4th quarter of 2015 the price index for new multi-dwellings and new detached houses was published as separate indices in the same release. It is planned to include the aggregate of these two indices and publish one price index for new dwellings. This price index will be transferred to Eurostat, together with the total index for all dwellings.

10.Concluding remarks

Statistics Norway has completed the development of an index for purchases of new dwellings.

During the project we have made some experiences that can help us to further improve the price index for new multi-dwellings. The time consuming data collection has potential to become more efficient. We can be more specific about the data we collect, now that we have experience with the regressions and price models. We will also further explore the possibilities of using the data provided by the Association of real estate agencies better.

The model used will also be object to further possible improvements. For instance the approach of estimating the hedonic regression equation for index calculation from the base period (2 years) means that it is not very efficient when it comes to using new data in estimation of the coefficients

We will also further explore the possibilities of getting price information of detached houses direct from the enterprises selling them.

References

EUROSTAT (2010): Technical Manual on Owner-Occupied Housing for Harmonised Index of Consumer Prices. Draft Manual.

EUROSTAT (2010): Working Group “Harmonization of Consumer Price Indices” to be held in Luxembourg. Owner-Occupied Housing (OOH) Manual. Paper by Eurostat.

EUROSTAT (2011) The treatment of housing co-operatives in the HPI/OOHPI. Coordination team

EUROSTAT (2013) Commission regulation (EU) No 93/2013

EUROSTAT (2013) Owner-Occupied Housing Price Indices, House Price Indices – Methodological manual referred to in Commission Regulation (EU) No 93/2013

EUROSTAT (2013) Handbook on Residential Property Prices Indices (RPPIs)

Goldberger, A.S. (1968): The interpretation and Estimation of Cobb-Douglas Functions. Econometrica Vol. 35, No 3-4.

Griliches, Z. (1992): Regression with Graphics: A Second Course in Applied Statistics. Belmont: Duxbury Press.

Johansen, I. & Nygaard, R. (2009): Owner-Occupied Housing in the Norwegian HICP, Reports 2009/18, Statistics Norway.

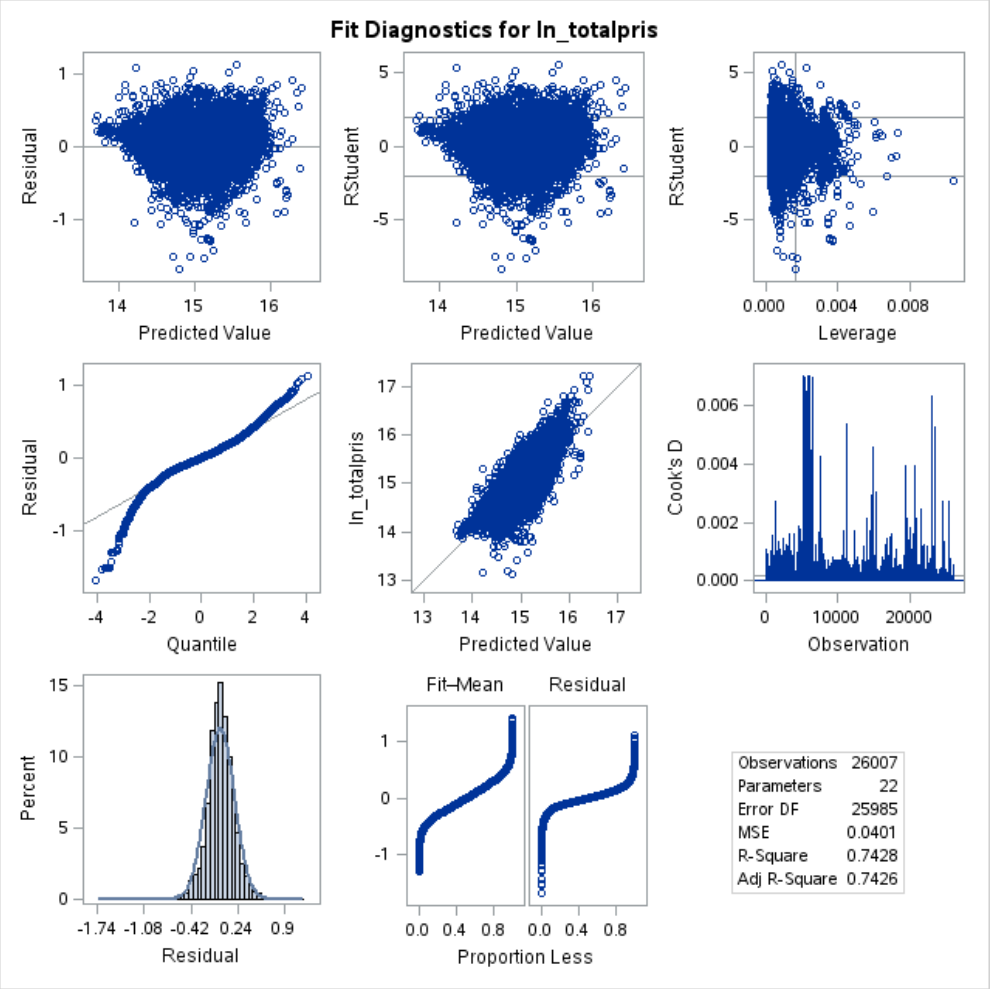
Rosen, S. (1974): Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition. Journal of Political Economy 82.

Statistics Norway (2006): Construction Price Indices and House and Property Price Indices 2006, Results and Methods. Official Statistics of Norway D 372.

Wigren, R. (1986): Småhuspriserna i Sverige. Forskningsrapport fra Statens Institut for Bygnadsforskning (in swedish only).

Appendix A: Figures

Figure 1 Fit diagnostics for the regression model for new multi-dwellings



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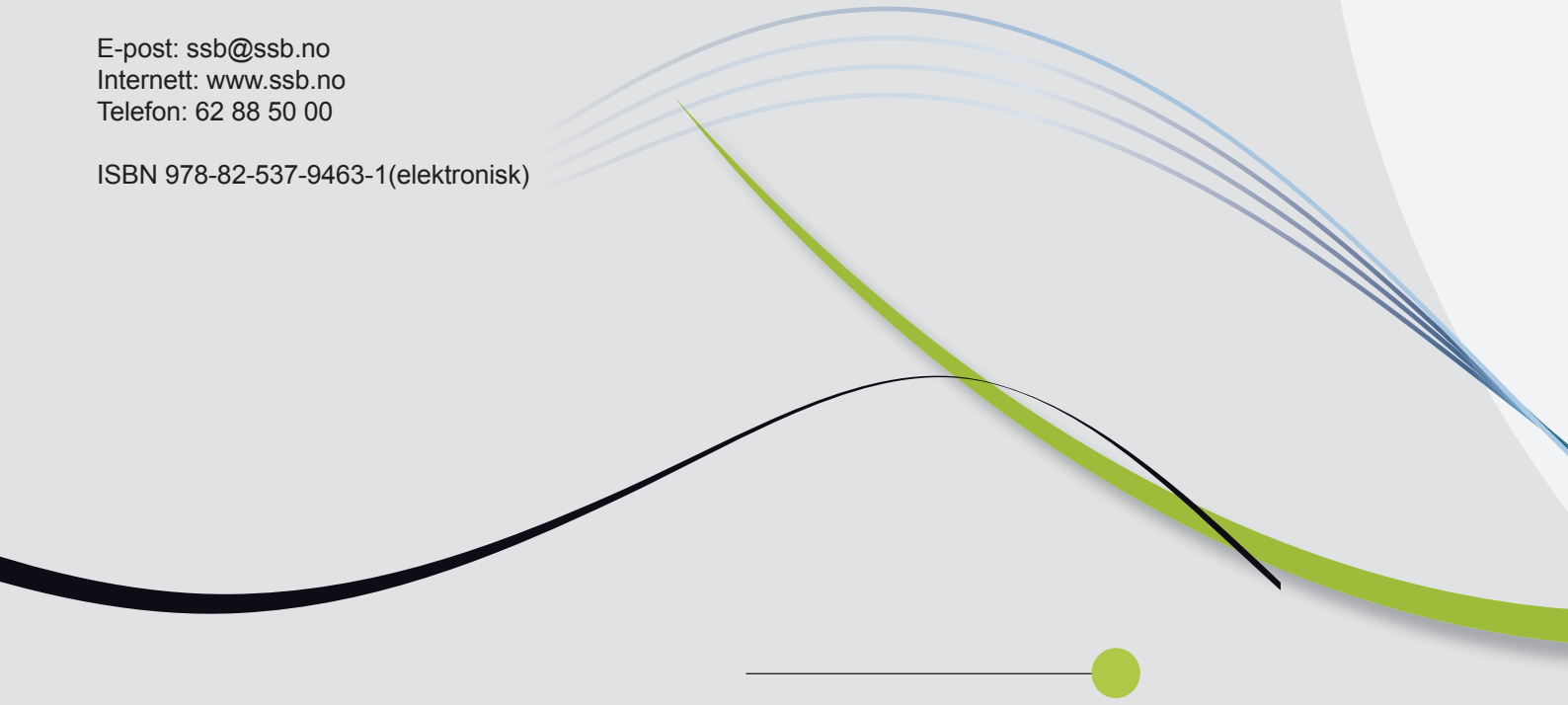

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