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Rising Inequality of Housing? Evidence from Segmented Housing Price Indices

Abstract:
This article uses the Case-Shiller technique for constructing housing price indices on a Norwegian data set of transactions for the period 1991-2002 consisting of 10 376 pairs of repeated sales. Using a weighted least squares scheme in order to control for heteroskedasticity, we construct a general housing price index by regressing differences in log prices for the subset of repeated sales of same, and thus identical, homes onto a set of binary time variables, one for each quarter in the period. The constructed index shows that nominal prices for identical homes in general have increased by a factor of 3.58 over the 11-year period, while the CPI increased by 1.28, creating substantial capital returns for early purchasers. We then segment the data set into five different housing types in order to control for finite mixtures of hedonic features, and find that price indices for the smallest and largest type show nominal increases by factors 4.40 and 2.77, respectively.

Keywords: distribution, hedonic model, housing price bubble, housing price index, inequality, repeated sales model, segmented housing types

JEL classification: C20, D40, G20, R21

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1. Introduction

The decision to purchase a home is often the most important financial decision a household makes. The magnitude of the price for such an asset usually equals several multiples of annual household income, and the total value of homes in an economy comprises a large part of total asset value. If price development is stable, predictable, and close to a time trend, purchasers may not need accurate assessments of the trend. They can simply buy when they like. However, if prices fluctuate and deviate significantly from trend, and if the trend may have break points, purchasers may discover that there are fortunate and unfortunate time periods of entrance to owning an apartment, which creates a desire to distinguish between such periods and beat the market. The former is consistent with equality between different population cohorts in terms of costs of entrance while the latter may result in large discrepancies between real housing prices for different generations over time. This may be a source of inter-temporal housing inequality. Moreover, if different types of housing follow different paths of appreciation, this change of relative prices within the housing category may be a source of housing inequality between different segments of the population -- at a given point in time and over time. In Norway, the possibility of housing inequality has become a source for policy concern and a topic of popular discussions. Anecdotal evidence and crude indices tell stories of tremendous price increases in the market for houses and apartments in Oslo during the booming 90s, and also of widely divergent paths of increases in value for different types. However, there exists no rigorous investigation of price increases for housing in Norway. One main reason lies in the challenge of identifying each dwelling uniquely. This article circumvents this problem by using the data files of the association of cooperatives, builder of houses and apartments, and at the same time Norway's largest housing agent, OBOS. OBOS has recorded every transaction of more than 60 000 objects of all sizes and distributed over the entire urban area of the Norwegian capital, Oslo. This article uses this data set to answer two core questions in housing inequality: How much have housing prices increased? How different are prices for different types of housing?

Housing prices are not only of interest to purchasers trying to compute a favorable entrance point to ownership. They are also of importance to banks and financial institutions since housing loans constitute a large proportion of credit creation in an economy. Any changes in real estate value will affect the security of mortgages. Because the aggregate of mortgages influences macroeconomic performance, central bankers and financial authorities are keen observers as well. Moreover, since the costs of housing comprise a large part of households' budgets, both changes in the relative price of housing and relative changes among prices of housing affect the distribution of wealth among consumers. For these reasons, housing prices are closely watched by individual households, economists, policymakers, and bankers.

Media often report developments in housing price indices. However, these indices are most often crude constructs of ratios of average transaction prices that may not well serve as basis for policymaking. This claim emerges from the existence of at least two challenges for indices. First, comparing average transaction prices for one period with the average from another period allows a potential selection bias to influence the results. If there are several types of homes and the transaction proportions for each of these types vary over time, then the ratio of average transaction prices may include both an appreciation and a selection effect. Second, controlling for the selection effect by using dwelling attributes to identify types can guarantee avoidance of selection effect only when the vector of attributes is exhaustive. However, there may often be unobserved features of an apartment or a house that affect realized sales price.

This article uses transaction data for twice-sold objects. This avoids selection bias due to changes in the composition of dwellings sold over time. Furthermore, since we use only price differences for the same object, we avoid the problem of unspecified attributes of dwellings as long as they are unchanged over time. This assumption is not innocuous, but quite plausible nevertheless. The degree of inaccuracy is related to the frequency and extent of restoration and redecoration of a given object. Moreover, in order to exploit information on hedonic traits, we segment into five types in order to utilize the benefits of observed attributes and to allow for different appreciation paths for different object types. Doing this we are in a position to investigate a general housing price index and specific indices for each type.

The indices constructed in this article show that nominal prices for identical apartments have increased by a factor of 3.58 in Oslo for the 11-year period from 1991 to 2002, at the same time as CPI increased by a factor of 1.28. This implies that apartments over the time period constituted a set of assets with returns that outperformed returns to most financial assets. Put differently, the most successful financial position to take during this period involved purchasing an apartment. On the flip side, households unable to, unwilling to, or simply not ready to purchase, are left later in the period facing a substantial financial barrier to entry. This is of interest to policymakers because a time-sensitive housing component of real costs-of-living has distributional implications for inter-temporal wealth formation and equality. Moreover, the index for one-room apartments increases as much as 4.40 and the index for five-room objects increases by a factor of 2.77. Not only is this wide difference an interesting indicator for strong separation between sub-markets for housing, it also is indicative of a wide difference in the time path of appreciation for different types is indicative of different developments in costs-of-living for different purchasers. This stems from the complication that housing is both an investment asset and a source for extraction of consumption services. Households with lower standards of living, which purchase smaller apartments not only for investment purposes but also to extract shelter services, experience an accelerated increase in costs-of-living relative to households with higher standards of living, which tend to purchase larger dwellings.

The estimation technique involves three steps. First, we regress differences in log prices onto a vector of binary variables for each time period, here quarters. Second, the resulting residuals from the first regression are squared and then regressed onto a time variable in order to investigate and control for the possibility of heteroskedasticity, i.e. time-sensitive variance. The set consisting of the inverse of the square root of fitted squared residuals serves as a set of weights in the final third step. In this step, a weighted least square regression is performed. This technique yields unbiased and efficient parameter estimates given the model assumptions.

The article is structured as follows. The next section outlines the literature background. The subsequent section introduces the econometric technique in more detail. The fourth section describes the data, and the fifth presents empirical results. The final section concludes and points toward policy implications.

2. Constructing Housing Price Indices

Creating good housing market indices is difficult. In addition to the practical problems concerning acquiring good data sets of sales, there are several challenges of more theoretical nature. For example, the only transactions seen in housing markets are recorded when the potential buyer's actual bid is equal to or higher than the seller's reservation price. Gatzlaff and Heurin (1997) stress this point and show that using only observed transactions may lead to serious biases. Nevertheless, estimation of housing price indices is roughly divided into two approaches, and none specializes in solving the obstacle pointed to by Gatzlaff and Heurin. One is the hedonic regression approach, introduced by Kain and Quigley (1970). Models in this group include observed attributes that are believed to influence the marked price as explanatory variables in a regression of transaction prices on attributes. Hedonic regression models face several challenges. The most severe is the complicated nature of identifying relevant attributes and finding an appropriate functional form. Some of the attributes tend to be unobservable or hard to quantify.[1] The second approach tries to circumvent this problem by looking at repeated sales only. If the attributes, observed or not, remain unchanged over time, two sales, repeated transactions of the same object, tell the correct story of how the complete package of attributes is priced in the market. The repeated sales approach dates back to Bailey, Muth and Nourse (1963). Their approach is later refined in the seminal article by Case and Shiller (1989). In the housing literature, it has been argued that using repeated sales may cause biases since objects that sell twice may be special. They may have a higher tendency of undesired features, thus stimulating a rapid resale. Furthermore, using only repeated sales entails the loss of much market information. However, there are ways to reconcile the two approaches using both repeated sales and hedonic regression. Several such hybrid models have been suggested (Quigley (1995), Hill et al. (1997), Englund et al. (1998)).

A branch of literature on housing prices, time trends, and the construction of indices arose with Gau (1984), who presented early rigourous models of the real estate market in Vancouver. Linneman (1986) was an early investigator of housing prices in Philadelphia. Case and Shiller's (1989) article studied house prices in Atlanta, Chicago, Dallas, and San Francisco/Oakland. The present article employs the technique introduced by Case and Shiller, and constructs price indices for housing in Oslo by using a data set for 1991-2002 consisting of 10 376 repeated transactions from OBOS. Since Case and Shiller's contribution, the literature has acknowledged the possible need to model certain properties of the stochastic process of prices in order to construct certain indices. For example, attention has been focused on whether or not the error structure is a random walk. Hill, Sirmans, and Knight (1999) use the Case-Shiller data to test for a random walk component in house prices of the four American cities. Moreover, Englund, Gordon, and Quigley (1999) have investigated whether there is evidence of a random walk component in the error term in Swedish house prices. For our purpose, we do not seek nor need an explicit investigation into the structure of the stochastic process of the error terms. Rather, we argue below that the original Case and Shiller technique is appropriate and employ it in this article.

In this article, we suggest our own version of combining repeated sales with observed attributes. We segment into different types of apartments. We thereby add to a growing body of combination studies. Several recent studies have compared the performance of repeated sales, hedonic regression and hybrid models. They indicate that hybrid models, exploiting all transactions and observable attributes,

[1] Typical examples are tall trees that partially block ocean view, disturbing scents from a nearby café, or proximity to a playground.

tend to yield price index estimates that have smaller variance. Furthermore, dwelling improvements may violate the maintained hypothesis of the repeated sales method (Englund et al. (1999), Meese and Wallace (1997)). In practice, however, data sets tend to be far from optimal. Attributes that are known to influence transaction price are not collected. Gathered information may prove to be of poor quality. Thus, selecting an appropriate model involves weighing theoretical considerations against empirical limitations. The strength of the repeated sales method is first and foremost that it relies less than other models on dwelling characteristics that may be difficult to measure.

In our case a repeated sales model seem most appropriate. The data set has a high percentage of repeated sales (60 percent). The percentage is much higher than any described data set in the housing literature. The high frequency of repeated sales is due to the size and location of the dwellings. They are all flats in urban parts of Oslo, implying that many flats will be resold due to changes in household size and wealth. Contributing to the high percentage is also the high quality of the data, implying that almost all repeated sales are detected. Furthermore, we suggest that an alternative way of bringing in hedonics is to use repeated sales models on segments. In hedonic regressions all estimated coefficients are estimated simultaneously, thus variables that are poorly measured may influence all coefficient estimates. Segmenting on the other hand steers clear of such problems, if the segments are defined by explanatory variables that are accurately measured. In our data set we segment along number of rooms and apartment size, variables that are of high quality.

3. The Econometric Model

We follow the structure and error term assumptions introduced by Case and Shiller, in which the logarithm of realized sales price consists of three additive terms: a city-wide price level, which shall be our index, a Gaussian random walk, which we take into account below through controlling for heteroskedasticity, and a classical noise term originating in the usual market imperfections. The former term is this article's focus of attention and constitutes what we aim to estimate. The middle term is caused by possible time-persistent drift off trend in dwelling value. Notice that we follow Case and Shiller in assuming that the *difference* between the middle term for the same object sold twice, only at different times, has zero mean and a constant variance and thus allows the treatment presented below. As pointed out by Case and Shiller, the latter term emerges as potential purchasers randomly arrive at sales events, or are obstructed from obtaining the relevant information and thus are absent, the skills and performance of the sales agents, weather, news events, and other factors that possible influence the final price. The Case-Shiller methodology for constructing housing price indices relies on a three-stage weighted least squares regression model on repeated house sales. The first stage estimates index parameters for each quarter in the period by regressing the difference in log sale prices for same homes on a set of binary variables for each quarter, as presented in equation (1).

$$(1) \qquad \log(p_{it}) - \log(p_{is}) = \gamma_2 T_{i2} + \gamma_3 T_{i3} + ... + \gamma_{46} T_{i46} + \varepsilon_{it}, \qquad i \in I; t, s, \in \{2,...,46\}, T_{it} \in \{-1,0,1\}$$

where p represents sale price, T is a dummy variable indicating first sale, second sale or no sale, t is the time period in which the second sale was undertaken, s the time period in which the first sale was undertaken (and thus s<t), subscripts i refer to a sale of a given object in the set of all repeated sales I such that i refers to an object sold at least and at most two times , γ's are index parameters to be estimated, and ε is an error term with zero-mean, and possibly non-constant variance caused by the drift mentioned above. The dummy time variable T is set to +1 in the second period it was sold and –1 in the first period it was sold for each object, unless this is the first time period, where the binary variable is set to 0. Having estimated the coefficients γ, one may compute the predicted changes for each sale, and compute the residual u between the predicted and observed changes in log price for each sale.

This first stage is the classical BMN-method, named after Bailey, Muth and Nourse (1963). In the case that the error terms are normally distributed with zero mean, identical variances and uncorrelated, the least square estimates of (1), give minimum variance and (linear) unbiased estimates of the γ's. However, if the error terms increase over time, this is no longer true. Most probably, the error terms are likely to be higher for dwellings were the time interval between sales is larger. The second stage estimates how much the error terms grow over time.

In the second stage, then, one squares the residuals and regresses the squared residuals onto a constant term and the time interval between sales, as shown in equation (2).

$$(2) \qquad u_i^2 = \alpha + \beta Q_i + \omega_i, \qquad w_i = \sqrt{\hat{u}_i^2}, \qquad i \in I,$$

in which parameters α and β relates the squared residuals to a counting-variable Q that denotes the time interval, i.e. number of quarters, between each sale within transaction pair i. The stochastic variable ω is a classic mean-zero, constant variance noise term, and w_i is denotes the inverse of the weight ascribed to each observation in the third step. The larger w is, the larger is estimated variance, and the smaller is the weight.

This procedure allows us to compute the fitted squared residuals for each observation and use them as estimates of time-sensitive variance caused by the possible presence of a Gaussian random walk. In the third stage, we take the square root of each fitted squared residual and use its inverse as weight for the corresponding observation in stage one. Thus, one proceeds to repeat as described by equation (3) the regression from equation (1) by using the obtained weights from equation (2).

$$(3) \qquad (\log(p_{it}) - \log(p_{is}))/w_i = \gamma_2(T_{i2}/w_i) + ... + \gamma_{46}(T_{i46}/w_i) + \varepsilon_{it}/w_i, \quad i \in I; t, s \in \{2,...,46\}, T_{it} \in \{-1,0,1\}.$$

From equation (3) we obtain a second and improved set of coefficient estimates γ_t, of the housing appreciation index.

4. The Data

The main obstacle for estimating housing price indices is often the lack of adequate data. Hedonic regressions rely heavily on having collected data on key attributes of each dwelling. In contrast, the repeated sales approach does not require data on these attributes if they do not change over time. However, the latter technique involves tracking each house over time, and identifying repeated sales. In practice, this requires some kind of register of houses and sales. Very few countries have such central registers. In their absence, more limited sales records for specific regions may be available. For instance, Case and Schiller use sales data from four American cities. Repeated sales were identified by mechanically comparing the addresses of the sales objects. Coupling, using an alphanumeric string, is problematic since different aberrations and misspellings result in undetected repeated sales. Norway does not have a register of houses or sales. In fact, until recently only one central register of properties was available. This register could in principle be used to identify single-family houses on self-owned properties. For dwellings on the same property, typically flats in building complexes, identification, however, is impossible. But a large portion of the privately owned flats in Oslo is organized in "borettslag"[2], a Norwegian term for a cooperative. Many of such cooperatives are administrated by OBOS, a company originally created by the government to provide housing to the working class. Today, it has changed its profile, and keeps the records of and serves as an accountant for a wide range of cooperatives. In essence, it is an association of cooperatives. In addition, OBOS is Norway's largest housing agent and also builds houses and apartments. The cooperatives are distributed all over Oslo, from the wealthy neighborhoods in the western part to more moderate housing facilities on the east

[2] "Borettslag" is a Norwegian word that in direct translation has the English counterpart "housing right association". Instead of buying a flat, one buys the *right* to live in the flat and this right can be resold. Buying and selling are subject to more regulations than standard house sales, but in most respects buying a flat and buying a dwelling right furnish a user with the same set of user opportunities.

side and in the Valley of Grorud. OBOS keeps a register of all flats, each flat uniquely identified. Every financial transaction is monitored. From mid-1991 onwards, all information on 60 000 flats of all sizes in approximately 500 cooperatives distributed all over Oslo has been recorded. Since each dwelling is uniquely identified by the cooperative and the apartment number identifying repeated sales is straightforward.

In our analyses 437 cooperatives were used, and a total of 55 961 sales were extracted. 34 025 were identified as repeated sales. Excluding those that were sold 3 times or more gave 20 804 sales. These correspond to 10 402 objects sold exactly twice, rendering them available for the Case-Shiller method. 26 observations contained obvious registration errors, and were omitted. This left us with 10 376 pairs of sales, i.e. 20 752 transactions.

Each sales record contains information on size in square meters, number of rooms, number of bedrooms, sales dates, and the amount of common financial liability the cooperative. In addition, we have complete information on geographical coordinates for each object as well as the construction year.

5. Empirical Results

Applying the Case-Schiller regression technique, we calculate price indices for every quarter from mid-1991 until the end of 2002. Table 1 summarizes the estimated general indices, their logs and their estimated standard errors. In 2002, the general nominal index is 3.58 times greater than in 1991. This implies that the *yearly* average price increase with respect to the 1991-level is 22 percent. The consumer price index grew only 28 percent over the same period -- in total, only a few percent per year. Looking at the ten year period from first quarter of 1993 until last quarter of 2002, we observe that the price increase is even more striking: It averages 27 percent annually with respect to the 1993 level, corresponding to a nominal price index of 4.5. Over the same period from 1993 to 2002, the consumer price index grew 23.5 percent. Correcting for inflation we get a real appreciation factor of 3.7, which is an extremely large number.

Table 1 tabulates the estimated price index in the fourth quarter of each year in the period and the adherent standard error of the estimate. We observe that the pattern is one of gradual year-by-year appreciation except for the fourth quarter of 1992, the only time the index stood lower than the fourth quarter of the preceding year. The index value reduction coincides with the Norwegian recession at the same time; see below for a discussion of the association between the housing market and the business cycle. By the fourth quarter of 1993, the index had regained the index value of fourth quarter in 1991. From then on, every fourth quarter stood higher than the year before, and the resulting index reports an asset appreciation of nearly 3.6 for the period in nominal terms. In the appendix, we tabulate in Table A1in addition the index for each quarter. In table A1, we also observe that the index reaches a global maximum of 3.71 in the third quarter of 2002, and falls to 3.58 in the fourth quarter of 2002.

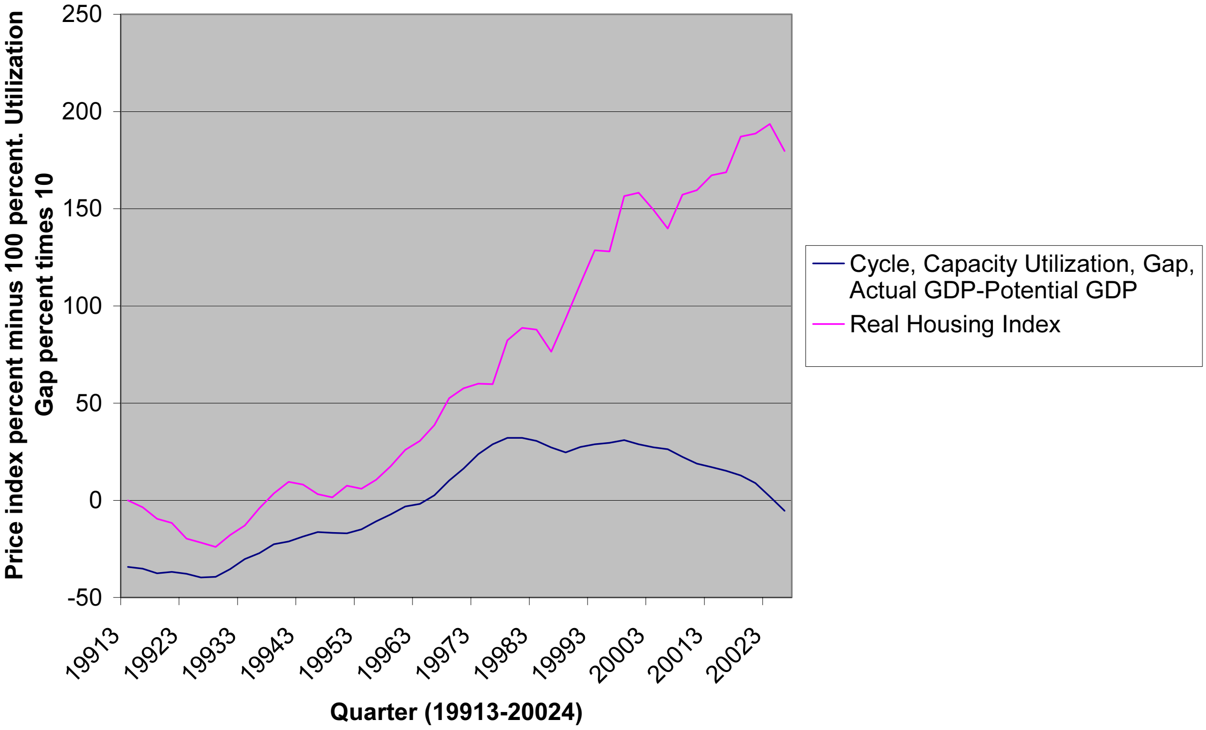
Moreover, from Table 1 we notice that the estimated standard errors are small. For example, an estimated standard error of 0.016 for the estimated log price index level of 0.711 in year 1998 indicates that the difference between the index level for fourth quarter in year 1997, which is 0.589, and 1998, which is 0.711, is both statistically significant and economically important. We notice that the computed adjusted R-squared is 0.92, indicative of good fit.

Table 1. General Price Index for All Types, Fourth Quarter, 1991-2002 (1991 III=1)

Year, Fourth Quarter	Estimated Price Index	Estimated Log Price Index	Estimated Standard Error
1991	0.964	-0.036	0.018
1992	0.800	-0.223	0.018
1993	0.999	-0.001	0.017
1994	1.094	0.089	0.017
1995	1.198	0.180	0.016
1996	1.528	0.424	0.016
1997	1.803	0.589	0.016
1998	2.037	0.711	0.016
1999	2.706	0.995	0.016
2000	2.931	1.075	0.016
2001	3.352	1.209	0.016
2002	3.585	1.276	0.019
No. of Observations (Pairs of Transactions)= 10 376, Est. Regression Variance=0.45, R^2-adj.=0.92			

It is important to note that housing prices fall and increase in tandem with the macroeconomic contraction and expansion. Figure 1 illustrates this point. The price index shows strong seasonal variations. In general, it yields higher second quarter prices compared to the following third quarter, even though the trend is steep. The seasonal fluctuations are higher than reported by Case-Shiller (1989) in their study of the four cities, San Fransisco, Dallas, Chicago and Atlanta, in the US.

Figure 1. The Housing Market vs. The Business Cycle, Oslo, 1991-2002



Note: The real housing index is computed by dividing the nominal housing index by the consumer price index for Norway. CPI figures for Norway can be found in Table 7 in CPI Figures, online: http://www.ssb.no. Capacity utilization is computed by subtracting trend mainland GDP from actual mainland GDP, then normalizing this difference by dividing it by trend mainland GDP. We use mainland GDP and not total GDP in order to control for volatile off-shore oil revenues in the Norwegian total GDP. The profile of the figure can be found in Økonomiske Analyser, 4/2003, Oslo: Statistics Norway.

The business cycle

The estimated real general housing index trend shows interesting parallels with the business cycle. The business cycle as computed by Statistics Norway (2003) shows capacity utilization in the mainland Norwegian economy, or rather: deviation from long-term trend, defining that trend denotes capacity. It displays relative capacity utilization of the mainland economy, i.e. the difference between actual mainland GDP and trend mainland GDP relative to trend mainland GDP. In other words, it reflects the business cycle in the economy, which is also known as the activity level. It is important to notice in Figure 1 that when the cycle curve is above 0, then the economy is above trend. Thus, as long as the cycle curve is above 0, regardless of whether the curve goes up or down, the economy is in booming times. Similarly, when the cycle curve is below 0, the economy is below trend. This article uses mainland GDP, and not total GDP, to suppress the volatility in the offshore oil export revenues Norway receives and the investments into offshore activities. The business cycle indicator reaches its minimum in the first quarter of 1993. At that point in time, there is an estimated 3.94 percent unused potential in the Norwegian economy, compared to trend, which indicates a recession. Intriguingly, this timing coincides with the lowest level, 0.761, in the estimated CPI-adjusted (real) housing index; as shown in Figure 1. The Norwegian economy then expands, first to reach trend, i.e. full capacity utilization, then expands further into over-utilization, i.e. activity above trend. The peak relative to capacity for the mainland GDP is found in the first quarter of 2000, in which the Norwegian economy is running at 3.10 percent above trend. After the peak, the economy contracts again, and enters underutilization in the fourth quarter of 2002. This quarter is the same quarter the real housing index starts to fall after its peak. Thus, there appears to be an association between the general activity level economy-wide and the development in the prices generated in the housing market. This is consistent with several plausible hypotheses. First, when an economy contracts, everything else being equal, unemployment increases, and the frequency of households that successfully apply for credit decreases since banks enforce stricter requirements. Second, when an economy contracts, households change their view of their economic positions, and reduce both the size and frequencies of credit applications.

Apartment Price vs. Price per Square Meter

In the media, the price per square meter is often used as a measure for price movements. And granted, it may be argued that a dwelling as a unit for the regression is not the natural choice. Over the years, the number of millions of square meters in residential buildings in a city may not change much, but this does not exclude a possibility that the number of dwellings can change. Often, minor constructional changes divide one large flat into two smaller ones or vice versa. From this point of view, the relevant parameter for a housing unit is area, e.g. measured by square meter. However, in our repeated-sales model, price differences between sales of identical apartments and price differences per square meter for identical apartments yield identical regressions.[3] This does not imply that in rule-of- thumb calculations, the product of number of square meters times price per square meter, gives an accurate description of the price of a given dwelling. Nor does it imply that we really have just one market of housing units. Whether or not the general prize index is interpretable as measure of price movements of housing units, may be answered by segmenting according to apartment size, and then perform Case-Schiller repeated sales regressions on each segment. Such segmenting, using number of rooms and size, shows that the index does depend crucially on the segment chosen. Table 2 summarizes these findings.

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[3] For a specific dwelling let the number of square meters be A, then, in the notation of Section 2: $\log(p_{it}/A) - \log(p_{it+s}/A) = \log(p_{it}) - \log(A) - \log(p_{it+s}) + \log(A) = \log(p_{it}) - \log(p_{it+s})$.

Table 2. Segment Specific Price Indices for Each Quarter, 1991 III - 2002 III, Oslo, Using Repeated Sales of Same Object

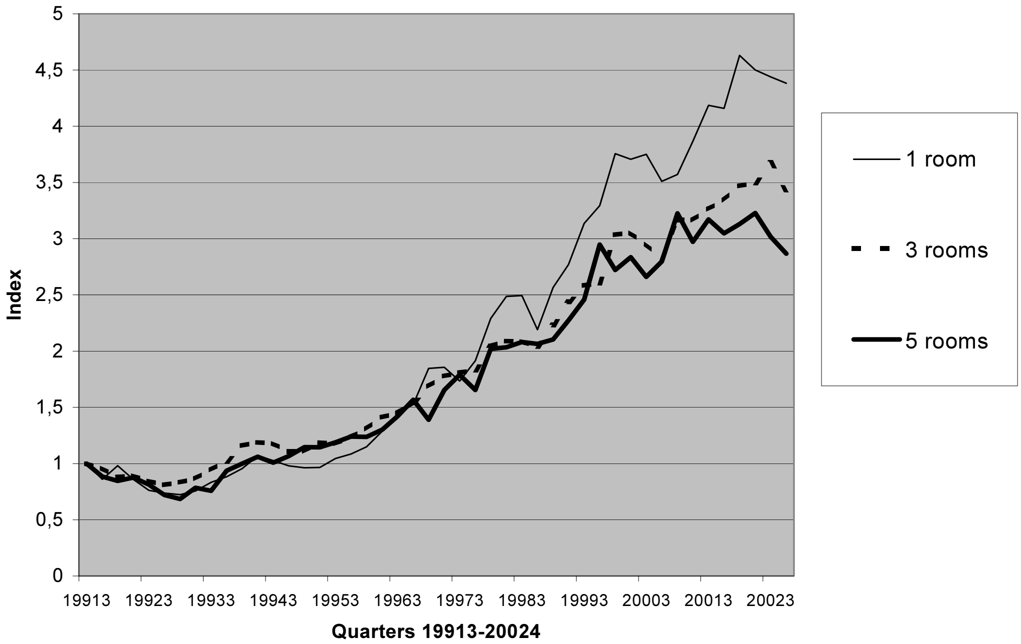
Quarter	General Index	Type A, 1 room	Type B, 2 rooms	Type C, 3 rooms	Type D, 4 rooms	Type E, 5 rooms
19913	1	1	1	1	1	1
19923	0,818	0,765	0,802	0,852	0,813	0,780
19933	0,907	0,844	0,890	0,953	0,879	0,732
19943	1,145	1,031	1,137	1,192	1,158	0,996
19953	1,149	1,055	1,167	1,188	1,166	1,167
19963	1,434	1,455	1,453	1,463	1,433	1,363
19973	1,798	1,741	1,816	1,825	1,779	1,723
19983	2,161	2,508	2,173	2,106	2,098	2,007
19993	2,686	3,150	2,712	2,609	2,541	2,364
20003	3,034	3,758	3,074	2,984	2,858	2,566
20013	3,327	4,207	3,334	3,292	3,091	3,058
20023	3,706	4,462	3,696	3,712	3,455	2,909

Note: The binary variables for quarter 19913 are set to unity in a normalization, and the third quarter of 1991 serves as a reference point. Segments: A: 1 room [20,40] m^2. B: 2 rooms [40,62] m^2. C: 3 rooms [55,85] m^2. D: 4 rooms [80, 120] m^2. E: 5 rooms, Nominal Terms

Segments of Different Types of Apartments

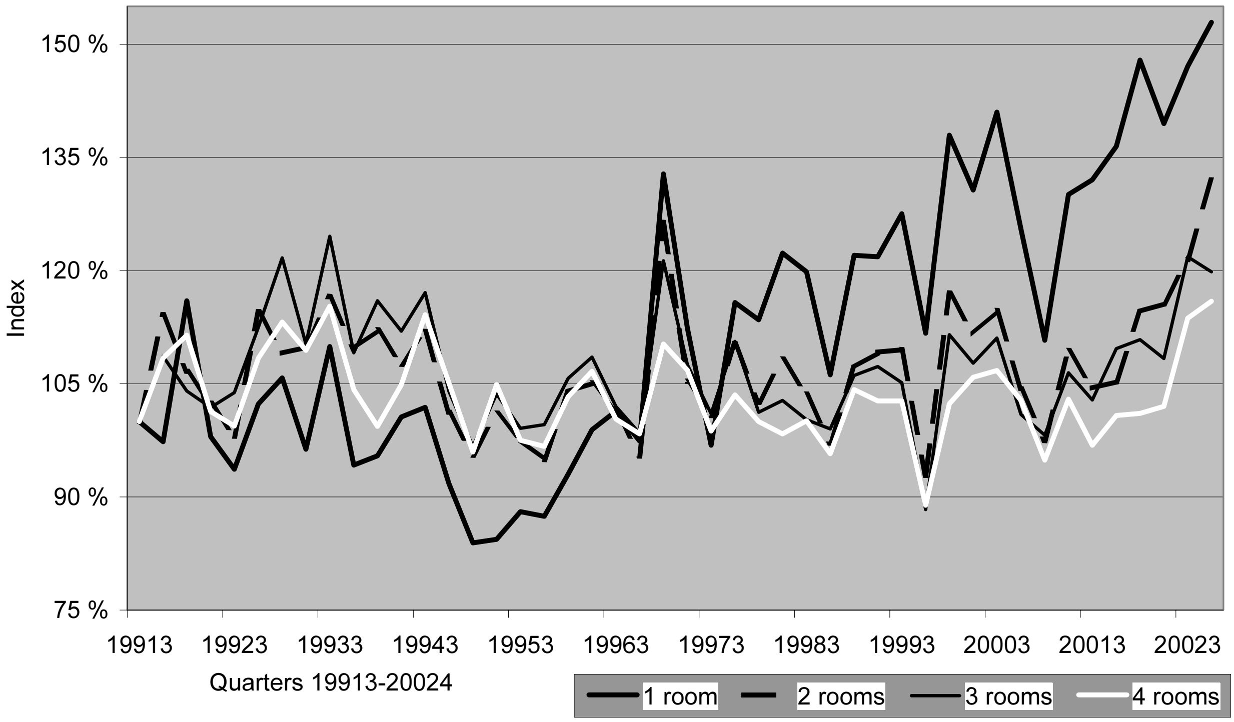
Figure 2 depicts price indices for different object types. The full table that contains all estimates, the basis upon which the figure constructed, is Table A1 in the Appendix. We observe from Figure 2 that the object types appear to share a similar pattern of steeply rising trend, but that appreciation is more accentuated for smaller objects. Utilizing Table A1 in the Appendix, we find that the index for small one-room apartments increases from unity in 1991 III to 4.40 in 2002 IV, peaking at 4.66 in the first quarter of 2002. Small two-room apartments increase to 3.70 over the period, with its maximum at 3.76 for the second quarter of 2002. Objects of three rooms end the observation period at 3.47, after reaching a top in the third quarter of 2002 at 3.71. Larger dwellings of 4 and 5 rooms have end-quarter indices of 3.35 and 2.77, respectively. They reached peaks in the third quarter of 2002 and the first quarter of 2001 at 3.46 and 3.11.

Figure 2. Segment Specific Price Indices for Each Quarter, 1991 III - 2002 IV, Oslo, Using Repeated Sales of Same Object (see Table 2 for segment definition)



We find pronounced variation between segments. The appreciation of small flats is much higher than for any other segment. One striking feature is that small flats vary more strongly with the business cycle in the sense that the 1992 bottom is lower than the indices for the larger flats, and the peak in 2002 is higher. In other words, prices for smaller objects are more volatile. Using large flats as reference, we may calculate the excess index, i.e. how much the smaller flats have increased or decreased in price relative to the price large flats. Figure 3 shows the excess indices for one room, two room, three room and four room apartments of given sizes. We see clearly that small apartments experience a dramatic increase -- of magnitude 1.53 -- relative to large apartments.

Figure 3. Excess Appreciation: Price index relative to the price index of five room apartments (I/I_5). 1 room, 2 rooms, 3 rooms and 4 room apartments, Oslo, 1991-2002



The price of a small flat increased by a factor of 6.04 nominally, and 4.89 in real terms, in the nine years between first quarter of 1993 and fourth quarter of 2002. This extreme appreciation is in part powered by the historically low apartment prices in 1993, but the increase relative to other larger flats accentuated in the late nineties and in the beginning of the new millennium must be attributed to other factors.

6. Concluding Remarks and Policy Implications

The market for apartments and homes in Oslo over the period 1991-2002 appears by empirical scrutiny to increase more than three-fold. We find that an apartment purchased at 1 million Norwegian kroner in 1991 would have sold at 3.58 millions in 2002. This happens in a time period in which general consumer prices increase only 28 percent. This large asset appreciation comes with macroeconomic ramifications and distributional consequences. First, it illuminates the on-going debate on monetary targets for central banks. If credit creation is decreasingly used on non-durable consumption goods, and increasingly on a combination of durable consumption goods and investment opportunities such as housing, then the consumer price index may not accurately reflect the relationship between credit expansion and prices. Thus the central bank may have to target more than a scalar consumer price index in a price-targeting monetary regime. Second, asset appreciation in housing is different from appreciation in financial instruments since it comes with different implications. Every household needs shelter, whereas not every household needs stocks or bonds, so if some cohorts of households may purchase their entrance tickets to home ownership at a lower cost than others, housing appreciation entails inter-temporal distributional effects between cohorts and generations. Third, emphasized by Case and Shiller, real estate appreciation may be self-sustaining and thus create an asset price bubble. Implosions or corrections of bubbles are associated with economic adjustments or disturbances that may prevent capacity utilization. Thus, policymakers may prefer to avoid them and accurate housing price indices, among other indices, constitute necessary instruments to that end.

And it makes our large appreciation estimates particularly interesting in the ongoing debate on housing finance regimes. It has been suggested that countries in which fixed-rate financing is the more frequent form of mortgages will experience less volatility than countries in which floating-rate financing is the more frequent form. In Norway most house mortgages are of the floating-rate type, and the fixed-rate type is not even available for most households or for long periods. Thus, the very large appreciation estimates we present may also be interpreted to support the claim that floating-rate regimes may allow in higher probability experiences with rapid and potentially dramatic price increases. When policymakers discuss public finance this is potent evidence.

This article also finds that there exist substantial differences in the price appreciation of different *types* of dwellings. The price of a small one-room apartment increases by a factor 4.40 while the price of a large five-room type increases by a factor of 2.77. There are several ways to interpret this phenomenon. First, it supports the often-heard statement that there is no one single market for housing in a large city. In stead, there are several, separate sub-markets that may experience different developments in supply and demand, and hence realized market prices. Second, the finding is consistent with the pressure on demand for a separate, sub-set of objects, namely small 1-room apartments, created from investors, speculators, mom-and-pop savers wanting to let, and parents of students seeking small apartments for their children to use. Such markets may be more volatile in prices, entail shorter periods of ownership, and have higher volumes in transactions. Thus, objects in this category may experience rapid appreciation and dramatic corrections. Third, households with lower standards of living may choose to own or rent smaller apartments while households with higher standards of living may prefer and can afford to live in larger ones. Different paths of home price appreciation entail different developments in costs-of-living for different segments of society. While a *general* home price appreciation affects cohorts and generations, and thus affect inter-temporal equity, *different* rates of appreciation for different housing types affect different groups of households and segments of the population differently, and may affect cross-sectional equity. This development may be a source for distributional concerns.

References

Bailey, M. J., R. F. Muth, and H. O. Nourse (1963): A Regression Method for Real Estate Price Index Construction, *Journal of the American Statistical Association,* **58,** *No. 304, pp. 933-942.*

Case, K. E. and R. J. Shiller (1987): Prices of Single Family Homes Since 1970: New Indexes for Four Cities, *New England Economic Review*, September/October 1987, pp. 45-56.

Case, K. E. and R. J. Shiller (1989): The Efficiency of the Market for Single-Family Homes, *American Economic Review*, **79**: 1, pp. 125-137.

Case, K. E. and J. M. Quigley (1991): The Dynamics of Real Estate Prices, *Review of Economics and Statistics,* **22***:1, pp.* 50-58.

Englund, P., T. M. Gordon, and J. M. Quigley (1999): The Valuation of Real Capital: A Random Walk down Kungsgatan, *Journal of Housing Economics*, **8**: 3, pp. 205-216.

Englund, P., J. M. Quigley, and C. L. Redfearn (1998): Improved Price Indexes for Real Estate: Measuring the Course of Swedish Housing Prices, *Journal of Urban Economics,* **44***, pp. 171-196).*

Englund, P., J. M. Quigley, and C. L. Redfearn (1999): The choice of Methology for Computing Housing Price Indexes: Comparison of Temporal Aggregation and Sample Definition, *Journal of Real Estate Finance and Economics,* **19:2,** *pp. 91-112*.

Gatzlaff, D.H. and D. R. Haurin **(**1997): Sample Selections and Biases and Repeat Sales Index estimates, *Journal of Real Estate Finance and Economics,* **14,** pp. 33-50.

Gau, G. W. (1984): Weak Form Tests of the Efficiency of Real Estate Investment Markets, *Financial Review*, **19**, pp. 301-320.

Hill, C., R., C. F. Sirmans, and J. R. Knight (1997): Estimating Capital Asset Prices, *Review of Economics and Statistics,* **79,** *pp. 226-233*.

Hill, R. C., C. F. Sirmans, and J. R. Knight (1999): A Random Walk Down Main Street? *Regional Science and Urban Economics*, **29**, pp. 89-103.

Kain, J. F. and J. M. Quigley (1970): Measuring the Value of Housing Quality, *Journal of American Statistical Association,* **65**, pp. 532-548.

Linneman, P. (1986): An Empirical Test of the Efficiency of the Housing Market, *Journal of Urban Economics*, **20**, pp. 140-154.

Meese, R., and N. Wallace (1997): The Construction of Residential Housing Price Indices: A Comparison of Repeated Sales, Hedonic Regression, and Hybrid Approaches, *Journal of Real Estate Finance and Economics* **14**, pp.51-74.

Quigley, J. M. (1995): A Simple Hybrid Model for Estimating Real Estate Price Indexes, *Journal of Housing Economics,* **4***,* pp. 1-12.

Statistics Norway (2003): The Business Cycle, in *Økonomiske Analyser*, 4/2003, p. 20, Oslo: Statistics Norway.

Appendix

Table A1. Estimates of Price Indices for Each Quarter, 1991 III - 2002 IV, Oslo, Using Repeated Sales of Same Object

Quarter	General Index	Type A, 1 room	Type B, 2 rooms	Type C, 3 rooms	Type D, 4 rooms	Type E, 5 rooms
1991 III	1	1	1	1	1	1
1991 IV	0,964429347	0,87045429	1,016591132	0,969798381	0,971026879	0,852681236
1992 I	0,915305804	0,986938935	0,908986301	0,88882087	0,949868111	0,819934453
1992 II	0,898755307	0,854382786	0,904120688	0,900556371	0,893384748	0,844376036
1992 III	0,818959044	0,765077412	0,802978361	0,852238736	0,813738057	0,780285734
1992 IV	0,799714754	0,740896546	0,831436762	0,818141323	0,785820357	0,695574813
1993 I	0,789454946	0,728294862	0,75132542	0,840550506	0,779482708	0,658903679
1993 II	0,854295289	0,760021722	0,869012971	0,873596505	0,864516763	0,757155661
1993 III	0,907448042	0,844749913	0,890191692	0,953776529	0,879526938	0,732650355
1993 IV	0,998843596	0,884697467	1,034029956	1,030275091	0,982589991	0,899709839
1994 I	1,084947626	0,959795991	1,13052255	1,171293015	1,001219921	0,957648438
1994 II	1,152523976	1,081082729	1,149150006	1,200590663	1,121305861	1,020810699
1994 III	1,145340681	1,031285933	1,137632969	1,192131773	1,158554782	0,996602387
1994 IV	1,093647067	0,984302645	1,086579047	1,118133798	1,128643333	1,028726632
1995 I	1,092964793	0,960443076	1,10410627	1,120454963	1,108227139	1,107444076
1995 II	1,162207046	0,976488507	1,166760466	1,19733119	1,209219244	1,10242262
1995 III	1,149699043	1,055156033	1,167725635	1,188960144	1,166949812	1,167924627
1995 IV	1,198368881	1,096429619	1,186576096	1,248258171	1,207499369	1,198940006
1996 I	1,273519788	1,155878894	1,297532524	1,318784591	1,286315816	1,191831943
1996 II	1,373944284	1,288888311	1,378212743	1,425268669	1,397396525	1,255892647
1996 III	1,434616144	1,45542277	1,453592537	1,463268339	1,433395128	1,363632279
1996 IV	1,528490896	1,530798321	1,506293246	1,557093625	1,552954218	1,483309134
1997 I	1,703263787	1,856492294	1,771021746	1,703396997	1,543890775	1,340374457
1997 II	1,767789289	1,86815946	1,752927024	1,793371846	1,7780732	1,595040447
1997 III	1,798140442	1,741266749	1,816728025	1,825697557	1,779933889	1,723253016
1997 IV	1,803172233	1,918582377	1,826757184	1,851758451	1,719526208	1,592727823
1998 I	2,084642045	2,304105107	2,086644642	2,063888619	2,033907147	1,891115248
1998 II	2,161734496	2,495433566	2,21898154	2,111296901	2,013777931	1,959497404
1998 III	2,161999351	2,5080716	2,173790061	2,106465253	2,098356371	2,00784384
1998 IV	2,037435298	2,202298975	2,020157176	2,062755636	1,988527863	1,991299678
1999 I	2,260843752	2,577988365	2,274835263	2,254365653	2,208614855	2,024831247
1999 II	2,477198401	2,784609427	2,503857465	2,462439863	2,350697032	2,186944464
1999 III	2,686720915	3,150620323	2,712391756	2,609133071	2,541523541	2,364986036
1999 IV	2,706194135	3,309016946	2,758348153	2,629796181	2,640043114	2,841627523
2000 I	3,075462167	3,772545697	3,208819843	3,061793617	2,805063199	2,611637576
2000 II	3,126537131	3,726424785	3,184447268	3,084050199	3,023803476	2,734321384
2000 III	3,034700286	3,758469326	3,074652239	2,984904611	2,858587651	2,566535232
2000 IV	2,930627235	3,528863639	2,960778926	2,849765524	2,895426696	2,694597249
2001 I	3,200123486	3,590642136	3,167659504	3,196162564	3,080905604	3,107078619
2001 II	3,261202298	3,861293911	3,279508273	3,197783631	3,089846928	2,861992694
2001 III	3,327837485	4,207931853	3,334767592	3,292569796	3,091624428	3,05825858
2001 IV	3,351781689	4,178230308	3,232962153	3,379280814	3,093574772	2,935488842
2002 I	3,607298808	4,656478299	3,614008618	3,502249374	3,18481653	3,003873632
2002 II	3,640933948	4,51444899	3,758787229	3,530738465	3,313940783	3,101559265
2002 III	3,706059453	4,462398112	3,696418052	3,712690011	3,455274763	2,90945849
2002 IV	3,584504326	4,40065636	3,813242502	3,473020499	3,346368354	2,768197341

Note: The binary variables for quarter 19913 are set to unity in a normalization, and the third quarter of 1991serves as a reference point. Segments: A: 1 room [20,40] m^2. B: 2 rooms [40,62] m^2. C: 3 rooms [55,85] m^2. D: 4 rooms [80, 120] m^2. E: 5 rooms, Nominal Terms

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