Constant-Quality House Price Indexes for Switzerland

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1. Introduction

House price indexes are important for numerous reasons. They are crucial inputs for academic research aimed at gaining a better understanding of housing markets (such as analyses of the determinants of house prices and of the efficiency of housing markets), and also for investigation of socially important issues (such as analyses of housing affordability or whether or not housing bubbles exist). Recent research discusses the benefits of hedging housing risk (Englund et al., 2002; Shiller, 2003), which requires a price index. Given the importance of housing in households' wealth, the measurement of house price movements is a vital topic from both academic and practical perspectives.

A desirable property of a house price index is that it should track price changes for a house that has the same characteristics over time. Price changes should result only from changes in the market prices of characteristics, and not from differences in the characteristics of properties that have transacted in the various periods. Some debate has arisen in the literature as to whether age and to some extent also quality of location should be held constant when constructing an index. It can be argued that if the aim is to measure the return to the typical homeowner, then these should not be controlled for in an index (Case and Shiller, 1987; Clapp and Giaccotto, 1992). However, house price indexes are often intended to measure affordability and thus should be constant quality with respect to age

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as well as other characteristics. So, apart from age and location in some instances, indexes should be constructed for a constant bundle of attributes.

Median house price indexes are widely available in several countries, but they are unable to distinguish between movements in prices and changes in the composition of dwellings sold from one period to the next. Methods that involve some quality control should thus be used. Two such methods are well known: the hedonic and repeat sales techniques. The hedonic method controls for quality by using multiple regression models with the properties' attributes as independent variables. With the repeat sales method, quality control is in theory achieved by considering only the subset of properties that have sold repeatedly over a period of time. These methods have been widely used internationally, but also for Switzerland (see, e.g., Hoesli et al., 1997).

The indexes of the Swiss housing market published by the Swiss National Bank (SNB) are calculated by Wüest and Partner (W&P) based on median list prices as published in newspapers and on the internet. On average, some 100 000 to 500 000 list prices are used annually for that purpose. Some adjustment for quality is undertaken by splitting the entire sample into sub-categories based on factors such as size, location, and quality of the building, and the medians from the various groups are then aggregated to create the index. Given that much research has criticized the use of medians of sale prices, it is questionable that using list prices would yield more accurate price indexes. In fact, such indexes could be prone to further biases. First, the spread between list prices and transaction prices is likely to vary depending on the state of the housing market. Second, the sample of properties as collected from advertisements may well not be representative of the population of transacted properties. Third, the same property could appear in several different advertisements in a given time period and also across multiple time periods if the property has not yet been sold.

The aim of this paper is to compare the list price indexes to indexes constructed using the hedonic method. This is done for both single-family houses and condominiums. Although there are some comparisons of various index methods in the literature, to date no study has compared an index of median list prices to a constant quality index. Our focus is on national indexes, with some discussion of the Zurich region. The hedonic indexes are constructed using data from the Informations- und Ausbildungszentrum für Immobilien (IAZI), who collect information on a majority of residential transactions in Switzerland. We also compare the list price indexes with hedonic indexes produced by W&P. We find that the list price indexes exhibit quite a different price path than the two hedonic indexes. In particular, they appear to overstate price changes in housing markets.

The remainder of the paper is organized as follows. In Section 2, we review the various methods for constructing house price indexes. Section 3 describes the list price indexes and the hedonic indexes that we construct, while Section 4 is concerned with the comparison of the two sets of indexes. The final section provides some concluding remarks.

2. House Price Index Methods

The easiest way to construct an index is to use a summary measure, such as the mean or median price per period. The median is usually preferred to the mean to control for the impacts of extreme values. In the United States, for instance, the index published by the National Association of Realtors is based on median prices. Such indexes are easy to construct, but they suffer from the fact that little or no control for quality is made (see, e.g., Case and Shiller, 1987; Wang and Zorn, 1997). This can lead to biases in the indexes given the heterogeneity of properties combined with the fact that only a small percentage of properties transact in any given time period. Thus it is unlikely that the same mix of properties will transact in every period. Mark and Goldberg (1984), Crone and Voith (1992), and Gatzlaff and Ling (1994) compare indexes based on medians (and, in the first two cases, means) with indexes constructed using methods designed to control for quality. The empirical results reported in these articles suggest that indexes based on medians or means do not adequately control for quality changes.

To control for the heterogeneity of properties within the context of an index based on medians, it is possible to identify subcategories of properties, and to compute the index values by aggregating the median prices for the various subcategories. Such a method is used by the Australian Bureau of Statistics (ABS). They stratify transactions by sale price, and aggregate the indexes for the various categories. Prasad and Richards (2008) find that such indexes are closely correlated with hedonic house price indexes. Both the ABS approach and the list price approach involve the use of weighted medians, although the ABS method is based on sale prices rather than list prices.

An index of median list prices is likely to suffer from further biases as compared to one based on median transaction prices. This bias results from the possibility that the relationship between list prices and transaction prices is not constant over the house price cycle. In general, one would expect transaction prices to be below list prices. However, the magnitude of the discount could vary with the price cycle. In a particularly hot market, properties may even transact at prices

higher than the list price. In a sharply falling market, transaction prices may be substantially lower than list prices due to sellers' aversion to loss and the fact that many listed properties do not sell (Genesove and Mayer, 2001).

Also, the composition of the sample of properties that is listed may change over the house price cycle even more than the composition of the sample of properties that transact. When markets go down, many owners may decide not to sell (and hence not to advertise), in anticipation of more positive market conditions. The method which is used in Switzerland controls for at least some sample composition issues by allocating listings to property sub-categories which are aggregated to construct the index.

The hedonic method is a widely used technique to control for the heterogeneous nature of properties when constructing transaction-based house price indexes. It recognizes that properties are composite products: although attributes are not sold separately, regressing the sale price of properties on their various characteristics yields the marginal contribution of each characteristic. Both structural and location attributes are included in a hedonic regression.

There are two basic ways of constructing an index using the hedonic method. In the first approach, a separate regression is performed for each time period and the index is constructed by applying the estimated implicit prices to a standardized bundle of attributes. In the second approach, one overall hedonic regression is performed and time dummy variables are included. The estimated coefficients on the time variables yield the price index. In the first case, the implicit prices vary over time (this variation may be constrained by cross-equation restrictions), while in the second case the prices do not vary unless additional flexibility is incorporated into the model (for example, by estimating implicit prices with a time trend or including a series of time dummies for each hedonic characteristic). An important difference between the two hedonic approaches is that the former allows the mean and variance of the error term to vary, while the latter restricts the mean and variance of the error term to be identical across all time periods. The hedonic method is used, for example, to construct indexes of single-family houses in the United Kingdom (Halifax and Nationwide) and of residential properties in Norway (Norway Statistics). Hedonic indexes are also widely used in Switzerland, both by IAZI and by W&P.

To obtain unbiased estimates of house price indexes, regression models should be specified correctly with respect to both functional form and independent variables. Some of the attributes that can be expected to influence the price of a property, particularly neighborhood and location variables, may not be readily available (Case et al., 1991). As for functional form, the log-linear form is usually preferred, in particular because it mitigates some statistical problems (Malpezzi,

2003). Recent work on hedonic price indexes has also focused on the impact of spatial dependence among nearby properties (Gelfand et al., 2004).

Although not used in this paper, the repeat sales method is another popular technique that controls for the heterogeneity of properties when constructing house price indexes. The method, originally developed by Bailey, Muth and Nourse (1963), in principle holds quality constant by measuring the same asset in two periods; hence there is no need to include the properties' attributes in the model. The model to be estimated is a regression of change in price on a set of variables that capture the times of the two transactions.[1] The estimated coefficients on the time variables are used to construct the repeat sales index. A version of the repeat sales method is used by the Office of Federal Housing Enterprise Oversight to construct quarterly house price indexes for single-family detached properties in the U.S. (Calhoun, 1996).

3. The List and Hedonic Price Index Methods in Switzerland

The Swiss house and condominium list price indexes are calculated by W&P and published by the SNB.[2] These indexes are based on a survey of advertisements for about 500 000 properties annually (100 000 between 1970 and 1995). The survey records list prices and other details about the properties. The listing information is used to assign the properties to segments based on characteristics such as size and location. A median list price is calculated within each segment. The price index is calculated as:

$$PI_{t/0} = \frac{\sum_{j=1}^{n} p_{j,t}\overline{g}_{j,t}}{\sum_{j=1}^{n} p_{j,0}\overline{g}_{j,t}} \times 100 \qquad (1)$$

where: PI is the price index for time t relative to base period 0; $p_{j,t}$ and $p_{j,0}$ are the median prices for segment j at times t and 0, respectively; $\overline{g}_{j,t}$ is the moving average weight at time t for market segment j; and n is the number of segments. Indexes are reported for the entire country and for eight regions.

1 The repeat sales framework can also be applied when only one of the two observations is a transactions price and the other is an assessed value (Bourassa et al., 2006).

2 See http://www.wuestundpartner.com and http://www.snb.ch. Details about these indexes are taken from the W&P web site.

The weights are defined as:[3]

$$\overline{g}_{j,t} = \frac{\overline{q}_{j,t}}{\sum_{j=1}^{n} \overline{q}_{j,t}}, \tag{2}$$

where $\overline{q}_{j,t}$ is a moving average number of listings for market segment j at time t:

$$\overline{q}_{j,t} = \frac{\sum_{m=t-l+1}^{t} q_{j,m}}{l}. \tag{3}$$

Here l is the number of time periods in the moving average (40 quarters in this case) and m refers to the first period. In other words, the weights correspond to the share of listings within a particular market segment, calculated using moving averages.

The IAZI indexes are based on actual transactions – covering about 60 percent of the national market (approximately 30 000 transactions annually) – as reported by mortgage lenders.[4] A hedonic equation is estimated that contains variables for various property characteristics plus time dummy variables and a macro-locational variable that adjusts for land value differences across locations.[5] The property characteristics are listed in Table 1. The macro variable is an index constructed for each postal code (initially these were calculated for communes rather than for postal codes) using about 60 locational characteristics that collectively capture most of the geographical variation in values.[6] These locational characteristics include variables from tax and income statistics, population density and distributions, infrastructure statistics, and local geographic and economic factors.[7]

3 The SNB index is a form of the broad Lowe class of indexes that in principle allows any set of weights to be used (INTERNATIONAL LABOUR OFFICE, 2004). The more common Laspeyres and Paasche indexes are types of Lowe index.

4 The W&P hedonic indexes are also based on transactions; see http://www.wuestundpartner.com for details.

5 A hedonic model is used instead of repeat sales due in part to the thinness of the repeat sales data. However, IAZI does produce repeat *rent* indexes for Switzerland (see http://www.iazi.ch/web/Portals/0/Newsletter/ Indice%20de%20loyer%20CIFI.pdf).

6 Another approach to this problem is presented by FAHRLÄNDER (2006).

7 The details are developed by SCOGNAMIGLIO (2000), pp. 132–157.

Table 1: Property Characteristics in the IAZI Hedonic Model

Characteristics for both houses and condominiums
Principal or secondary residence
Quality of the location within the commune (4 levels)
Freehold or leasehold
Presence of utilities
Year of construction
Year of last major renovation
Condition of the building (4 levels)
Net floor space
Number of living/sleeping rooms
Number of bathrooms
Number and type of parking spaces
Luxury features such as swimming pools, design by a well known architect, etc.
Additional characteristics for houses only
Land area
Type of house (detached, semi-detached, etc.)
Volume
Finished attic
Additional characteristics for condominiums only
Situation within the building (4 levels)
Size of balconies or terraces
Share of ownership of building
Number of condominiums in the building
Type of condominium (single floor or duplex)

The hedonic equation is in semi-logarithmic form:

$$\ln P_{i,t} = \alpha + \beta_C x_{C,i} + \beta_t D_{t,i} + \beta_{M,t} x_{M,j,t} + \varepsilon_{i,t}, \tag{4}$$

where: $P_{i,t}$ is the sale price of property i at time t; $x_{C,i}$ are the characteristics of property i; $D_{t,i}$ is a set of time dummies equal to 1 if property i sold in time period t or 0 otherwise; $x_{M,j,t}$ is the macro-locational variable for location (postal code) j at time t; α is the constant term; β_C, β_t, and $\beta_{M,t}$ are vectors of parameters to be estimated; and $\varepsilon_{i,t}$ is the error term.

Equation (4) is estimated each quarter using 12 quarters of data. Then the quarterly price index change for location j is calculated as:

$$\frac{p_{j,t}}{p_{j,t-1}} = \frac{f \cdot \exp^{\alpha+\beta_C \bar{x}_{C,j}} \cdot \exp^{\beta_t} \cdot \exp^{\beta_{M,t} x_{M,j,t}}}{f \cdot \exp^{\alpha+\beta_C \bar{x}_{C,j}} \cdot \exp^{\beta_{t-1}} \cdot \exp^{\beta_{M,t-1} x_{M,j,t-1}}}, \quad (5)$$
$$= \exp^{\beta_t - \beta_{t-1}} \cdot \exp^{\beta_{M,t} x_{M,j,t} - \beta_{M,t-1} x_{M,j,t-1}}$$

where: $p_{j,t}$ and $p_{j,t-1}$ are the prices of a typical house in postal code j at times t and $t-1$; $f = (1+\sigma_\varepsilon^2/2)^{-1}$, which adjusts for the bias due to the logarithmic transformation of the dependent variable; $\bar{x}_{C,j}$ are the mean property characteristics for postal code j; and all other terms are as defined previously.[8]

The IAZI national or regional indexes are calculated as the weighted average of the indexes for postal codes using the Laspeyres method, meaning that the weights are based on the initial period:

$$PI_{t/0} = \frac{\sum_{j=1}^{n} p_{j,t} q_{j,0}}{\sum_{j=1}^{n} p_{j,0} q_{j,0}} \times 100. \quad (6)$$

Here n is the number of postal codes in the country or region and the weights, $q_{j,0}$, refer to the total number of properties in postal code j as of the base period.

Weighting the indexes by the size of the local housing stock partly overcomes the selection bias problem that results from the use of transactions to estimate an index for an entire market. GATZLAFF and HAURIN (1998) show that changing economic conditions affect the statistical composition of the samples of sold properties. As a consequence, hedonic regression methods may estimate house price changes that differ from the true movements in values of the stock in spite of the methods' controls for variations in the characteristics of houses sold. The IAZI method controls for variations in the geographical distribution of transactions. Given that the geographical units of analysis are fairly small (postal codes), this also probably controls for much of the variation in the distribution of the quality of sold properties not otherwise controlled for by the hedonic method.

8 Note that p and j have somewhat different definitions for the purposes of the IAZI index than for the index published by SNB.

4. Index Comparisons

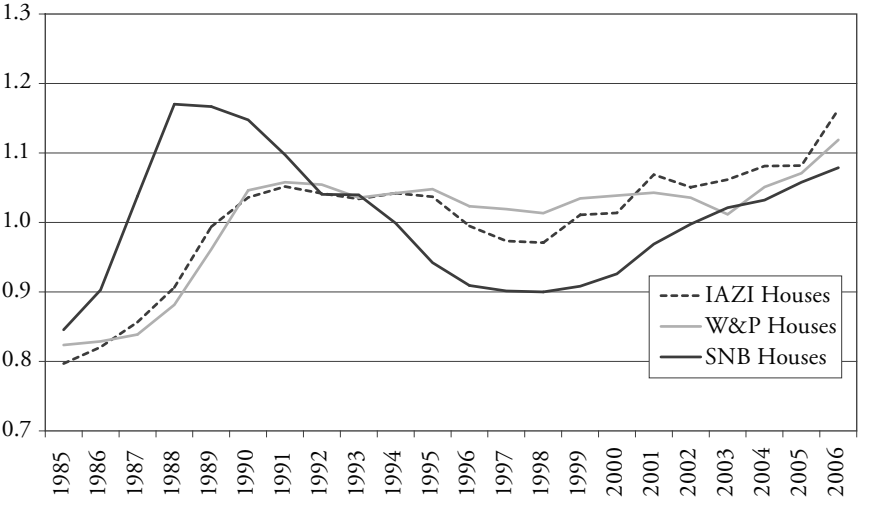
Figures 1 and 2 contain the list price indexes published by SNB and the IAZI and W&P hedonic price indexes for single-family houses and condominiums, respectively, for the period 1985 to 2006. The data are scaled so that the geometric mean of each series is equal to 1. Generally speaking, the period can be divided into three phases. Prices went up significantly during the 1980s, followed by a downturn in the 1990s, and a market rally in the new millennium. One obvious point to note from these graphs is that the two hedonic price indexes tend to track each other. The list price index tends to move in the same direction as the other two indexes, but the rate of change is greater and the peaks and troughs of the cycle – at the end of the 1980s and 1990s, respectively – are more extreme. Overall, the hedonic indexes appear to have a closer relationship with a residential rent index (not reported on the graphs) than does the list price index.[9]

The inconsistencies between the list and hedonic price indexes suggest that they are not measuring the same thing. In particular, the list price indexes may not control for quality changes in the set of properties on the market as well as the hedonic indexes do, and the quality of properties may vary with the stage of the property cycle, thus causing the list price index to deviate from the hedonic indexes. Dividing the sample of properties which are listed into subcategories can partially account for quality differences, but the number of relevant attributes is potentially quite large and, as discussed in Section 2, the hedonic framework is better suited to fully capture the multi-dimensional nature of housing markets. Sample composition changes are thus likely to explain the apparent tendency of the list price index to overstate price changes.

The advantage of indexes constructed with transaction prices and which control for the quality of properties is highlighted when regional indexes are considered. It is likely that property cycles will be more pronounced in some regions, and hence that the biases from using list prices will be greater. This is evident in Figures 3 and 4, which show the SNB and IAZI indexes for single-family houses and condominiums, respectively, for the Zurich region. One striking feature of the Zurich indexes is again the overshooting of list price indexes at the end of the 1980s. As is the case with the national indexes, the subsequent drops are very large. The list price index for Zurich condos, for instance, dropped by 35 percent in the 1990s. This is a likely consequence of compositional differences such as the lesser quality of properties which are on the market in bearish housing markets.

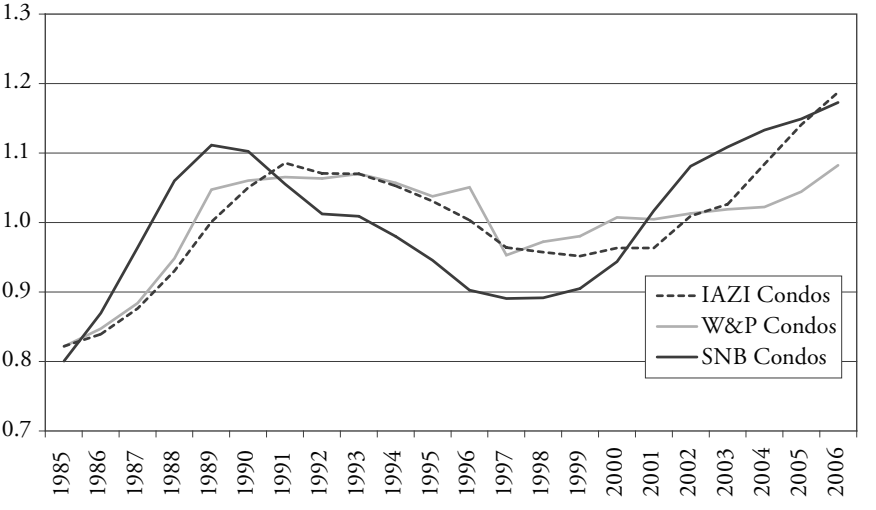
9 This rent index is reported by the Swiss Federal Statistical Office (see http://www.bfs.admin.ch/bfs/portal/fr/index/themen/05/06/blank/key/mietpreise_/index.html).

Figure 1: SNB, W&P and IAZI Indexes for Single-Family Houses in Switzerland (1985–2006)



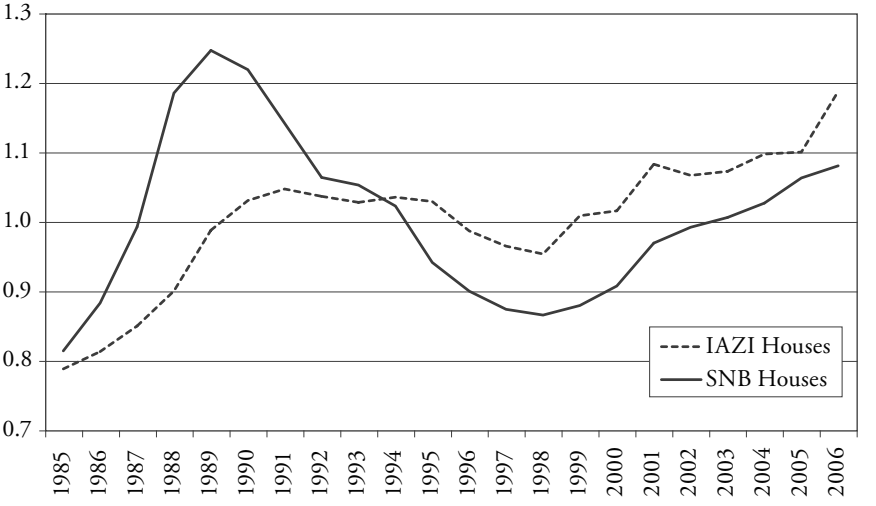
Note: Each series is scaled so that its geometric mean equals 1.

Figure 2: SNB, W&P and IAZI Price Indexes for Condominiums in Switzerland (1985–2006)



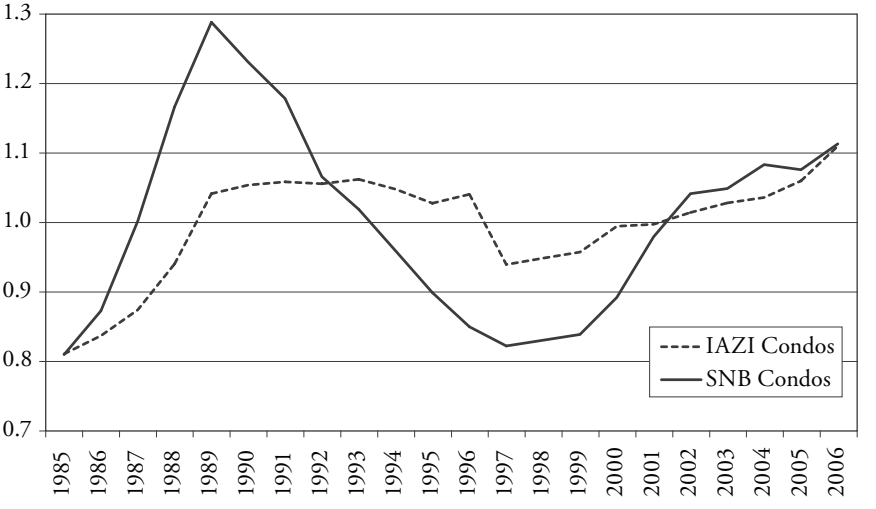
Note: Each series is scaled so that its geometric mean equals 1.

Figure 3: SNB and IAZI Price Indexes for Single-Family Houses in the Zurich Region (1985–2006)



Note: Each series is scaled so that its geometric mean equals 1.

Figure 4: SNB and IAZI Price Indexes for Condominiums in the Zurich Region (1985–2006)



Note: Each series is scaled so that its geometric mean equals 1.

To demonstrate the fact that the characteristics of properties on the market evolve over time, Figure 5 shows the median lot size of single-family houses sold over the 1986 to 2006 period, while Figure 6 shows the median size of condominiums sold over the period 1987 to 2006. Particularly notable is the fact that the size of both houses and condos tended to decrease in the declining markets of the 1990s, which could help account for the larger drops in the list price indexes relative to the hedonic indexes. Also, the same property could appear in several different advertisements in a given time period, thus exaggerating the effect of the change in sample composition. The high number of observations reported by W&P (an average of 500 000 per year after 1995) suggests that this is the case. Also, the same property is likely to appear in various time periods if the property has not yet been sold.

5. Concluding Remarks

House price indexes are needed for various reasons, but for these indexes to be reliable they should exhibit specific qualities. The most desirable property is to be constant-quality, that is to track the price changes over time of a property with unchanged attributes. The house price indexes published by the Swiss National Bank are based on medians of list prices. Although some quality control is undertaken in the construction of these indexes, the control is not likely to fully capture the complexity of housing markets. Also, the relationship between list and transaction prices could vary over time, suggesting that it would be preferable to base an index on the latter.

The aim of this paper has therefore been to compare the SNB indexes for both single-family houses and condominiums to indexes constructed using the internationally well established hedonic method. Comparisons are undertaken for the country as a whole and for the Zurich region. Our analyses suggest that there are marked differences between the two types of indexes. List price indexes have a tendency to overstate price changes in housing markets. Changes over time in the composition of the sample of properties on the market appear to account for at least part of the differences between the indexes based on median list prices and those based on hedonic modeling of sale prices.

Figure 5: Median Lot Size of Single-Family Houses Sold in Switzerland (m^2, 1986–2006)

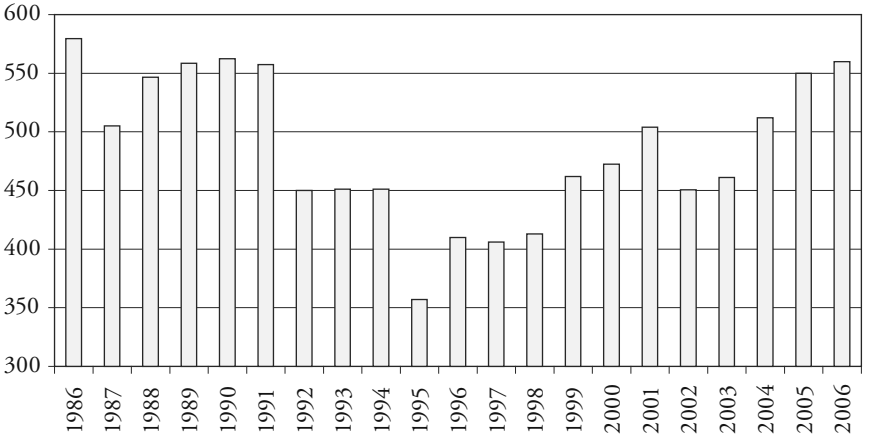
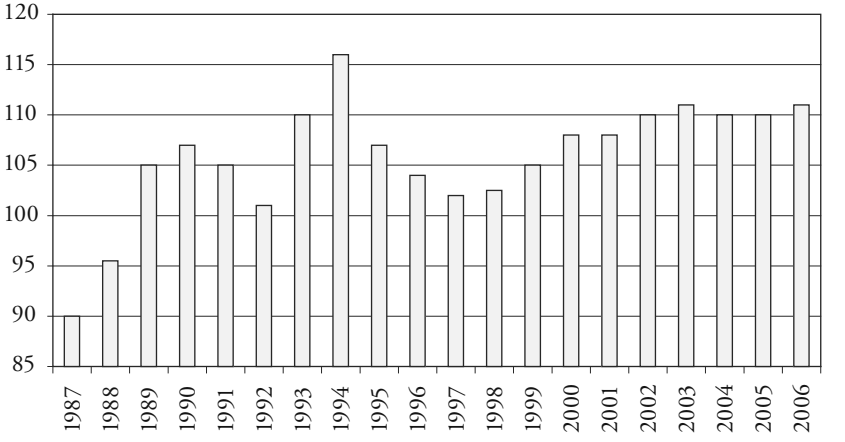


Figure 6: Median Living Area of Condominiums Sold in Switzerland (m^2, 1987–2006)



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SUMMARY

The measurement of house price movements is a vital topic from both academic and practical perspectives and hence has been the focus of much research. There is almost unanimous consensus in the literature that house price indexes should control for the quality of properties; the most widely used methods to attain this aim are the hedonic and repeat sales approaches. The objective of this paper is to compare the Swiss house prices indexes published by the Swiss National Bank (SNB), which are constructed using medians of list prices as published in newspapers and on the internet, to hedonic indexes based on sale prices for the period 1985 to 2006. We find that the list price indexes exhibit quite a different price path than the hedonic indexes during the period. In particular, they appear to overstate price changes in housing markets. We attribute this, at least in part, to changes over time in the composition of the sample of properties on the market.