Residential real estate price indices as financial soundness indicators: methodological issues

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I. Introduction

The purpose of this conference on real estate indicators and financial stability is "to promote the development of reliable, timely and consistent statistics on real estate prices" in order to support policy initiatives to promote macroeconomic stability. The recent volatility of asset prices and the Asian financial crisis of 1997 have focused attention on the role of asset markets and, in particular, real estate markets in the generation of financial crises and economic instability across nations.[2] With contagion effects driven by fast and large flows of capital, such national crises threaten global financial stability. Hence the need for monitoring devices and policy instruments to respond to the heightened potential for asset market induced global financial instability.

This paper focuses on the potential uses of residential real estate price indices as a tool to monitor asset market instability, and the methodological issues involved in their development. In Section II we examine how real estate price indices can serve as a monitoring device to help minimise financial instability. Section III reviews the methodological issues in the development of residential price indices, and Section IV provides a discussion of the availability of data in the United States to support the development of such indices. Section V discusses what we learn from the price trends revealed in the indices. Section VI concludes.

II. The use of price indices to monitor asset markets and promote financial stability

Although there are many possible empirical methods and data sources for estimating real estate price indices, not all of them can be expected to play an effective role in promoting financial stability. Before discussing the methodological and data considerations involved in developing a price index, we must consider the function of a properly constructed real estate price index in monitoring asset markets and promoting financial stability.

Fundamentally, the price of any property is equal to the present discounted value of all future services (ie housing) that will be provided by that property while it is owned by its current owner, plus the present discounted value of the price at which the owner will be able to sell the property in the future. In general, we would expect the value of housing services to change only gradually, but the future market price could change more rapidly. To take this a step further, the "market price" of any property at a given time can be defined as the highest price at which the owner would be able to find exactly one willing buyer for that property at that time. This market-clearing price, however, may fluctuate sharply over time: because of changes in the availability of particular types of housing services, because of changes in the cost of financing housing purchases, or because of changes in expectations about future increases in the market-clearing prices among other market participants.

Indeed, a market "bubble" can be thought of as an increase in the market-clearing prices that is justified only by expectations that those price increases will continue into the indefinite future, and not by current or expected changes in the value of housing services or the cost of financing. Although all types of financial instability can be disruptive, it is important to distinguish these market bubbles from

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[1] The views expressed are those of the authors and do not represent official views of the Board of Governors of the Federal Reserve System or its staff.

[2] See Mera and Renaud (2000).

what may be termed "fundamentally supported" fluctuations in asset values. Both sources of boom-bust cycles are cause for concern, but they may call for sharply different policy responses.

Property markets and real estate prices are inherently subject to booms and busts. One reason for this is construction lags: if a surge in demand pushes the price of existing property above its replacement cost, then developers have an incentive to build more properties. But new properties may take years to complete, and until the new supply is forthcoming, market-clearing prices will remain high. In the presence of construction lags, then, price increases efficiently reflect the current scarcity of housing services. Nonetheless, this increase in market-clearing prices will tend to be followed by a drop once the new supply is forthcoming. This cyclicality in asset values means that lending at any given loan-to-value (LTV) ratio during the price boom - when the demand for construction financing is strongest - may well produce a portfolio of loans with higher than anticipated LTVs when asset values drop after supply responds.

A second reason for cyclicality in asset values is the absence of short selling in real estate markets. Myopic buyers tend to extrapolate price increases into the future, even when sustained price increases are not justified by market fundamentals. In an efficient market, such price rises would be countered by non-myopic investors selling short (that is, selling something for future delivery that they do not currently own, in the hope that they will be able to buy it more cheaply later). But, due to the underlying heterogeneity of properties, there are no organised futures or options markets for individual property sales. In markets with no short sellers, prices will be driven by myopic buyers so long as the upward trend continues. Moreover, as Herring and Wachter (1999, 2002) show, in an economy in which real estate prices have risen over a long period of time with no declines, buyers typically underestimate the likelihood of an eventual downturn. That is, investors are prone to "disaster myopia", the tendency over time to underestimate the probability of low-frequency shocks.[3]

Real estate markets are made more vulnerable to fluctuations because of the role played by the banking system. As Herring and Wachter (1999) show, increases in the price of real estate raise the economic value of bank capital to the extent that banks own real estate; thus banks increase their exposure to real estate when prices are rising. Higher prices also lift the value of banks' own property holdings and hence their capital, which encourages them to relax their lending standards. If prices fall, this process goes viciously into reverse, and a credit crunch can amplify the impact of falling prices.

Moral hazard may also contribute to a bank's supply of capital to real estate, exacerbating booms and busts. To the extent that bank managers' salaries and bonuses are based on reported short-term profits without adjustment for reserves against shocks, the line officers who are in the best position to assess such dangers will be rewarded for disregarding them (Pavlov and Wachter (2004)). Moreover, Pavlov and Wachter (2003) show that, due to competitive pressures in the banking industry, all managers will be pushed to underprice the risk of real estate loans, and, additionally, bank shareholders themselves will incentivise such behaviour.

In addition to problems of moral hazard, poor information and inadequate analysis of real estate risk contribute to the vulnerability of the banking system. Banks and individual managers, besides being poorly incentivised, have little data on which to base careful analysis of future real estate prices. The property value appraisal process is based on observing the prices of comparable properties to estimate the market value of properties (and therefore LTV ratios). While lending decisions would ideally be made on the basis of long-term expectations about the market value of the property throughout the life of the loan, the observed transaction prices of comparable properties are market-clearing prices, subject to bubbles and other sources of short-term fluctuation. Moreover, prices of comparables cannot be used for appraisal purposes until after the transaction is closed, which means that price indices based on appraisals generally lag actual movements in real estate prices.

Real estate price indices can serve in two ways to reduce boom-bust cyclicality in asset value markets, and the attendant cyclicality in the banking system. First, to counter the tendency for banks and appraisers to underestimate LTV ratios by basing them on short-term real estate price booms (whether induced by bubbles or not), indices of current market-clearing prices can be compared to measurements of what might be called long-term property values. "Long-term value", for example, might be thought of as the (relatively stable) value of housing services, plus an average over the range

[3] See Tversky and Kahneman (1982) and Guttentag and Herring (1986).

of future non-bubble market values (all discounted to present value). One advantage of estimating such long-term value is that it could potentially prevent banks from financing property transactions or construction based on unrealistic expectations about future market prices. A major concern, however, is that it is far more difficult to construct indices of long-term value than of current market value. This has consequences for the availability of credit. Transactions occur only at the current market-clearing price: for example, if governments mandate that sales cannot occur at any price above (or below) the long-term value, then sellers (or buyers) will generally refuse to sell (buy) if the current market-clearing price differs from the long-term value.[4] In any case, the tendency for banks to increase exposure to real estate by liberalising LTV ratios during real estate booms can be countered.

Second, extreme volatility in the price index, or extreme differences between the index of current market-clearing prices and "long-term value", can function as a warning that a market bubble has occurred, perhaps requiring a different public policy response. While a discussion of the feasibility of developing such methodologies is a subject for another paper, it may be useful to offer some suggestions on how these analyses could be implemented. For this to work, for example, methodologies could be developed to estimate expected volatility, or the extent of deviations from long-term equilibrium values. Estimation methodologies could be based on housing cycles or on ratios that are derived from such models. Additionally, under simplifying assumptions, ratios of prices to rents could be used to uncover prevailing price change expectations (given real interest rates), which can be compared to model-generated expected price changes. Generally, actual price realisations could be compared to model-specified price outcomes through simulation based on assumptions on supply and demand functional forms. While there are many possible housing market models and the specifications would vary with the underlying characteristics of the economy, all empirical models that are designed to track current asset price realisations as compared to longer-run outcomes must first identify and measure the current market asset price of housing. As the following details, this is not a small task, conceptually or practically.

Finally, it is worth noting that moral hazard and scale economies suggest that the development of real estate price indices is an appropriate exercise of the government's regulatory function. Banks cannot be relied on to construct market-wide price indices, both because they do not individually have adequate data and because their incentive structures may oppose the collection of reliable market data. Furthermore, technology and data requirements mean that there are likely to be strong economies of scale in the development and maintenance of price indices, which suggests the value of centralised price index estimation. While there is certainly a place for private sector estimation of real estate price indices, the goal of financial stability may well best be served by the development of appropriate price indices at the central government level.

III. Methods used to construct residential real estate price indices

As noted above, there are many possible empirical methods and data sources for estimating real estate price indices, and selecting the most appropriate method and data must depend in large part on the function to be served: monitoring asset market instability and promoting financial stability. Each methodology is usually best suited to a certain type of application. In this section we discuss the different empirical methods available, evaluating the extent to which each method can be expected to further the goal of financial stability.

Four methods are commonly used to compile residential real estate price indices. The most straightforward is simply the *average* or *median price*[5] during each time period. For example, in the United States, the National Association of Realtors publishes an index giving the median price of existing single-family residential properties that transacted in each quarter for each metropolitan

[4] Some governments currently attempt to embody long-term market value in price indices constructed using judgment of local appraisers and assessors. While intuitively interesting from a policy perspective, it is difficult to judge how well such procedures have worked. Moreover, appraisers in the United States and Royal Chartered Surveyors are required to estimate the current market-clearing price, rather then long-term value.

[5] Our discussion focuses on price (at transaction), but indices may also be compiled on the basis of value (at or between transactions). Below we discuss the choice between using transaction prices and values.

statistical area (MSA) in the United States The median price is generally preferred to the average because the distribution of prices is sharply skewed, so that fluctuations in sales volume among expensive properties would have a strong effect on average selling price but a muted effect on median selling price; for some applications, however, average price might be preferable. The data requirements for this method are minimal: simply the prices at which all (or a representative sample of) properties transacted during the time period.

The major problem with this method, however, is quite substantial: it fails to control at all for changes in the quality of the properties whose prices were observed in each period. Quality, of course, tends to improve over time as new properties are constructed, older properties are demolished, and existing properties are renovated; because of this, an average- or median-price index tends to substantially overstate the increase in price for a constant-quality property, or for any existing (and depreciating) property. Moreover, the sample of properties that transacts in a given time period is not constant over time; because of this, an average- or median-price index tends to overstate price increases when all that is happening is that relatively expensive properties are overrepresented among transactions, and understate price increases when relatively inexpensive properties are overrepresented.

A second reasonably straightforward technique to track property prices, the *representative-property* method, is implemented by defining a representative property and then recording in each period the price (or value) of a property conforming to the specified characteristics. The shelter component of the US consumer price index (CPI) essentially proceeds in this way, as do some proprietary indices such as the National Real Estate Index published by Global Real Analytics. The only data item that is actually collected is the price of the representative property in each time period. In order to implement this method, the data collector must observe all of the characteristics used in defining the representative property in order to select one conforming to the definition. The major problem with this method is that data points may not be fully comparable across markets or over time, because of differences among data collectors in subjectively interpreting the definition of the representative property and applying that definition to choose a representative property. A second problem is unmeasured quality change: specifically, quality improvements that are not captured by the definition of the representative property. For example, if a property is defined with respect to location, lot size, living space, and number of rooms but not with respect to major amenities such as central air conditioning, then any increase in the prevalence of those amenities will show up improperly as an increase in the price index rather than properly as an improvement in quality. Finally, because the method focuses on the price of only one property (the representative), it does not take advantage of information contained in the prices of all other properties; in fact, in extreme cases it may not reveal the movements in the general price level if, for whatever reason, the representative property's price does not respond in the same way.

In order to avoid the problems inherent in the average-/median-price and representative-property methods, economists estimate price indices using *hedonic-price* models. These models postulate that the transaction price of any given property is a function of the time period in which it transacted as well as its hedonic characteristics - that is, the physical features of the house or lot, and the features of its location and neighbourhood, that affect the price at which it transacts. If we know the hedonic function, then regression analysis can be used to estimate the parameters of this function. For example, a common hedonic-price function is

$P_{it} = \alpha X_i^{\beta_1} e^{\beta_2 Y_i + \gamma_1 T_{i1} + \gamma_2 T_{i2} + \ldots + \gamma_n T_{in}}$ or, in logs,

$$\ln P_{it} = \alpha + \beta_1 \ln X_i + \beta_2 Y_i + \gamma_i T_{i1} + \gamma_2 T_{i2} + \ldots + \gamma_n T_{in}$$

where P_{it} is the transaction price of property i during time period t; X_i and Y_i are hedonic attributes of the property (with X measured continuously - say, square feet of living space - and Y measured discretely - say, presence of central air conditioning); $T_{i\tau}$ are dummy variables indicating whether the transaction took place during time period τ; and α, β_j and γ_τ are the parameters to be estimated. In particular, the series of parameters γ_τ is the price index.

The hedonic-price method offers several advantages over the average-/median-price and representative-property methods. First, and most importantly, the hedonic-price method controls for quality change: specifically, if there has been any change in the attributes measured X_i and Y_i - either because the quality of individual properties has changed or because different-quality properties are more likely to transact - then this quality change will be reflected in the hedonic measures rather than in the parameters (including the price index). This is a great advantage over the use of the median and average price. Compared to the representative-property method, the hedonic-price method does not

require subjectively interpreting the definition of the representative property or applying that definition to choose a representative property, nor does it fail to make use of data from other properties.

On the other hand, the method does have some disadvantages as well. The data requirements are much more onerous than for the average-/median-price method,[6] as the analyst should have data on all of the hedonic attributes of the property, as well as its price, at the time of the sale. This method potentially shares the problem of unmeasured quality change; if the hedonic measures do not capture amenities that improved over time, then any increase in the prevalence of those amenities will show up improperly as an increase in the price index rather than properly as an improvement in quality.

Another disadvantage is the problem of determining the correct model specification. The hedonic-price function must be specified correctly - that is, the analyst must use the correct "functional form" and include all relevant hedonic characteristics (ie must not have any omitted variables) in order to generate unbiased estimates of the price index.[7] Moreover, the parameters on the hedonic-price attributes (β_j, called the "implicit market prices" of the attributes) must not have changed over time, or if they have, then that must be incorporated into the functional form. Any violation of these conditions - incorrect functional form, omitted variables or changing parameters - *theoretically* will result in biased estimates of the price index. In practice, however, it appears that the hedonic-price method is quite robust to reasonably minor violations of these conditions: for example, it appears that the estimated price index will be fairly close to the true price index as long as several of the most important hedonic attributes (eg number of bathrooms) are included. Thus it seems, in practice, that the major disadvantage associated with the hedonic-price method is the cost of data collection.[8]

The onerous data requirements of the hedonic-price method (as well as of the representative-property method) have encouraged analysts to use a simpler method derived from hedonic-price models, called the *repeat-sales method*. This method takes advantage of the fact that when a given property transacts twice, many or most of the hedonic attributes of that property will not have changed at all between transactions. To the extent that this is true, the analyst need not collect data on the level of each hedonic attribute at the time of either sale; it is enough to know that the attribute has not changed. In these cases, the change in price of the property between transactions can be expressed as a simple function of the time periods elapsed between transactions. The cost and ease of implementation advantages of the repeat-sales method have made it the price index methodology of choice for large-scale applications: for example, price indices for single-family residential properties in several hundred US metropolitan areas (as well as at the national, regional and state levels) are published quarterly by both Freddie Mac and the Office of Federal Housing Enterprise Oversight (OFHEO). Nonetheless, as discussed further below, there are important measurement disadvantages in the use of such indices. Chief among these disadvantages is the need for frequent transactions. The repeat-sales methodology can only be used in markets where properties are transacted frequently and plenty of sales data are available. In western Europe, for example, the repeat-sales methodology is not useful given the small number of housing transactions. Moreover, it should be noted that repeat-sales price indices need to be combined with initial priced hedonic indices to compute comparable price levels across markets.

The repeat-sales model is derived from the hedonic-price model by expressing the ratio of the prices for two transactions of the same property as the ratio of the right-hand-side hedonic functions for those two transactions:

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[6] But no more onerous than the representative-property method: although only the price of the representative property is actually recorded, information on the full set of hedonic characteristics should be used to define and identify a representative property.

[7] Halvorsen and Pollakowski (1981) addressed the difficulty of selecting the correct functional form for a hedonic price model. Meese and Wallace (1991) proposed a non-parametric method for estimating the implicit market prices of hedonic attributes in order to avoid this problem.

[8] Constant-quality methodologies are ideal for many uses and applications such as attempting to identify a "bubble" in housing markets. In this type of analysis, the pure price signal is what should be identified and analysed in an attempt to see if pricing has become irrationally high. Nonetheless, a financial institution attempting to "mark to market" LTV ratios on a portfolio of mortgages would not want to use a "constant-quality" methodology since improvements in quality on a collateral property are real improvements in value that should be considered.

$$\frac{P_{it}}{P_{it'}} = \frac{\alpha X_i^{\beta_1} e^{\beta_2 Y_i + \gamma_1 T_{i1} + \gamma_2 T_{i2} + \ldots + \gamma_n T_{in}}}{\alpha X_i'^{\beta_1} e^{\beta_2 Y_i' + \gamma_1 T_{i1}' + \gamma_2 T_{i2}' + \ldots + \gamma_n T_{in}'}}$$ or, in logs,

$$\ln \frac{P_{it}}{P_{it'}} = \beta_1 \ln \frac{X_i}{X_i'} + \beta_2 (Y_i - Y_i') + \gamma_1 (T_{i1} - T_{i1}') + \gamma_2 (T_{i2} - T_{i2}') + \ldots + \gamma_n (T_{in} - T_{in}').$$

Because $X_i' = X_i$ and $Y_i' = Y_i$, this can be simplified to

$$\ln \frac{P_{it}}{P_{it'}} = \gamma_1 (T_{i1} - T_{i1}') + \gamma_2 (T_{i2} - T_{i2}') + \ldots + \gamma_n (T_{in} - T_{in}')$$

where P_{it}' is the transaction price at the time of the previous sale; X_i' and Y_i' are the hedonic attributes of the property at the time of the previous sale; $T_{i\tau}'$ are dummy variables indicating whether the previous transaction took place during time period τ; and the series of parameters γ_τ is the price index. Two points are worth noting about the right-hand side of this equation. First, the expressions $T_{in} - T_{in}'$ take the values –1 during the time period of the first transaction, +1 during the time period of the second transaction and 0 otherwise. Second, any property that sold at least twice[9] *in different time periods* can be included in the analysis, but if all transactions of that property occurred during the same time period, then the property must be dropped from the analysis because all terms on the right-hand side will have the value 0.

As noted, the major advantage of the repeat-sales model is that it requires little data collection. This applies so as long as it is known that none of the relevant hedonic characteristics of the property have changed between transactions. However, it is easy to overestimate this advantage in practice, because an analyst must have some reliable way to determine whether, indeed, the property's characteristics have remained constant. This generally means that the practical data requirements of the repeat-sales model are quite similar to those of the hedonic-price model or, alternatively, the potential that an index increase is simply due to quality increases cannot be determined.

In practice, analysts generally assume that hedonic attributes have *not* changed between transactions, and this assumption of course greatly reduces the data collection burden. This assumption, however, is not generally true, and for this reason the unmeasured quality change introduces an unknown positive bias into the estimated price index, thus undermining its use in monitoring unsustainable price increases.

An advantage of the repeat-sales model is that it automatically controls for *all* hedonic characteristics that remained unchanged between transactions, whereas the hedonic-price model controls only for those that are measured. Because of this, the repeat-sales method makes more efficient use of the information contained in repeat transactions of a given unchanged property. There is a major cost associated with this, however: because it uses information only on transactions of those properties that sold at least twice during the study period (and remained unchanged between transactions), the repeat-sales method ignores a very large amount of potential information from transactions of properties that sold just once during the study period (or that changed between transactions). The number of property transactions ignored in this way varies with the length of the study period and the level of market activity, but generally is the great majority of available transactions.[10]

Another disadvantage of the repeat-sales model is the changing-parameters problem discussed above in connection with hedonic-price models: the parameters on the hedonic-price attributes (β_j, the implicit market prices) must not have changed over time, or if they have, then that must be incorporated into the functional form of the hedonic-price equation. In the standard repeat-sales formulation, however, there is no way to modify the functional form of the equation to incorporate

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[9] If a property has transacted more than twice during the study period, then each observation (transaction pair) on that property must be weighted to correct for collinearity in the disturbance terms. See Bailey et al (1963) and Palmquist (1982).

[10] Moreover, properties may be more or less likely to transact depending on whether prices are increasing rapidly or slowly (or declining), in which case a repeat-sales price index could potentially be biased. Note that this problem of sample selection bias would also exist for hedonic-price methods, but would be much less serious even than for repeat-sales methods.

changes in implicit market prices; instead, the effect of the changed implicit market prices will be improperly reflected in the price index.[11]

This disadvantage, together with the other shortcomings of the repeat-sales method - failure to use information from properties that transacted just once, (measurable) changes in hedonic attributes, and changes in implicit market price parameters - motivated the development of a hybrid model that combines attributes of both the repeat-sales and the hedonic-price method.[12] The essence of hybrid models is that they "stack" repeat-sales and hedonic models, and then estimate the two models imposing a constraint that estimated price changes over time are equal in both models. In effect, such methods are weighted averages of the hedonic and repeat-sales methods. The evidence suggests that repeatedly sold properties may differ in unobserved ways from other properties, in which case the stacking method induces measurement error. While such indices, unlike hedonic or repeat-sales indices, do use all available information, Case et al (1991) do not find clear efficiency gains from using the hybrid model instead of the hedonic approach.

IV. Types of price data with which to create residential price indices

In addition to the wide variety of empirical methods available, there are also many different types and sources of data that could be used to construct real estate price indices. As we discuss in this section, however, few of these data sources would support the development of reliable price indices that can be expected to promote the goal of financial stability.

In the United States, there are several sources of data on real estate prices or values, some collected by government agencies and provided to the public free of charge, others collected privately and kept private or offered for sale. The Census Bureau of the US Department of Commerce, for example, provides data on sales price, and median and average prices, on an annual and quarterly basis, for *New Houses Sold* and another set of price indices for *Median Prices of Existing Family Dwellings*.[13] The major limitation of these data series is the overstatement of house price appreciation, because they do not account for the changes in quality that occur over time. The Census also constructs, based on new construction, a *Constant-Quality Pricing Index*, since 1978, although its value is lessened due to its geographical limitations. A set of statistical models relating sales price to selected standard physical characteristics of house units is used to derive the average price for a constant-quality unit. Generally, the geographic distribution of these indices is limited to an aggregate index of the United States and the four major census regions.[14] An issue to be considered when prices are based off new construction is where the new construction occurs. Because new construction is likely to occur on the fringe of urban areas where supply is elastic, such indices may underestimate property price appreciation. For example, price appreciation of newly constructed homes in suburban Rhode Island or Massachusetts would not be comparable to the appreciation rates of condominiums in downtown Boston. New construction methodologies therefore may not pick up the effects of land scarcity in a market, and may tend to underestimate overall market price appreciation for this reason.

A second US government source for house price data, the CPI published by the Bureau of Labor Statistics of the US Department of Labor, is constructed using the representative-property method.[15] The largest part of the CPI's housing series is in the shelter category,[16] which covers rent of primary

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[11] Shiller (1993) showed that a generalisation of the standard repeat-sales formulation, however, permits the estimation of a separate price index for each hedonic attribute.

[12] See Case and Quigley (1991).

[13] These data are constructed by the National Association of Realtors (NAR), who also release a quarterly, quality-unadjusted series for a panel of large MSAs based on median prices from the local Board of Realtor Multiple Listing Service.

[14] In addition, the decennial census data record house prices and rents, and publish median values for MSAs and even smaller jurisdictions.

[15] See http://www.bls.gov/cpi/cpifact6.htm for more information.

[16] Other parts include the price of household furnishings, appliances, utility services, etc.

residence[17] and owner's equivalent rent (far and away the most heavily weighted item in the overall series). Owner-equivalent rent is constructed from data provided by homeowners themselves. Homeowners are asked what their unit would rent for.[18] This methodology appropriately calculates changes in owner user costs and, by design, it does not measure changes in house prices or values. As discussed above, change in the owner-equivalent rental component of the CPI can be compared to value change as an indicator of asset price inflation relative to changes in the price of the underlying stream of housing services, but it cannot be used to measure house price inflation.

A third source of price data is mortgage transactions, which are used for repeat-sales price indices provided by OFHEO. As federal regulator of the two government-sponsored enterprises (Freddie Mac and Fannie Mae), OFHEO has access to the nation's largest database of mortgage transactions, over 23 million repeat transactions on conforming, conventional single-family loans insured by the GSEs. Both OFHEO and Freddie Mac make quarterly series, organised by census division, state, MSA, or national, available on their website, free to the public. The indices are easily downloadable in Excel or text format, generally two months after quarter-end. The national, census division, and state series are available back to 1975, but the MSA series have different starting points because an MSA series is only published if at least 1,000 observable transaction pairs exist in the area. One advantage of these data is the high frequency, but this also leads to frequent revisions. Each quarter, recent mortgage transaction data from the GSEs are combined with past data and calculations are then performed on this updated dataset. The index is created by looking at all properties which have been sold at least twice and comparing the two sale prices using a modified Case-Shiller method.[19]

A disadvantage of the OFHEO and Freddie Mac series, besides those discussed above that are generic to repeat-sales price indices, is their limited geographical coverage. Private analysts, such as Case and Shiller (1989, 1990), present basic results for an additional but still limited number of locations. The private firm Fiserv CSW (formerly Case-Shiller-Weiss) and a collaboration of the research departments of Fannie Mae and Freddie Mac have produced such indices for a wide range of MSAs and smaller areas; however, the small area indices are proprietary and not readily available for research purposes.

Most of the discussion in this paper has been phrased in terms of a price index based on property transactions, but that is not the only type of data that can be used (or that is commonly used) to compile residential real estate price indices. The advantages of using actual sales prices from property transactions are, first, that sales prices (from arm's length, non-coerced transactions) represent the most reliable indicator of the actual market value of any given property; and, second, that data on sales prices may already be readily available if they are collected for the administration of real property taxes, transfer taxes, deed recording fees, or other public purposes. The disadvantages of using sales prices from property transactions are, first, that during a given study period only a fraction (generally a small fraction) of all properties will have transacted even once; and, second, that if some properties are more or less likely to transact depending on whether prices are increasing rapidly or slowly (or declining), then the use of transaction prices may introduce sample selection bias into the estimation of the price index. These disadvantages appear to be minor compared to the quality advantage of data from actual market transactions.[20]

It is also possible, however, to compile residential real estate *value* indices from observations on what is believed to be the underlying market value of a given property, as opposed to the price observed (only) when that property transacts. Perhaps the most straightforward source is estimates of the market value of each property that are recorded for the purposes of assessing real property taxes,

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[17] Shelter also includes lodging away from home, housing at school, excluding board, other lodging away from home including hotels and motels, and tenant's and household insurance.

[18] From 1987 to 1998, CPI data collectors gathered information from the owners to calculate an appropriate initial, implicit rent. Changes for similar (based on structure and attributes) renter-occupied units were then applied to the initial value to calculate changes in owner-occupied implicit rents. Since 1998, the rent index of the survey has simply been reweighted to rents on the CPI Housing Survey.

[19] http://www.ofheo.gov/Media/Archive/house/hpi_tech.pdf.

[20] For owner-occupied multifamily rental properties, price indices that are based on transactions may reflect variation in liquidity over the business cycle, which affects the ease with which owners are able to sell properties. Fisher et al (2003) propose a constant-liquidity price index method, and find that movements in the constant-liquidity index tend to lead movements in a transaction-based index.

which are imposed almost universally in the United States. Real property tax assessment records are readily available in any jurisdiction that imposes the real property tax, and they are established regularly, generally every year. Unfortunately, real property tax assessment records are generally considered to be of very poor quality. Even if they are updated annually, the updating process may bear little relation to changes in the market price level, for several reasons. First, for simplicity most jurisdictions adjust the assessed values of all properties within the jurisdiction by the same factor, regardless of whether prices in parts of that jurisdiction have increased more or less rapidly than the average. Second, the adjustment factor is set through a political process that need not reflect actual market fluctuations. Third, assessed values for individual properties may be set closer to market prices only when those properties transact; indeed, in some jurisdictions (such as California) assessed values may be explicitly prevented from adjusting to the same extent as market prices. Finally, homeowners are much more likely to challenge the estimated values on which their property tax assessments are based when those values have increased sharply, so property tax assessment records generally tend to understate the actual pace of property value increases. For these reasons property tax assessments are rarely, if ever, used as residential real estate value indices in themselves.

A much more commonly used source of market values is records from private appraisals, which are generally conducted in connection with mortgage transactions - whether purchase-money mortgages upon a property transaction, or mortgage refinancings. Indeed, in the United States the indices published by Freddie Mac and OFHEO both include appraised values from records of refinanced mortgages purchased by Freddie Mac (and, for the OFHEO index, Fannie Mae). The quality of private appraisals is probably much higher than the quality of property tax assessment records, but appraisals may still differ sharply from underlying market values because of the subjectivity of the appraisal process, particularly if the subject property did not transact at the same time and there were few transactions of closely comparable properties during the same time period. Moreover, appraisal-based price indices may suffer from sample selection bias, especially since homeowners may be more or less likely to refinance their mortgages if property values are increasing rapidly.[21] For these reasons, economists have found that price indices based on appraisal records tend to be smoother than price indices based on transaction records and tend to misrepresent the times at which market prices reach their peaks or troughs. Also for these reasons, in the United States both Freddie Mac and OFHEO are considering deleting appraisals that were conducted in connection with mortgage refinancings from the computation of their price indices.

Another source of information on property values is records on listing prices of properties offered for sale: for example, various local multiple listing service (MLS) databases in the United States have been used to construct value indices. The advantages of these data are that (1) listing prices are established with the assistance of real estate agents, who may have especially good judgment regarding the value that would be assigned to each property in a well functioning market, and (2) the number of properties listed for sale during any time period is even greater than the number of property transactions. The disadvantages of these data, however, are closely related to the advantages. First, listing prices may differ sharply from underlying market values, partly because neither real estate agents nor homeowners may be good judges of market value and partly because they may in fact have incentives not to equate the listing price with the market value. Second, properties with particularly low listing prices relative to market value can be expected to transact quickly, while properties with particularly high listing prices relative to market value can be expected to remain on the market for a long time and perhaps never transact. For these reasons listing prices are generally not considered a reliable source of market value data.

Nonetheless, the underlying data collected on assessments and listing prices have themselves been used in estimation of hedonic indices (Clapp and Giacotto (1992)). Moreover, the underlying data on sales transactions, including prices, date of sale, and housing attributes, collected by the MLS and by municipalities, are potentially valuable for the construction of price indices. Appraisal and assessor

[21] In addition, some property appraisals may be motivated not by mortgage transactions but simply by the observation that the pace of market price increases seems to have changed significantly. This is much less common among (single-family) residential properties than among commercial properties (including multifamily residential properties), but should be recognised because price indices based on appraisals that are motivated in part by sharp increases, or declines, in the general property price level can be expected to suffer from sample selection bias.

agencies are moving towards using these data for statistical-model based price estimation. Assessors are incorporating hedonic methodologies in computer-assisted mass appraisal (CAMA) and appraisers are using automated valuation methods (AVMs) for desk review appraisals and for mortgage underwriting. Thus lenders and municipal authorities are increasingly making use of statistical methods to estimate the market value of homes; these technologies also have the potential to generate standardised[22] hedonic local area residential price indices.

A final source of market values is simply a survey of homeowners requesting that they assess the value of their own properties. The American Housing Survey, for example, records owner-assessed property values, and these values have been used to construct value indices.[23] In principle, owner-assessments can provide a useful source of market value information, as homeowners (1) are particularly knowledgeable about the condition and amenities (structural and locational) of their properties, and (2) often observe market prices of comparable neighbouring properties. However, property owners are not necessarily good judges of the value that would be assigned to their properties by a well functioning market. Indeed, economists have found that homeowners tend to overestimate the market values of their properties, and tend furthermore to underestimate the rate of increase in the market values of their properties (Kiel and Zabel (1999)). For this reason owner assessments are generally not considered a reliable source of market value data with which to construct property value indices. Nonetheless, these data have been used by researchers to construct hedonic indices for the United States. For example, Malpezzi et al (1980) used AHS data from the 1970s to construct constant-quality indices for a sample of MSAs. This work was subsequently updated and expanded by Thibodeau (1992, 1995).

V. What stories do the US residential real estate price indices tell?

The most important story told by residential price indices about the US residential real estate market is that, in the long run, housing price increases in the United States have tracked increases in the overall price level quite closely. Graph 1 below shows the overall CPI, CPI Rent, CPI Owner-Equivalent Rent and Census Constant-Quality price indices from 1979 to 2002. The growth rates of these indices over this roughly 20-year period were similar; however, the close relationship between housing prices and overall prices often does not hold over short time periods. For example, in Graph 2, year-over-year growth rates in the CPI, CPI Housing and Census Constant-Quality indices are shown from 1997 to 2003. In six of the seven years since 1997, the appreciation in the CPI Housing index has exceeded the growth in the overall CPI index. However, using the growth of the Census Constant-Quality index as a measure, the housing price growth rate was significantly higher than the growth of the overall CPI and CPI Housing indices only in 2002.

In order to determine if there is currently a “bubble” in US residential real estate, it is important to look not only at housing price increases, but also at rent increases. If house prices are appreciating rapidly, this does not necessarily imply that a “bubble” exists if rent prices are increasing just as rapidly, since consumers are rationally pricing increasing rents into owner-occupied housing units.

The data in Graphs 1 and 2 do not demonstrate the existence of a bubble in US residential real estate markets. Over the past seven years shown in Graph 2, rents and constant-quality appreciation have been very similar, and in most years appreciation in rents (CPI indices) has actually been higher than growth in constant-quality home prices. While the ratio of CPI Rent index to the housing price, using the Constant-Quality index, does not show any decline, some private data collected on rents do imply declining rents over 2001 and 2002 that, when coupled with increasing constant-quality house prices, could lend some strength to arguments that a “bubble” does exist. Private data compiled by REIS, RERI and others show rents declining over 2001 and 2002. These indices include only effective rents on newly leased properties, and do not consider rental increases on properties which are already

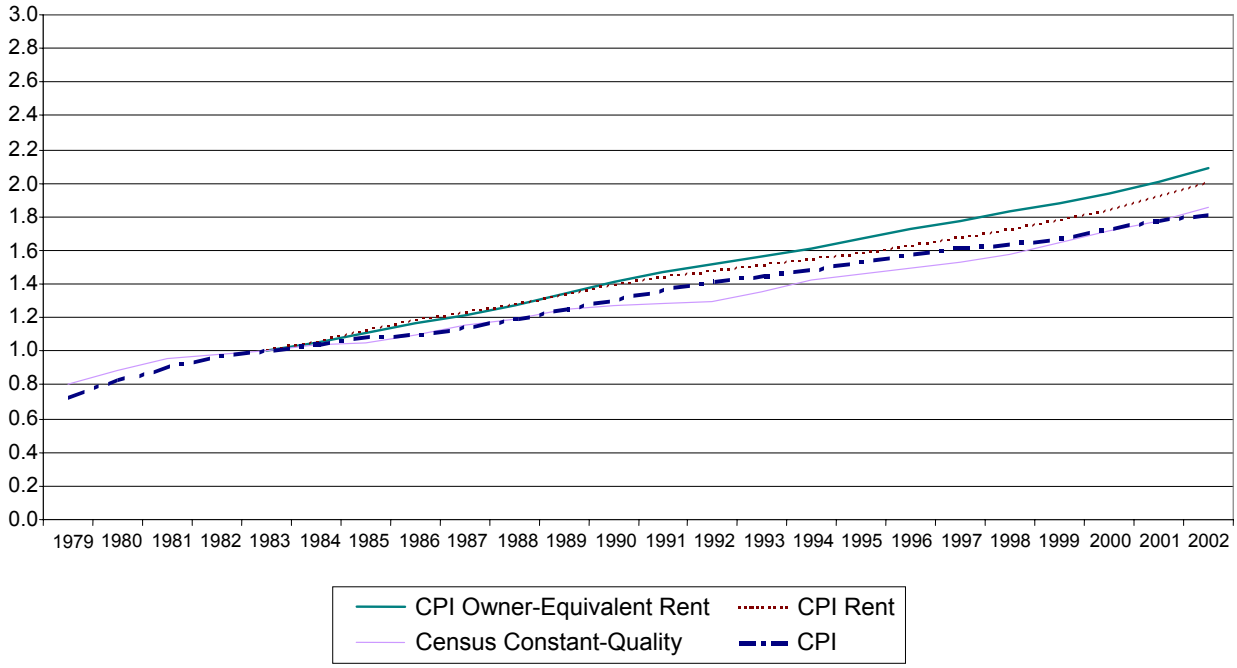
[22] Some municipalities collect information on numerous housing attributes, others on few. However, the use of geographical information, which is available for all municipalities, can substitute for an inclusive list of attributable variables.

[23] To supplement the decennial census, the Commerce Department releases the American Housing Survey, started as an annual survey in 1973 and changed to a biannual one in the early 1980s. Currently, the AHS covers about 50,000 housing units throughout the United States.

leased. These data therefore may more accurately reflect the current state of rental markets, rather than the "smoothed" CPI indices that include rents and escalations on existing leases.

Graph 1

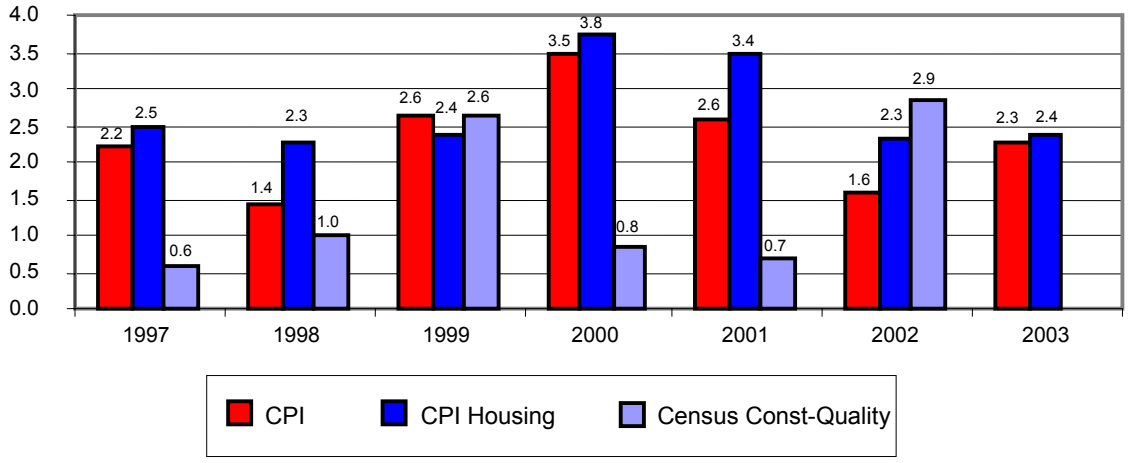
CPI vs Census Constant-Quality, CPI Rent and CPI Owner-Equivalent Rent - 1979-2003 (1983 = 1.0)



Graph 2

Annual growth in overall CPI, CPI Housing and Census Constant-Quality Indices, 1997-2003

September-September (in per cent)

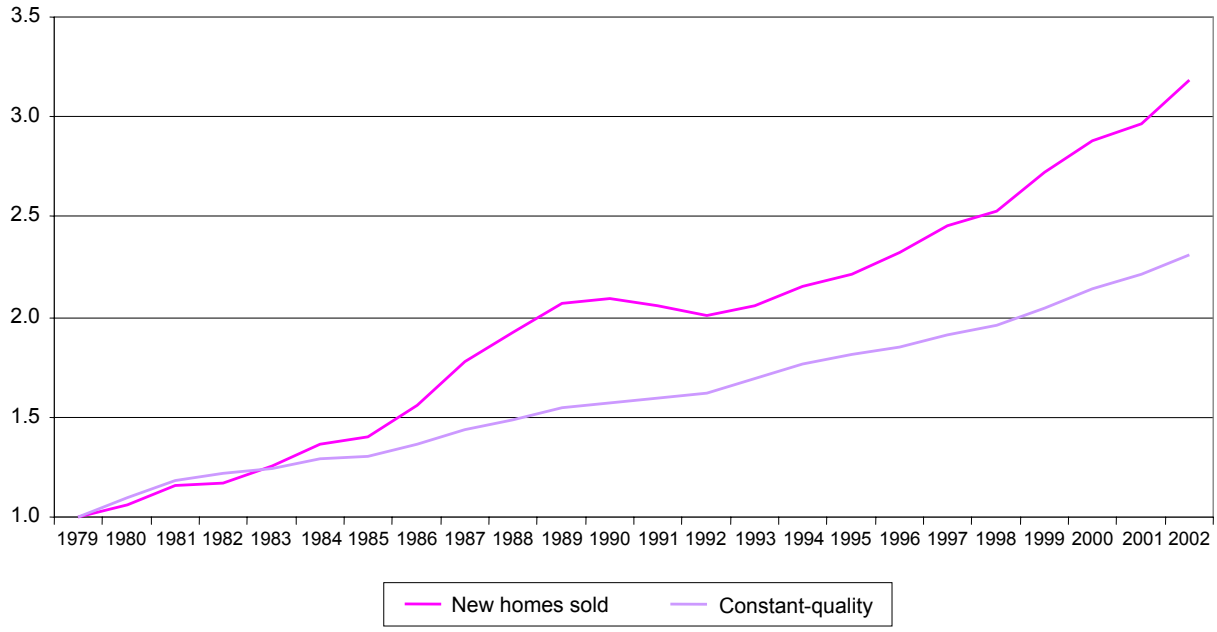


It should also be remembered that the recent accelerating growth in constant-quality prices shown in Graph 2 above is within a range of increases that would be predicted given the tremendous declines in mortgage rates experienced over the past 10 years. While some observers consider the effects of declining interest rates on housing prices a "bubble", it is important not to confuse a "bubble" with a commonly experienced cycle. Bubbles usually refer to irrational asset pricing, but consumers have been completely rational to bid up home prices as interest rates have declined. However, this is not to say that housing prices will not experience some weakness as the cycle turns, and consumers bid lower amounts due to increasing interest rates.

While "headline" price indices, such as means and medians, have shown rapid growth in recent years, it is important to remember that these numbers are influenced by increasing quality of housing, and are not representative of pure price inflation. In Graph 3, a price index for new homes sold is compared to a constant-quality price index. The much greater increase in new home prices when compared to the increase in constant-quality prices shows that Americans are increasingly demanding much better quality in their housing, and that this demand is driving overall housing transaction prices higher. However, one must remember that this quality-related appreciation is not a "bubble", since consumers are paying more for a better product, a completely rational economic behaviour.

Graph 3

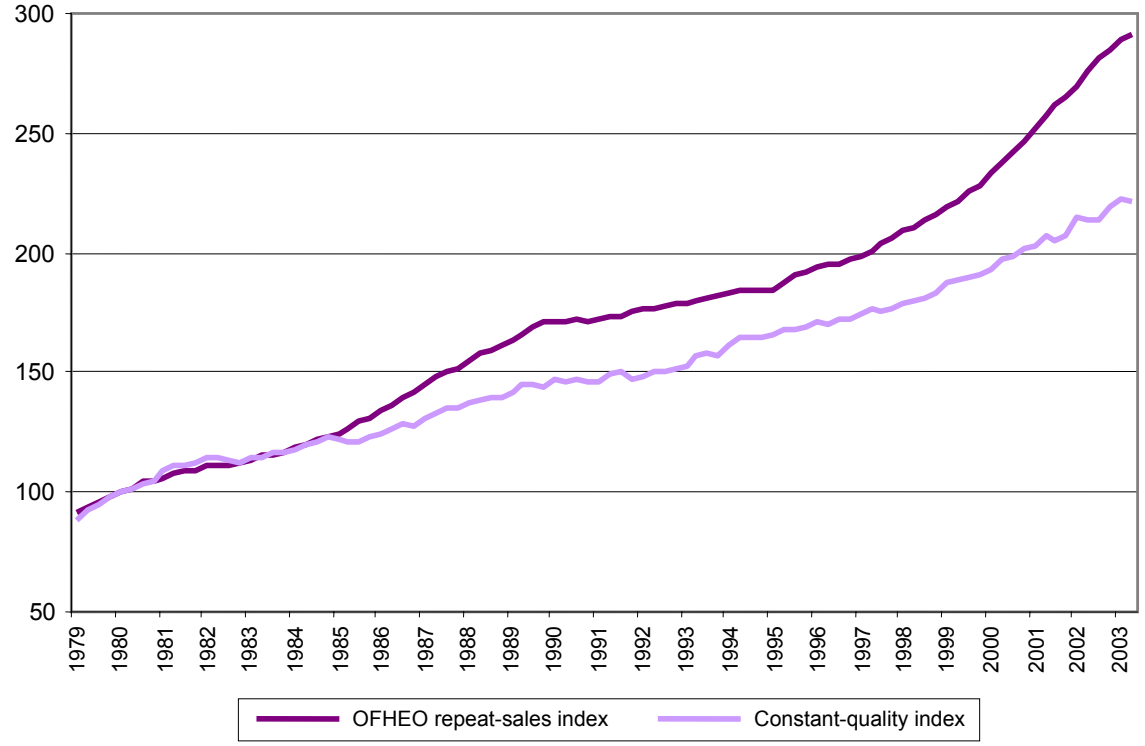
Price indices for new homes sold vs constant-quality price index
1979-2003



Many people feel that repeat-sales indices control for changes in housing quality, but, in reality, this is not the case. The quality of a single house is not static between transactions, since owners may renovate, expand, or make other quality improvements to the property. The data shown in Graph 4 bear out this hypothesis. In the graph, the OFHEO repeat-sales index is compared to a constant-quality index. Since 1985, the OFHEO index has increased much more rapidly than the constant-quality index, showing that repeat-sales indices do not fully control for changes in housing quality since owners may improve quality between transactions. While this does show real positive investment in the nation's housing stock, this is not to say that this investment in quality will continue indefinitely. If interest rates increase, demand for real estate may decline, and the current investment in real estate quality may prove excessive.

Graph 4

OFHEO repeat-sales index vs constant quality index, 1979-2003



One important caveat to the above analysis is that all the indices used were national, and while they do not seem to imply the existence of a national residential real estate bubble, it does not follow from this that bubbles do not exist in any individual regional markets. Real estate markets are regional in nature, and anyone who wishes to analyse the state of the market should rely more heavily on regional price indices of interest rather than aggregated national indices. Individual markets or regions can have vastly different current situations and historical experiences with real estate pricing and appreciation than does the nation as a whole.

VI. Conclusion

The organisers of this conference have recognised the fundamental connection between real estate markets and financial stability, and therefore the need for prudential supervision and monitoring of real estate markets. Because banks are exposed to cyclicality in real estate markets, and because banks' incentive structures may lead them to exacerbate boom-bust cycles in real estate markets, fluctuations in real estate prices have the potential to strain financial stability and even to jeopardise entire financial systems. In countries in which banks play a dominant role - such as Japan, where banks hold some four fifths of total assets - the consequences for the real economy can be severe.

In particular, for several reasons, banks are liable to increase their origination of real estate loans at the same time that short-term, market-clearing asset prices are at their peaks. As asset prices revert to their longer-term values, however, the result is that banks hold portfolios of loans with higher LTV ratios than anticipated. To counter this tendency - whether it is associated with market bubbles or simply "fundamentally supported" price fluctuations - it is necessary to continually monitor real estate markets, in particular to challenge weakening of underwriting standards when short-term asset prices are rising. This task requires the development of reliable real estate price indices.

There is a wide variety of empirical methods and data sources that could be used to construct real estate price indices; as we point out in this paper, however, not all can be expected to support the goal of financial stability. One straightforward method, for example, simply reports the average or median price of houses transacting during each time period. This method, however, fails to control at all for quality changes or for changes in the mix of transacting properties; thus it presents a picture of asset price movements that is both biased upwards (because quality increases over time) and unreliable (because the mix of transacting properties may change during different parts of the market cycle). A second straightforward method, reporting the price of a representative property, is not well suited for measuring residential property asset value, since such properties transact infrequently.

The hedonic-price method offers a way of avoiding the quality change, comparability and narrowness problems associated with the first two methods; unfortunately, the data required to estimate a hedonic-price model make this method relatively expensive to implement. Because of this, perhaps the most reliable price index method in wide use in the United States, for the nation as a whole as well as for the states, is the repeat-sales method, which requires only two pieces of data (transaction price and date) along with the troublesome assumption that no relevant characteristics of the property changed between transactions. Hybrid models offer the potential to improve on repeat-sales methods where additional data are available, but have not yet been shown to be appreciably superior to repeat-sales methods.

Several data sources could be used to estimate real estate price indices, but many of these are unsuitable for the purposes of monitoring asset markets and promoting financial stability. Owner assessments of property value, property listing prices, and property tax appraisals all suffer from severe problems of bias and unreliability. The best source of data is records of property transaction prices and dates. In the United States, these records are commonly collected and made public in local real property tax assessment systems, many of which also contain records of hedonic property characteristics, thus offering the potential of hedonic-based residential price indices for local areas.

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A comparison of UK residential house price indices

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Summary

The measurement of house prices poses significant conceptual and practical problems, mainly because dwellings are heterogeneous assets whose prices can only be observed when they are sold. There are now seven main house price indices for the United Kingdom. In broad terms, each measures one of three different concepts: the *value* of a representative set of house transactions; the *price* of a house with "typical" characteristics; the *value* of the housing stock. The indices are constructed from different data using different methods. Consequently, the available measures of house prices can give conflicting or misleading signals about house price inflation.

The data and methods used to construct the indices can vary in three key respects: the point in the house purchase process at which the price is measured; the techniques used to adjust for differences in the characteristics of houses; and the weighting scheme used. Indices that measure the price earlier in the purchase process are able to detect price changes first, but will measure final prices with error because prices can be renegotiated extensively before the deal is finalised. This is not necessarily a disadvantage, because it is useful to have a measure of prices at each stage of the purchasing process and those indices measuring prices earlier in the purchase process may lead other indices. Quality adjustment aids interpretation of price changes, and can have significant effects on measured house price inflation. A variety of methods and specifications are used, each with advantages and disadvantages. The choice of weighting scheme allows the index to measure different concepts of house prices and movements in price for different sets of dwellings. Again, a variety of methods are used.

All the available indices have advantages and disadvantages so it is important to look at a wide range of indicators and examine the reasons for the differences between them. Observers and policymakers must always be careful to match the measure of house prices they use with the concept they are interested in, and to ensure that the information in short-run changes in house price inflation is not over-interpreted, because sampling and estimation error in monthly and quarterly house price inflation rates appears to be substantial.

1. Introduction

As with many economic statistics, the measurement of house prices poses significant conceptual and practical problems. This is mainly because dwellings are heterogeneous assets whose prices can only be observed when they are sold. The United Kingdom does not have a definitive dataset of all the characteristics and prices of all transacted houses so there has been, and is, significant scope for various organisations and government departments with access to different proprietary or public datasets to each produce a house price index.

There are now seven main house price indices in the United Kingdom, three of which are "official" indices, in the sense that they are constructed by different government departments; two are

[1] The views expressed in this paper are those of the author, and not necessarily those of the Bank of England. I am grateful for helpful comments and suggestions from Gregory Thwaites, Simon Whitaker and Ian Bond, any remaining errors are my own. Robert Wood, Structural Economic Analysis Division, Monetary Analysis, Bank of England, Threadneedle Street, London, EC2R 8AH; e-mail: Rob.Wood@bankofengland.co.uk.

constructed by the Office of the Deputy Prime Minister (ODPM) and one by the Land Registry.[2] A further two are constructed by two of the main mortgage lenders in the United Kingdom; HBOS (formerly the Halifax Building society) and the Nationwide Building Society. Finally, two companies with an interest in the housing market, Hometrack and Rightmove, have introduced indices in the last few years. In addition to these indices there are two main survey based measures of house price inflation, produced by the Royal Institution of Chartered Surveyors and the House Builders Federation, and a number of less well known indices and surveys some of which are regional or concentrate on specific market segments (such as Buy to Let purchases).

The data and methods used to construct the indices vary. This is because there are several valid concepts of house prices - such as the average transaction price, the price of a typical house and the housing stock deflator - and the methods to calculate each are different. However, the methods used vary even within the set of indices measuring each particular type of house price. The data used are often proprietary to the institution constructing the index.

These issues introduce significant complexity and confusion into determining house price movements in the United Kingdom. The range of available measures of house prices almost always give different estimates of the rate of house price inflation and since the indices use different methods and samples it is difficult to analyse why there are differences. This paper compares the available indices in the United Kingdom; both their construction methods and their outturns. Since there are seven main house price indices that is a difficult task. The focus of the paper, therefore, is to try to identify the advantages and disadvantages of each method relative to the other methods. The paper then compares the outturns of the indices with a view to highlighting the importance of the different methods.

The next section considers how house prices could be measured, and sets up a framework for categorising the various methods and data sets that can be used to measure prices. The third section then categorises the available residential house price indices and compares the methods used to construct the various indices. Section 4 compares the outturns of the indices with a view to considering the impact of the different methods used to construct them.

2. Methods and data sets used to construct residential house price indices

2.1 Why are house prices difficult to measure?

The price of housing is harder to measure than that of most other goods and assets because of three key distinguishing characteristics. First, and most importantly, dwellings are heterogeneous. No two dwellings are identical, if only because they cannot occupy quite the same location. This means that sampled house prices may be a poor indicator of all house prices because we cannot always reliably predict the sales price of a given dwelling from the price of another.

Second, the market price of a given dwelling cannot easily be observed without it being sold. Dwellings are typically transacted at a price reached through negotiation or at auction, so the advertised price can be a poor guide to the eventual selling price. The set of observations that can be used to estimate house prices is therefore usually restricted to transactions prices, so the mixture of prices that can be observed will be determined by the types of houses transacted in any given period. There is, however, no definitive dataset of all the characteristics and prices of all transacted houses in the United Kingdom. Consequently, many similar house price indices can coexist because they use different, mostly proprietary, datasets.

Third, houses are generally sold infrequently: over the 1990s the number of private dwellings sold per year was around 7% of the stock. At that rate, each house would be sold, on average,

[2] The Financial Times (FT) has recently begun publishing an index that is a forecast of a monthly and seasonally adjusted version of the Land Registry index.

approximately once every 14 years. So the most recent price observation for a given house will be, on average, seven years old, and will therefore be an unreliable guide to the price it would fetch today.

As well as prices being hard to measure, there is no single definitive concept of the UK house price. A simple average of transaction prices in a given period has a clear interpretation: the mean price of houses sold in that period. This is a useful measure if one wants to estimate the value of turnover in the housing market (which will be related, for example, to stamp duty receipts and estate agents' turnover). But, we may equally well be interested in the value of the total housing stock - sometimes referred to as housing wealth - or the price of a representative house. To calculate indices consistent with those other concepts the data must be quality adjusted - because changes in the mean price over time may reflect changes in the mix of houses being sold rather than in the value of the stock of dwellings or the price of a typical house - and weighted correctly - because the mix of houses sold each period is unlikely to be a consistently reliable indicator of the mix of houses whose price the index is trying to measure eg the mix of houses typically transacted or the mix of houses in the housing stock.

2.2 Methods for quality adjusting data and their advantages and disadvantages

Constant-quality measures of house prices try to standardise, and make comparable over time, the information available in the data, to overcome the limitations of simple averages. Three main methods can be used: hedonic regression; mix-adjustment; and the repeat-sales method:

- *Hedonic regression*. The price of a house depends on its location and its physical characteristics. Hedonic regression is a way of estimating the value the marketplaces on each of those attributes. The estimates are then used to construct the price of a synthetic house with a representative amount of each characteristic.

- *Mix adjustment*. House price observations are grouped into sets or "cells" of observations on houses with similar location and physical attributes. For instance, the old ODPM index contained around 300 cells (the new ODPM index contains around 150,000 cells). The mean prices in each cell are weighted together to give a "mix-adjusted" price. A change in the composition of the sample will alter the number of observations in each cell. But if the cells are defined sufficiently precisely, so that all elements of the cell have similar prices and price trends, then such compositional changes will not systematically affect the mix-adjusted house price.

  The mix-adjustment and hedonic regression techniques can give very similar results if they control for the same house characteristics.

- *Repeat sales*. Both of the previous methods require a large number of dwelling characteristics to be recorded if they are to be reliable. In some cases this information is not readily available. Instead, there may be information on the history of transactions for a large sample of dwellings, which allows us to examine the price changes of individual houses. Observing the sale prices of a given house at two points in time will give an estimate of general house price inflation between those two transactions. With a sufficient number of estimates from partially overlapping periods, house price inflation could be estimated. No repeat sales indices yet exist for the United Kingdom.

All these methods have disadvantages. Both hedonic and mix-adjusted indices will suffer from the same problems as simple averages if they do not control for all relevant characteristics. If some characteristics were omitted from the hedonic regression or cell structure a change in the distribution of these characteristics over time would create inaccuracies in the estimated change in the price of a constant-quality house. For example, if fitted kitchens became more common, but were not recorded as a characteristic of the houses in the sample, the price index may rise too quickly: higher prices from the inclusion of fitted kitchens may be mistaken for an increase in the price of a constant-attributes house.[3] To the extent that the existing house price indices do not measure such quality improvements

[3] It should be noted that the impact of an excluded variable is particularly complicated if the existence of that characteristic, for instance fitted kitchens, is correlated with some other characteristic that is included in the hedonic regression or mix-adjustment.

as they become more prevalent, they may overstate the rate of constant-quality house price inflation. Furthermore, if these unobserved attributes were more common in properties sold at certain phases of the cycle (for example, if the top end of the market were relatively active during booms) then the amplitude of fluctuations in house price inflation may be understated or overstated accordingly.

Changes in the sample mix between houses with different inflation rates would affect the estimates from simple repeat-sales indices. For example, if detached and terrace houses appreciate at 0% and 5% per year respectively, a shift in the sample towards terrace houses will increase the estimated average inflation rate, because no account is taken of the characteristics of the sample. Furthermore, the estimated appreciation rate will also be biased if the property is altered or its condition changes between the two price observations. Hybrid hedonic repeat-sales indices can remove this problem by controlling for the characteristics of the sample, but such indices will be subject to similar disadvantages to those for hedonic indices and will have similar data requirements.

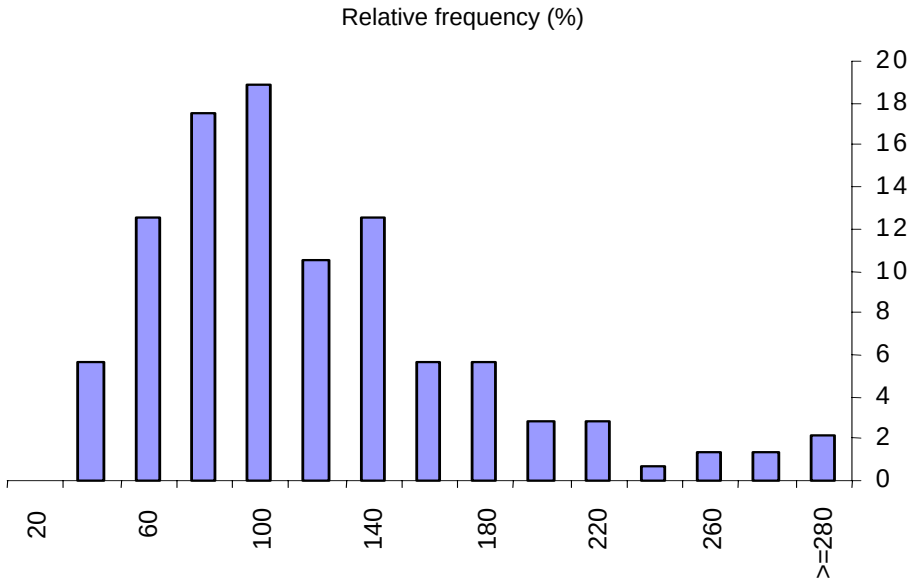
2.3 Weighting

The levels and inflation rates of house prices in the United Kingdom are widely dispersed - the prices of similar dwellings in different locations can vary by a factor of more than seven (see Chart 1) - so the choice of weights for an index could have significant effects on measured house prices and inflation. The weighting scheme will depend on two factors:

- Which constant notional house or set of houses the index is representing. For instance, is the index measuring the price of typically transacted houses or the stock of dwellings?
- Whether the index is measuring the change in *value* of a set of houses or the change in *price* of a typical member of a set of houses (which need not be an actual house, it could be the average or median house in a group). In other words, the weighting scheme will depend on whether expensive houses in the set should receive more weight, commensurate with their share of expenditure on the set? We can choose to represent the price of a house with typical characteristics, where all houses in a set have equal weight in determining what is typical. This would involve "volume weighting". Alternatively, we can represent the price of a representative collection of houses, where more expensive houses have an accordingly higher weight. This would involve "expenditure weighting".

Chart 1

Distribution of average transacted flat and maisonette prices in localities in England and Wales in 2002 Q3



Source: Land Registry.

If all houses were appreciating at a common rate, both price indices reflecting expenditure and volume weights would appreciate at that rate. But if low- and high-value houses were to exhibit different price trends, the inflation rates of volume and expenditure-weighted indices would diverge.

2.4 Available datasets

The Land Registry dataset[4] contains the prices of all transacted houses in England and Wales, including those purchased without a mortgage (so called cash transactions). However, it has two disadvantages. First, only a very limited number of characteristics are recorded for each house so it is unsuitable for use in an hedonic regression; it does not include house size which is one of the more important characteristics. Second, it is only available quarterly and with a six week lag. Missing observations are then added to the dataset a further three months later; so the final dataset is not available until four and a half months after the quarter to which it refers. The Council of Mortgage Lenders (CML), an organisation representing the industry, compiles a sample of its members' mortgage approvals called the Survey of Mortgage Lenders (SML). However, until recently the sample proportion has been small (it has only increased from a 5% sample in the last couple of years) to date and it is not available until four weeks after the end of the month.

The problems with the Land Registry and SML datasets mean there is significant scope for other organisations with access to house price data, such as mortgage lenders, estate agents and advertisers, to produce house price indices based on that data. This, of course, makes comparison of the indices difficult because differences could be due to two factors: differences in the data or differences in the construction methods.

3. Comparison of the methods used to construct the seven main UK house price indices

3.1 UK house price indices

Table 1 describes the seven main UK house price indices.[5] The first three could be considered "official" indices because they are produced by government departments. The old and new ODPM indices both use the SML dataset but use different methods. The new index replaces the old one; it is based on a much larger sample of mortgage approvals than the old ODPM index and uses a more sophisticated mix-adjustment method.[6] It is intended that the new index will, in due course, become a National Statistic, but currently only a short back-run of data is available (extending back to February 2002) and it was published for the first time in September 2003, so both the old and new indices have been included in this analysis.

The Land Registry index has been discussed previously. The Halifax and Nationwide indices are produced by two UK mortgage lenders. Rightmove is a website on which estate agents post adverts for properties for sale or to rent. They use the posted asking prices on their internet site to construct a house price index. Hometrack use a survey of estate agents to construct an index.

3.2 Housing market timeline

The main indices measure the price of dwellings at different points in the house purchase process, shown in Chart 2. Indices nearer the beginning may detect changes in house prices first: the house

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[4] The "Land Registry" is a government department that maintains a register - the Land Register - of the ownership of all property and land in the United Kingdom. The Land Registry must be informed of changes in ownership for them to be legally recognised, so it is able to maintain a database of all housing market transactions.

[5] The Land Registry, Hometrack and Rightmove indices cover only dwellings in England and Wales but are included because transactions in England and Wales account for a large proportion of those in the whole of the United Kingdom.

[6] See Wall (1998) and Fenwick and Duff (2002). Further information about the new index is also available from the ODPM website: http://www.odpm.gov.uk/stellent/groups/odpm_control/documents/contentservertemplate/odpm_index.hcst?n=1618&l=3.

prices appearing in the September Halifax and Nationwide indices will not appear in the ODPM sample until October or November. However, because house prices are usually reached through negotiation the sale price may change through the process. A buyer may agree a price with a seller somewhat below the seller's initial asking price (recorded by the Rightmove index). A survey of the property carried out for the mortgage lender at the mortgage approval stage may lead to further revisions of the price. This may occur if, for instance, the surveyor suggested to the mortgage lender that the house was not worth the price agreed between buyer and seller. Finally, the price may be renegotiated following the approval of a mortgage (the stage at which the price is measured by the Halifax, Nationwide and Hometrack indices).

Table 1

Main UK house price indices

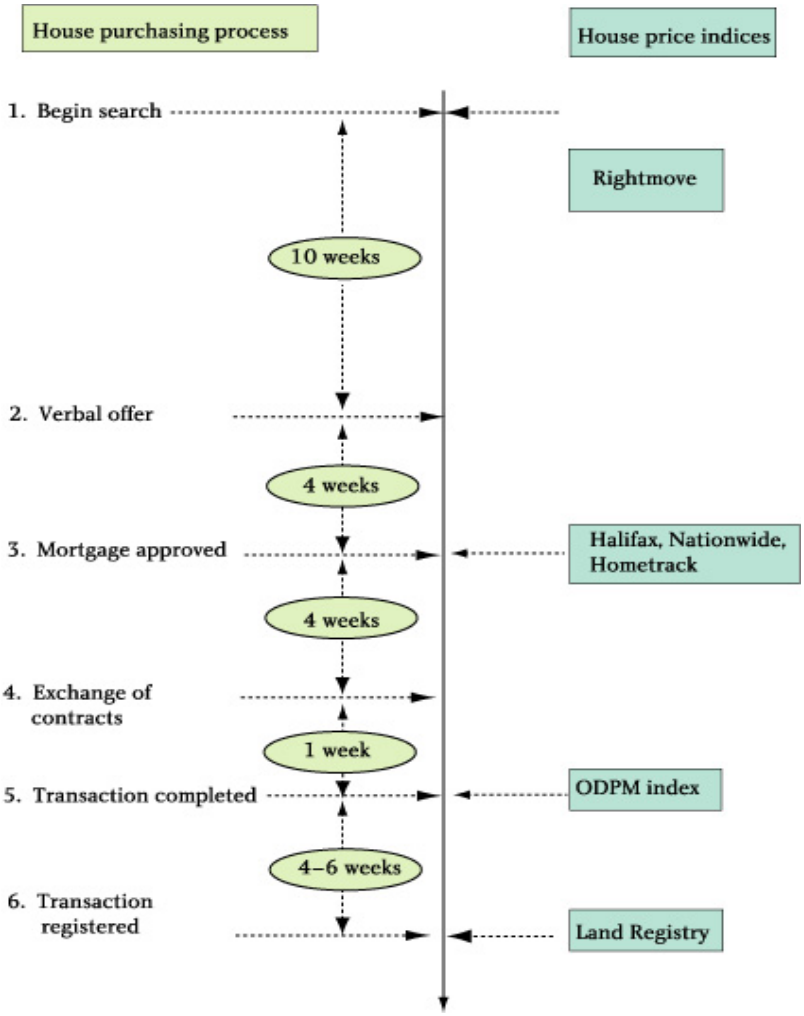
	Data	Quality adjustment method	Seasonally adjusted?	Weights used	Weighting method	Measures
"Old" ODPM	SML 5% sample of CML eligible completions	Mix adjustment	No	Rolling average of SML transactions	Expenditure	Value of average set of transacted dwellings
"New" ODPM	SML 30-50% sample of CML eligible completions	Mix adjustment	No	Rolling average of Land Registry transactions	Expenditure	Value of average set of transacted dwellings
Land Registry	100% of sales registered in England and Wales	Simple average	No	None	Expenditure	Value of set of transacted dwellings
Halifax	Loans approved for house purchase by Halifax	Hedonic regression	Yes	1983 Halifax loan approvals	Volume	Price of "Halifax" representative dwelling
Nationwide	Loans approved for house purchase by Nationwide	Hedonic regression	Yes	Rolling average of SML, Land Registry and Nationwide transactions	Volume	Price of "Nationwide" representative dwelling
Hometrack	Survey of approx 4,000 estate agents' estimated local average prices	Mix adjustment	No	England and Wales housing stock	Expenditure	Value of housing stock
Rightmove	Sellers' asking prices posted on internet site	Mix adjustment	No	England and Wales housing stock	Expenditure	Value of housing stock

The prices at each stage of the house purchase process have uses. For instance, estate agents may be interested in the extent to which sellers are changing asking prices. But in general the indices exist, or are used by many observers, to provide an estimate of changes in the final or actual "price of housing". Indices based on mortgage approval data will exclude some transactions, cash transactions, from their datasets. This may be important if the sample also does not include houses similar to those purchased with cash. But to the extent that the price of houses purchased with cash do not behave differently to those purchased with a mortgage and that the size and incidence of price revisions do

not vary over time, an index positioned at any point in the house purchase process should measure changes in the final agreed prices correctly. Both these conditions are, however, unlikely to hold.

Chart 2

House purchase timeline and house price indices



Sources: Bank of England; ODPM.

Comparing the indices, the Rightmove index will detect price changes earliest in the timeline, but the prices used by Rightmove will be the most likely to be revised. At the other extreme, the prices in the Land Registry index will never be revised (because they record how much buyers *have* paid for a dwelling), but price changes will be captured by Rightmove six months earlier than by the Land Registry (nearly eight months if the lag in compiling the Land Registry dataset is taken into account).

The Halifax and Nationwide indices are in many ways a good compromise between accuracy and timeliness. Their data is likely to measure final prices more accurately than the Rightmove data, but less accurately than the Land Registry data. Their datasets will be subject to sample selection bias to some extent, since each index relies only on the lender's own mortgage approvals, which may depend on the competitiveness of the mortgage rates offered by each lender. However, the Halifax and Nationwide indices will measure price changes nearly three months earlier than the Land Registry index (nearly five months if the lag in compiling the Land Registry dataset is taken into account).

Price revisions between mortgage approval and transaction completion stage may, however, be systematic and wide-spread. In times of house price rises, price revisions are likely to be systematically positive, whilst when prices are falling revisions are likely to be negative. In England

and Wales, an agreed sale can be cancelled by either side of the transaction at any point until ownership changes (transaction completed). This leaves each side an alternative option should the value of a house change after a sale is agreed. Sellers can accept a higher offer from another buyer (called "gazumping"), and buyers can agree a price for another property. Consequently, when prices are rising sellers may be able to take advantage of the outside option of accepting another offer to revise the price upwards. When prices are falling buyers may be able to take advantage of the outside option of purchasing another, cheaper property. Transactions and search costs complicate this simplistic picture, but the broad point is likely to stand.

Finally, the Hometrack index is a measure of house prices at the mortgage approval stage. But it makes use of estate agents' estimates of average prices by postcode and house type (detached, semi-detached, terraced, bungalow). Estate agents are exposed directly and frequently to the market so they might be considered the correct group to survey about house prices. Such a survey requires estate agents to accurately estimate local average prices. But as long as any errors made are not systematically biased then they should have little effect on measured of house price inflation.

3.3 Quality adjustment

All indices other than the Land Registry use hedonic regression or mix-adjustment methods to quality adjust their data to take account of the effect of changes from one period to the next in the mix of houses transacted. The mix adjustment and hedonic regression methods for quality adjusting the data can be similar under certain circumstances. If mix-adjustment is undertaken with the same house characteristics as in an hedonic regression, both indices use the same weights, and the mix-adjusted index is a geometric mean of the cell prices, then the two indices should give similar results.

In practice, the hedonic regression methods used by the Halifax and Nationwide have been more encompassing than the mix-adjustment method used to construct the "old" ODPM index. The old ODPM index was mix-adjusted using a small number of characteristics: region; number of bedrooms; house type (ie detached/bungalow/flat, semi-detached, terraced); old or new; type of buyer (first time buyer or former owner occupier). Consequently, the old index had only 300 "cells". Table 2 below shows that the Halifax and Nationwide indices control for the effects of many more characteristics, and so are less likely to be affected by changes in the mix of houses sold than the old ODPM index; the ODPM index may change if the number of houses in the sample with, for instance, bathrooms, or garages, or a garden, changes. The Halifax and Nationwide indices are unlikely to be affected to the same extent.

The new ODPM index controls for more characteristics than the old version and each characteristic is included in more detail. For instance, local authority district is used instead of region; the exact number of rooms is used instead of allocating dwellings to a group eg five or less rooms, five to seven rooms etc. The seven characteristics used are: location (local authority district); cluster (an ONS classification of local authorities); type of neighbourhood (ACORN classification); dwelling type (detached, semi-detached, bungalow, flat, terraced); number of rooms; old or new; type of buyer (first time buyer or former owner occupier). The new index has over 150,000 cells instead of 300 in the old index.

Turning to comparing the Halifax and Nationwide indices, Table 2 shows that the hedonic regressions employed by the two indices differ to some extent in the judgements they embody: each is based on a somewhat different set of characteristics, and some characteristics contribute to the house price in different ways. For instance, both lenders assume that the number of bathrooms affects the price of a house. But the Halifax index treats each successive bathroom as contributing the same additional amount to the house price, whereas the Nationwide index makes no distinction between a house with two bathrooms and one with three or more.[7] Such discrepancies may give rise to differences in the two indices' estimates of the rate of house price inflation; the inclusion of a variable in one equation but not another is likely to affect the coefficients on other variables in the equations. So even if the Halifax and Nationwide used the same data and definition of a typical house, their estimates of the price of a typical house would be likely to differ.

[7] The method used to construct the Halifax index is discussed in some detail in Fleming and Nellis (1984), available on request from the Halifax.

The Hometrack and Rightmove indices mix-adjust data by postcode and property type. The location used is defined at a lower level of aggregation than that in any other index, but both indices exclude a large number of other relevant characteristics (such as number of bedrooms). The mix-adjustment used in these two indices can be considered to be broader than that in the Land Registry index but narrower than used in other indices.

Table 2

Characteristics in the Nationwide and Halifax hedonic regressions

Characteristic	In the Nationwide regression?	In the Halifax regression?
Detached house	✓	✓
Terraced house	✓	✓
Detached bungalow	✓	✓
Semi-detached bungalow	✓	But uses one bungalow dummy variable rather than two
Purpose built flat/maisonette or new converted	✓	✓
Converted flat/maisonette	✓	But uses one flat dummy variable rather than two
Tenure	✓	✓
Number of bedrooms	✓	x
Number of habitable rooms	x	✓
Double garage	✓	x
Number of garages	x	✓
Number of garage spaces	x	✓
Parking space or no garage	✓	x
Central heating type	✓	✓
Floor size (sqft)	✓	x
Number of acres	x	✓
More than one bathroom	✓	x
Number of bathrooms	x	✓
Number of toilets	x	✓
Garden	x	✓
Subject to a road charge	x	✓
Property age	x	✓
New	✓	x
Region	✓	✓
ACORN (A Classification of Residential Neighbourhoods) classification	✓	x
Parliamentary constituency	✓	x

3.4 Weighting

There are two issues to consider when comparing the weighting schemes of the indices. First, which constant notional house or set of houses is the index representing? Second, is the index volume or expenditure weighted?

In terms of the first issue, the indices can be put into one of two groups with respect to the type of price they are trying to measure.

- *Transactions weights* (Old ODPM, New ODPM, Land Registry, Halifax and Nationwide). Indices in this group measure either the price of a typically transacted house, or the value of a set of typically transacted dwellings. The Land Registry index is a special case in this group because, in a strict sense, the average price uses transactions weights from the most recent month or quarter.
- *Housing stock weights* (Hometrack and Rightmove). Indices in this group measure either the price of a typical member of the housing stock, or the value of the housing stock.

The indices also differ in their use of current or base weights:

- *Base weights* (Halifax and Rightmove). The weights are defined by the transactions or housing stock from a particular year and are never changed. For instance, the Halifax index measures the price of a dwelling that has characteristics typical of dwellings transacted in 1983.
- *Rolling weights* (Old ODPM, New ODPM, Nationwide, Hometrack and Land Registry). The weights are updated periodically, usually annually, with new data on transactions or the housing stock.

The differences are summarised in Table 3. If the type of houses transacted or the characteristics of the housing stock changeover time the indices using base weights are most likely to measure the change in price of a currently representative house or group of houses with error.

Table 3

Weights used in UK house price indices

	Transactions weights	**Stock weights**
Base weights	Halifax	Rightmove
Rolling weights	Old ODPM New ODPM Nationwide Land Registry	Hometrack

The Halifax “standard house” is defined by the characteristics of the average house on which the Halifax approved a mortgage in 1983. All other indices base their weights on information from a wide range of mortgage lenders (SML transactions) or on all transactions (from the Land Registry) or the housing stock. These other weights may be more representative of the UK housing market than those based on dwellings on which mortgages were approved by the Halifax alone. For instance, the North of England may be over-represented, compared to the true regional distribution of housing market transactions, in the Halifax weights because the Halifax used to have a larger presence in the North of England than in the South.

Comparing the weights used in the other indices, those using transactions weights based on Land Registry information are likely to be the most representative of the typically transacted house or typically transacted set of houses, because the Land Registry records all housing market transactions. Those indices using weights based on SML transactions will not be quite as representative because, whilst the survey includes data from almost all mortgage lenders, it excludes cash transactions which account for approximately 25% of all housing market transactions in the United Kingdom. Of course, indices using SML transactions weights will be representative of the change in price of a typical house or set of houses purchased with a mortgage, which might be a useful price for mortgage lenders’ to monitor.

Comparing stock and transactions weights is difficult. The different weights just allow the index to measure a different concept of the price. The preferred weights will depend on which measure the user is interested in.

The second issue was whether the indices were volume or expenditure weighted. Of the seven main UK house price indices, two are volume weighted and five are expenditure weighted. Neither weighting method is better than the other for all applications; they measure different concepts of the price of housing which are useful for different applications. Observers and policymakers must be careful to match the measure they use with the concept they are interested in.

3.5 Where does the comparison of the methods used to construct the indices leave us?

One point apparent from the discussion in this section is that it is complicated to compare the indices because of the wide variety of samples, methods, and weighting schemes used. However, we can draw some conclusions from the analysis of this section:

- The main indices measure the price of dwellings at different points in the house purchase process. The Rightmove index measures asking prices, the Hometrack, Halifax and Nationwide indices measure prices at the loan approval stage, the ODPM index measures prices at the loan completion stage and the Land Registry index measures final transaction prices. It is therefore important for observers to match the measure of house prices used with the concept they are interested in eg it may be unwise to use the ODPM instead of the Rightmove index to analyse asking prices.

But there are further conclusions we can draw, some of which depend on the extent to which the indices are used to measure final transaction prices:

- The Land Registry index uses the largest dataset; it covers all transactions in England and Wales. But the dataset is not timely and does not record many dwelling characteristics, so quality adjustment is difficult.
- For the purposes of measuring final transaction prices the Halifax and Nationwide datasets can be considered a good compromise between accuracy and timeliness.
- The Rightmove dataset appears to have the least accurate measure of final transaction prices. Asking prices are the earliest in the housing market timeline and so most likely to be revised during the transaction process.
- The Hometrack index places a significant computational burden on estate agents, and so may be subject to greater measurement error.
- The Halifax and Nationwide datasets are the most likely to be affected by sample selection bias. This is particularly the case for the Nationwide index, whose dataset is somewhat smaller than the Halifax's.
- The Land Registry index uses the simplest possible price measure - the average price of transacted houses. So it is likely to be most affected by changes in the mix of houses sold each quarter.
- The Halifax and Nationwide have until recently used the most comprehensive quality-adjustment methods, and were therefore least likely to be affected by changes in the mix of houses sold. It is difficult to judge whether their methods are more or less comprehensive than those used to construct the new ODPM index, since both have advantages and disadvantages.
- Current weights based on Land Registry data will be most representative of all current housing market transactions in England and Wales.

4. Empirical comparison of the available UK house price indices

In this section we consider the implications of the different methods used to construct the main UK house price indices; to what extent can the different methods of construction explain the differences between the outturns of the indices.

4.1 Long-run vs short-run

Chart 3 shows that the main house price indices have very similar long run trends. In other words, the estimated rate of house price inflation over long time horizons is similar across all the main indices. Chart 4 shows, however, that in the short run the indices - even those purporting to measure the same price - can give quite different estimates of house prices.[8]

Chart 3

Halifax, Nationwide, old ODPM and Land Registry indices

1997 Q1 = 100

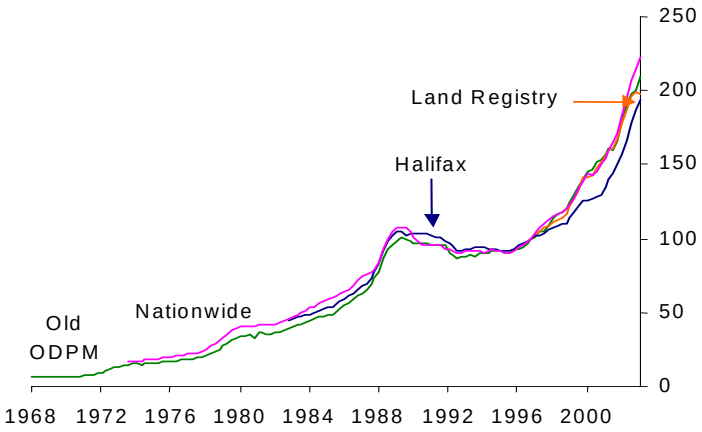
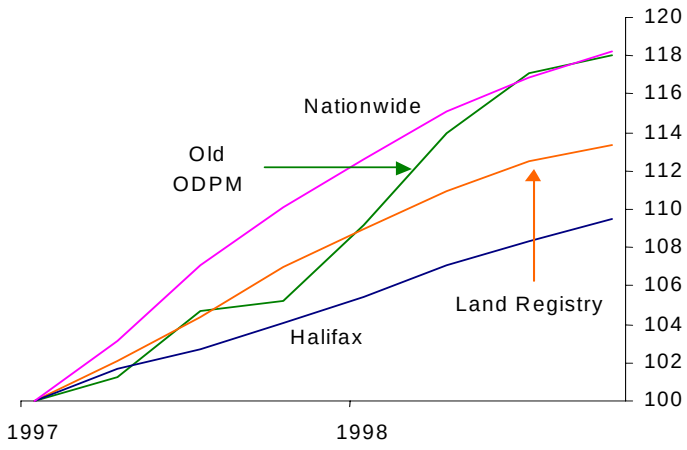


Chart 4

Halifax, Nationwide, old ODPM and Land Registry indices

1997 Q1 = 100



[8] Some indices were not included because only a short back run of data is available for them.

In times of uniform market-wide inflation, all measures of house prices will move by similar amounts. Consequently, these charts suggest that differences in methodology have an effect in the short run because different house types appreciate at different rates, but over a long-period of time all houses appreciate by a similar amount. So the choice of house price measure matters much more for analysis of short-run movements in prices than long-run movements.

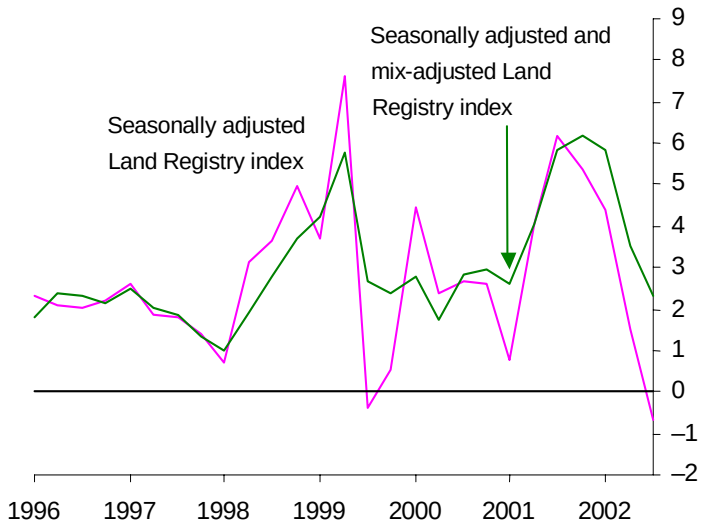
4.2 Effect of quality-adjustment

Chart 5 shows the quarterly house price inflation rate measured by a seasonally adjusted version of the Land Registry index and a mix-adjusted and seasonally adjusted version. The mix-adjustment is simple since it controls for the effect of only two house price characteristics: location (defined by county and London Borough); and house type (detached, semi-detached, terraced, flat/maisonette). Nevertheless, the mix-adjustment has a marked effect on the estimated quarterly inflation rate. Using the mix-adjusted index would have led to a very different interpretation of developments during late 1999, than if the not mix-adjusted index had been used. More recently, both indices have shown a slowdown in house price inflation, but the rate of inflation of the not mix-adjusted index has fallen about twice as much from its peak than the mix-adjusted index. So even the most basic mix-adjustment has empirically significant effects and can aid interpretation of house price movements.

Chart 5

Effect of quality-adjustment on the Land Registry index

Percentage change on previous quarter



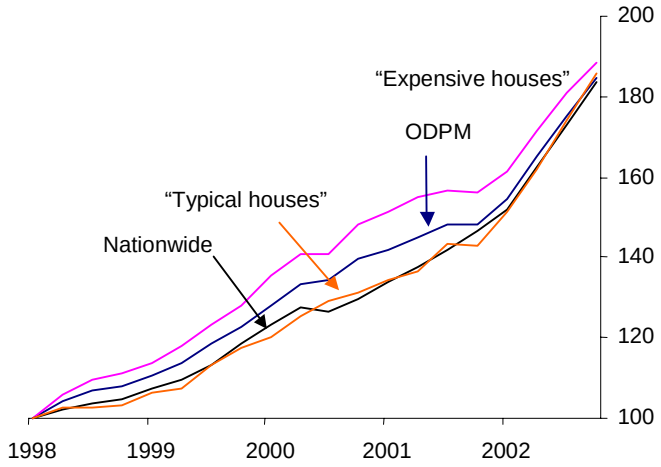
4.3 Volume vs expenditure weights

To demonstrate the practical effect of the difference between volume and expenditure weights Chart 6 shows two sub-indices based on the most expensive quartile and the middle-priced 50% of the cells in the old ODPM index, which can be interpreted as indices of “expensive” and “typical” houses. The ODPM and Nationwide indices are also shown. As expected, the ODPM index, which is expenditure weighted, is more in line with the expensive index than the Nationwide index is.

Chart 6

Effect of volume weighting

Index (1998 Q1 = 100)



4.4 Can the differences between the Halifax and Nationwide indices be explained?

The Halifax and Nationwide indices both use similar methodology, but Charts 7 and 8 show that the short-term (ie month on month) and long-term (ie annual) growth rates of the two indices can diverge significantly and sometimes for relatively long periods of time. This might be expected because the definition of the typically transacted dwelling differs slightly between the indices, the characteristics they control for in their regressions are somewhat different (see Table 2), and they use different samples. But how important are these methodological differences?

Chart 7

Monthly Halifax and Nationwide house price inflation

Percentage change on previous month

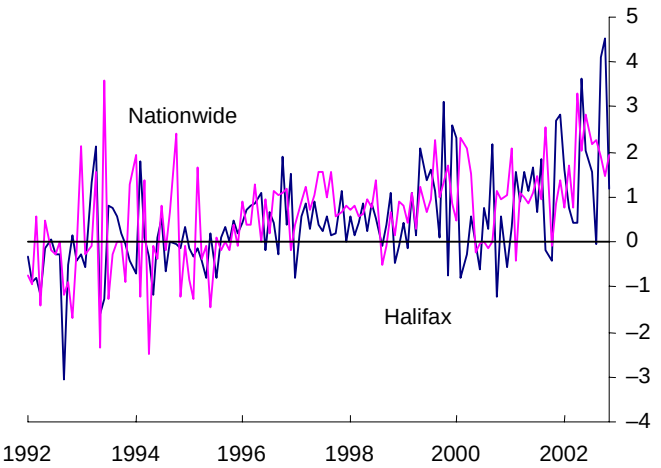
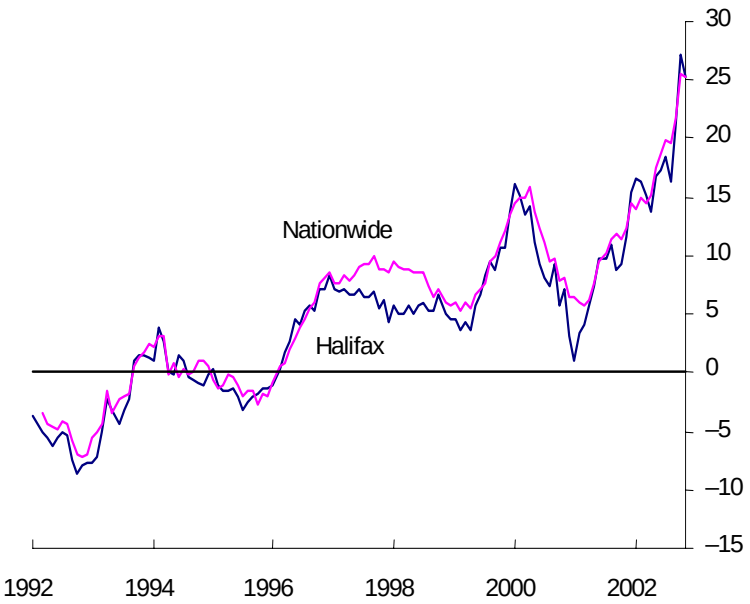


Chart 8

Annual Halifax and Nationwide house price inflation

Percentage change on previous year



The common framework used by the two indices for estimating prices means there are four possible explanations for the divergence between their growth rates: different typical house; different specification of the hedonic regression equations; different data; estimation error. However, these explanations cannot be assessed without access to the underlying data. Some work has found that the differences between the weights used in the two indices do not explain much of the differences between the monthly growth rates of the two indices. The most likely candidate for the differences between the monthly growth rates of the two indices appears to be estimation error. It may be reasonable to expect that estimation error in an individual month would dominate the effect of there being different typical houses, but over a longer time period the effect of the different typical house becomes more marked.

4.5 Summary of empirical comparison of the main UK house price indices

We have seen that all the indices give similar estimates of house price inflation over long periods (10-20 years) but they can differ in the short run. Considering the reasons for the differences we found that quality adjustment and the choice of expenditure or volume weights can have significant impacts on measured house price inflation. But, estimation error is likely to dominate other explanations for differences in measured monthly or quarterly house price inflation rates from different mix-adjusted indices.

5. Conclusions

There are several valid concepts of house prices and many possible ways of constructing an index to measure each type of price. Combinations of methods and datasets have given rise to seven main UK house price indices, and a large number of other indices and surveys.

Comparing the available indices is complicated, although some conclusions can be drawn from an analysis of the methods and data sets used. The most important point to note is that no one method of constructing an index or concept of the price of a house is “right”. The main indices in the

United Kingdom use a variety of methods and measure the price of dwellings at different points in the house purchase process, so they have distinct uses. But, we can still learn from the advantages and disadvantages of the methods used by the main UK indices.

The Land Registry index uses the most complete dataset, in the sense that it covers all residential housing market transactions. But that dataset does not record details of many dwelling characteristics so only very simple quality adjustment can be applied to the data. However, we have seen that even simple quality adjustment can have a large impact on measured rates of house price inflation. The Hometrack and Rightmove indices are likely to measure final transacted prices with error, and use, relative to other indices, narrow quality adjustment methods. The Halifax and Nationwide indices use the broadest quality-adjustment techniques and a dataset that, for measuring final transacted prices, represents a good trade-off between accuracy and timeliness. But their samples exclude cash purchases and are smaller than that used by the new ODPM index.

The indices available in the United Kingdom are useful because they allow observers to examine a range of information when assessing past or prospective changes in house prices. But the existence of a large number of indices, whose differences are hard to analyse and interpret because they rely on proprietary data, can create confusion and complexity in what is anyway a difficult area to monitor - because house prices are inherently difficult to measure. Observers and policymakers must, therefore, always be careful to match the measure of house prices they use with the concept they are interested in, and to ensure that the information in short-run changes in house price inflation is not overstated, because sampling and estimation error in monthly and quarterly house price inflation rates appears to be substantial.

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Methodological issues regarding residential real estate prices

Paul Hilbers

Before commenting on the excellent papers by Case and Wachter (2003) and Wood (2003), I would like to emphasise that I will be reviewing the issue of developing residential real estate price indices from a user point of view rather than as a compiler or statistical expert. In that light, I would like to spend a few words on the particular interest of my Department - the Monetary and Financial Systems Department (MFD) in the IMF - in the important work on improving residential real estate indicators that is currently taking place worldwide, as reflected in the many papers discussed during this conference.

As already noted by the Managing Director in his opening remarks, the IMF, together with the World Bank, set up a programme in 1999 to assess the financial systems of our member countries. This so-called Financial Sector Assessment Program (FSAP) is voluntary in nature. So far about 60 countries have participated in the programme, including many systemically important ones (such as Canada, Germany, Japan, Korea, Switzerland, the United Kingdom, etc), and about 30 more have indicated their willingness to do so in the near future.

The programme has two key components: assessments of compliance with international standards and codes and a macroprudential analysis of the soundness of the financial system. The former is guided by the financial sector standards and accompanying methodology documents developed in recent years by international standard-setting bodies, such as the Basel Committee for Banking Supervision. For the latter component, however, there was a need to develop a set of Financial Soundness Indicators (FSIs). Therefore, MFD and the Statistics Department (STA) organised a consultative meeting in September 1999 on Macroprudential Indicators (MPIs), since renamed FSIs.[1] The purpose was to develop a list of relevant indicators for analyses of financial sector soundness, including to support our FSAPs. An important conclusion of that consultative meeting was that one should pay close attention to developments on asset markets, and in particular real estate markets.[2]

As a follow-up, in 2001 a study was issued on the link between real estate price developments and financial crises.[3] An important conclusion was that in many cases there seemed to be a clear relation. In particular, the paper concluded that imbalanced real estate price developments often contribute to financial sector distress and trends in real estate markets should be monitored closely in the context of financial sector assessments. It also noted that the lack of good quality and timely data with respect to developments in the real estate markets was a major complicating factor.[4]

The papers by Case and Wachter and Wood illustrate the complexities of developing useful and reliable indicators for developments in residential real estate prices. They show that (1) there are many different ways of compiling price indicators for residential real estate, (2) there are many different sources of data, both official and private, and (3) these indicators and sources may give different pictures of developments in residential real estate prices (although Wood concludes that differences are larger in the short term than in the long term). The question then is: what makes real estate markets so special? Both papers deal with this issue, and let me make a few general points about this taken from our 2001 study, focusing first on the markets, then on the causes of cycles/bubbles, and finally on the important role of the banks.

Real estate markets are characterised by heterogeneity. No two properties are identical and information on market transactions is often limited and not generally available. Also, real estate

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1 See IMF (2003).

2 For details, see Evans et al (2000).

3 Hilbers et al (2001). For a study focused on Asia, see Collyns and Senhadji (2002).

4 See also Sundararajan et al (2002), pp 32-4.

markets are typically characterised by infrequent trades, a negotiated pricing process, large transaction costs and rigid supply. In contrast to stock markets and other financial markets there is, therefore, no clear market price. Differences in financing structure, regulatory framework, tax treatment, and the use of real estate as collateral further complicate international comparisons.

The price of a property should in principle equal the discounted present value of the expected stream of future income (rents - this is also what Case and Wachter say on page 3). In a well-functioning market, this price should equilibrate demand and supply. The fundamental equilibrium price can be thought of as the price at which the stock of existing real estate equals the replacement cost. However, the real estate market is characterised by several market imperfections that distort the adjustment toward equilibrium. First, the market suffers from imperfect information about future demand. Second, supply is rigid in the sense that new construction may take several years to be completed, and in many markets the supply of land is a binding constraint. Also, in markets where collateralised lending is widespread, real estate prices affect the availability of resources to finance real estate, which may again affect the price of real estate. Some of these market imperfections can lead to cycles that differ from the economic cycle or to bubbles.

Certain mechanisms can trigger or amplify the appearance of these cycles and bubbles in real estate markets. Some of them are related to non-financial characteristics of real estate markets, but in many cases banks and their lending policies play a large role. Key mechanisms include:

- *The combination of fixed supply and the optimistic investor*. In markets where supply (land and in the short run also buildings) is fixed, a few investors willing to pay a price above the fundamental price can determine the market price, if their demand is sufficient to clear the market. In efficient financial markets, such a process of price increases would be moderated by investors selling short and supply would increase until the price has returned to its fundamental level, but in markets with fixed supply this mechanism does not function well, at least not in the short run. These optimistic investors are likely to stay in the market as long as prices are rising and financial resources are available.
- *Construction lags and imperfect information*. When the price of existing real estate rises above the replacement cost, developers will initiate new construction and increase the supply.[5] However, as new construction may take several years to be completed, the adjustment to equilibrium will be slow. Prices will continue to rise until the new construction is ready for occupancy. By that time, demand for real estate may have fallen or several competing construction projects may have resulted in over-supply, without a fundamental equilibrium being reached.
- *Collateral*. Increasing real estate prices raise the market value of collateral on outstanding real estate loans. This lowers the risks for lenders and may increase their willingness to lend more to finance real estate projects. Hence, the use of real estate as collateral tends to exacerbate real estate cycles.
- *Financial liberalisation*. Following liberalisation and deregulation, new financial markets and institutions tend to emerge. Prime borrowers find that their funding needs can be met at lower costs on domestic and international capital markets. Faced with shrinking margins, banks will search for better yields and may move to new categories of borrowers while underestimating the risk of these loans, eg, in Eastern Europe.
- *Bank holdings of real estate*. As noted also in Case and Wachter, rising real estate prices may finally encourage increased lending to the real estate sector as a bank's own holdings of real estate rise in value.

Evidence from several financial sector crises points to a high exposure of banks to the real estate sector. As also indicated by Case and Wachter, this exposure can take different forms:

- holdings of real estate assets in the banks' portfolios;
- lending to customers for real estate purchases (often collateralised);

[5] Herring and Wachter (1999).

- financing of real estate developers and construction companies;
- lending to non-bank intermediaries, such as finance companies, that engage in real estate lending; and
- relying on real estate to collateralise other kinds of lending.

The higher the exposure of banks to real estate, the more amplified the cycles in real estate markets can become. Still, banks tend to underestimate the risks associated with high exposure to this sector. As also indicated by Case and Wachter, there are two important explanations.

- *Disaster myopia or low frequency shocks*. Real estate cycles are often long and an entire generation may have passed since the last serious decline in prices occurred. If real estate prices have risen steadily for many years, the repayment record of real estate loans will likely be good. Hence, during a real estate boom, lenders can be lulled into a false sense of security, as real estate prices are rising and loan-to-value ratios on outstanding loans decline, leading to a higher portfolio quality. Profitability in terms of expected returns is high, but the risks are underestimated.
- *Inadequate data and weak analysis*. Banks may underestimate the risk of heavy exposure to the real estate sector because of inadequate information and weak analysis.

This brings us to the key subject of the papers in this session, namely how can we compile better indicators for residential real estate prices. This is not only important for the buyer/seller of residential real estate but also for financial institutions involved in financing, which provide an important link to financial stability. Both the paper by Case and Wachter and the one by Wood discuss in detail the methodology for developing residential real estate indicators, describing the pros and cons of the key types of indicators, and comparing the actual behaviour of these indicators over the past period (see Box 1). An important conclusion seems to be that the better the indicator from a theoretical point of view - and hedonic indicators are clear favourites - the more difficult it is to compile. Both papers seem to agree here, but at the same time it is interesting to note that there is a discrepancy in the empirical results. Whereas Case and Wachter note important differences in the outcomes over a longer period in the United States, Wood concludes that in the long run the results for the different indicators in the United Kingdom seem to converge. It would be interesting to know the reason behind this difference.

Box 1

Price indices for residential real estate: a comparison

	Advantage	**Drawback**
(a) Average or median prices	– Easy to collect	– No correction for quality changes
(b) Representative property method	– Avoid (most) quality change problems	– Focuses only on one sort of properties and ignores developments elsewhere
(c) Hedonic price models	– Control for quality changes – Not just one representative property (as b)	– Data requirements – Potential bias from incorrect model specification
(d) Repeat-sales method - derived from hedonic price model	– Less data requirements – Less dependent on model	– Requires at least two sales – Quality of same property may change between sales

To start where I began, from a user point of view I would prefer to have available a range of indicators rather than just one. This will provide the user with the broadest set of information, provided the caveats that come with the different indicators are clearly identified. From that perspective, the papers discussed here are very useful, and more work in further developing a methodology and comparing the empirical results, not just for the United States and the United Kingdom but also for other countries, would be welcome.

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