

Why Country House Price Indices May Differ

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A key factor in understanding the global recession is an understanding of movements in residential property price indices (RPPIs), over time, between countries, and, as is often the case, within countries for the more than one RPPI produced. While economic fundamentals naturally have a major bearing, within- and between-country variation may also be determined by variation in the methodology used to construct the indexes. Key RPPI methodological issues include: (i) the use of stocks or flows and values or quantities for weights; (ii) method of enabling constant quality measures; (iii) coverage in terms of geography, type of housing and financing; and (iv) valuation of prices. The paper outlines such issues and reports on empirical work in progress to estimate the effects of such measurement issues on RPPI changes for two countries, as case studies, and for an international panel data set.

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¹ Many of the residential property price indexes used in this study have been drawn from the Bank for International Settlements' (BIS) database of property price indexes available at: <http://www.bis.org/statistics/pp.htm>. Use of the database requires a citation of the appropriate national source as given in Annex 2. We also acknowledge the help of Marc Prud'Homme (Statistics Canada), C Chihiro Shimizu (Reitaku University), and Niall O'Hanlon (Central Statistical Office, Ireland).

² The views expressed herein are those of the author and should not be attributed to the IMF, its Executive Board, or its management. Any errors or omissions are the author's responsibility.

I. INTRODUCTION

As the October 2009 Report to the G-20 Finance Ministers and Central Bank Governors on the *Financial Crisis and Information Gaps*³ described, data on dwellings and their associated price changes are critical ingredients for financial stability policy analysis. The six major banking crises in advanced countries since the mid-1970s were all associated with a housing bust (Reinhart and Rogoff, 2009).⁴ An understanding of deviations from equilibrium prices in housing markets requires reliable and, for international comparisons, consistently-measured, residential property price indices (RPPIs)—hereafter the terms RPPIs and house prices indexes (HPIs) are used interchangeably, the latter to include apartments. RPPIs are particularly prone to methodological differences, which can undermine both within-country and cross-country analysis. It is a difficult but important area. There is an important empirical question as to whether, and, if so, the extent to which, measurement differences matter.

Against this background, the paper first, outlines the quite significant methodological differences that can occur with the measurement of RPPIs. Two case studies are then considered to ground the analysis—the United Kingdom and its six major RPPIs and the United States and its two major RPPIs.⁵

The formal empirical analysis is based on a panel of about ten years of quarterly data for over 100 RPPIs from nearly 20 countries; all the series differ (at least within countries) with regard to their methodological features. A fixed effects (for country) model with RPPIs regressed on measurement characteristics will help identify the extent to which measurement differences matter and the salient measurement features.

Key RPPI measurement variables include: (i) the use of stocks or flows (transactions) for weights; (ii) values or quantities for weights; (iii) fixed or chained weights; (iv) the method of enabling constant quality measures (repeat sales pricing, hedonic approach, mix-adjustment through stratification, sale price appraisal ratio (SPAR); (v) coverage in terms of geography (capital city, urban etc.), (vi) type of housing (single family house, apartment etc.); (vi) new or existing property; (vii) valuation method (and source data) of prices (asking, transaction, appraisal etc.).

³ Available at: <http://www.imf.org/external/np/seminars/eng/2010/infogaps/index.htm>.

⁴ Claessens, Kose, and Terrones (2008, page 25) find that “...recessions associated with house price busts are on average over a quarter longer than those without busts. Moreover, output declines (and corresponding cumulative losses) are typically much larger in recessions with busts, 2.2 (3.7) percent versus 1.5 (2.3) percent in those without busts. These sizeable differences also extend to the other macroeconomic variables, including consumption, investment and the unemployment rate.”

⁵ For example, annual changes in the S&P Case-Shiller National Home Price Index turned negative in 2006 Q4, but such changes in the FHFA “purchases only” house price index turned negative a full year later in 2007 Q4. Both indices use the repeat-sales methodology, but differ in coverage, weighting and source data.

A. The Potential for Mismeasurement and International Guidelines

There are at present, no internationally-accepted guidelines on compiling HPIs. However, a recent initiative to produce a *Handbook on Residential Property Price Indices*⁶ is near completion. Further, pilot experimental results on the development of comparable house price indices for owner-occupied housing (OOH) have been developed by Eurostat (2010a) in the framework of the Harmonized Indices of Consumer Prices (HICP) for countries in the euro area and at the European Union level. A common set of accepted methods and approaches is described in a technical manual published by Eurostat (2010b). The report notes methodological shortcomings but also draws attention to significantly and continuously improved indices since the early stages of the project. Yet the Paper stresses that the HPI results “...must be understood as experimental and they have therefore been labeled as such.” (2010a, page 5).

The application of such guidelines is not be straightforward. The heterogeneity of houses, in terms of location and characteristics, and the low turnover of sales complicate the determination of average house price changes. Further, methods of compiling HPIs are to a large extent dictated by the source data on house price transactions, the nature of which is often the result of the variable country-specific administrative arrangements for financing and purchasing houses. Moreover, even single-country studies require a choice between measures with often more than one HPI available. There is also a question of transparency and compliance. In many countries house price indices by private organizations such as realtors and lenders serve to advertise their business. The available information on their methodology is generally not up to the standard of a statistical office, and for some users, there will always be skepticism as to conflicts of interest, whether justified or not. If the source data of the private agencies do not meet the standards of the international guidelines, private organizations are unlikely to abandon their indices.

Extreme care is thus required when comparing house price indices of different countries for which the nature of source data and methods employed may be quite different. But what of measuring house prices changes for an individual country? Surely that should be straightforward. Economists should have a single reliable measure upon which to base their work. We consider two case studies, the United Kingdom and the United States on the coexistence of national HPIs using different data and methods.

⁶ The U.N. Inter-Secretariat Working Group on Price Statistics (IWGPS) is responsible for developing internationally-accepted guidelines on price indices. Under its aegis, Eurostat is acting as the lead agency for developing a *Handbook on Residential Property Price Indices* and in 2009 commissioned its writing expected to be completed in late 2011. The current draft is available at: http://epp.eurostat.ec.europa.eu/portal/page/portal/hicp/methodology/owner_occupied_housing_hpi/rppi_handbook.

B. Case studies on National House Price Indexes

United Kingdom House Price Indices

There are **eight** major residential property price indices in the UK based on different types of source data.⁷ The Land Registry records form the basis of both the *Land Registry* index, compiled by Calnea Analytics Limited, and the *LSL/Acadametrics* (Financial Times) index (*AcadHPI*). Prices are the registered transaction price on completion of the sale. The *Halifax* and *Nationwide* indices are based on their own mortgage approval records and the Department of Communities and Local Government (*DCLG*) index on all transactions bought with a mortgage issued by one of about 50 lenders. *Rightmove*'s index is based on the asking prices of property included on Rightmove.co.uk. There are two survey-based indices, one carried out by the Royal Institution of Chartered Surveyors (*RICS*) based on the opinions of a sample of their members and the *Hometrack* survey which is based on the opinions of a sample of estate agents (realtors) and surveyors. These opinion-based "net balance" indicators are excluded from the analysis below as they are not designed for the analysis of change

Do UK property price indices differ?

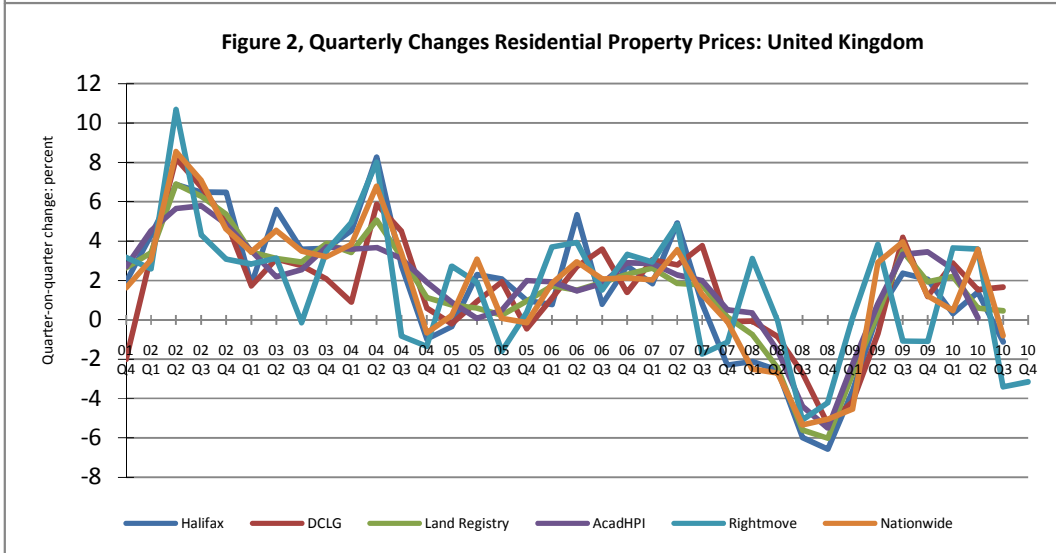
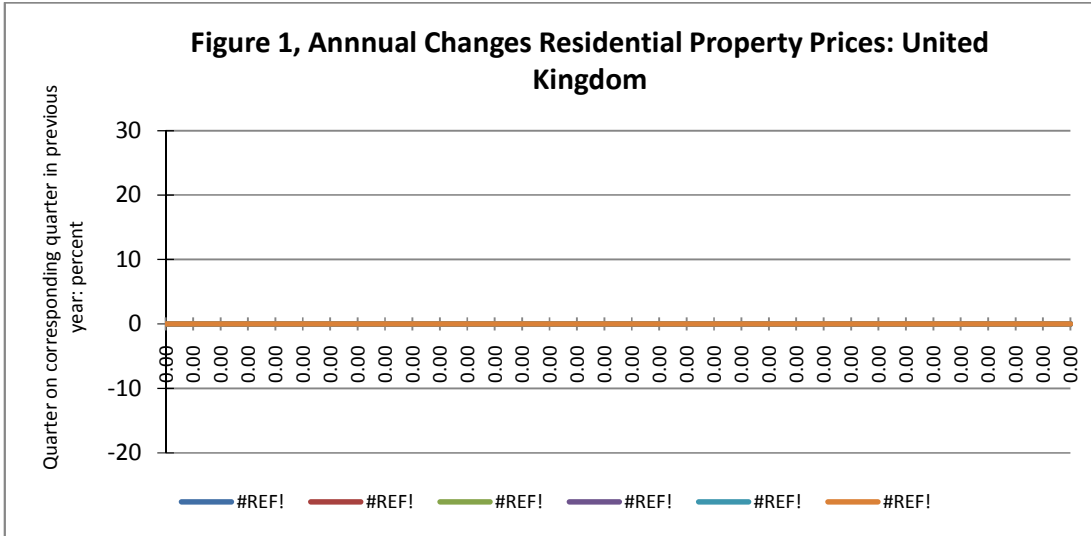
Figure 1 shows that in spite of the substantial methodological and data differences outlined below, there is a striking similarity in trend and timing of the turning points for annual changes (quarter-on-corresponding previous year's quarter). Differences do exist, especially in the amplitude of the 2003/4 turning points and 2008/09 trough. For 2008 Q4, the average fall for the six indices was 11.8 percent, but the range was about 10 percentage points: falls of 16.2 for Halifax and only 6.3 percent for Rightmove.

Figure 2 shows the more volatile quarter-on-quarter changes, though for 63 percent of the periods all series changes in the same direction and for 85 percent of the periods only one showed a different direction of change. Yet the magnitudes of the difference are often substantial, especially for the Rightmove. For example, Rightmove showed a 2009 Q2/Q1 *quarterly* fall of 1.1 percent when all other indices showed increases averaging 3.5 percent. The coincidence of the trends and turning points suggests either some commonality in measurement or, in these respects, measurement differences don't matter.

Are there commonalities in measurement?

Land Registry and AcadHPI are both based on the same data and can be seen from Figure 2

⁷ Details of these methods can be found in review papers including Fenwick and Duff (2002), Wood (2005), Dey-Chowdhury (2007), and, in some detail, UK Government Statistical Service (2010)—though see also Carless (2011)—as well as the methodological papers from the originating organizations, links for which can be found in ONS South West Regional Team (2009, Annex A).



to more closely track each other. They both record the price “on completion,” that is, the price returned to the Land Registry as part of the legal process of registering the completed sale. They are comprehensive in their coverage of transactions,⁸ at least for England and Wales. There is a need to control for the changing mix in the quality of houses sold. More expensive houses may be sold one month leading us to think average prices have increased when this may not be the case. The repeat sales methodology employed by Land Registry constrains its coverage to properties transacted more than once, so that an average of the price changes of the same houses is compiled.⁹ The prices of like are, broadly speaking,

⁸ There remains a sample selection bias if the indices are used to represent price changes of the stock of houses (Mason and Pryce, 2011).

⁹ The Land Registry data is a record of all residential property transactions made in England and Wales since January 1995. At the time of writing it contained details on over 15 million sales. Of these, just over five

(continued)

compared with like, at the cost of using a more limited sample and a selection bias. AcadHPI uses the Land Registry's entire transaction database. Its mechanism of adjusting for the differential quality mix is to weight strata categorized by property type and location.¹⁰ The weights are transactions-based relative quantities between January 2000 and December 2003. Land Registry is implicitly weighted by the relative number of repeat transactions in the sample.

Nationwide and Halifax include prices for properties for which they are the mortgagee. The DCLG index covers all transactions bought with a mortgage issued by one of about 50 lenders (about 55 percent of mortgage transactions—more than Nationwide and Halifax) reporting to the Regulated Mortgage Survey of the Council of Mortgage Lenders. All three indices cover transactions in the United Kingdom but, unlike the Land Registry-based indices, exclude cash sales—about 25 percent of all purchase. While the lender-based source data have some similarities, there is much in their construction that differs.

Nationwide and Halifax are based on the asking price when a mortgage is first approved—when the property is under offer, that is later than when first advertised but prior to completion. Not all approved applications will go through to completion. DCLG is based on transaction prices “on completion.” DCLG is a transaction value-weighted¹¹ average of individual stratum indices with weights updated annually based on a three year moving average. Nationwide and Halifax are compiled as stock quantity-weighted averages of the strata. Weights for Nationwide are updated every two years based on four year moving averages of data, while Halifax uses constant weights from 1983. All three indices use hedonic regressions to minimize the effect of changes in the quality-mix on price measurement, though the specifications of the regressions differ.¹² DCLG strata are both valued and defined by quality (price-determining) characteristics of properties estimated from hedonic regressions.¹³ Halifax and Nationwide define “typical” properties by fixed

million were identifiable matched pairs.

<http://www.landreg.gov.uk/kb/Default.asp?ToDo=view&questId=344&catId=32>.

¹⁰ Due to delays in processing Land Registry (LR) data, the AcadHPI results are not termed “final” until a significant volume of LR data is available which is normally after three months have passed. AcadHPI forecast results makes use of Halifax, Nationwide, and DCLG indices. One month after any given month, LR provides average house prices based upon circa 70% of the eventual total transactions, which are used to replace the AcadHPI “forecast” result with an AcadHPI “updated” result. A further month later, LR provides prices based upon circa 90% of the eventual total transactions which are used to replace the first with a second AcadHPI “updated” result. Three months after any given month, LR provides prices based upon circa 95% of the total transactions for the month. Taking the current month as month T, in month T + 4 the AcadHPI results are regarded as sufficiently updated to be described as the AcadHPI “final” index (Meissner and Satchell, 2010, page 14).

¹¹ Fixed quantity baskets are applied to estimated prices in the months compared yielding a value-weighted index of price changes.

¹² See Dey-Chowdhury, 2007.

¹³ As an example, DCLG include in their regression variables relating to location (local authority district or London borough), property type (PT), type of neighborhood (using the ACORN classification), local authority

(continued)

characteristic sets and value them over time using the estimated coefficients of hedonic regression equations.

In spite of these quite substantial differences, the indices can be seen to track the broad phenomena of the trend and turning points in residential property prices. Interestingly, there is no more commonality between mortgage-based indices than those based on Land Registry data.

Rightmove advertises properties for sale online throughout the United Kingdom covering asking prices of the 90 percent of estate agents stated to advertise on their site. Properties that do not sell are also included. The index is compiled from the asking prices of properties, the prices at the very beginning of the buying and selling process. Weights (and mix-adjustment) are according to the stock of properties in terms of geographical distribution and property type. Rightmove is distinct in its use of asking price and has the least commonality with other indices.¹⁴

Do the commonalities in measurement matter?

Three main points are apparent:

- Similar trends and turning points are tracked by all indices in spite of their data and methodological differences, yet substantial differences remain especially at some peaks and troughs, and more so for quarter-on-quarter comparisons.
- The use of quarterly *annual* changes in Figure 1 does much to smooth the discrepancies endemic in the quarter-on-quarter indices in Figure 2.
- Indices using similar source data seem to move more closely together, even though the coverage of the data and methodology may vary considerably. The correspondence between the Land Registry and AcadHPI is the most striking, being based on the same data but having very different coverage, weighting, and methodologies for controlling for quality mix.

But these points are based on a single country's experience. Consider a further example, the United States.

cluster membership, defined by the Office for National Statistics, number of habitable rooms, old or new (New), first-time buyer or former owner-occupier (FT), plus interaction terms for ACORN and PT, ACORN and FT, and PT and New. Each combination of the variables in the regression forms a stratum defined by the combinations of characteristics of the property, about 1,000 property types/strata.

¹⁴ At least in terms of its correlation. The correlation coefficient between Rightmove and each of Halifax, DCLF, Land Registry, AcadHPI, and Nationwide are, respectively, 0.71, 0.55, 0.68, 0.62, and 0.73. No other correlation coefficient for comparison between these series has a lower correlation coefficient. Land Registry and AcadHPI, based on the same source data, has a correlation of 0.98.

House price indices for the United States

The United States has two main indices for residential property prices, the Federal Housing Finance Agency (FHFA)¹⁵ “purchases only” house price index¹⁶ and the S&P/Case-Shiller National Home Price Index. Both FHFA and Case-Shiller use the same repeat-sales methodology to control for quality changes in the mix of houses sold. They have the same coverage of type of properties; that is, they include transactions on one-family houses and exclude 2- to 4-family houses, condominiums and cooperatives, and weight changes in regional price indices over 9 US census divisions.¹⁷

Different movements

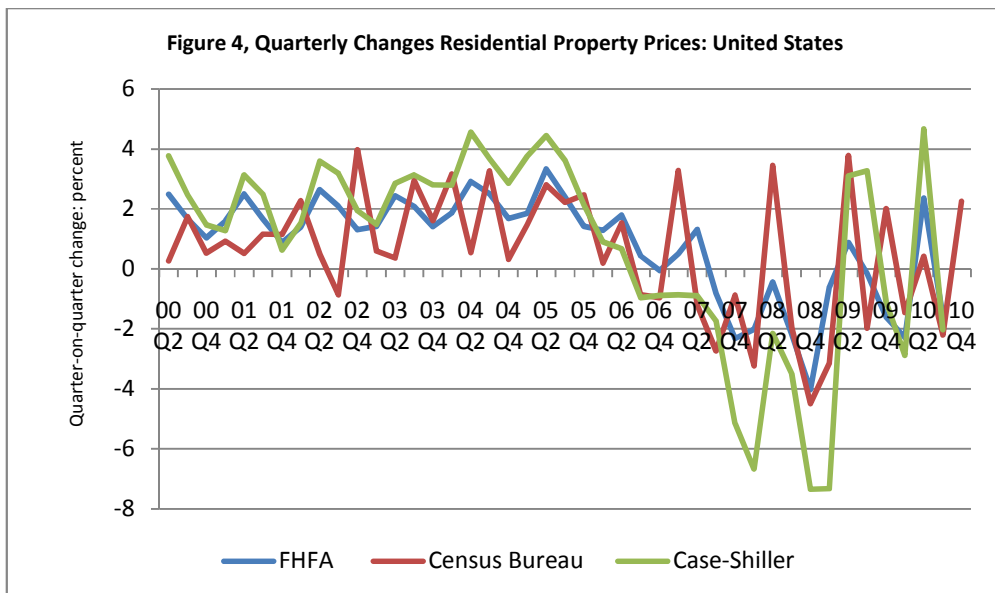
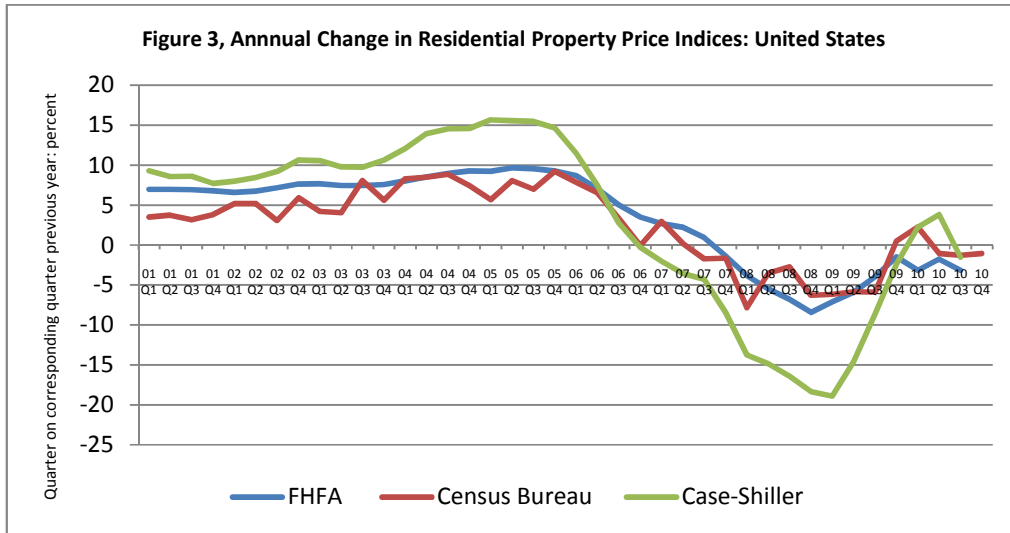
- Figure 3 shows the Census Bureau’s index to be quite different from FHFA and Case-Shiller, though this is to be expected since its coverage is of new houses only.
- What is striking from Figure 3 is the different timing of the downturn in house prices: Annual changes in Case-Shiller turn negative in 2006 Q4 in Figure 3, but FHFA turns negative a full year later in 2007 Q4. Figure 4 shows quarterly changes in Case-Shiller to turn negative in 2006 Q3, while FHFA dips into a negative change in 2006 Q4 to subsequently have positive changes for the next two quarters to then turn negative in 2007 Q3.
- The difference in the magnitude of the 2008/09 downturn is also striking. Figure 3 shows for 2008 Q4 and 2009 Q1 Case-Shiller registering annual falls of over 18 percent compared with falls of around 7–8 percent for FHFA; similar discrepancies are apparent from Figure 4.

¹⁵ The Federal Housing Finance Agency regulates Fannie Mae, Freddie Mac and the 12 Federal Home Loan Banks.

¹⁶ The FHFA produces an “all transactions” HPI that includes refinance appraisals that are not sales that comprise nearly 90 percent (about 35 million of the 40 million repeat transactions). FHFA itself notes evidence that prices based on appraisals submitted for refinancing tend to lag market trends and have an appraisal bias. The “purchases-only” HPI excludes refinancing transactions. Leventis (2008) estimates that removing appraisals accounts for 1.54 percentage points of FHFAs 4.27 percent average difference over Case-Shiller for the four-quarter price change estimates over 2006Q3-2007Q3 for the ten original MAs.

¹⁷ The FHFA, Case-Shiller and Census Bureau indices do not incorporate Condominiums. However, in November 2008, Standard & Poor's launched indices designed to track condominium prices in five major metropolitan areas—Boston, Chicago, Los Angeles, New York and San Francisco. The National Association of Realtors provides median values (by quarter) for a larger number of cities for condominium prices, but these are not quality adjusted.

- Even the nature of the differences cannot be relied upon. From Figure 3, up to 2006 Q2 Case-Shiller exceeded FHFA, this being reversed between 2006 Q3 to 2009 Q4, and reversed again from 2010 Q1.
- Figure 4 shows highly volatile quarter-on-quarter changes. Yet in spite of methodological differences, the peaks and troughs of Case-Shiller and FHFA roughly coincide—peaking in Q2—though their amplitudes differ.



Differences in methods

Differences in the indices are to be expected. While both indices use repeat sales methodology and cover the same type of houses, the coverage, weighting, and implementation of the repeat sales methodology differ.

On coverage, the Case-Shiller *National* Home Price Index is based on publicly available transaction sales prices from local recording offices while the FHFA index is based on data on conventional, conforming mortgage transactions obtained from Fannie Mae and Freddie Mac. The “conforming” loan limit for mortgages is a capped and FHFA data are biased against houses purchased with relatively “high” or “low” mortgages.¹⁸ The Case-Shiller National HPI does not have valuation data from 13 states while FHFA’s index uses data from all states (363 metropolitan areas).

On weighting, the FHFA HPIs is a geometrically-weighted average of price changes of the nine census division; the weights are the relative *number* of one-family housing units. Case-Shiller is an arithmetically-weighted average of price changes; the weights are the relative dollar *value* of one-family housing units. For example, the Case-Shiller index places a 22 percent weight on the Pacific division in contrast to the 14 percent weight of the FHFA HPI, due to the relatively higher house prices in California. The weights used for aggregating both indices are estimated using US Census data, updated every ten years, that is, in 1990, 2000, and 2010, though linear interpolations are used by FHFA to chain-weight the indices retrospectively once the subsequent benchmark census results are available.

On the implementation of the repeat sales methodology, sales pairs with longer time intervals are given less weight than sales pairs with shorter intervals¹⁹ The down-weighting for lengthy intervals used for Case-Shiller National HPI is more modest than that used by FHFA.

Studies undertaken by FHFA economists on why the two indices differ find the most important reasons are the non-coverage by FHFA of “low and moderate-priced” sales, somewhat offset by the non-coverage of “high-priced” sales, and differences in down-weighting long-intervals and filters used exclude non-arms-length sales.

¹⁸ The upper end is also not fully represented both because such transactions are less likely to use conventional mortgage loans, and because the size of the associated mortgages can lie above the conforming loan limits (loan amount restrictions) in the agencies. However, the study found that the bias due to this was limited.

¹⁹ This procedure is well justified when phrased as a correction for heteroskedastic error variances as greater noise accompanies ratios over longer periods. The correction reduces the error but does not increase bias.

The case studies, while of interest to ground more detailed analysis are, in a statistical sense, constrained by their limited degrees of freedom, that is too many variables on too few observations. It is natural to consider a data set of many countries each with more than one HPI with different coverage's and utilizing different methodologies. The panel structure of the data would have measures of house price inflation as cross sections with different source data and methodologies as explanatory variables. The time series dimension of the panel would be the quarterly series of the HPIs. Fixed effect controls would be by country.²⁰

II. DOES MEASUREMENT MATTER? INTERNATIONAL EVIDENCE

Given theories of international co-movements of prices the possibility exists *a priori* of country differences in HPI rates being explained by measurement error. Certainly there is evidence of differential HPI growth rates between countries.²¹ But there is also a variety of quite dispirit methods employed between countries for calculating HPIs.

III. HOUSE PRICE INDICES: NATURE AND CO-MOVEMENTS

A. The HPI series

The study comprises, from 2000:Q2 to 2010:Q2, an unbalanced panel with 157 series of quarterly house price indices (HPIs) for 24 countries. Details of the HPI series are given in Annex 2. Log rates of changes in quarterly HPIs are given for HPI series $i=1, \dots, N_c$ in country $c=1, \dots, C$ over $t=1, \dots, T$ quarters where N_c is the number of HPIs in country c , given in Annex 2 alongside each country name.

$$dhpi_{i,c}^t = \ln \left(\frac{hpi_{i,c}^t}{hpi_{i,c}^{t-1}} \right)$$

²⁰ An alternative approach is retrospective country studies that use different HPI methodologies. These include, for Ottawa, Canada: Li, Prud'homme, and Yu (2006); Sydney, Australia: Hill and Melser (2008); the USA: Leventis (2008); Tokyo, Japan: Shimizu, Nishimura and, and Watanabe (2009). Such studies provide valuable insights into the empirical effect of methodological differences, though are usually on constrained data sets, for example to a single city, and undertaken not on real time series. This study benefits from using cross country information and examines the measurement issues concerning real time HPIs.

²¹ Hilbers *et al.* (2008) demonstrated the variability in European country HPI growth rates by distinguishing between European countries by HPI average (real) growth rate between 1985 and 2005-07. House prices in Spain, Belgium, Ireland, the United Kingdom, the Netherlands, and France more than doubled; the Nordic countries, Italy and Greece increased by about 50–100 percent; and Germany, Austria, Switzerland, and Portugal remained largely flat or fell over the two decades.

Our concern is explaining variation in inflation *rates*, not levels. Following Levin, Lin, and Chu (2002) unit root tests were based on pooled data approaches. For the 2000:Q2 to 2008:Q2 price *levels* series the Levin, Lin, and Chu *t* statistic of 1.491 did not reject the null hypothesis that each individual series had a common integrated time series versus the alternative hypothesis that all individuals series are stationary. However, after differencing, the inflation *rate* series defined above had a Levin, Lin, and Chu *t* statistic of -30.275 and the null hypothesis that each individual series had a common integrated time series, versus the alternative hypothesis that all individuals series are stationary, was rejected (*p-value*=0.0000). Unit root tests of individual integrated series, against stationary ones were also rejected, as given by Im, Pesaran and Shin *W*-statistic of -46.09, the ADF Fisher Chi-square statistic of 2,504.2, and the Phillips and Perron Fisher Chi-square statistic of 3,520.8—all test statistics rejected the null hypothesis of unit roots at a 0.01 percent level.

B. Coverage and measurement of explanatory variables

Explanatory variables include:²²

²² Information on the characteristics of the property price indexes was based on the methodological notes attached to the source data, survey papers, and, often, extensive email correspondence with the providing institutions.

- **Vintage** (benchmarked on *both* new and existing).
New (newly constructed dwelling=1 (0 otherwise); **Xsting** (existing dwelling) =1.
- **Quality-mix adjustment** (benchmarked on *price per dwelling*, no adjustment)
Hedonic regression-based=1 (0 otherwise); **Repeat** sales=1 (0 otherwise); **SPAR**=1 (0 otherwise); **MixAdjust**=1 (0 otherwise); **SqMeter**=1 (0 otherwise).
- **Geographical coverage** (benchmarked on *national* coverage).
Capital (major) city=1 (0 otherwise); **Big cities**=1 (0 otherwise); **Urban** areas (0 otherwise); **Notcapital**=1 (0 otherwise); **Rural**=1 (0 otherwise).
- **Type of dwelling** (benchmarked on *both* apartments and single family homes).
Apartment=1 (0 otherwise); Single family home (**Sfh**)=1 (0 otherwise).
- **Type of price** (benchmarked on *transaction price*).
Asking price =1 (0 otherwise); Tax/mortgage **Appraisal price**=1 (0 otherwise).
- **Weights: as a flow of sales transactions or stock** (benchmarked on *sales*=0).
Wstock=1 (0 otherwise).
- **Weights: quantity or value shares** (benchmarked on *value*=0).
Wquantity=1 (0 otherwise); **Wsqmeter**=1(0 otherwise); **Wpopulation**=1(0 otherwise); **Wprice** in base-period =1(0 otherwise).
- **Weights: fixed or chained/regularly-updated or unweighted** (benchmarked on *fixed*=0).
Wchain=1 (0 otherwise); **Unweighted**=1 (0 otherwise).
- **Weights: rolling/average or annual** (benchmarked on *annual*=0).
Wrolling=1 (0 otherwise).
- **Aggregation at higher level: geometric or arithmetic** (benchmarked on arithmetic).
Geometric=1(0 otherwise).

Interaction variables were included, but with little success. Some dummy variables were included to reflect changes in methodology over time.

The categorization is of course not always straightforward. For example, for the Austrian HPIs, the *Immobilienpreisindex*, since one third of the data are transaction prices and two thirds are quotation prices the index was characterized as being based on transaction prices.

C. The Results

The estimator is a cross-section SUR specification to allow for conditional correlation between the contemporaneous residuals for cross-sections, but restricts residuals in different periods to be uncorrelated (Beck and Katz (1995)). The estimator was tested for efficiency against OLS and time series SUR estimators.

The results are presented in Table 1, which includes the fixed country effects, though not given here for brevity.²³ These 23 dummy variables were, for the large part statistically significant (17 cases at the 5 percent and 3 cases at the 1 percent level). **Their coefficients provide estimates of the extent to which country inflation rates differ**, benchmarked on Poland, conditioned on the differential coverage and measurement of the HPI series within and across countries.

In Table 2 country fixed effects are again not shown, and neither are all explanatory variables. Variables with little explanatory power were not included following the usual principles applied when moving from a general to a parsimonious representation.

Of note is that the coverage of the index, in term of whether new or existing properties (benchmarked against all properties) (surprisingly) do not seem to matter. Use of pricing per square meter, as against per house increases measured house price inflation while use of the repeat sales method decreases it. Covering big cities and urban areas, against a national coverage increases measured house price inflation. The use of stocks as weights, as opposed to transactions, decreases it. So too does the use of relative (base period) prices as weights or simple unweighted indices, as does the use of rolling averages as weights.

Note the \bar{R}^2 is very low. This low value is based on a specification that includes the fixed country effects. Were these fixed effects excluded, the \bar{R}^2 would be 0.008. **This suggests that the measurement variables, although some are statistically significant, have little to no relative explanatory power for month-on-month house price inflation.**

The relatively low \bar{R}^2 is of interest. The regression is attempting to explain variation in inflation across up to 157 measures over 40 quarters. While measurement variables attempt to account for cross-sectional variation, they are, for the large part, constant over the time series. The structural economic conditions that may explain variation over time in house price inflation are absent from the model. Our concern is explaining the extent and nature of variation in house price inflation attributable to measurement issues.

²³ Results are available from the author.

- \bar{R}^2 for a regression of the panel data on a constant is of course **zero**; increasing to
- **0.027** when the 157 cross-section fixed effects are included; to
- **0.033** when the 157 fixed effects are replaced by 24 country fixed effects; to
- **0.109** when just time dummies are included; to
- **0.146** when both country and time fixed effects are included; and to
- **0.147** when also conditioned on salient measurement variables.

Of note, (i) cross-sectional variation is small, but significant, relative to the time series variation of the inflation series themselves,²⁴ and (ii) while some measurement variables are significant, they do not seem to explain much of the month-on-month price variation.

There are three caveats for the latter result.

- First, the results will be adversely affected by the relatively crude measures adopted for the coverage and methodology used.
- Second, some facets of coverage and measurement, given fixed country effects, may still have limited degrees of freedom for the data to reveal any relationships.
- Third, the regressions have no structural explanatory variables to explain house price inflation by means of the supply and demand (and financing) of country's housing market, as in, for example, Muellbauer and Murphy (2008).²⁵ Measurement may matter in some absolute sense, but not relative to the substantial variation that such economic and financial variables may account for.

Figure 5 provides a measure of house price inflation for the 24 countries derived from the fixed time effects and whose implicit country weighting is the number of series in each

²⁴ When the fixed effects were tested against an unrestricted model for such effects, the null hypothesis was rejected. For the fixed time effect, $F=19.37$ (p -value=0.00); cross-section, $F=2.26$ (p -value=0.00); both cross-section and time fixed effects, $F=5.67$ (p -value=0.00).

²⁵ The papers finds the main drivers of house prices to include income, the housing stock, demography, credit availability, interest rates, and lagged appreciation.

country.²⁶ The time series is conditioned in the regression on the measurement variables and thus takes account of differences in measurement.

IV. CONCLUSIONS

The paper outlined the wide variation in the form house price indices can take both with respect to coverage and methodology. The case studies, while showing that different house price indices broadly follow similar trends and turning points, clearly demonstrate that for month-on-month inflation, differences in the coverage and measurement matter. The stance taken by the paper is that there is much in the data sources available and institutional arrangements by which houses are bought and sold that makes harmonisation of methods between countries difficult. Indeed, the publication of house price indices by commercial organisations as a means of promoting their business provides for differences in measures within countries.

For national house price indices within countries quite substantive difference occurs between series that purport to measure the same thing. The panel data analysis, however, finds that while the measurement variables have some explanatory power, it is very small relative to the overall variability in month-on-month house price inflation within and between countries and, more so, over time. The framework outlined provides a means by which the impact of measurement differences can be ascertained and measures of global house price inflation, conditioned on such differences, can be established. Continuing work is to refine the measurement variables and extend the data set.

²⁶ The weighting is not in itself a methodological issue in that weighting by, say, relative household consumption expenditures could be introduced using a framework outlined in Diewert (2005).

Table 1, General model results**Estimation:**

Method: Pooled Least Squares

Sample: 2000Q2 2010Q1

Total pool (unbalanced) observations: 5486

Cross-section SUR (PCSE) std. errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
XSTING	-0.0012	0.002	-0.733	0.46
NEW?	-0.0013	0.003	-0.432	0.67
HEDONIC	-0.0035	0.003	-1.379	0.17
REPEAT	-0.0051	0.002	-2.332	0.02
MIXADJUST	0.0003	0.002	0.125	0.90
SPAR?	-0.0003	0.003	-0.090	0.93
SQMETER	0.0091	0.005	1.732	0.08
CAPITAL	0.0003	0.001	0.245	0.81
BIGCITIES	0.0054	0.002	2.523	0.01
URBAN	0.0105	0.004	2.765	0.01
APARTMENT	-0.0007	0.002	-0.438	0.66
SFH	0.0003	0.002	0.180	0.86
APPRAISAL	0.0088	0.005	1.737	0.08
WSTOCK	-0.0064	0.002	-2.907	0.00
WPRICE	-0.0036	0.002	-2.101	0.04
WQUANTITY	0.0008	0.002	0.524	0.60
WPOP	0.0030	0.005	0.625	0.53
WCHAIN	-0.0001	0.002	-0.058	0.95
UNWEIGHTED	-0.0074	0.002	-3.443	0.00
WROLLING	-0.0111	0.002	-5.593	0.00
R-squared	0.041	Mean dependent var	0.015	
Adjusted R-squared	0.033	S.D. dependent var	0.041	
S.E. of regression	0.040	Akaike info criterion	-3.575	
Sum squared resid	8.858	Schwarz criterion	-3.522	
Log likelihood	9849.503	Hannan-Quinn criter.	-3.556	
Durbin-Watson stat	1.971			

Table 2, Results from parsimonious model

Estimation:

Sample: 2000Q2 2010Q1

Total pool (unbalanced) observations: 5566

Cross-section SUR (PCSE) std. errors & cov. (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
REPEAT	-0.0033	0.00	-2.01	0.04
SQMETER	0.0089	0.00	2.01	0.04
APPRAISAL	0.0059	0.00	1.34	0.18
BIGCITIES	0.0050	0.00	2.75	0.01
URBAN	0.0091	0.00	2.84	0.00
WSTOCK	-0.0061	0.00	-2.81	0.00
WPRICE	-0.0033	0.00	-2.93	0.00
UNWEIGHTED	-0.0055	0.00	-2.31	0.02
WROLLING	-0.0097	0.00	-4.66	0.00
R-squared	0.0401	Mean dependent var		0.0145
Adjusted R-squared	0.0346	S.D. dependent var		0.0409
S.E. of regression	0.0402	Akaike info criterion		-3.5863
Sum squared resid	8.9209	Schwarz criterion		-3.5470
Log likelihood	10013.6700	Hannan-Quinn criter.		-3.5726
Durbin-Watson stat	1.9601			

Table 3, With country and time fixed effects

Estimation:

Method: Pooled Least Squares

Sample: 2000Q2 2010Q1

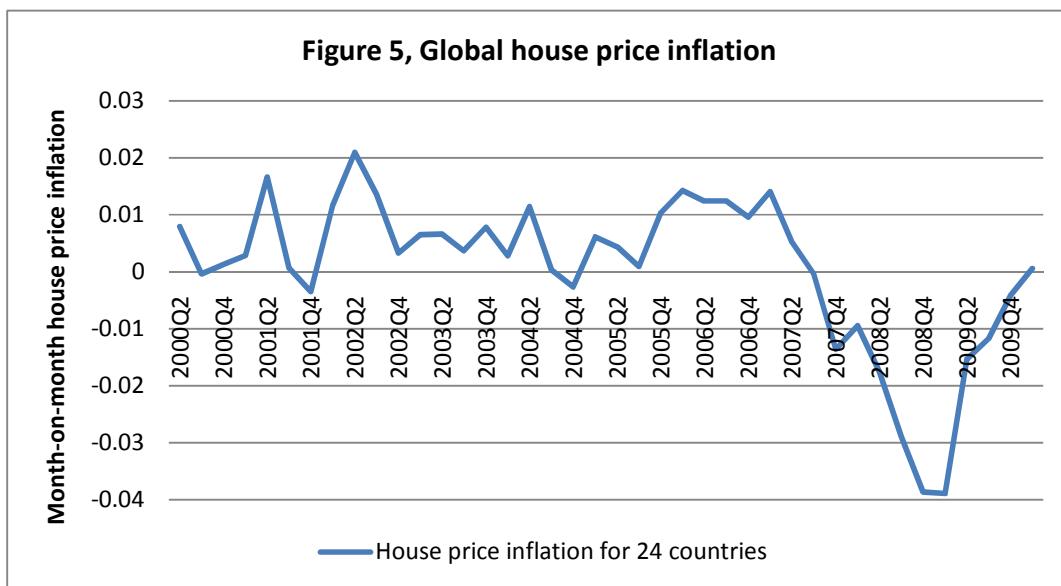
Total pool (unbalanced) observations: 5486

Cross-section SUR (PCSE) std. errors & covariance (d.f. corrected)

Includes fixed time effects (not shown here)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.0100	0.005	2.168	0.030
AU?	0.0108	0.005	2.199	0.028
BE?	0.0106	0.005	2.139	0.033
CN?	0.0204	0.005	4.246	0.000
CH?	0.0010	0.003	0.282	0.778
CZ?	0.0064	0.007	0.904	0.366
DK?	0.0027	0.006	0.451	0.652
EE?	0.0260	0.018	1.449	0.147
ES?	0.0053	0.006	0.908	0.364
FI?	0.0085	0.004	2.106	0.035
FR?	0.0042	0.004	0.963	0.336
GR?	0.0087	0.006	1.566	0.117
IE?	-0.0024	0.007	-0.361	0.718
JP?	-0.0034	0.003	-1.016	0.310
NO?	0.0084	0.005	1.552	0.121
NL?	0.0027	0.005	0.535	0.592
NZ?	0.0083	0.006	1.477	0.140
PO?	0.0260	0.017	1.499	0.134
RU?	0.0421	0.007	5.716	0.000
SI?	0.0167	0.006	2.903	0.004
SK?	0.0152	0.008	1.860	0.063
SW?	0.0130	0.005	2.734	0.006
US?	0.0007	0.006	0.126	0.900
UK?	0.0123	0.006	1.981	0.048
HEDONIC?	-0.0041	0.002	-1.861	0.063
REPEAT?	-0.0041	0.002	-2.521	0.012
BIGCITIES?	0.0021	0.002	1.342	0.180
UNWEIGHTED?	-0.0047	0.003	-1.783	0.075
WPRICE?	-0.0018	0.001	-1.790	0.074
WROLLING?	-0.0055	0.002	-2.273	0.023

R-squared	0.157802	Mean dep var	0.01449
Adjusted R-sqrd	0.147384	S.D. dep var	0.040866
S.E. of regr.	0.037734	AIC	-3.70417
Sum sqrd. resid	7.827078	D-W stat	2.183484
Log likelihood	10377.71		
F-statistic	15.14663		
Prob(F-statistic)	0		



ANNEX 1: Issues in HPI methodology

HPIs methodology can vary according to method used to control for quality mix, coverage, nature of prices, and weights—Eiglsperger (2006), Fenwick (2006), Hill (2011) and the draft *Handbook on Residential Property Price Indices*.²⁷

A. Stocks or transactions

A key issue is whether the purpose of the HPI is to measure changes in the price component of the value of the stock of housing or the value of houses transacted. If the former, then the weights must be based on relative stock values, as outlined in section E below, and the prices reflect price changes in the stock of housing, as opposed to those sold. HPIs that utilize data on the prices of houses sold, or for sale, are subject to selectivity bias if the sample of houses is not a random sample of the stock. Appraisal data, usually required for property tax assessment, may be available for the much of the stock of housing and while open to errors from appraiser bias²⁸ or changes in appraisal rules, enable HPIs to be estimated that are free from selectivity bias. Alternatively, HPIs based on price data of houses sold may be estimated using dummy time variables in a hedonic regression, but a correction for selectivity bias incorporated in the two-stage censored regression estimator, as undertaken in Gatzlaff and Haurin (1998).²⁹

B. Constant-quality comparisons

At their simplest HPIs are measured as weighted changes in average (often median) prices. Yet since housing is heterogeneous there is a need to make ensure that average price change measures are not tainted by changes in the quality mix. Alternative methods include:

²⁷ The current draft is available at:

http://epp.eurostat.ec.europa.eu/portal/page/portal/hicp/methodology/owner_occupied_housing_hpi/rppi_handbook.

²⁸ Quan and Quigley (1991) point to a problem of appraisal smoothing. Appraisers are argued to work by updating current estimates of comparable property values each time a transaction occurs. The appraiser's role is identified as signal extraction that, as a result of their larger set of information and experience, reduces the price dispersion of equivalent transaction prices by buyers and sellers. An implication is a process known as appraisal smoothing or "appraisal lag." Geltner *et al.* (2003) discuss the process of de-lagging appraisal indices to remove the effects of smoothing, the lag bias, and provide a summary of the results of empirical studies.

²⁹ The two-stage estimator requires joint estimation of the probability that a house will sell and the transaction price. The first stage for the probability of a sale uses as explanatory variables, property, owner, and macroeconomic factors that affect reservation and offer prices. From the results, a selection bias correction variable is calculated. Once inserted in the second stage OLS regression of transaction prices, unbiased OLS estimates of HPIs can be derived from the coefficients on the time dummies.

Repeat sales pricing

restrict the comparison to repeat sales. The repeat-sale method was developed by Bailey, Muth and Nourse (1963) and has since been extended by amongst others Shiller (1991, 1993). Each period, data are collected on sales and if a record of an earlier transaction for the home is identified, the two transactions are paired and treated as a repeat sale. By limiting the sample to price comparisons of pairs of like sales it mitigates the shortcomings of HPIs based on median sales that have no control for quality change. The primary disadvantages are (i) the quality of a repeat purchase may depreciate, with wear and tear, or appreciate, with renovations;³⁰ (ii) there is potential sample selectivity bias³¹ and error due to relatively small sample sizes—houses not sold or sold once³² in the period are omitted and atypical houses may be sold more frequently thus biasing the sample (see Gatzlaff and Haurin (1998), Hwang and Quigley (2004) and Mason and Pryce (2011) for correction mechanisms for sample selection bias); (iii) time dummies are used in a regression of prices of repeat sales to generate average house price indices.³³ As a result, as new transaction pairs become available with the addition of new historical data, the index is subject to a volatile revision history;

Hedonic approach

has as its basis regression of house prices on price-determining characteristics. It can be used for a data set of prices of all houses, say using appraisal data, as long as each price has an associated characteristic data set. There are two major forms: characteristics price (or hedonic imputation) indices in which the quality characteristics in a fixed period are revalued by the coefficients from hedonic regressions in each period as the basis for constant quality indices. There are as many possible HPIs as there are fixed reference periods, but index number theory provides guidance on an appropriate choice. Alternatively, time dummies are included in the hedonic regressions and their coefficients provide the basis for estimates of

³⁰ Some fairly arbitrary methods are used to mitigate such effects, for example, the CS-HPI (i) assigns smaller weights to sales pairs with large price changes relative to the community around them—in large metro areas typically 10–15 percent of pairs are down-weighted; (ii) sales pairs with longer time intervals are given less weight than sales pairs with shorter intervals—in large metro areas the interval weights for sales pairs with ten-year intervals will be 20–45 percent smaller than those for six-month intervals; (iii) deeds that indicate that the sale is unlikely to be arms-length are excluded; and (iv) homes that sell more than once within 6 months are excluded as they are considered likely to following a major remodeling. The hedonic repeated measure developed by Shiller (1991, 1993) makes it possible to account for possible changes in house characteristics between first and second sales.

³¹ If the purpose of the measure relates to changes in the stock of house prices.

³² A hybrid measure combines information on single sales and repeat sales using characteristics to control for quality, see Englund, Quigley and Redfearn (1998). Chau, *et al.* (2005) surveys the percentage of repeat sales pairs to number of transactions (maximum 50%) in a number of studies finding high inter-country variability, for example, 23 percent for Hong Kong for comparisons over 10 years compared with 6.6 percent over 18 years for areas in California.

³³ Dreiman and Pennington-Cross (2004) address the implications for the estimator of the (asymmetric and positive) relationship between the time between transaction and the variance of the error term.

quality-adjusted price changes. Silver and Heravi (2007), Diewert, Heravi and Silver (2008) provides accounts of these approaches the factors determining differences in their results and Li, Prud'homme, and Yu (2006) and Hill and Melser (2008) provide empirical work on how such HPIs based on these approaches differ.

Mix-adjustment through stratification

Mix-adjusted HPIs may be compiled as weighted averages of strata based on location and other price-determining characteristics (see examples in Wood (2005). Such indices are equivalent to hedonic time dummy indices for which the stratifying factors are dummy variables in the regression. The advantage of using a regression (hedonic) formulation is that estimates for standard errors are obtained for the (HPI) coefficients on the time dummy variables.

Sale price appraisal ratio (SPAR) method

SPAR combines information from appraisals and transactions. It includes unmatched transactions and, unlike the repeat purchase method, does not need to be revised when a new transaction is paired. There is claimed to be a constant quality, except for age, provided that appraisals are adjusted by the value of improvements—see Bourassa, Hoesl, and Sun (2006) for details. The unmatched comparisons between say periods t and $t-1$, are the average prices of the “new” (sold only in period t) compared with the “old” (sold only in period $t-1$) and the quality adjustment used can be shown³⁴ to be the ratio of the average appraised values in some previous period 0 of the new against the old. The viability of the method depends critically on the quality of appraisals and their not becoming out of date.

Standard ‘model’ portfolio approach

This approach is based on controlling for quality changes by making periodic valuation of a standard property portfolio or standard units of different types/specifications in a given areas. The sample may be changed over time to keep constant the age of the property. The sample may be based on active transactions and/or appraisals (Chau *et al.*, 2005).

C. Coverage

Geographical

HPIs can be national, cover just the capital city, major cities, major urban areas, rural areas, or some or all of the above being aggregated from sub-indices of regional or more local administrative areas. The evidence is of substantial variation in inter-area growth rates in HPIs (for example, Abraham and Hendershott (1996) and Capozza *et al.* (2002). The concern of this paper is where a reliable national HPI is not available for a country but a say reliable

³⁴ Algebraically, this can be easily done using geometric, recommended for an unweighted SPAR by Vries *et al.* (2008), as opposed to arithmetic means.

capital city HPI is used as a proxy for a national one. In such a case the “national” index has a defective geographical coverage.

Type of housing

HPIs may be restricted to (combinations of) types of housing such as newly built houses and or apartments, single-family houses, apartments, apartment *and* terrace houses. These serve different purposes, for example, newly-built house price indices are appropriate for measuring the cost of shelter in a consumer price index using the net purchase (or acquisitions) concept (see Diewert (2004) and Baldwin, Nakamura and Prud'homme (2006)).

Source data and financing

Administrative data sources used to record prices may be restricted to purchases financed by a particular mortgage organization. For example the aforementioned OFHEO HPI is based on data on conventional conforming mortgage transactions (including refinancing) obtained from Freddie Mac and Fannie Mae, about 60 percent of all loans. Notable exclusions are transactions for properties financed by government insured loans, Jumbo mortgages, sub-prime loans, private loans or no loans.

D. Prices: source data, valuation, and time-lines

The sale and purchase of a house usually touches a number of organizations to promote its sale (real estate agents), finance its purchase (mortgage lenders), administer taxes (tax authority), and register its legal title (Land Registry or notary³⁵). The price may change along the timeline of the process from asking price to final completion (of contract) price. The continuum is such that the asking price for an individual property can change, and is likely to fall, the longer the property is on the market. While generally it is the final completion price that HPIs should measure, prices at earlier stages may be used for HPIs for pragmatic reasons.

For example, the final completion price data base may not be timely or may exclude many price-determining characteristics necessary for mix-adjustments, while an earlier data base, say from mortgage lenders, may have sufficient price-determining characteristics and be more timely, but would exclude cash sales and the effects of any renegotiation of prices between mortgage approval and completion. The length of the timeline, potential for renegotiating price, and adequacy of source data will vary between countries and over time for individual countries. An illustration is provided below based on Wood (2005 for the U.K. timeline which may take 6 months, though see also the analysis by Shimizu, Nishimura, and Watanabe (2011).

³⁵ In France, all real estate transactions have to be registered in front of a notary who have a monopoly Gouriéroux and Laferrère (2006).

The Rightmove HPI is based on the sellers' asking prices posted on internet site. Such prices may well be revised by the time they are used by the Halifax, Nationwide, and Hometrack HPIs at mortgage approval stage, but the samples are restricted to loans approved by mortgage lenders Halifax and Nationwide, and for Hometrack, a survey of approx 4,000 estate agents. Yet prices can be renegotiated further even at this late stage (called "gazumping") and the ODPM index registers prices at completion based on data from a larger sample of mortgage lenders. The Land Registry while released even later, included all transactions including those purchased by cash without a mortgage. There is an apparent tradeoff between the timeliness of the indicator and its quality.

E. Weights: stocks or transactions and values or quantities

HPIs can be designed to measure changes in transaction prices or the price component of changes in the value of the stock of housing, depending on analytical need. The implications for price measurement were outlined in Section A above, Here our concern is with weights.

First, there is the issue whether democratic or plutocratic weights should be used. For an index aggregated over regions, types of housing, and possibly other stratification factors, democratic weights would require the relative volumes of transactions of each stratum while plutocratic weights would require the relative monetary nominal values. Such values may be purchase values or stock values, depending on the purpose of the index. As outlined in section IIA above, an HPI of the price component of changes in the value of the stock of houses not only requires relative stock value weights, but that the prices, if based on transactions, be adjusted for selectivity bias, something not always feasible.

Weights should be updated as regularly as possible and annual chained Lowe indices or, more so, geometric Young indices are preferred as most likely approximations, given timely weights will be unavailable, to chained superlative indices (see ILO *et al.* (2004) for these index number issues). For regression formulations weighted least squares (WLS) estimators can be used since there is an equivalence between different weighting systems used for such estimators and individual weighted index number formulas (see Silver (2002) and Diewert (2005)).

ANNEX 2: HOUSE PRICE SERIES

Many of the residential property price indexes used in this study have been drawn from the Bank for International Settlements' (BIS) database of property price indexes available at: <http://www.bis.org/statistics/pp.htm>. The codes cited below alongside "BIS" refer to this database. Use of the database requires a citation of the appropriate national source as noted at: <http://www.bis.org/statistics/pp/disclaimer.htm> and given below along with the websites used.

The BIS country series have been supplemented by further residential property price indexes, not always published, from the national sources indicated below.

Australia: 14 series

BIS: Q:AU:2:1:1:1:0:0 and Q:AU:4:1:1:1:0:0; House Price Indexes; original source: Australian Bureau of Statistics: <http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/6464.02009?OpenDocument>.

RP Data; RP Data-Rismark's Home Value Indexes: Capital Gain (final values), Repeat Sales, and Stratified median; data provided to author by RP Data; website: <http://www.rpdata.com/>. See also: www.rpnz.com.au/derivatives/pdfs/Basing_NZ.pdf

Austria: 10 series

BIS:Q:AT:2:8:0:0:1:0, Q:AT:1:1:0:0:1:0, Q:AT:1:8:0:0:1:0, Q:AT:2:8:1:0:1:0, Q:AT:1:2:1:0:1:0, Q:AT:1:8:1:0:1:0, Q:AT:1:8:2:0:1:0, Q:AT:2:1:0:0:1:0, Q:AT:2:2:1:0:1:0, Q:AT:2:8:1:0:1:0; Residential Property Price Index; original source: Oesterreichischen Nationalbank: <http://www.oenb.at/isaweb/report.do?lang=EN&report=6.6>.

Belgium: 8 series

BIS: Q:BE:2:2:1:2:0:0; Stadim Indexes; original source and further indexes: STADIM (Study and Advice Bureau on Immovables): <http://www.stadim.be/index.php?page=stadimindexen&hl=en>.

BIS: Q:BE:0:1:1:0:0:0, Q:BE:0:2:1:0:0:0, Q:BE:0:3:1:0:0:0, Q:BE:0:4:1:0:0:0, and Q:BE:0:8:1:0:0:0; Prix Ventes de Biens Immobiliers original; original source: SPF Economie, DGSIE (Service public federal Economie, Direction Generale Statistique et Information Economique (FPS Economy, DGSEI (Federal Public Service, Directorate-General Statistics and Economic Information)): http://statbel.fgov.be/fr/modules/publications/statistiques/economie/ventes_de_biens_immobiliers.jsp.

Canada: 6 series

Teranet (developed in alliance with the National Bank of Canada); Teranet House Price Index; source: <http://www.housepriceindex.ca/Default.aspx>.

New Housing Price Index; Statistics Canada; source: <http://www.statcan.gc.ca/daily-quotidien/110210/dq110210a-eng.htm>

Resale-Housing Prices (Royal LePage); Bank of Canada; source: http://www.bankofcanada.ca/en/rates/indinf/real_data_en.html.

The Canadian Real Estate Association (CREA); Residential Average Price; source: CREA, available on subscription: <http://creastats.crea.ca/natl/>.

Czech Republic: 2 series

BIS: Q:CZ:0:2:1:1:3:0 and Q:CZ:0:8:1:1:1:0; Price Indexes of Houses and Flats; original source: Czech Statistical Office, Tables 1–6 and 2–6: <http://www.czso.cz/CSU/2009EDICNIPLAN.NSF/P/7009-09>.

Denmark: 4 series

BIS: Q:DK:0:2:0:1:0:0 and Q:DK:0:8:0:1:0:0; Price index for sales of property; original source: Statistics Denmark: <http://www.statbank.dk/STATBANK5A/DEFAULT.ASP?W=1024>.

Association of Danish Mortgage Banks; Average Sqm. Prices of Owner Occupied Dwellings: http://www.realkreditraadet.dk/Statistics/Prices_and_trades_of_owner_occupied_homes.aspx

Estonia: 2 series

BIS: Q:EE:0:8:0:1:1:0 and Q:EE:2:8:0:1:1:0; original source via Statistics Estonia: Estonian Land Board from whose website a data query facility is available: <http://www.maaamet.ee/kinnisvara/htraru/Start.aspx>. The facility is in Estonian, however, an English-language Guide to its use and technical information are available at: http://www.maaamet.ee/index.php?lang_id=2&page_id=453&menu_id=78.

Finland: 9 series

BIS: Q:FI:0:1:1:1:1:0, Q:FI:0:1:2:1:1:0, Q:FI:0:2:1:1:1:0, Q:FI:0:8:1:1:1:0, Q:FI:4:2:1:1:1:0, Q:FI:9:1:1:1:1:0, Q:FI:9:1:2:1:1:0, Q:FI:A:1:1:1:1:0, and Q:FI:A:1:2:1:1:0; House Price Index; original source: Statistics Finland, unpublished and available from Bank of Finland (Suomen Pankki): http://www.suomenpankki.fi/en/julkaisut/selvitykset_ja_raportit/main/Pages/default.aspx.

France: 8 series

BIS: Q:FR:2:8:1:1:0:0; Indice d'Évolution des Prix des Logements Anciens: original source: INSEE, National Institute of Statistics and Economic Research:

http://www.insee.fr/fr/themes/document.asp?ref_id=ip1297 and

http://www.indexes.insee.fr/bsweb/servlet/bsweb?action=BS_RECHGUIDEE&BS_IDARB O=05000000000000.

BIS: Q:FR:0:2:2:3:0:0, Q:FR:0:8:2:3:1:0, Q:FR:3:2:2:3:0:0, and Q:FR:3:8:2:3:1:0; Enquete Commercialisation Logements Neufs; original source: Ministère de l'Équipement Ministère de l'Écologie, de l'Énergie, du Développement durable, et de la Mer (Meeddm).

Greece: 9 series

BIS: Q:GR:0:8:0:0:0:0, Q:GR:0:8:1:0:0:0, Q:GR:0:8:2:0:0:0, Q:GR:1:1:0:0:1:0, Q:GR:3:8:0:0:1:0, Q:GR:4:8:0:0:1:0, Q:GR:5:8:0:0:0:0, Q:GR:8:8:0:0:0:0, and Q:GR:9:8:0:0:1:0; Index of the Price of Dwellings; original source: Bank of Greece:

<http://www.bankofgreece.gr/PAGES/EN/STATISTICS/REALESTATE.ASPX>.

Ireland: 11 series

BIS: Q:IE:0:1:0:2:0:0, Q:IE:1:1:0:2:0:0, and Q:IE:2:1:0:2:0:0; Permanent tsb House Price Index; original source: Economic and Social Research Institute (ESRI) based on data from Permanent TSB Bank; http://www.esri.ie/irish_economy/permanent_tsbagri_house_p/ and <https://www.permanenttsb.ie/aboutus/housepriceindex/#d.en.1460>.

BIS: Q:IE:0:1:1:3:0:0, Q:IE:0:1:2:3:0:0, and Q:IE:2:1:1:3:0; Average house prices; original source and further series: The Department of the Environment, Heritage, and Local Government; available at:

<http://www.environ.ie/en/Publications/StatisticsandRegularPublications/HousingStatistics/FileDownload,15295,en.XLS> and

<http://www.environ.ie/en/Publications/StatisticsandRegularPublications/HousingStatistics/>

Netherlands: 10 series

BIS: M:NL:0:1:1:1:0:0, M:NL:0:2:1:1:0:0, and M:NL:0:8:1:1:0:0; House Price Index and Average Purchase Prices; original source and further series: CBS (Central Bureau voor de Statistiek) published in cooperation with the Dutch Land registry Office, Kadaster:

<http://statline.cbs.nl/STATWEB/SELECTION/?DM=SLEN&PA=71533ENG&LA=EN&V W=T>.

New Zealand: 3 series

BIS: Q:NZ:0:1:0:3:0:0, Q:NZ:0:3:0:3:0:0, and Q:NZ:4:3:0:3:0:0; Quotable Value Quarterly House Price Index; original source: Quotable Value Limited; available at: Reserve Bank of New Zealand: <http://www.rbnz.govt.nz/keygraphs/1697975.html>.

Norway: 4 series

BIS: Q:NO:0:1:0:1:0:0, Q:NO:0:3:0:1:0:0, Q:NO:0:4:0:1:0:0, and Q:NO:0:8:0:1:0:0; House Price Index; original source and further series (see “More Tables in StatBank”): Statistics Norway: http://www.ssb.no/english/subjects/08/02/30/bpi_en/.

Poland: 4 series

BIS: Q:PL:2:8:1:2:1:0, Q:PL:2:8:2:2:1:0, Q:PL:4:8:1:2:1:0, and Q:PL:4:8:2:2:1:0; Average Asking Prices of Flats; original source: National Bank of Poland (growth rates): <http://www.nbp.pl/HOMEN.ASPX?F=/EN/SYSTEMFINANSOWY/STABILNOSC.HTML>.

Russia: 2 series

BIS: Q:RU:9:1:1:1:1:0 and Q:RU:9:1:2:1:1:0; Indices of Prices in Primary/Secondary Market of Dwellings; original source: Federal State Statistics Service: <http://www.gks.ru/wps/wcm/connect/rosstat/rosstatsite.eng/figures/prices/>.

Slovak Republic: 3 series

BIS: Q:SK:0:1:1:2:1:0; Residential Property Price Indices; original source and further series: National Bank of Slovakia: <http://www.nbs.sk/EN/STATISTICS/SELECTED-MACROECONOMICS-INDICATORS/RESIDENTIAL-PROPERTY-PRICES>.

Slovenia: 6 series

BIS: Q:SI:0:1:1:1:0:0, Q:SI:0:8:2:1:0:0, and Q:SI:2:1:1:1:0:0; Residential Housing Price Indices; original source and further series: Statistical Office of the Republic of Slovenia: http://www.stat.si/eng/novica_prikazi.aspx?id=3714.

Spain: 2 series

BIS: Q:ES:0:1:1:1:1:0 and Q:ES:0:1:2:1:1:0; Precio M² Vivienda Libre; original source: Banco de Espana: http://www.bde.es/infoest/si_1_6.csv.

Sweden: 2 series

BIS: Q:SE:0:1:0:1:0:0; Real Estate Prices; original source and other indexes; Statistics Sweden: http://www.scb.se/Pages/Product_10966.aspx and <http://www.ssd.scb.se/databaser/makro/produkt.asp?produktid=BO0501&lang=2>.

Switzerland: 6 series

BIS: CH:0:2:0:2:0:0 and CH:0:8:0:2:0:0; Real Estate Price Indices; original source: Swiss National Bank:

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United Kingdom: 27 series

BIS: Q:GB:3:1:0:2:0:0; Halifax House Price Index; original source and further series:

Halifax Research: http://www.lloydsbankinggroup.com/media1/research/halifax_hpi.asp (historical house price data).

BIS: Q:GB:0:1:2:1:0:0; Communities and Local Government House Price Index; original source and further series: Department of Communities and Local Government, available at:

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Rightmove; House Price Index; source: <http://www.rightmove.co.uk/news/house-price-index>.

United States: 3 series

BIS: Q:US:0:2:2:1:0:0; US Census Bureau; Constant Quality (Laspeyres) Price Index of New One-Family Houses Sold; original source:

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