Measuring house prices in the long run: Insights from Dublin, 1900-2015

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Abstract Despite the importance of housing in macroeconomic fluctuations, underscored by the Great Recession, there remains a dearth of information about housing markets prior to the 1980s, thus depriving social scientists of a wealth of case studies from which to draw insights. This paper constructs for the first time a housing price index for Dublin stretching back to 1900. Principal contributions of the paper include the assembly of a micro-level dataset of transactions 1900-1949, using a sample of 66 Dublin streets, and a dataset of newspaper listings from 1949 until modern data series begin. Hedonic price indices are constructed for both datasets, which are then combined with indices covering more recent periods. The nominal price index suggests a steady fall in housing prices early in the twentieth century, undone with post-war inflation, before two decades of volatility but no obvious trend. Rapid housing price inflation started in the 1940s and was an almost ever-present feature thereafter, with the exception of the 1950s and the post-2007 period. Much of the 400-fold increase in nominal housing prices in this period, however, can be attributed to changes in the general price level, which rose by a factor of roughly 100 during the same period. Real housing prices in the mid-2010s were about 3.5 times their 1900 level. The only decades to witness significant increases in real housing prices were the 1920s, the 1940s, the 1960s and Celtic Tiger period (1990s-2007). The indices outlined here provide the basis for a more detailed study of the relationship between housing prices and their determinants, including inflation, incomes, supply, user cost and credit conditions.

Keywords: Long-run housing markets; housing prices; real estate economics; 20th Century; Ireland.

JEL Classification Numbers: E32, N93, N94, R21, R31.

1 Introduction

Despite the importance of housing in macroeconomic fluctuations, underscored by the Great Recession starting in 2008, there remains a dearth of housing market data prior to the 1970s, thus depriving social scientists of a wealth of case studies from which to draw insights. Moreover,

those long-run series that do exist are typically based on small samples and elementary analytical techniques, meaning they may be of limited reliability.

This paper adds to the body of knowledge on housing prices prior to the 1970s, constructing for the first time a housing price index for Dublin, Ireland, stretching back to 1900. Given the detailed micro-level nature of the dataset, it is possible to use modern methods of mix adjustment, in particular the hedonic regression technique, to construct a constant-quality index. By being able to compare this with indices based on simpler measures used in much of the literature so far, this means that a significant contribution of this paper is the light it sheds on the limitations of existing house price indices, such as those for the USA extending back to 1890.

In addition to this methodological contribution, trends in the Dublin market are worthy of study in their own right. Ireland's economic history since 1900 contains a number of shocks and dramatic policy changes. These include factors common to other economies, such as the Great War, the end of the first wave of financial globalization and the rise of the second, but also factors specific to Ireland, including the War of Independence and Civil War (in the decade to 1923), and a switch from autarky to openness, as well as the Celtic Tiger period and a subsequent economic collapse. With a constant-quality house price index, it will now be possible to include house prices in quantitative analyses of Irish history.

2   Theoretical background

2.1   Why housing prices matter

Residential housing comprises a substantial proportion of all wealth. As highlighted by Davis & Heathcote (2007), in 2006, the stock of US residential housing was worth $24,100bn, almost 50% more than the combined capitalizations of the NYSE, Nasdaq and Amex exchanges at the same time. Thus, any wealth effect at all in housing will have a significant impact on consumption. A significant body of research has found that there is indeed such a wealth effect and that this effect is determined in part by financial technology, which affects the liquidity of housing equity (Duca et al. 2010, Muellbauer 2010).

For example, Slacalek (2009) estimates that, once sluggishness of consumption growth is accounted for, the long-run marginal propensity to consume out of total wealth is 5 per cent in developed countries. This is a general wealth effect; in relation to housing wealth, he finds an effect of similar magnitude since the early 1990s for a subset of countries, in particular the U.S. and the UK, where mortgage markets are more developed. The connection between housing prices and private consumption has led some macroeconomists to believe that trends in the housing sector are amongst the most important in the economy (Davis & Heathcote 2005, Leamer 2007).

The literature on housing and macroeconomic fluctuations ties in with a more general recognition in macroeconomics, since the Great Financial Crisis of 2007-2008, that the financial sector

matters. As mentioned above, credit conditions affect the relationship between housing and consumption. Work such as Offer (2013) and Jordà et al. (2014) place the modern system of universal banks within a long-run context, in particular the relative stability of the banking system for a century up to the 1970s. Such research highlights the importance of understanding the distinctive features of the current macroeconomic regime, as distinct from previous financial systems, including those that characterized the first wave of globalization in the late nineteenth century and credit rationing in the postwar period. To test hypotheses about the relationship between housing, finance and real economic outcomes, long-run data series on these topics are needed.

2.2 Why the measure of housing prices matters

One of the principal contributions of this paper is a price index for Dublin housing prior to 1950. The choice of method for calculating changes in housing prices is far from straightforward. Three issues hamper intertemporal comparisons. Firstly, each dwelling is a unique good, comprising a range of location-specific and building-specific attributes that no other dwelling shares perfectly. In addition, dwellings are infrequently traded, which places greater data requirements on the researcher. Lastly, the built structure component of a dwelling depreciates over time, rendering intertemporal comparisons subject to assumptions about depreciation and maintenance.

In relation to the first issue, a practical implication of this is shown in Figure 1. Two hedonic indices, the mortgage-based CSO index and the listings-based daft.ie index, showed housing prices falling at 12-14% year-on-year in early 2011; in contrast, a simple unweighted average of the price of second-hand dwellings (produced by Ireland's Department of the Environment) showed prices of second-hand homes in Dublin nearly 20% *higher*. In other words, due to the characteristics of the average dwelling varying with the market cycle, an inappropriate measure of housing prices may lead to precisely the wrong conclusion about trends in prices. This issue may affect the reliability of existing series based on simple averages, such as the US series for the period 1934-1953 (discussed below).

The clear implication is that, for reliable results, mix-adjustment is required, typically through a hedonic price regression, where the price of each dwelling is decomposed into its constituent parts (such as location, size, type and age). This follows from a stylised fact of the literature on constructing housing price indices: hedonic techniques are needed (Knight et al. 1995, Shimizu et al. 2012, Wallace & Meese 1997). Hedonic techniques also help overcome the second issue mentioned above, i.e. the fact that properties are infrequently traded. Taken to their limit, hedonic techniques are equivalent to repeat sales, which can be thought of as dwelling-specific fixed effects. An important limitation to the validity of the repeat sales method, however, is that properties may be improved over time.

3

Figure 1: *Year-on-year change in housing prices, by method*
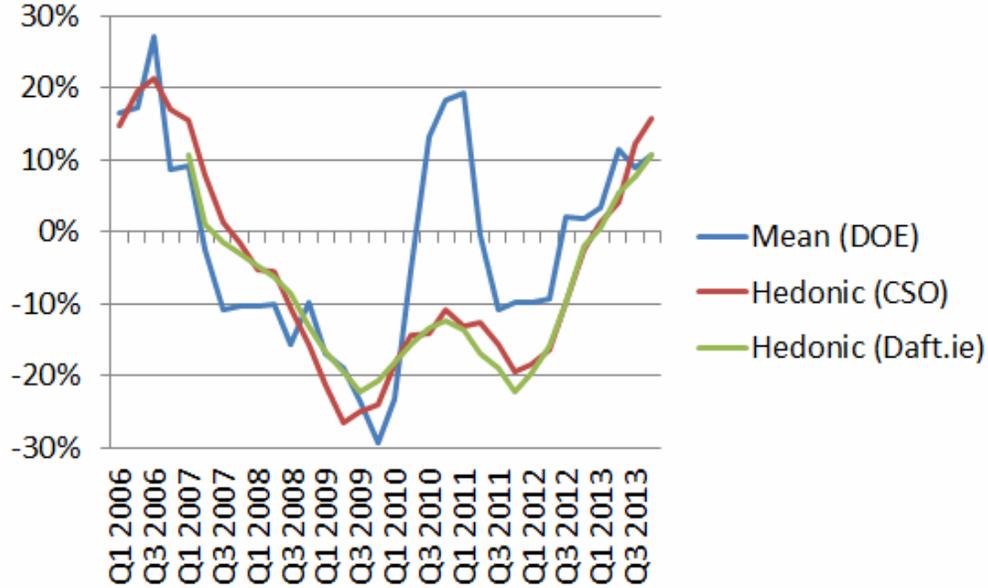
Depreciation Similarly, properties depreciate over time. In theory, one would like to measure the price of A_0, a fixed set of dwellings with a constant flow of accommodation services. The nature of real estate means that, over time, A_t is $\rho^t A_0$, as the asset depreciates (where the depreciation factor, ρ, is $(1 - \delta)$, the depreciation rate and constant over time). Another complication is the construction of new dwellings, B_t, which may differ in quality (in particular, quality may drift up over time). Many housing price series, including those for Dublin after 1950, are for all second-hand dwellings, rather than a fixed sample, so over time, some fraction λ_{tk} of B_{t-k} is added each period to A_t. For example, a second-hand index of Dublin housing prices now includes properties built in the 1990s and in the 1950s, as well as those built in the 1890s.

Related to this are improvements. Over time, housing built before 1900 will have been subject to a number of improvements, such as electrification and the installation of plumbing and sewerage connections. These improvements (b_t^I) make existing dwellings $(b_t^I \rho^t A_0)$ more comparable to new dwellings (B_t) than would otherwise be the case. Lastly, there is general maintenance, b_M. Whereas improvements are designed to increase the quality of the accommodation service, maintenance is merely the preservation of the existing service, i.e. it is an attempt to offset depreciation. This means one can think of net depreciation, δ_{NET}, as the difference between δ and b_M. Ignoring the issue of improvements, if maintenance offsets depreciation completely, then an unadjusted price series will reveal the true value of housing, on a like-for-like basis over time. If maintenance is minimal, then the longer the series, the greater an upward adjustment is needed to reflect the effects of depreciation.

3 Related Literature

Knoll et al. (2014) assemble 56 studies of housing prices across fourteen countries since 1870, in an attempt to compile a long-run global housing price index. While they outline some basic stylised facts, they note that any conclusions must be tempered by the methodological heterogeneity across countries and within countries over time. In particular, very few of the studies use modern methods to compile house price indices: of the 56 studies, just 22 use methods used for modern indices (repeat sales, mix-adjustment or hedonic regressions) and almost all of those relate to the post-1970 period.

In only six cases have modern methods been applied to housing price data extending back before 1970: France, the Netherlands, Norway, Sweden, Switzerland and the USA. The Dutch paper is probably the best known: Eichholtz (1997) charts nominal and real housing prices on the Herengracht in Amsterdam from the 1620s on. The principal finding is that, once inflation in general prices is stripped out, there is no long-run trend over three and a half centuries. Nonetheless, Eichholtz's index, while based on the repeat sales method, does not allow for either net depreciation or net improvements over time, implicitly assuming that these balance out over the very long run. Similar concerns exist for the French data, and also for work on Norway and Sweden by Eitrheim & Erlandsen (2004), Söderberg et al. (2014) and Bohlin (2014).

In relation to the work on the USA, the seminal housing price index in this regard is Shiller (2005). Up to 1953, however, Shiller's index is based on two sources that have been challenged. The first, covering the period 1890-1934, is taken from Grebler et al. (1956) and is ultimately based on a 1934 survey (Wickens 1937) of owner-occupiers, who were asked to report the amount paid when they bought the property and assess the value at the time of the survey. The second, covering the period 1934-1953, is based on a simple average of median asking prices across five US cities, using newspaper listings. The sample size is reported as roughly 30 observations per city-year. As outlined in Lyons (2013), simple averages can lead to the wrong conclusion about the timing and magnitude of housing market cycles.

In addition, recent research, such as Fishback & Kollmann (2012) and Nicholas & Scherbina (2013), has cast doubt on whether the trends reported for the interwar period are reliable. Fishback & Kollmann (2012), using six different sources, find that the 1934 survey may strongly understate housing price growth in the 1920s, while the combination of Shiller's sources appear to overstate the recovery in housing prices after 1930. As highlighted by Fishback & Kollmann (2012), particularly when long-run studies are concerned, the treatment of depreciation matters. An unadjusted price index for the U.S. suggests that, for example, housing prices in 1928 were roughly the same as in 1920. Adjusted for depreciation, however, prices are estimated to have risen by over 10%. In other words, on a like-for-like basis, i.e. if depreciation had not occurred (equivalent to comparing the price of two identical dwellings newly built in different years), the reported values of housing would have been higher.

Concerns such as these mean that in practice, little is known for certain about the path of

housing prices anywhere, prior to 1970. This study aims to address that gap for one market and, in doing so, provide a template for compiling indices for other markets while addressing the methodological issues raised.

4   Data

The housing price index presented here combines five principal sources. For the period from 1995 on, housing price indices using modern methods are available. Ireland's official housing price index, published monthly maintained by the Central Statistics Office, covers the period 2005-2014 and is based on hedonic regression techniques, using a dataset of all mortgage-backed transactions. For the period 1996-2005, a similar (hedonic) index is used, published by the Economic & Social Research Institute and using the price of dwellings backed by mortgages issued by *permanent tsb*, one of the largest mortgage lenders in the Irish market.

4.1   Housing Prices, 1949-1969

For the period 1949-1996, a dataset is being assembled, using archives of the *Irish Times* newspaper. As location, house type and other dwelling characteristics are included in the listings, a hedonic price index is constructed for this period. As of late August 2015, this dataset covers the periods 1949-1971 and 1980-1988 and contains over 8,000 newspaper listings of Dublin properties for sale. Listings were taken for the final Friday (Thursday from 1988 on) in February, May, August and November, for each year. For each complete year of listings, there were an average of 251 complete listings. The use of listed prices, rather than transaction prices, may appear problematic but research from real estate economics indicates that, when hedonic methods are used, trends in list prices are extremely highly correlated with those from transaction prices (Lyons 2013, Malpezzi 2003, Shimizu et al. 2012).

For the periods where no Irish Times listings listings have yet been collected – 1971-1980 and 1988-1996 – information published by Ireland's Department of the Environment is used temporarily. The figures, based on mortgage-backed transactions, are simple means, i.e. the average housing price in a given quarter for a particular region (Dublin) and dwelling type (second-hand).

4.2   Housing Prices before 1950

For the period prior to 1950, a dataset of housing prices has been constructed from records at Ireland's Registry of Deeds. The Registry was established in 1707 and its aim was to simplify the process around establishing, through priority, ownership of real estate. In brief, its archives include free-to-access indices by street of property deeds and also free-to-access transcriptions of the summary (memorial) of each deed. These memorials include information on the location of the property, the parties involved and in many cases the price. Due to the size of the archives, a sample

of 66 streets was chosen. This raises one issue of sample selection, while another is whether the price was listed in any given memorial. Both of these sample selection issues are tested for. After cleaning up the sample, this left an average of 26 transactions per year.

While the grantee of the property retained the original deeds, a summary known as a memorial was lodged at the Registry. All memorials were transcribed by Registry staff and can be browsed free of charge at the Registry's Dublin offices. To do this, an index number – identifying the year, book and number – is required. Deed memorials were indexed both by grantor surname and by location until 1949, after which point indexing was done by grantor surname only. Within Dublin city, indexing by location was done according to street name. This means that, up to 1949, it is possible to establish all transactions on a street, by using the location-based indexes.

Constructing a dataset of transactions and prices required the selection of a sample of streets, for which information is known currently about the attributes of the dwelling in question. Four criteria informed the choice of 66 streets. The first and most important criterion in establishing the dataset was selecting streets where the typical dwelling currently (as of 2014) dates from the early 1900s or before. The second criterion was that a mix of streets be chosen, so that the price trend identified would not reflect changes in the relative price of one particular area or type of housing.[1] Related to this, thirdly, to the greatest extent possible, dwellings on the street should be as homogeneous as possible. Lastly, where possible a mix of dwellings by size was sought within different districts.

A map of the streets covered is given in Figure 2: the colour reflects a relatively crude assessment of the size of dwellings on the street, where red denotes large, orange medium and green small. The final dataset of 66 streets reflects some attrition from an initial list of 100 streets, due principally to either atypical ownership structures[2] or a lack of transactions due to small street size[3].

Price entry   It is important to note that it was not required for the solicitors registering the deeds to include the price in the memorial of the deed. This means, firstly, that a greater volume of deeds needed to be collected to ensure a reasonable sample size and, secondly, that issues of sample selection may arise. Future work will use dwellings characteristics – known both from the 1901/1911 Censuses and from the current status of the dwellings - to test the issue of sample selection; related to this, a more general assessment of how representative of Dublin the streets chosen were will be undertaken, using 1901/1911 Census information.

A total of 11,698 deed memorials were indexed, of which 10,645 have been transcribed, as

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[1]Clearly, the exception to this is vintage, as any growth in a "vintage premium" will pervade a dataset of dwellings at least a century old.

[2]For example, it was initially hoped to include Oxmantown Road in the Stoneybatter area of Dublin. However, this street was constructed by the Dublin Artisan Dwellings Company in the 1890s, who remained as owners of each property until the 1960s.

[3]Emerald Street, in Dublin's North Docks contained just three transactions with price information during the period 1900-1949.

Figure 2: *Streets chosen for sample*
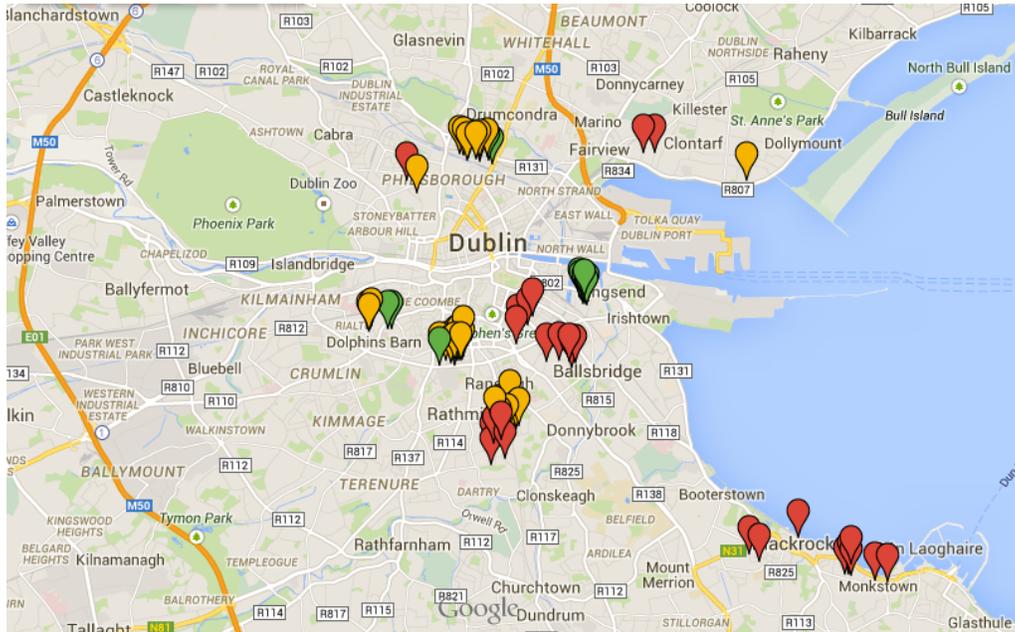
of early November 2014. Slightly more than half of these (5,824) relate to transactions[4] while a further 30% relate to mortgages (2,098) and leases (1,044). The balance relate to further charges, releases (relating to a mortgage being paid off), and a variety of other deeds (such as appointment of trustees).

Of the 5,824 transactions, just over one in five (1,245) contained information on the transaction price. (Almost 40% of mortgages (789 of 2,098) also included price information.) This means that for the five decades as a whole, there is an annual average of 26 transactions where price information is known. This varies considerably by year, as shown in Figure 3, with just seven price-points available in 1935 compared to 60 in 1920. There is in general a downward trend, although the series is marked by volatility.

While there is strong evidence that a declining fraction of transactions included price information over time, there is significantly less evidence that there was systematic variation across streets and thus that the underlying hedonic regression might in some way be biased in favour of certain segments. A straightforward probit model including categorical variables for year and street reveals statistically significant coefficients for just nine of the 66 streets.

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[4]Transactions can take one of three forms during this period. The first is a lease just after the property is built, typically for a period of more than 100 years, which creates a leasehold, on which annual ground rent was due. The second is the assignment of this leasehold (at the original fixed nominal ground rent). The final transaction type is a conveyance of freehold, which in certain cases involved a set annual payment.

Figure 3: *Percentage of transactions with price information*
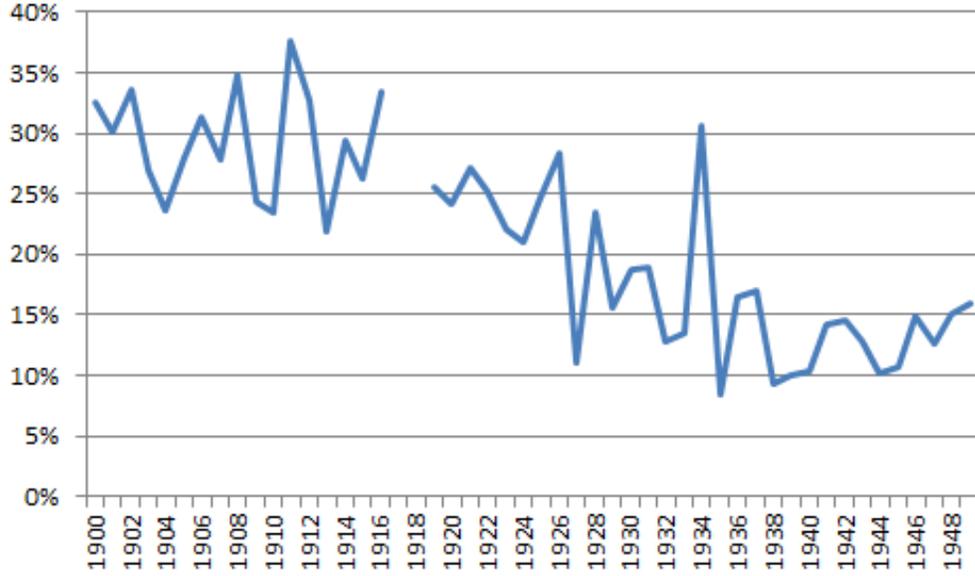
4.3 Other data

Both nominal and real housing price series are presented below. To convert from nominal to real, a long-run cost-of-living index for urban Ireland by Kennedy (2003) is used for the period 1900-1922. For the period from 1922 on, the official Central Statistics Office index of consumer prices is used. In addition, depreciation-adjusted indices are presented. As discussed above, over long time spans, (net) depreciation of a particular dwelling will affect like-for-like comparisons over time. To establish bounds for the true path of housing prices in Dublin in the period 1900-1949, two series are presented. The first is unadjusted, i.e. it assumes that, in the long-run, maintenance offsets depreciation. The second is that net depreciation of 1% occurs each year. This can be considered an upper bound, as it implies that after 50 years, despite all maintenance undertaken, the typical home has lost roughly 40% of its original value (and more than 60% after 100 years).

5 Method

To establish trends in housing prices during the period 1900-1969, two hedonic regression models are used. For the period to 1949, information from Ireland's 1911 Census on dwelling attributes is added to information from the Registry of Deeds on housing market transactions. This allows the following analysis, where y_i refers to the natural log of the dwelling's recorded price, $x1_i$ to its location (at street level), $x2_i$ to dwelling size (number of rooms) and $x3_i$ to the year it was transacted:

$$y_i = \alpha + \beta_1.x1_i + \beta_2.x2_i + \beta_3.x3_i + u_i$$

9

A similar model is applied to the 1949-1969 dataset of newspaper listings, with adjustments made for location controls (at neighbourhood level) and dwellings controls (house type and age included).

6 Results

Figure 4 shows, on a log scale, the trajectory of housing prices in Dublin from 1900 until 2015. Nominal prices in 2015 were between 415 and 676 times higher than in 1900, depending on the net depreciation rate assumed for the period prior to 1950. The preferred series is the zero net depreciation rate, which implies that, between 1900 and 1950, nominal housing prices rose by a factor of 4.2 (rather than 6.8 for the 1% net depreciation rate). Nominal housing prices then rose by a factor of over 27 between 1950 and 1990, before rising by a factor of 4.4 between 1990 and mid-2015 (ignoring the peak in 2007).

Figure 4: *Dublin housing price index, nominal (1950=100)*
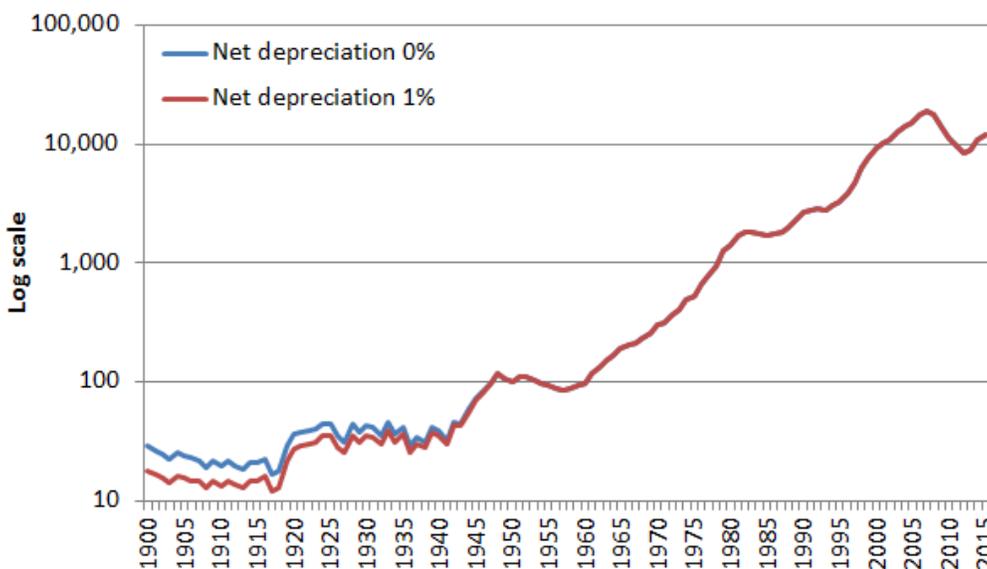

Figure 5 shows the real housing price index, again with and without adjustments for depreciation prior to 1950. As the 1950-1990 period suggests, much of the increase in nominal housing prices is due to a general increase in the price level, which rose by a factor of 116 over the period as a whole (and a factor of 17 in the period 1950-1990 alone). When general inflation is stripped out, there is significantly more stability in housing prices, with values in 2015 being roughly four times their 1950 level and 3.6 (or 5.8) times their 1900 level (depending on assumptions about depreciation).

Summary statistics by decade are presented in two tables, one for nominal house prices and one for real. Index 1 refers to an index with zero net depreciation 1900-1950 (the preferred series), while Index 2 refers to 1% net depreciation per year during that period.

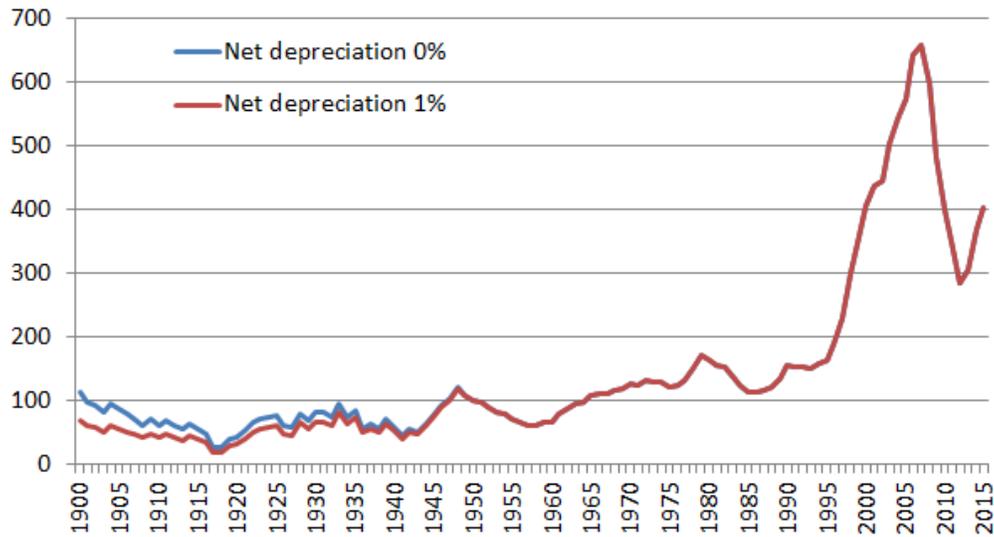**Figure 5:** *Dublin housing price index, real (1950=100)*

Figure 6: *Nominal housing prices in Dublin, overview by decade*

Year	Index 1	Index 2	Change in decade	Annualized change	Decade
1900	28.8	17.7			
1910	19.8	13.4	-31%	-4%	1900s
1920	35.9	26.9	81%	6%	1910s
1930	42.3	35.0	18%	2%	1920s
1940	39.1	35.7	-8%	-1%	1930s
1950	100.0	100.0	156%	10%	1940s
1960	98.0	98.0	-2%	0%	1950s
1970	301.7	301.7	208%	12%	1960s
1980	1,419.5	1,419.5	370%	17%	1970s
1990	2,725.8	2,725.8	92%	7%	1980s
2000	9,220.7	9,220.7	238%	13%	1990s
2007	19,229.4	19,229.4	109%	11%	2000-07
2015	11,920.2	11,920.2	-38%	-6%	2007-15

It is clear in particular from the chart of real housing prices that assumptions about depreciation matter over longer periods. If it is assumed that net depreciation is close to zero, i.e. that owners offset the bulk of depreciation, then real housing prices in 1950 were very similar to the level seen in 1900 (roughly 5% lower). If, on the other hand, it is assumed that net depreciation is close to 1% per year, then the conclusion would be that, instead of falling 11% in the five decades to 1950, housing prices instead rose by 45% (or 0.7% a year). Both series, however, point to a significant fall in real housing prices between 1900 and 1920. Choosing a net depreciation rate more definitively will required additional analysis.

11

Figure 7: *Real housing prices in Dublin, overview by decade*

Year	Index 1	Index 2	Change in decade	Annualized change	Decade
1900	113.2	69.5			
1910	61.4	41.7	-46%	-6%	1900s
1920	43.2	32.4	-30%	-3%	1910s
1930	81.8	67.7	89%	7%	1920s
1940	59.3	54.2	-27%	-3%	1930s
1950	100.0	100.0	69%	5%	1940s
1960	67.6	67.6	-32%	-4%	1950s
1970	127.6	127.6	89%	7%	1960s
1980	163.5	163.5	28%	3%	1970s
1990	156.4	156.4	-4%	0%	1980s
2000	406.1	406.1	160%	10%	1990s
2007	657.6	657.6	62%	7%	2000-07
2015	404.0	404.0	-39%	-6%	2007-15

6.1 Housing prices in perspective

A rent index is available (at national level) for the period from 1947 on. The nominal (zero net depreciation) housing prices and the nominal rent series are plotted together in 8. It points to significantly greater inflation in housing prices than in rents, roughly by an order of seven. Given what is known about average rents and gross yields (the annual rental income relative to the price) in Dublin as of 2015, it implies that gross yields were of the order of 50% in the late 1940s and early 1950s. While economic history suggests that credit rationing took place, thus limiting the extent to which yields converged with mortgage interest rates, it is nonetheless very likely that at least some of the trends observed in rents relate to mismeasurement, in particular a lack of mix-adjustment. Thus, hedonic rent indices for Dublin will be required before an analysis of long-run yields similar to Eichholtz et al. (2012) can take place. Irish Times listings of rental ads will be used for this purpose.

A monthly Irish equity price index is available from a work-in-progress extension of Grossman et al. (2014). This allows a comparison of the performance of two widely held asset classes, residential real estate and publicly traded equities, over the period 1900-2015. The indices take account only of price changes (i.e. capital gains) and not rental or dividend payments. A comparison of the two price indices is shown in Figure 9, with 1950 set as the base (as with other graphs). For the period as a whole, nominal housing prices increased nearly four times more than nominal equity prices. However, the bulk of this differential is due to the performance of the two asset classes prior to 1950. In particular, while housing prices grew 60% in the period between 1918 (the end of World War I) and 1922 (the birth of the Irish Free State), equity prices did not rise at all.

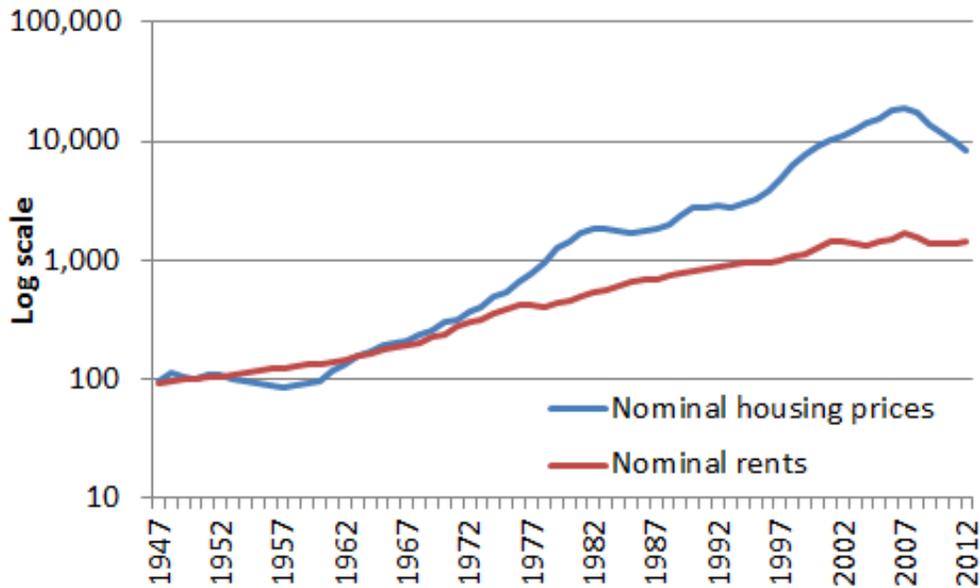**Figure 8:** *Dublin housing prices and rents, compared (1950=100)*

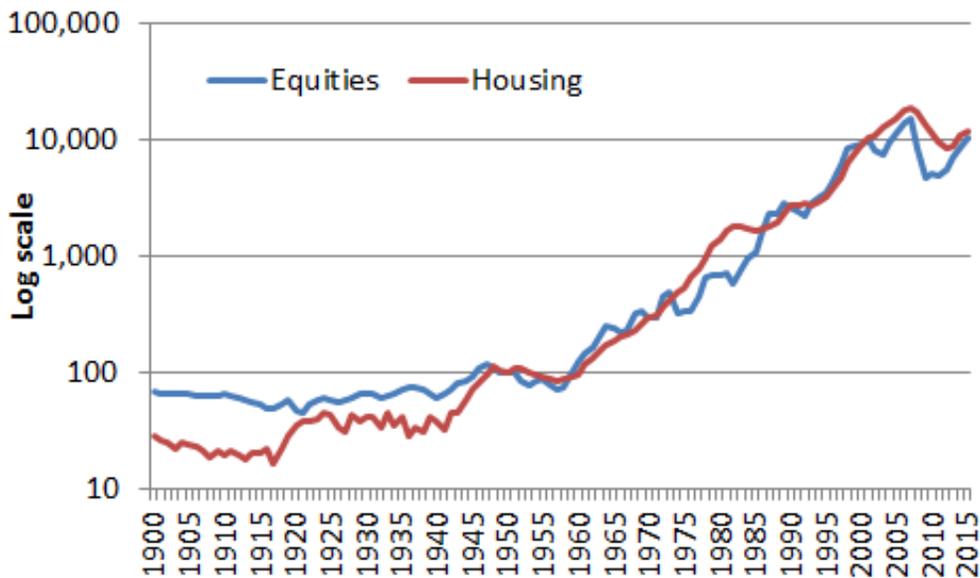**Figure 9:** *Dublin housing prices and Irish equity prices, compared (1950=100)*


6.2 Measuring housing prices

Currently, much of the cliometric housing price literature is based on simple annual averages, either median or mean, and using relatively small samples per year. For example, the 1934-1953 dataset for the U.S. compiled by Shiller (2005) relies on medians from roughly 30 observations per city

per year and its findings have not always been replicated by more detailed studies (Fishback & Kollmann 2012). Figure 10 compares real house price indices for Dublin 1900-1963 based on a hedonic mean and a simple median. While the two series are highly correlated, it is clear that, where the variable of interest is the annual change in real house prices, a median may be subject to measurement error. Indeed, the correlation coefficient between the annual change in a hedonic real house price price index and its median counterpart is just 35% for the period 1900-1963 (55% for the mean).

Figure 10: *Hedonic and median real housing price indices in Dublin, 1900-1963*
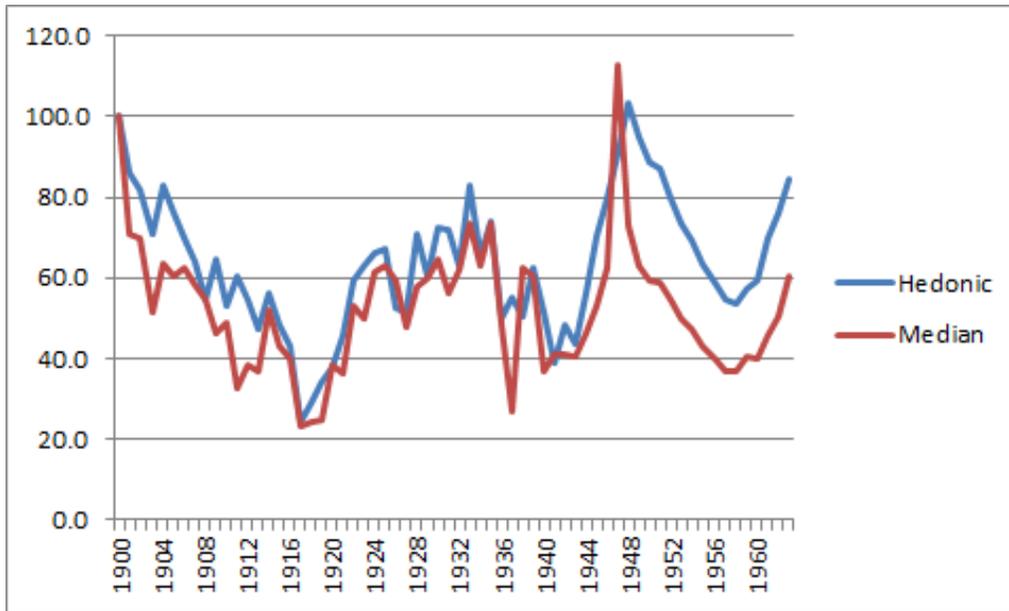
Additionally, house price volatility may be overstated by simple metrics, with median and mean prices more volatile than mix-adjusted series. Lastly, the timing and magnitude of housing market cycles is affected by choice of measure. For example, the median price in Dublin fell by 60% between 1900 and 1911, whereas the hedonic average fell by just 25% in the same period. Similarly, the mean price rose by almost 80% between 1919 and 1925, compared to 50% growth in the hedonic average. These issues highlight the importance of more rigorous measures of house prices trends in, for example, the USA prior to the 1950s.

7 Conclusion

The principal aim of this paper was to construct a housing price index for Dublin for the period 1900-2015. It did this both by combining existing sources for the period from 1996 on with two new datasets. The first, covering the period from 1950 on, comprises newspaper listings for family homes in Dublin. The second was on a dataset of over 1,000 transactions from a sample of 66

14

Dublin streets, for the period prior to 1950. Given the detailed micro-data in both cases, modern methods of hedonic price regression were used to develop average prices by year. In addition to mix-adjustment, assumptions about the rate of net depreciation are central. The preferred series here, which assumes that depreciation was offset by maintenance, implies that nominal housing prices rose by a factor of slightly more than 450 over the entire period (750 if a 1% net depreciation rate is assumed). Much of this increase is in the period 1950-1990, a time of high inflation. The real housing price index increase by a factor of four (or 6.5 with 1% depreciation).

These high-level changes mask important fluctuations over smaller time-spans. Both nominal and real indices suggest a steady fall in housing prices early in the century, of between one third (nominal) and one half (real), undone with post-war inflation. The bulk of the interwar years saw volatility but no obvious trend. Rapid housing price inflation started in the 1940s and was an almost ever-present feature thereafter, with the exception of the 1950s and the post-2007 period. The only decades to witness significant increases in *real* housing prices were the 1920s (7% on average), 1940s (6%), the 1960s/1970s (just under 4%) and 1990-2007 Celtic Tiger period (nearly 10%).

7.1 Future Work

In addition to extending the series back to the 1860s, the work undertaken here can be thought of as laying the foundations for two streams of future research. The first relates to the Irish housing market and economy over the long run. From the perspective of urban economics and economic geography, a panel of area-level house prices indices from 1900 on can be used to investigate a number of economically meaningful questions, for example the evolution of the bid-rent gradient over time and the relationship between transport infrastructure and economic rent, as reflected in housing and land values.

From the perspective of macroeconomic research, the micro-level dataset underpinning the period 1900-1949 can also be used to develop indices of credit conditions (the percentage of single-dwelling transactions backed by a mortgage), and of transactions (the percentage of dwellings on a street that were traded in any given period). Combined with information from other sources, such as street directories and Censuses, it should also be possible to construct measures of tenure (the percentage of dwellings in owner-occupancy). More generally, housing prices work within a broader economic system, in which they respond to general price levels, incomes, demographics, housing supply, the user cost (including expectations and property tax) and credit conditions. Variables such as credit conditions, tenure and housing supply may of course respond to housing prices also. The construction of long-run series of housing prices, both real and nominal, will allow a better understanding of the determinants of equilibrium housing prices. If real housing prices in Ireland have risen by a factor of four over the last century or so, what explains this?

The second stream of research is international. For most cities, no source comparable to the

Registry of Deeds exists, although in almost all cases, newspapers listings survive. For Dublin, it will be possible to assess the reliability of a hedonic price index based on newspaper listings data, compared to one derived from transaction prices. This is of relevance given the preponderance of simple averages, both means and medians, in the cliometric literature on housing prices to date. If we are to understand the relationship between housing prices and broader economic outcomes, good-quality price series are the essential tools of the trade.

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A   Appendix

The table below shows regression output for a model with street-level and year-by-year fixed effects. Statistical significance is of less importance in this setting than in others, as the coefficients are merely descriptive.

Year	Coefficient	t-statistic
1900.year	0.000	(.)
1901.year	-0.080	(-0.62)
1902.year	-0.144	(-1.21)
1903.year	-0.260*	(-1.97)
1904.year	-0.128	(-0.98)
1905.year	-0.178	(-1.47)
1906.year	-0.237	(-1.81)
1907.year	-0.275*	(-1.99)
1908.year	-0.406**	(-2.91)
1909.year	-0.285	(-1.86)
1910.year	-0.374*	(-2.48)
1911.year	-0.292*	(-2.25)
1912.year	-0.376**	(-2.98)
1913.year	-0.460**	(-2.71)
1914.year	-0.323*	(-2.38)
1915.year	-0.326*	(-2.20)
1916.year	-0.242	(-1.69)
1917.year	-0.540***	(-3.83)
1918.year	-0.496***	(-3.89)
1919.year	0.020	(0.17)
1920.year	0.220	(1.96)
1921.year	0.280*	(2.28)
1922.year	0.311*	(2.48)
1923.year	0.342**	(2.66)
1924.year	0.444***	(3.32)
1925.year	0.436***	(3.51)
1926.year	0.199	(1.72)
1927.year	0.082	(0.51)
1928.year	0.417**	(3.21)
1929.year	0.271	(1.90)
1930.year	0.384**	(2.76)
1931.year	0.355*	(2.34)
1932.year	0.195	(1.12)
1933.year	0.471**	(3.03)
1934.year	0.232	(1.81)
1935.year	0.374*	(2.06)
1936.year	0.008	(0.06)
1937.year	0.172	(1.02)
1938.year	0.070	(0.46)
1939.year	0.378	(1.69)
1940.year	0.305	(1.62)
1941.year	0.115	(0.68)
1942.year	0.476**	(2.93)
1943.year	0.446**	(3.10)
1944.year	0.711***	(4.37)
1945.year	0.922***	(6.25)
1946.year	1.054***	(6.95)
1947.year	1.227***	(8.59)
1948.year	1.409***	(8.64)
1949.year	1.298***	(8.69)
_cons	6.111***	(61.48)
R-squared	0.642	
N	1051	
FEs	Street-level	

Table 1: *Regression output - street-level fixed effects*