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No Price Like Home: Global House Prices, 1870–2012*

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Abstract

How have house prices evolved in the long-run? This paper presents annual house price indices for 14 advanced economies since 1870. Based on extensive data collection, we are able to show for the first time that house prices in most industrial economies stayed constant in real terms from the 19th to the mid-20th century, but rose sharply in recent decades. Land prices, not construction costs, hold the key to understanding the trajectory of house prices in the long-run. Residential land prices have surged in the second half of the 20th century, but did not increase meaningfully before. We argue that before World War II dramatic reductions in transport costs expanded the supply of land and suppressed land prices. Since the mid-20th century, comparably large land-augmenting reductions in transport costs no longer occurred. Increased regulations on land use further inhibited the utilization of additional land, while rising expenditure shares for housing services increased demand.

JEL codes: N10, O10, R30, R40

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Contents

1 Introduction

For Dorothy there was no place like home. But despite her ardent desire to get back to Kansas, Dorothy probably had no idea how much her beloved home cost. She was not aware that the price of a standard Kansas house in the late 19th century was around 2,400 dollars (Wickens, 1937). She could also not have known whether relocating the house to Munchkin Country would have increased its value or not. For economists there is no price like home – at least not since the global financial crisis: fluctuations in house prices, their impact on the balance sheets of consumers and banks, as well as the deleveraging pressures triggered by house price busts have been a major focus of macroeconomic research in recent years (Mian and Sufi, 2014; Shiller, 2009; Case and Quigley, 2008). In the context of business cycles, the nexus between monetary policy and the housing market has become a rapidly expanding research field (Adam and Woodford, 2013; Goodhart and Hofmann, 2008; Del Negro and Otrok, 2007; Leamer, 2007). Houses are typically the largest component of household wealth, the key collateral for bank lending and play a central role for long-run trends in wealth-to-income ratios and the size of the financial sector (Piketty and Zucman, 2014; Jordà et al., 2014). Yet despite their importance for the macroeconomy, surprisingly little is known about long-run trends in house prices. This paper aims to fill this void.

Based on extensive historical research, we present house price indices for 14 advanced economies since 1870. A large part of this paper is devoted to the presentation and discussion of the data that we unearthed from more than 60 different primary and secondary sources. There are good reasons why we devote a great deal of (printer) ink and paper discussing the data and their sources. Houses are heterogeneous assets and when combining data from a variety of sources great care is needed to construct plausible long-run indices that account for quality improvements, shifts in the composition of the type of houses and their location. We go into considerable detail to test the robustness and corroborate the plausibility of the resulting house price data with additional historical sources.

For the construction of the long-run database, we were able to build in part on the existing work of economic and financial historians such as Eichholtz (1994) for the Netherlands and Eitrheim and Erlandsen (2004) for Norway. In many other cases we collected new information from regional and national statistical offices, central banks as well as from tax authorities such as the UK Land Registry or national real estate associations such as the Canadian Real Estate Association (1981). In addition to house price data, we have also assembled, for the first time, corresponding long-run data for construction costs, farmland prices as well as expenditures on housing services.

Using the new dataset, we are able to show that real house prices in the advanced economies since the 19th century have taken a particular trajectory that, to the best of our knowledge, has not yet been documented. From the last quarter of the 19th to the mid-20th century, house prices in most industrial economies were largely constant in real terms. By the 1960s, they were, on average, not much higher than they were on the eve of World War I. They have been on a long and pronounced ascent since then. For our sample, real house prices have approximately tripled since the beginning of the 20th century, with virtually all of the increase occurring in the second half of the 20th century. We also find considerably cross-country heterogeneity. While Australia has seen the strongest, Germany has seen the weakest increase in real house prices in the long-run. Moreover, we demonstrate that urban and rural house prices have, by and large, moved together and that long-run farmland prices exhibit a similar long-run pattern.

We go one step further and study the driving forces of this hockey-stick pattern of house prices. Houses are bundles of the structure and the underlying land. An accounting decomposition of house price dynamics into replacement costs of the structure and land prices demonstrates that rising land prices hold the key to understanding the upward trend in global house prices. While construction costs have flat-lined in the past decades, sharp increases in residential land prices have driven up international house prices. Our decomposition suggests that about 80 percent of the increase in house prices between 1950 and 2012 can be attributed to land prices. The pronounced increase in residential land prices in recent decades contrasts starkly with the period from the late 19th to the mid-20th century. During this period, residential land prices remained, by and large, constant in advanced economies despite substantial population and income growth. We are not the first to note the upward trend in land prices in the second half of the 20th century (Glaeser and Ward, 2009; Case, 2007; Davis and Heathcote, 2007; Gyourko et al., 2006). But to our knowledge, it has not been shown that this is a broad based, cross-country phenomenon that marks a break with the previous era.

How can one explain the fact that residential land prices remained stable until the mid-20th century and increased strongly in the past half-century? We discuss this question both theoretically and empirically. Our emphasis is on the different dynamics in land supply before and after the middle of the 20th century. From the 19th to the early 20th century the transport revolution – mostly the construction of the railway network, but also the introduction of steam shipping and cars – led to a massive and well-documented drop in transport costs, often referred to as the transportation revolution (Jacks and Pendakur, 2010; Taylor, 1951). An important effect of the transport revolution was to substantially augment the supply of economically usable land. We develop a model with land heterogeneity to demonstrate how a sustained decline in transport costs endogenously triggers an expansion of land such that the land price may remain low despite continuous growth of incomes and population. We show that this land-augmenting decline in transport costs subsides in the second half of the 20th century so that land increasingly became a fixed factor. At the same time, zoning regulations and other restrictions on land use also inhibited the utilization of additional land in recent decades (Glaeser et al., 2005a; Glaeser and Gyourko, 2003) while rising expenditure shares for housing services added further to the rising demand for land.

Our findings also have potentially important implications for the much debated issue of long-run trends in distribution of income and wealth. More precisely, we offer a vantage point for a reinterpretation of Ricardo's famous principle of scarcity. Ricardo (1817) argued that, in the long run, economic growth disproportionately profits landlords as the owners of the fixed factor. As land is highly unequally distributed across the population, market economies therefore produce ever rising levels of inequality. Writing in the 19th century, Ricardo was mainly concerned with the price of agricultural land and reasoned that as population growth pushes up the price of corn, the land rent and the land price will continuously increase. In the 21st century, we may be more concerned with the price of housing services and residential land, but the mechanism is similar. The decline in transport costs kept the price of residential land constant until the mid-20th century. Yet the price surge in the past half-century could be an indication that Ricardo might have been right after all.[1]

The structure of the paper is as follows: the next section describes the data sources and the challenges involved in constructing long-run house price indices. The third section discusses long-run trends in house price for each of the 14 countries in the sample. The fourth section distills three new stylized facts from the long-run data: (i) on average, real house prices have risen in advanced economies, albeit with considerably cross-country heterogeneity; (ii) virtually all of the increase occurred in the second half of the 20th century; (iii) these trends apply equally to urban and rural house prices as well as farmland and are robust to a number of additional checks relating to quality adjustments and sample composition. In the fifth part, we use a parsimonious model of the housing market to decompose changes in house prices into changes in replacement costs and land prices. The key result of the decomposition is that land price dynamics hold the key to understanding the observed long-run house price dynamics. The sixth section discusses, empirically and theoretically, explanations for the observed trajectory of land prices. We show (i) how the sharp drop of transportation costs during the late 19th and early 20th century expanded land supply and capped prices; and (ii) that this factor not only faded in the second half of the 20th, but coincided with rising expenditures shares for housing services as well as growing restrictions on land which pushed up prices. The final section concludes and outlines avenues for further research.

2 The data

This paper presents a novel dataset that covers residential house price indices for 14 advanced economies over the years 1870 to 2012. It is the first systematic attempt to construct house price series for advanced economies since the 19th century on a consistent basis from historical sources. Using more than 60 different sources, we combine existing data and unpublished

[1]See Piketty (2014) for a discussion of the Ricardo hypothesis in the context of inequality dynamics.

material. The dataset reaches back to the early 1920s (Canada), the early 1910s (Japan), the early 1900s (Finland, Switzerland), the 1890s (UK, U.S.), and the 1870s (Australia, Belgium, Denmark, France, Germany, The Netherlands, Norway, Sweden). Long-run data for Finland and Germany were not previously available. We also extended the series for the United Kingdom and Switzerland by more than 30 years and for Belgium by more than 40 years. Compared to existing studies such as Bordo and Landon-Lane (2013) we are able to work with nearly twice the number of country-year observations. Building such a comprehensive data set required locating and compiling data from a wide range of scattered primary sources, as detailed below and in the appendix.

2.1 House price indices

An ideal house price index would capture the appreciation of the price of a standard, unchanged house. Yet houses are heterogeneous assets whose characteristics change over time. Moreover, houses are sold infrequently, making it difficult to observe their pricing over time. In this section, we briefly discuss the four main challenges involved in constructing consistent long-run house price indices. These relate to differences in the geographic coverage, the type and vintage of the house, the source of pricing, and the method used to adjust for quality and composition changes.

First, house price indices may either be national or cover several cities or regions (Silver, 2012). Whereas rural indices may underestimate house price appreciation, urban indices may be upwardly biased. Second, house prices can either refer to new or existing homes, or a mix of both. Price indices that cover only newly constructed properties may underestimate overall property price appreciation if new construction tends to be located in areas where supply is more elastic (Case and Wachter, 2005). Third, prices can come from sale prices in the market, listing prices or appraised values. Sale prices are the most reliable indicator because listing and appraisal prices may be biased if homeowners or real estate agents have an incentive to overstate the value of a property (Geltner and Ling, 2006). Fourth, if the quality of houses improves over time, a simple mean or median of observed prices can be upwardly biased (Case and Shiller, 1987; Bailey et al., 1963).

There are different approaches to deal with such quality and composition changes over time. Stratification is an approach that splits the sample into several strata with specific price determining characteristics. Then, a mean or median price index is calculated for each sub-sample and the aggregate index is computed as a weighted average of these sub-indices. A stratified index with M different sub-samples can thus be written as

$$\Delta P_T^h = \sum_{m=1}^{M} (w_t^m \Delta P_T^m), \tag{1}$$

where ΔP_T^h denotes the aggregate house price change in period T, ΔP_T^m the price change in sub-sample m in period T, and w_t^m the weight of sub-sample m at time t. The weights used to aggregate the sub-sample indices are either based on stocks or on transactions and on quantities or values (European Commission , 2013; Silver, 2012).[2]

A similar and complementary approach to stratification is the hedonic regression method. Here, the intercept of a regression of the house price on a set of characteristics – for instance the number of rooms, the lot size or whether the house has a garage or not – is converted into a house price index (Case and Shiller, 1987). If the set of variables is comprehensive, the hedonic regression method adjusts for changes in the composition and changes in quality. The most commonly employed hedonic specification is a linear model in the form of

$$P_t = \beta_t^0 + \sum_{k=1}^{K} (\beta_t^k z^{n,k}) + \epsilon_t^n, \tag{2}$$

where β_t^0 is the intercept term and β_t^k the parameter for characteristic variable k and $z^{n,k}$ the characteristic variable k measured in quantities n.

The repeat sales method circumvents the problem of unobserved heterogeneity as it is based on repeated transactions of individual houses (Bailey et al., 1963). A method similar to the idea of repeat sales is the sales price appraisal (SPAR) method which, instead of using two transaction prices, matches an appraised value and a transaction price. But a house that is sold (or appraised and sold) at two different points in time is not necessarily the exact same house because of depreciation and new investments. The constant-quality assumption becomes more problematic the longer the time span between the two transactions (Case and Wachter, 2005). By assigning less weight to transaction pairs of long time intervals, the weighted repeat sales method (Case and Shiller, 1987) addresses the problem. Since the hedonic regression is complementary to the repeat sales approach, several studies propose hybrid methods (Shiller, 1993; Case et al., 1991; Case and Quigley, 1991), which may reduce the quality bias.

2.2 Historical house price data

Most countries' statistical offices or central banks began to collect data on house prices starting in the 1970s. For the 14 countries in our sample, these data can be accessed through three repositories: the Bank for International Settlements, the OECD, and the Federal Reserve Bank of Dallas (Bank for International Settlements, 2013; Mack and Martínez-García, 2012; OECD, 2014). Extending these back to the 19th century involved a good many compromises between

[2]Since stratification neither controls for changes in the mix of houses that are not related to the sub-samples nor for changes within each sub-sample, the choice of the stratification variables determines the index' properties. Stratifying, for instance, according to the age class of the house may reduce the quality bias. If the stratification controls for quality change, the method is known as mix-adjustment (Mack and Martínez-García, 2012).

the ideal and the available data. The historical data we have at our disposal vary a great deal across country and time with respect to their coverage and the method used for index construction. We often had to link different types of indices. As a general rule, we chose constant quality indices where available and opted for longitudinal consistency as well historical plausibility. A central challenge for the construction of long-run price indices has to do with quality changes. While homes today typically feature central heating and hot running water, a standard house in 1870 did not even have electric lighting. Controlling for such quality changes is clearly essential. We also aimed for the broadest possible geographical coverage and attempted to keep the type of house covered constant over time, i.e., single-family houses, terraced houses, or apartments. We generally chose data for the price of existing houses instead of new ones.[3] Finally, we consulted reference volumes of financial history and primary sources such as newspapers to corroborate the plausibility of the price trends that our indices showed.

In sum, we are confident that the resulting indices give an accurate picture of the underlying price developments in the housing markets covered by our study. Yet the list of compromises we had to make is long. Some series rely on appraisals, others on list or transaction prices. Despite our efforts to ensure the broadest geographical coverage possible, in a few cases – such as the Netherlands prior to 1970 or the index for France before 1936 – the country-index is based on a very narrow geographical coverage. For certain periods no constant quality indices were available, and we relied on mean or median sales prices. Nevertheless, we discuss potential distortions from these compromises in great detail below. Further, while acknowledging the potential problems these distortions raise, we remain confident that they do not systematically distort the aggregate trends we uncover.

In order to construct long-run house price indices for a broad cross-country sample, we could partly relied on the work of economic and financial historians. Examples include the Herengracht-index for Amsterdam (Eichholtz, 1994), the city-indices for Norway (Eitrheim and Erlandsen, 2004) and Australia (Stapledon, 2012b, 2007). In other cases we took advantage of previously unused sources to construct new series. Some historical data come from dispersed publications of national or regional statistical offices. Examples include the Helsinki Statistical Yearbook, the annual publications of the Swiss Federal Statistical office as well as the Bank of Japan (1966). Such official publications contained data relating to the number and value of real estate transactions and in some cases, house price indices. We also drew upon unpublished data from tax authorities such as the UK Land Registry or national real estate associations such as the Canadian Real Estate Association (1981).

In addition, we collected long-run price indices for construction costs to proxy for replace-

[3]When two or more series (when more than one city is given, for example) of comparable quality were available, we used an average. This is, for example, the case for the long-run indices of Australia and Norway. When additional information on the number of transactions was available, we used a weighted average (e.g. Germany, 1924–1938). In some cases, we worked with a moving average to smooth out the fluctuations stemming from year-to-year variation in the number transactions.

ment costs and the price of farmland through a combination of official statistical publications and series constructed by other researchers. For construction cost indices, we assembled publications by national statistical offices and the work of other scholars such as Stapledon (2012a); Fleming (1966); Maiwald (1954) as well as national associations of builders or surveyors, e.g. Belgian Association of Surveyors (2013). All macroeconomic and financial variables used in this study come from the long-run macroeconomic dataset of Schularick and Taylor (2012) and the update presented in Jordà et al. (2014).

Table 1 presents an overview of the resulting index series, their geographic coverage, the type of dwelling covered, and the method used for price calculation. This paper comes with a roughly 100-page data appendix (see Appendix B) that specifies the sources we consulted and discusses the construction of the country indices in greater detail.

3 House prices in 14 advanced economies, 1870–2012

In this section, we present long-run historical house prices country-by-country and briefly discuss their composition and coverage. We also outline the main trends for the individual countries and the key sources.

3.1 Australia

Australian residential real estate prices are available from 1870 to 2012 (Figure 1). They cover the principal Australian cities. The index that we use is computed on the basis of two series for Melbourne from 1870 to 1899 (Stapledon, 2012b; Butlin, 1964) and an aggregate index for six Australian state capitals (Adelaide, Brisbane, Hobart, Melbourne, Perth, and Sydney) from 1900 to 2002 (Stapledon, 2012b). We used a mix-adjusted index for Darwin and Canberra in addition to these six state capitals from 2003 to 2012 (Australian Bureau of Statistics, 2013b). We splice the series using the growth rates of the historical indices to extend the level of the most current index backward in time. The long-run data for Australia show that house prices have increased more than tenfold since 1870 in real terms. During the 1870–1945 period, house prices remained trendless. In 1949 after wartime price controls were abandoned, prices entered a long-run growth path and rose 3.6 percent per year on average from 1955 to 1975. House price growth slowed down in the second half of the 1970s, but regained speed in the early 1990s. Between 1991 and 2012, Australian real house prices nearly doubled.

Country	Years	Geographic Coverage	Property Vintage & Type	Method
Australia	1870–1899	Urban	Existing Dwellings	Median Price
	1900–2002	Urban	Existing Dwellings	Median Price
	2003–2012	Urban	New & Existing Dwellings	Mix-Adjustment
Belgium	1878–1950	Urban	Existing Dwellings	Median Price
	1951–1985	Nationwide	Existing Dwellings	Average Price
	1986–2012	Nationwide	Existing Dwellings	Mix-Adjustment
Canada	1921–1949	Nationwide	Existing Dwellings	Replacement Values (incl. Land)
	1956–1974	Nationwide	New & Existing Dwellings	Average Price
	1975–2012	Urban	Existing Dwellings	Average Price
Denmark	1875–1937	Rural	Existing Dwellings	Average Price
	1938–1970	Nationwide	Existing Dwellings	Average Price
	1971–2012	Nationwide	New & Existing Dwellings	SPAR
Finland	1905–1946	Urban	Land Only	Average Price
	1947–1969	Urban	Existing Dwellings	Average Price
	1970–2012	Nationwide	Existing Dwellings	Mix-Adjustment, Hedonic
France	1870–1935	Urban	Existing Dwellings	Repeat Sales
	1936–1995	Nationwide	Existing Dwellings	Repeat Sales
	1996–2012	Nationwide	Existing Dwellings	Mix-Adjustment
Germany	1870–1902	Urban	All Kinds of Existing Real Estate	Average Price
	1903–1922	Urban	All Kinds of Existing Real Estate	Average Price
	1923–1938	Urban	All Kinds of Existing Real Estate	Average Price
	1962–1969	Nationwide	Land Only	Average Price
	1970–2012	Urban	New & Existing Dwellings	Mix-Adjustment
Japan	1913–1930	Urban	Land only	Average Prices
	1930–1936	Rural	Land only	Average Price
	1939–1955	Urban	Land only	Average Price
	1955–2012	Urban	Land only	Average Price
The Netherlands	1870–1969	Urban	All Kinds of Existing Real Estate	Repeat Sales
	1970–1996	Nationwide	Existing Dwellings	Repeat Sales
	1997–2012	Nationwide	Existing Dwellings	SPAR
Norway	1870–2003	Urban	Existing Dwellings	Hedonic, Repeat Sales
	2004–2012	Urban	Existing Dwellings	Hedonic
Sweden	1875–1956	Urban	New & Existing Dwellings	SPAR
	1957–2012	Urban	New & Existing Dwellings	Mix-Adjustment, SPAR
Switzerland	1900–1929	Urban	All Kinds of Existing Real Estate	Average Price
	1930–1969	Urban	Existing Dwellings	Hedonic
	1970–2012	Nationwide	Existing Dwellings	Mix-Adjustment
The United Kingdom	1899–1929	Urban	All Kinds of Existing Real Estate	Average Price
	1930–1938	Nationwide	Existing Dwellings	Hypothetical Average Price
	1946–1952	Nationwide	Existing Dwellings	Average Price
	1952–1965	Nationwide	New Dwellings	Average Price
	1966–1968	Nationwide	Existing Dwellings	Average Price
	1969–2012	Nationwide	Existing Dwellings	Mix-Adjustment
United States	1890–1934	Urban	New Dwellings	Repeat Sales
	1935–1952	Urban	Existing Dwellings	Median Price
	1953–1974	Nationwide	New & Existing Dwellings	Mix-Adjustment
	1975–2012	Nationwide	New & Existing Dwellings	Repeat Sales

Table 1: Overview of house price indices.

3.2 Belgium

The house price index for Belgium covers the years 1878 to 2012 (Figure 2). Prior to 1951, the index is based only on data for Brussels. For 1878 to 1918, we rely on the median house prices calculated by De Bruyne (1956). For 1919 to 1985, we use an average house price index constructed by Janssens and de Wael (2005). For the 1986–2012 period, we use a mix-adjusted index published by Statistics Belgium (2013a). From the time our records start, Belgian real house prices have increased by 220 percent. Before World War I, Belgian real house prices stagnated. They fell sharply during the first war and did not reach the same level as 1913 until the mid-1960s. In the past two decades prices have approximately doubled.

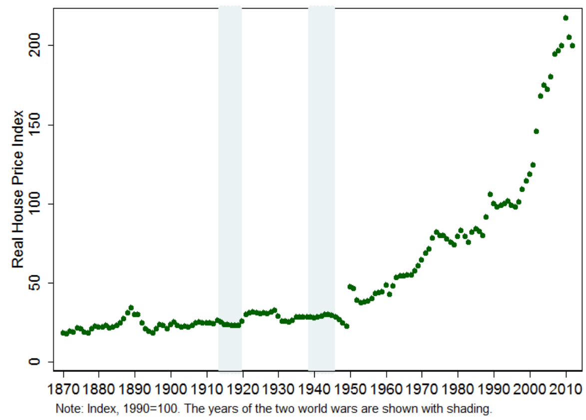


Figure 1: Australia, 1870–2012.

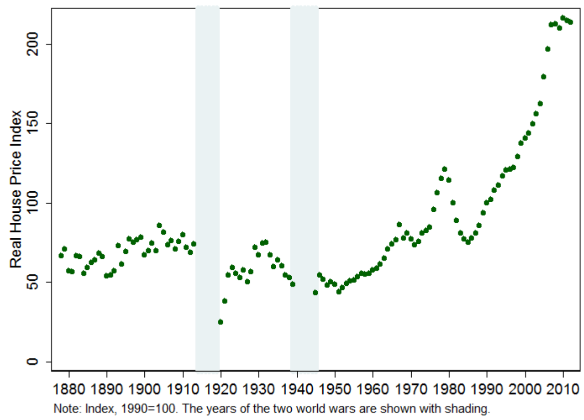


Figure 2: Belgium, 1878–2012.

3.3 Canada

Canadian residential real estate prices are available from 1921 to 2012 for the entire country, interrupted by a minor gap immediately after World War II. The index refers to the average replacement value (including land) prior to 1949 (Firestone, 1951) and to average sales prices from 1956 to 1974 (Canadian Real Estate Association, 1981). From 1975 onwards, we draw on an index based upon weighted average prices in five Canadian cities (Centre for Urban Economics and Real Estate, University of British Columbia, 2013). As can be seen in Figure 3, Canadian real house prices remained fairly stable prior to World War II. They rose on average 2.8 percent per year throughout the post-war decades until growth leveled off in the 1990s. After a brief period of stagnation, Canada experienced a significant house price boom period in the 2000s with average annual growth rates of close to 5 percent.

3.4 Denmark

Danish house price data are available from 1875 to 2012. For the 1875–1937 period, the index is based on the average purchase prices of rural real estate. From 1938 to 1970, the house price index covers nationwide purchase prices (Abildgren, 2006). From 1971 onwards, we draw on an index calculated by the Danish National Bank using the SPAR method. From 1875 to the eve of World War II (as shown in Figure 4), Danish house prices remained essentially constant. After the war, house prices entered several decades of substantial growth. Particularly strong increases were registered in the 1960s and 1970s and during the decade that preceded the global financial crisis of 2007/2008. During these episodes, prices rose on average between 5 and 6 percent per year.

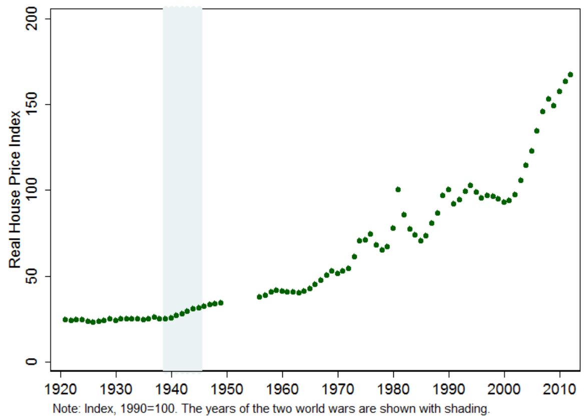


Figure 3: Canada, 1921–2012.

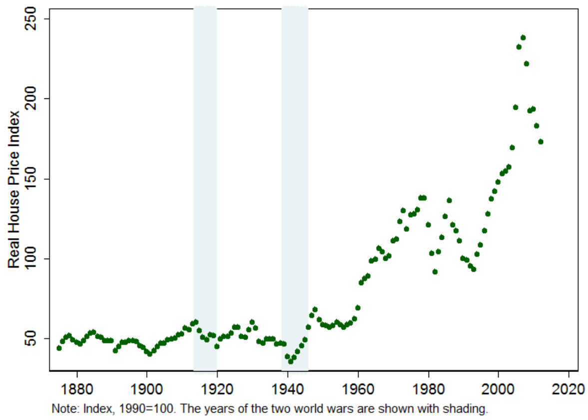


Figure 4: Denmark, 1875–2012.

3.5 Finland

The Finnish house price index covers the period from 1905 to 2012. Prior to 1946, the index refers to a three year moving average of average prices per square meter of residential building sites in Helsinki (Statistical Office of the City of Helsinki, various years). For the 1947–1969 period, we use an unpublished house price series by Statistics Finland that relies on average square meter prices in Helsinki. Since 1970, we use a mix-adjusted hedonic index constructed by Statistics Finland (2011). As Figure 5 shows, Finnish house prices increased by 1.8 percent per year on average since 1905. House prices fluctuated heavily but remained constant until the mid-20th century and then entered a long upward trend.

3.6 France

House price data for France are available for the period from 1870 to 2012 (Figure 6). For the 1870–1934 period, we rely on a repeat sales index for Paris (Conseil General de l'Environnement et du Developpement Durable, 2013b). We splice this series with a repeat sales index for the entire country (1936–1996, Conseil General de l'Environnement et du Developpement Durable (2013b)). For the years from 1997 to 2012, we use the hedonic, mix-adjusted index published by National Institute of Statistics and Economic Studies (2012). The data suggest that French house prices trended slightly upwards before World War I, declined sharply during the war and remained depressed throughout the interwar period. In the second half of the 20th century, house prices rose about 4 percent per year on average.

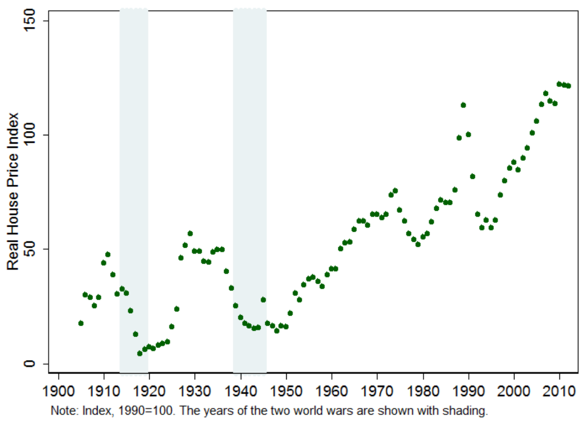


Figure 5: Finland, 1905–2012.

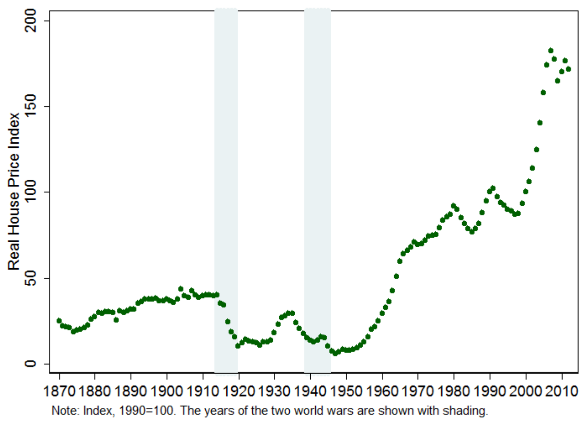


Figure 6: France, 1870–2012.

3.7 Germany

Data on residential real estate prices in Germany are available for the years 1870 to 1938 and then again from 1962 to 2012 (Figure 7). For the pre-war period, we use raw data for average transaction prices of developed building sites in a number of German cities. Using data from the Statistical Yearbook of Berlin (Statistics Berlin, various years), Matti (1963), and the Statistical Yearbook of German Cities and Municipalities (Association of German Municipal Statisticians, various years), the index is based on data for Berlin from 1870 to 1902, for Hamburg from 1903 to 1923, and ten cities from 1924 to 1937. For the period 1962–1969, we use average transaction price data of building sites as published by the Federal Statistical Office of Germany (various years,b). For the period thereafter, we used the mix-adjusted house price index constructed by the Bundesbank. We link the two series for 1870–1938 and 1962–2012 using an estimate of the price increase between 1938 and 1959 by the Deutsches Volksheimstättenwerk (1959).

German house prices rose before World War I, contracted during World War I and remained low during the interwar period. They did not recover their pre-1913 levels until the 1960s. German house prices grew at an average rate of nearly 4 percent between 1961 and the early 1980s. Between the 1980s and 2012, house prices decreased by about 0.8 percent per year in real terms. Germany is an outlier in the sense that the country did not participate in the global house price boom of the past few decades.

3.8 Japan

Our Japanese house price data stretch from 1913 to 2012 (Figure 8). We splice several indices for sub-periods published by the Bank of Japan (1986a, 1966) and Statistics Japan (2013b, 2012). The index relies on price data for urban residential land. The history of Japanese real estate prices is marked by a long period of stagnation until the mid-20th century. After World War II, house prices grew strongly for three decades. Between 1949 and the end of the 1980s, house prices rose at an average annual rate of nearly 10 percent. The boom came to an end in the late 1980s. In the past two decades real values of real estate fell by 3 percent per year on average.

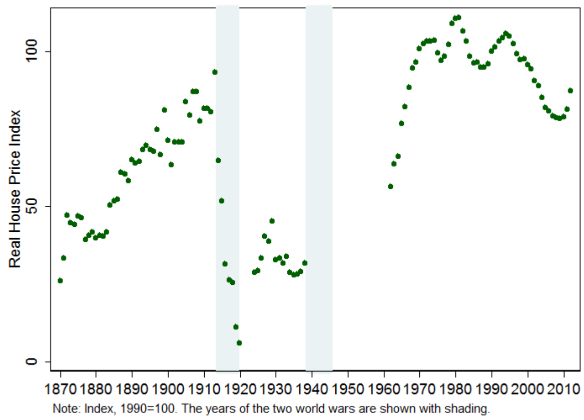


Figure 7: Germany, 1870–2012.

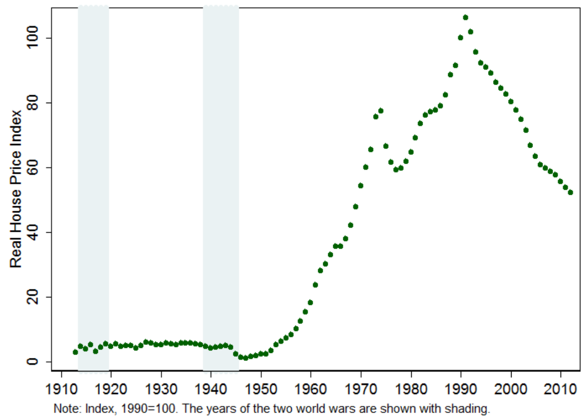


Figure 8: Japan, 1913–2012.

3.9 The Netherlands

Our long-run series covers the period from 1870 to 2012 (Figure 9). Prior to the 1970s, the data are based on Eichholtz (1994) who calculated a repeat sales index for Amsterdam. We extend this series to the present using an index constructed by the Dutch Land Registry based on median sales prices until 1991 and repeat sales from 1992 onwards. After 1997, we use a mix-adjusted SPAR index published by Statistics Netherlands (2013d). The index for the Netherlands depicts an already familiar pattern. Dutch house prices fluctuated until World War II but were, by and large, trendless. In stark contrast to the first half of the 20th century, after World War II prices rose at an average annual rate of slightly more than 2 percent. The increase was particularly strong in the most recent boom when prices rose by about 5.4 per year on average. Between 1870 and 2012, Dutch house prices nearly quadrupled.

3.10 Norway

The index for Norway covers the period from 1870 to 2012 (Figure 10). For the years 1870 to 2003, we relied on a hedonic-weighted repeat sales index for four Norwegian cities (Eitrheim and Erlandsen, 2004). From 2004 onwards, we use a simple average of the hedonic indices for these four cities published by the Norges Eiendomsmeglerforbund (2012). During the past 140 years, Norwegian house prices quadrupled in real terms, equivalent to an average annual rise of 1.2 percent. Our long-run index first shows a substantial increase in house prices in the last decades of the 19th century before leveling off. House prices increased continuously after World War II. This was briefly interrupted by the financial turmoil of the late 1980s. The increase has been particularly large since the early 1990s.

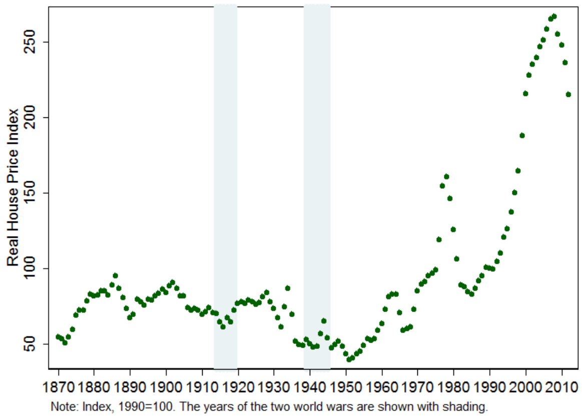


Figure 9: The Netherlands, 1870–2012.

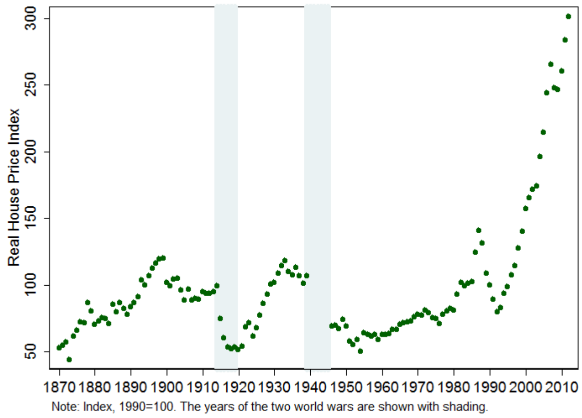


Figure 10: Norway, 1870–2012.

3.11 Sweden

Data on residential real estate prices in Sweden are available for the years 1875 to 2012 (Figure 11). They cover two major Swedish cities, Stockholm and Gothenburg. For 1875–1957, we combine data for Stockholm by Söderberg et al. (2014) and for Gothenburg by Bohlin (2014). Both indices are calculated using the SPAR method. We also use SPAR indices for the two cities collected by Söderberg et al. (2014) for the period from 1957 to 2012. Since 1875, Swedish house prices nearly tripled in real terms. The developments mirror those in neighboring Norway. House prices rose slowly until the early 20th century and contract during the 1930s and 1940s. In the second half of the 20th century, Swedish house prices trended upwards, but were volatile during the crises of the late 1970s and late 1980s. During the subsequent boom between the mid-1990s and late 2000s, house prices increased at an average annual growth rate of more than 6 percent.

3.12 Switzerland

The index for Switzerland covers the years 1901 to 2012 (Figure 12). For the early years from 1901 to 1931, we draw on data from Swiss Federal Statistical Office (2013) for square meter prices of developed and undeveloped sites in Zurich. From 1932 onwards we rely on two residential real estate price indices published by Wüest and Partner (2012) (for 1930–1969 and 1970–2012). From the time our records start, Swiss house prices increased by 115 percent in real terms. Prices were, by and large, trendless until World War II but fluctuated substantially. In the immediate post-war decades, real estate prices increased by nearly 40 percent and have stayed constant since the 1970s. On average, Swiss house prices increased 0.7 percent per year over the period from 1901 to 2012.

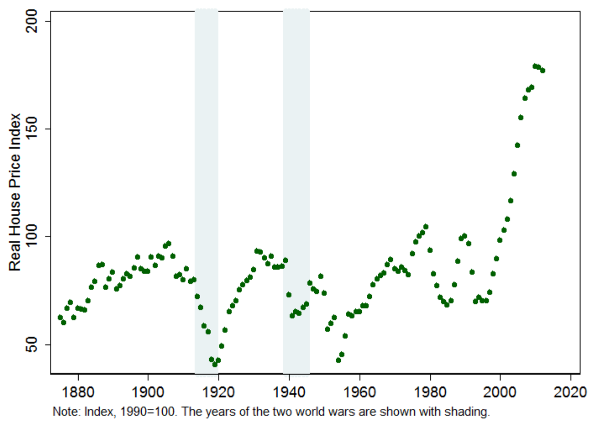


Figure 11: Sweden, 1875–2012.

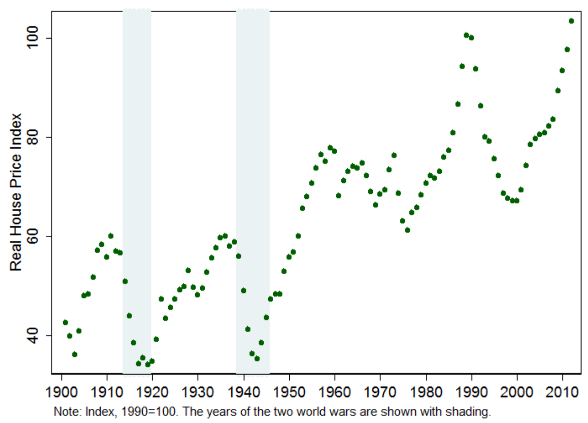


Figure 12: Switzerland, 1901–2012.

3.13 United Kingdom

The house price series for the United Kingdom covers the years 1899 to 2012. For the period before 1930, we use data for the average property value of existing dwellings in urban South-Eastern England (London, Eastbourne, and Hastings). Starting in 1930, we rely on the long-run index for the UK published by the Department for Communities and Local Government (2013) based on average prices until 1968 and mix-adjusted from 1969 onwards. For the years after 1996, we use the Land Registry (2013) repeat sales index for England and Wales. As shown in Figure 13, British house prices rose by 380 percent since 1899. Yet the path is quite remarkable. Between 1899 and 1938, UK house prices fell on average by 1 percent per year. After World

War II, house prices rose continuously with particularly high rates of price appreciation in the late 1990s and 2000s.

3.14 United States

The index for the U.S. covers the years from 1890 to 2012 (Figure 14). For the 1890–1934 period, we use the depreciation-adjusted house price index for 22 cities by Grebler et al. (1956). The index is calculated using an approach similar to the repeat sales method by matching sales prices and housing values estimated by homeowners. For the years 1935 to 1974 we use the house price index published by Shiller (2009). It is based on median residential property prices in five cities until 1952, and on a weighted-mix adjusted index for the entire U.S. after 1953. For 1975 onwards, we rely on the weighted repeat sales index of the Federal Housing Finance Agency (2013).

Between 1890 and 2012, U.S. house prices increased by 150 percent in real terms. Prices rose 1.8 percent per year on average until World War I, contracted during the war, but recovered during the interwar period. However, the extent of the price appreciation in the interwar period continues to be debated. While the Grebler et al. (1956)-Shiller (2009)-hybrid index suggests a substantial recovery of real house prices during the 1930s, a competing series by Fishback and Kollmann (2012) shows that during the Great Depression house prices fell back to their early 1920s level. Following World War II, house prices first surged, but then remained remarkably stable until the early 1990s. Davis and Heathcote (2007) argue, however, that the index constructed by Shiller (2009) underestimates house price appreciation during the 1960s and early 1970s. Several regional house price booms and busts in the 1970s and 1980s are visible in the nationwide index (Shiller, 2009). During the past two decades, real estate values increased substantially before falling steeply after 2007.

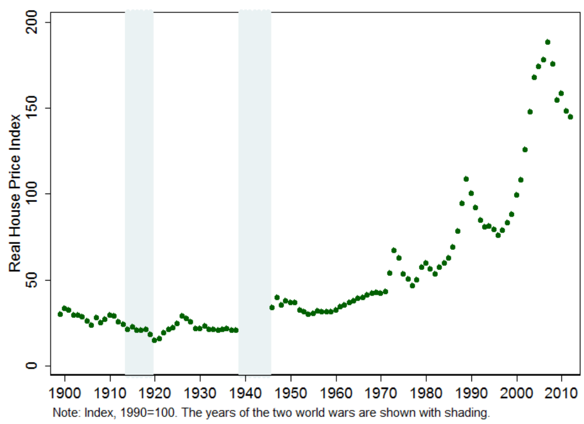


Figure 13: United Kingdom, 1899–2012.

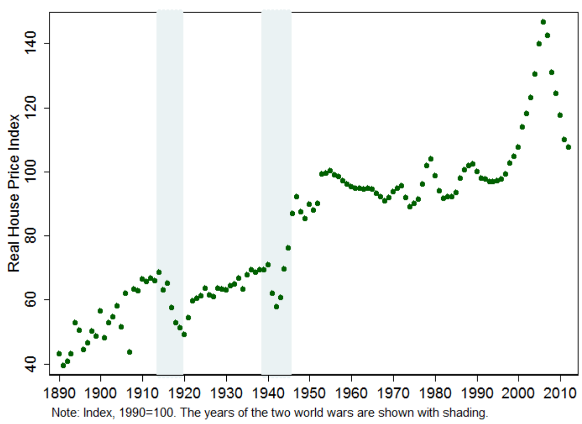


Figure 14: United States, 1890–2012.

4 Aggregate trends

What aggregate trends in long-run house prices can we identify? In this section, we will present three stylized facts: First, house prices in advanced economies increased in real terms since the 1870s, although there is considerable cross-country heterogeneity. Second, the time path of this trend follows a hockey-stick pattern: real house prices remained broadly stable from the late 19th-century to the mid-20th century and increased strongly since then. Third, we demonstrate that urban and rural house prices display similar long-run trends. We also present a number of additional test and consistency checks to corroborate these stylized facts.

4.1 Prices rise on average

The first important fact that emerges from the data is that between 1870 and 2012, real house prices increased in all advanced economies. The (unweighted) mean and median of the 14 house price indices are shown in Figure 15. Adjusted by the consumer price index, house prices in the early 21st-century are well above their late 19th-century level. On average, house prices in advanced economies have risen threefold since 1900, equivalent to an average annual real rate of growth of a little more than 1 percent. Note that this is lower than average annual GDP per capita growth of about 1.8 percent for the sample average. That is to say, house prices have risen significantly over the past 140 years relative to the consumer prices but have lagged income growth in most countries. We will return to this point later.

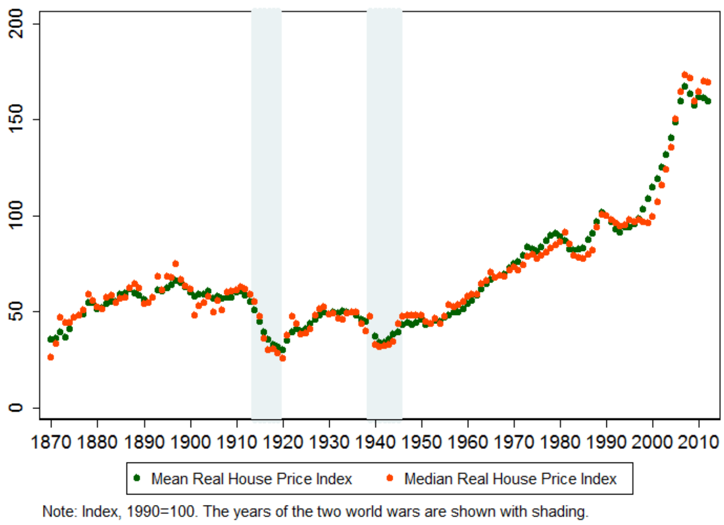


Figure 15: Mean and median real house prices, 14 countries.

As we already saw in the previous section, this global picture conceals considerable country variation. Figure 16 demonstrates the heterogeneity of cross-country trends. House prices merely increased by 40 basis points per year in Germany, but by about 2 percent on average in Australia, Belgium, Canada and Finland. Since 1890, U.S. house prices have increased at an annual rate of a little less than 1 percent; both the UK and France have seen somewhat higher house price growth of 1 percent and 1.4 percent, respectively. Exploring the causes of such divergent price trends is an important object for future research, but is beyond the scope of this study.

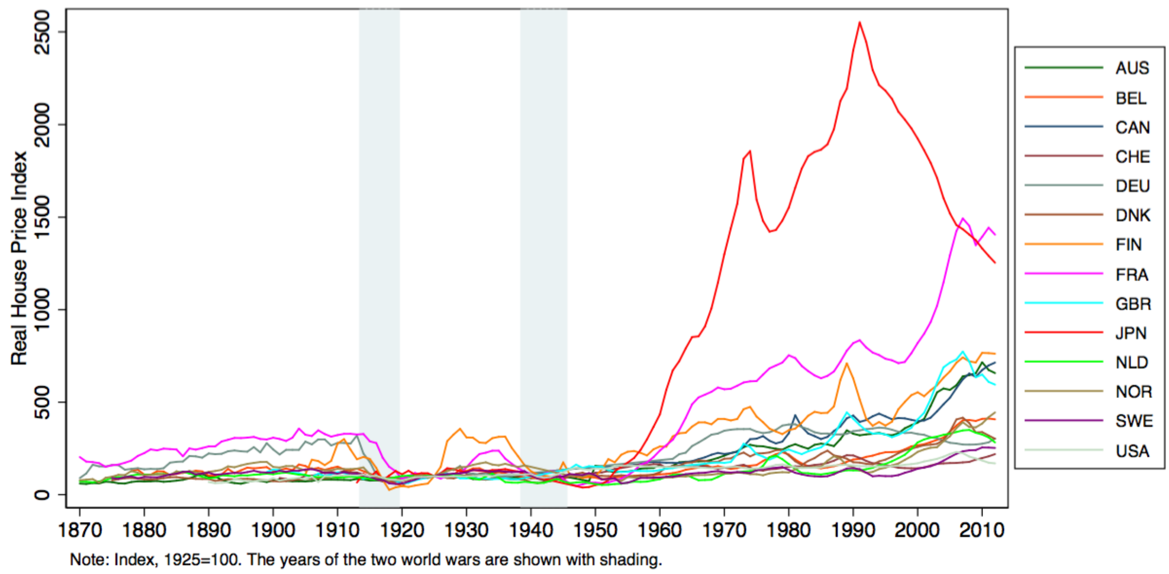


Figure 16: Real house prices, 14 countries.

4.2 Strong increase in the second half of the 20th century

A second central insight from Figure 15 is that the growth of real house prices has not been continuous. Our data show that house prices remained constant until World War I, fell in the interwar period and began a long lasting recovery after World War II. On average, it took until the 1960s for real house prices to recover their pre-World War I levels. Since the 1970s, house prices trended upwards and the past 20 years show a particular steep incline. In other words, real house prices in most Western economies stayed within a relatively tight range from the late 19th to the second half of the 20th century. In subsequent decades, they have broken out of this range and increased substantially in real terms. Table 2 shows average annual growth rates of house prices for the entire dataset and for the sub-periods before and after World War II. While real house price growth was roughly zero before World War I, after World War II, the average annual rate of growth was above 2 percent.

	Δ log Nominal House Price Index			Δ log CPI			Δ log Real GDP p.c.		
	N	mean	s.d.	N	mean	s.d.	N	mean	s.d.
Australia									
Full Sample	127	0.047	0.106	127	0.027	0.047	127	0.016	0.040
Pre-World War II	62	0.009	0.083	62	0.001	0.037	62	0.011	0.054
Post-World War II	65	0.083	0.114	65	0.052	0.041	65	0.021	0.019
Belgium									
Full Sample	119	0.043	0.094	126	0.022	0.054	127	0.021	0.041
Pre-World War II	54	0.029	0.126	61	0.008	0.069	62	0.019	0.055
Post-World War II	65	0.056	0.054	65	0.034	0.031	65	0.023	0.020
Canada									
Full Sample	75	0.048	0.078	127	0.019	0.044	127	0.018	0.046
Pre-World War II	17	-0.014	0.048	62	-0.001	0.048	62	0.017	0.062
Post-World War II	58	0.066	0.076	65	0.038	0.032	65	0.019	0.023
Denmark									
Full Sample	122	0.032	0.074	127	0.021	0.053	127	0.019	0.024
Pre-World War II	57	-0.002	0.060	62	-0.004	0.058	62	0.017	0.025
Post-World War II	65	0.061	0.074	65	0.046	0.032	65	0.020	0.024
Finland									
Full Sample	92	0.088	0.156	127	0.031	0.059	127	0.026	0.034
Pre-World War II	27	0.094	0.244	62	0.006	0.055	62	0.023	0.036
Post-World War II	65	0.085	0.105	65	0.054	0.053	65	0.028	0.031
France									
Full Sample	127	0.062	0.075	127	0.031	0.082	127	0.020	0.038
Pre-World War II	62	0.023	0.055	62	0.013	0.107	62	0.013	0.049
Post-World War II	65	0.099	0.072	65	0.047	0.040	65	0.027	0.022
Germany									
Full Sample	110	0.040	0.108	123	0.025	0.097	127	0.027	0.043
Pre-World War II	60	0.043	0.140	58	0.022	0.139	62	0.019	0.049
Post-World War II	50	0.037	0.046	65	0.027	0.026	65	0.034	0.035
Japan									
Full Sample	84	0.078	0.155	127	0.027	0.120	127	0.029	0.046
Pre-World War II	19	-0.006	0.093	62	0.011	0.150	62	0.015	0.049
Post-World War II	65	0.103	0.162	65	0.043	0.081	65	0.042	0.038
The Netherlands									
Full Sample	127	0.026	0.091	127	0.015	0.044	127	0.019	0.031
Pre-World War II	62	-0.009	0.086	62	-0.007	0.049	62	0.014	0.036
Post-World War II	65	0.059	0.084	65	0.036	0.026	65	0.024	0.023
Norway									
Full Sample	127	0.041	0.087	127	0.020	0.058	127	0.023	0.027
Pre-World War II	62	0.013	0.085	62	-0.007	0.066	62	0.018	0.033
Post-World War II	65	0.068	0.080	65	0.045	0.035	65	0.027	0.018
Sweden									
Full Sample	122	0.036	0.077	127	0.021	0.047	127	0.022	0.029
Pre-World War II	57	0.010	0.052	62	-0.004	0.045	62	0.022	0.036
Post-World War II	65	0.059	0.089	65	0.045	0.035	65	0.022	0.021
Switzerland									
Full Sample	96	0.030	0.051	127	0.008	0.048	127	0.019	0.035
Pre-World War II	31	0.019	0.062	62	-0.008	0.061	62	0.016	0.044
Post-World War II	65	0.036	0.044	65	0.024	0.022	65	0.016	0.024
United Kingdom									
Full Sample	98	0.044	0.089	127	0.024	0.047	127	0.015	0.025
Pre-World War II	33	-0.008	0.088	62	-0.004	0.035	62	0.011	0.030
Post-World War II	65	0.070	0.080	65	0.050	0.042	65	0.019	0.019
United States									
Full Sample	107	0.029	0.073	127	0.015	0.040	127	0.017	0.041
Pre-World War II	42	0.015	0.105	62	-0.007	0.040	62	0.015	0.053
Post-World War II	65	0.038	0.039	65	0.036	0.027	65	0.020	0.023
All Countries									
Full Sample	1533	0.045	0.097	1900	0.024	0.069	1905	0.021	0.037
Pre-World War II	645	0.016	0.102	925	0.004	0.082	930	0.016	0.048
Post-World War II	888	0.066	0.088	975	0.043	0.046	975	0.025	0.027

Note: World wars (1914–1919 and 1939–1947) omitted.

Table 2: Annual summary statistics by country and by period.

This shape is all the more surprising since income growth much more stable over time. Figure 17 displays the relation between house prices and GDP per capita over the past 140 years. House prices remain, by and large, stable before World War I despite rising per capita incomes. Relative to income, house prices decline until the mid-20th century. After World War II, the elasticity of house prices with respect to income growth was close to or even greater than 1. Finally, in the past two decades preceding the 2008 global financial crisis, real house price growth outpaced income growth by a substantial margin.

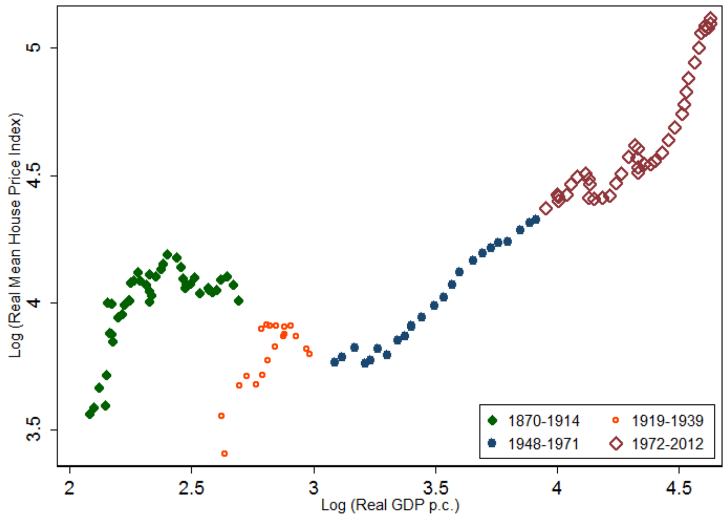


Figure 17: House prices and GDP per capita.

4.3 Urban and rural prices move together

Has the strong rise in house prices since the 1960s been predominantly an urban phenomenon, driven by growing attractiveness of cities? Urban economists have pointed to the economic advantage of living in cities, explaining high demand for urban land (Glaeser et al., 2001, 2012). However, a third key fact that emerges from our data is that urban and rural prices moved together in the long run.

As a start, we were able to separate urban and rural house prices for a sub-sample of five countries for the decades after 1970. We divided regions in these five countries into urban and rural ones based on population shares. Regions with a share of urban population above the country-specific median are labeled predominantly urban. Regions with urban population below the median of the country are considered predominantly rural. The urban (rural) indices are then calculated as the simple mean of the urban (rural) state or region indices.[4]

[4]For Germany we use data only on the price of building land instead of data on house prices (Federal Statistical Office of Germany, various years,b). For Finland we use Statistics Finland's index for the capital region as the urban index and the index for the rest of the country as the rural index. The capital region includes Helsinki, Espoo and Vanta.

Figure 18 plots the development of urban and rural house prices for Finland, Germany, Norway, the United Kingdom and the United States since the 1970s. The graph shows that urban house prices have increased more than rural ones – the average annual growth rate is 2.14 percent since 1970 compared to 2.01 percent for non-urban house prices. Yet both price series follow the same trajectory and the differences are relatively small. Both rural and urban house prices trended strongly upwards in recent decades.

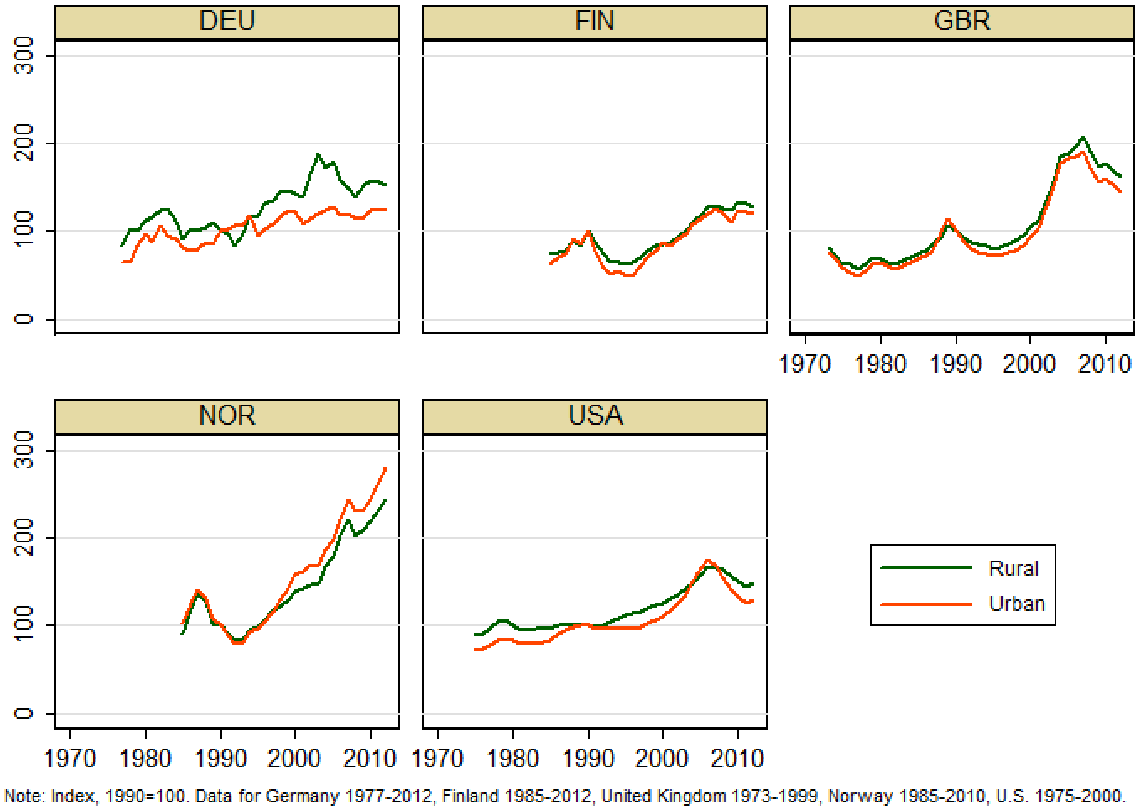


Figure 18: Urban and rural house prices since the 1970s, 5 countries.

We also collected data for the price of agricultural land. Long-run data since 1900 are available for Canada, Denmark, Germany, Japan, the UK and the U.S. Data for five others start in the mid-20th century.[5] If one assumes that construction costs in rural and urban areas move together in the long-run and that there is a correlation between changes in the price of rural land used for farming and housing, then farmland prices can serve as a rough proxy for non-urban prices.

Figure 19 plots mean farmland prices for 11 countries together with the global house price index for our 14-country sample. Two facts are noteworthy. First, farmland prices have more

[5]Data on farmland prices is available for Belgium 1953–2009, Canada 1901–2009, Switzerland 1955–2011, Germany 1870–2012, Denmark 1870–2012, Finland 1985–2012, United Kingdom 1870–2012, Japan 1880–2012, the Netherlands 1963–2001, Norway 1914–2010 and the United States 1870–2012. See Appendix B for sources and description.

than doubled since 1900 in real terms. Clearly, farmland is substantially cheaper than building land per area unit, but the long-run trajectories appear similar. The long-run growth in farmland prices was only slightly lower (by about 0.3 percentage points per year) than the average growth rate of house prices.

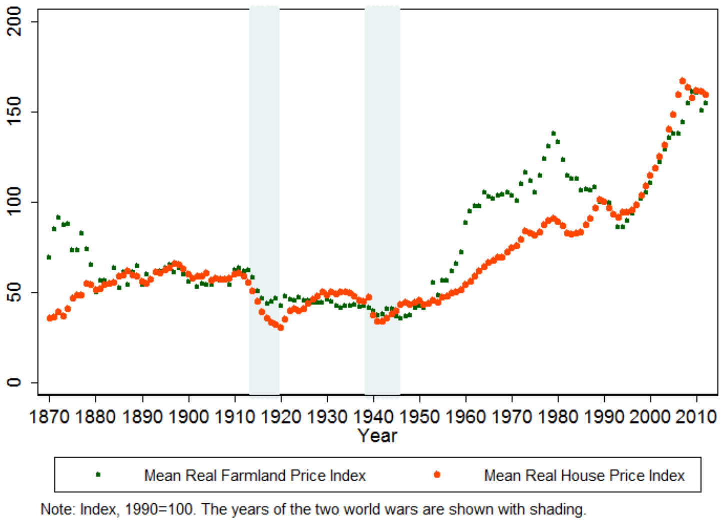


Figure 19: Mean real farmland and house prices, 11/13 countries.

The second striking fact is that, as in the case of house prices, the path of farmland prices also follows a hockey-stick pattern. Prior to World War II, farmland prices were, by and large, stationary. Yet for the second half of the 20th century, there is a clear upward trend with real farmland prices rising on average by about 2 percent per annum. Farmland surpassed house prices. The boom was followed by a major correction in the 1980s. Since then, the price of agricultural land has risen hand in hand with residential real estate prices.

4.4 Further checks

Thus far we have demonstrated that real house prices have risen on average since 1870. The increase has been non-continuous considering that house prices remained essentially stable from the pre-World War I era until the mid-20th century and every increase has occurred thereafter. These trends appear to apply equally to urban and rural prices. In this section, we subject these trends to additional robustness and consistency checks.

We address three issues: first, the aggregate trends could be distorted by a potential mismeasurement of quality improvements in the housing stock which could overstate the price increase in the post World War II period; second, the aggregate price developments could be an artifact of a compositional shift from predominantly (cheap) rural to (expensive) urban areas over time; finally, small countries and/or a bias in the sample towards European countries could drive the overall trends. We will, however, argue that none of these points is likely to pose a serious challenge to the stylized facts outlined in the previous section.

4.4.1 Quality improvements

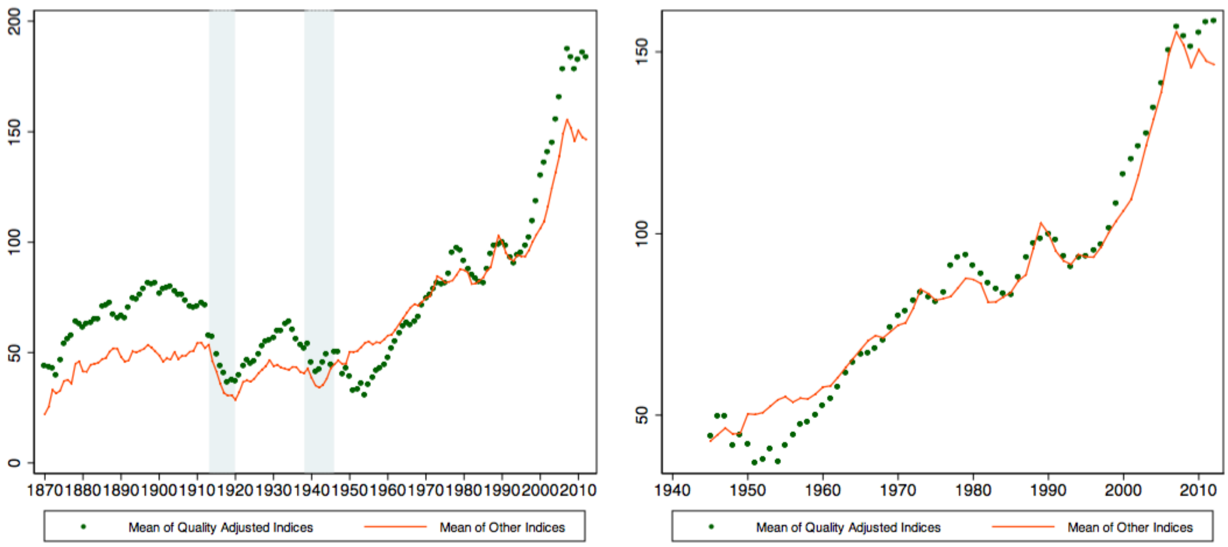
As the quality of homes has risen notably over the past 140 years, the long-run trends could be upwardly biased if the quality improvement of houses is understated. For instance, Hendershott and Thibodeau (1990) gauge that the U.S. National Association of Realtors median house price series overstates the increase in house prices by up to 2 percent between 1976 and 1986. Case and Shiller (1987) also estimated a 2 percent bias for 1981–1986. In contrast, Davis and Heathcote (2007) suggest that quality gains only amounted to less than 1 percent per year between 1930 and 2000. For Australia, Abelson and Chung (2004) calculate that spending on alterations and additions added about 1 percent per year to the market value of detached housing between 1979/80 and 2002/03.Stapledon (2007) confirms this. For the United Kingdom, Feinstein and Pollard (1988) estimate that housing standards rose about 0.22 percent per year between 1875 and 1913. This gives us a time-varying range by which the non-adjusted indices may overstate the increase in constant quality house prices: between 0.22 and 2 percent per year. Clearly, this is a potential bias that we need to take seriously.

As a first test, we can get an idea of the potential mis-measurement by comparing house price trends for countries for which we have reliable quality adjusted price information with countries where the constant quality assumption is more doubtful. In the pre-World War II period, three of our country indices have been constructed using the repeat sales or the SPAR method (France, Netherlands, Norway, and Sweden). The price series for Japan covers only residential land values and is thus not influenced by changes in the quality or size of the structure. For the immediate post-World War II years, we can also include the index for Switzerland that has been constructed using a hedonic approach and the index for Germany, which includes the prices of building lots.

Figure 20 plots a simple average of these indices vis-à-vis the average of other countries where the constant quality assumption is less solid. The left panel shows the overall increase in house prices since 1870. The right panel zooms in on price trends in the second half of the 20th century. In both cases, the constant quality indices and the others display very similar overall trajectories. We also note that the most significant improvements in housing quality such as running water and electricity had entered the standard home before 1945.[6] If a mis-measurement of these improvements would cause an upward bias in our house price series, it would lower the quality-adjusted price increase pre-World War II but not affect the increase in the post-World War II period. We will also see later that rising land prices play an important

[6]By 1940, for example, about 70 percent of U.S. homes had running water, 79 percent electric lighting and 42 percent central heating (Brunsman and Lowery, 1943).

role for the increase in house prices in many countries.



Note: Index, 1990=100. The years of the two world wars are shown with shading. The mean of quality adjusted indices includes the following countries: FRA, NLD, NOR, SWE, JPN (left figure); FRA, NLD, NOR, SWE, JPN, DEU, CHE (right figure).

Figure 20: Quality adjustments.

4.4.2 Composition shifts

The world is considerably more urban today than it was in 1900. Only about 30 percent of Americans lived in cities in 1900. In 2010, the corresponding number was 80 percent. In Germany, 60 percent of the population lived in urban areas in 1910 and 74.5 percent in 2010 (United Nations, 2014; U.S. Bureau of the Census., 1975). The UK is the only exception as the country was already more urban at the beginning of the 20th century when 77 percent of the population lived in cities, only slightly less than the 79.5 percent recorded in 2010 (United Nations, 2014; General Register Office, 1951).

If the coverage of house price indices also shifted from (cheap) rural to (expensive) urban prices over time, it could push up the average prices that we observe. Figure 21 plots the share of purely urban house price observations for the entire sample. It turns out that the share of urban prices is actually declining over time, mainly because many of the early observations rely on city data only (e.g., Paris, Amsterdam, Stockholm) and the indices broaden out over time to include more non-urban price observations. Compositional shifts in the indices are unlikely to generate the patterns that we observe.

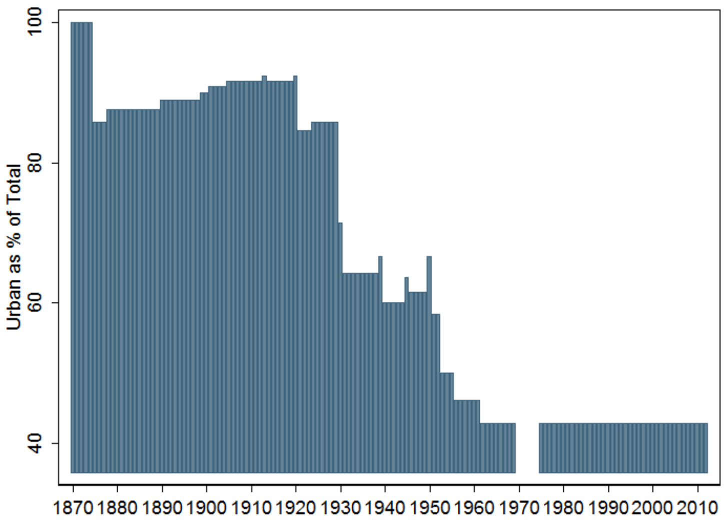


Figure 21: Composition of house price data, urban vs. rural.

4.4.3 Country sample and weights

The path of global house prices displayed in Figure 15 was based on a simple unweighted average of 14 country indices in our sample. It is conceivable that small and land-poor European countries, which constitute a large share of our sample, have a disproportionate influence on the aggregate trends. We also calculated population and GDP weighted indices, which are displayed in Figure 22. It turns out that the weighted indices show a more moderate increase in the past two decades as house price appreciation was stronger in many small European countries than it was in the larger economies in our sample — the U.S., Japan, and Germany. Yet over the past 140 years, the shape of the overall trajectory is similar: house prices have stagnated until the mid-20th century and increased markedly in the past six decades.

Moreover, as our sample is Europe-heavy, the trends – in particular the stagnation of real house prices in the first half of the 20th century may be distorted by the shocks of the two world wars and their effects on the housing stock. However, trends are surprisingly similar in countries that experienced major war destruction on their own territory and countries that did not (e.g. Australia, Canada, Denmark, and the U.S). While it remains a possibility that the world war disasters depressed asset prices in all advanced economies in the first half of the 20th century (Barro, 2006), the trends we observe are not an artifact of sampling issues or weights.

Note: Index, 1990=100. The years of the two world wars are shown with shading.

Figure 22: Population and GDP weighted mean and median real house price indices, 14 countries.

5 Decomposing house prices

A house is a bundle of the structure and the underlying land. The replacement price of the structure is a function of construction costs. If the price of the house rises faster than the cost of building a structure of similar size and quality, the underlying land gains in value (Davis and Heathcote, 2007; Davis and Palumbo, 2007). In this section, we introduce data on long-run trends in construction costs that we use to proxy replacement costs. Details on the data can be found in the Appendix B. Figure 23 plots the long-run construction cost indices country by country.

We then introduce a stylized model of the housing market in order to study the role of replacement costs and land prices as drivers of the increase in house prices over the past 140 years. The result is straightforward: higher land prices, not construction costs, are responsible for the rise in house prices in the second half of the 20th century. Real land prices remained, by and large, constant in the majority of countries between 1870 and the 1960s, but rose strongly in the following decades.

To conceptualize the decomposition of house prices into construction costs and land prices in a simple way, consider a housing sector with a large number of identical firms (real estate developers) who produce houses under perfect competition. Production requires to combine land Z_t^H and residential structures X_t according to a Cobb-Douglas technology

$$F(Z^H, X) = (Z_t^H)^{\alpha}(X_t)^{1-\alpha}, \tag{3}$$

where $0 < \alpha < 1$ denotes a constant technology parameter (Hornstein, 2009b,a; Davis and Heathcote, 2005). Profit maximization then implies that the house price p_t^H equals the equilibrium unit costs as given by

$$p_t^H = B(p_t^Z)^{\alpha}(p_t^X)^{1-\alpha}, \tag{4}$$

where p_t^Z denotes the price of land at time t, p_t^X the price of residential structures as captured by construction costs, and $B := (\alpha)^{\alpha}(1-\alpha)^{-(1-\alpha)}$, respectively. Equation 4 describes how the house price depends on the price of land and on construction costs.

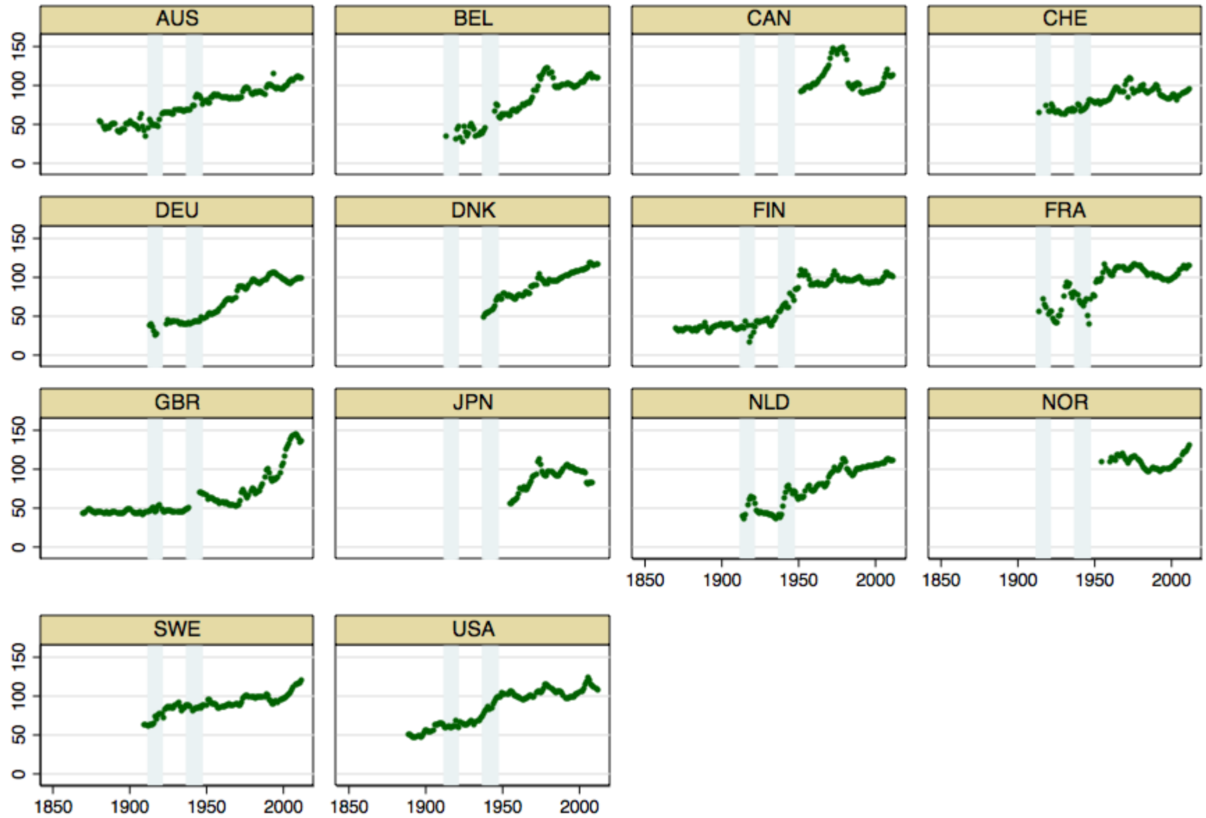
Given information on house prices and construction costs, Equation 4 can be applied to impute the price of residential land as proposed by Davis and Heathcote (2007). This accounting exercise in turn allows us to discuss the relative importance of construction costs and land prices as drivers of long-run house prices.

5.1 Construction costs

Figure 24 shows average construction costs side by side with house prices.[7] It can be seen from Figure 24 that construction costs, by and large, moved sideways until World War II. Construction costs before World War II were likely held down by technological advances such as the invention of steel frame which allowed for the construction of taller buildings. For instance, the world's first skyscraper, the 10-storied Home Insurance Building in Chicago, was constructed in the 1880s.

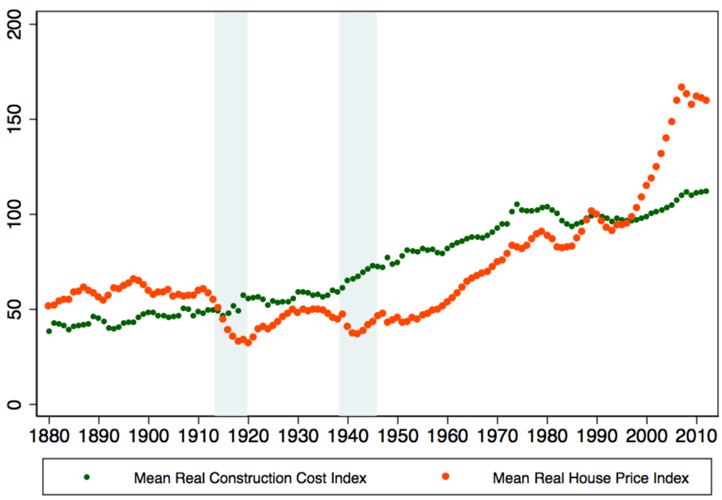
The data show that construction costs rose in the interwar period, and increased substantially between the 1950s and the 1970s in many countries, including in the U.S., Germany and Japan. This potentially reflected real wage gains in the construction sector. What is equally clear from the graph is that since the 1970s, construction cost growth has leveled off. During the past four decades, construction costs in advanced economies have remained broadly stable, while house prices surged. All in all, changes in replacement costs of the structure do not seem to explain the strong increase in house prices in the second half of the 20th century.

[7] The graph starts in 1880 as we only have data for construction costs for two countries for the 1870s.



Note: Index, 1990=100. The years of the two world wars are shown with shading.

Figure 23: Real construction costs, 14 countries.



Note: Index, 1990=100. The years of the two world wars are shown with shading.

Figure 24: Mean real construction costs and mean real house prices, 14 countries.

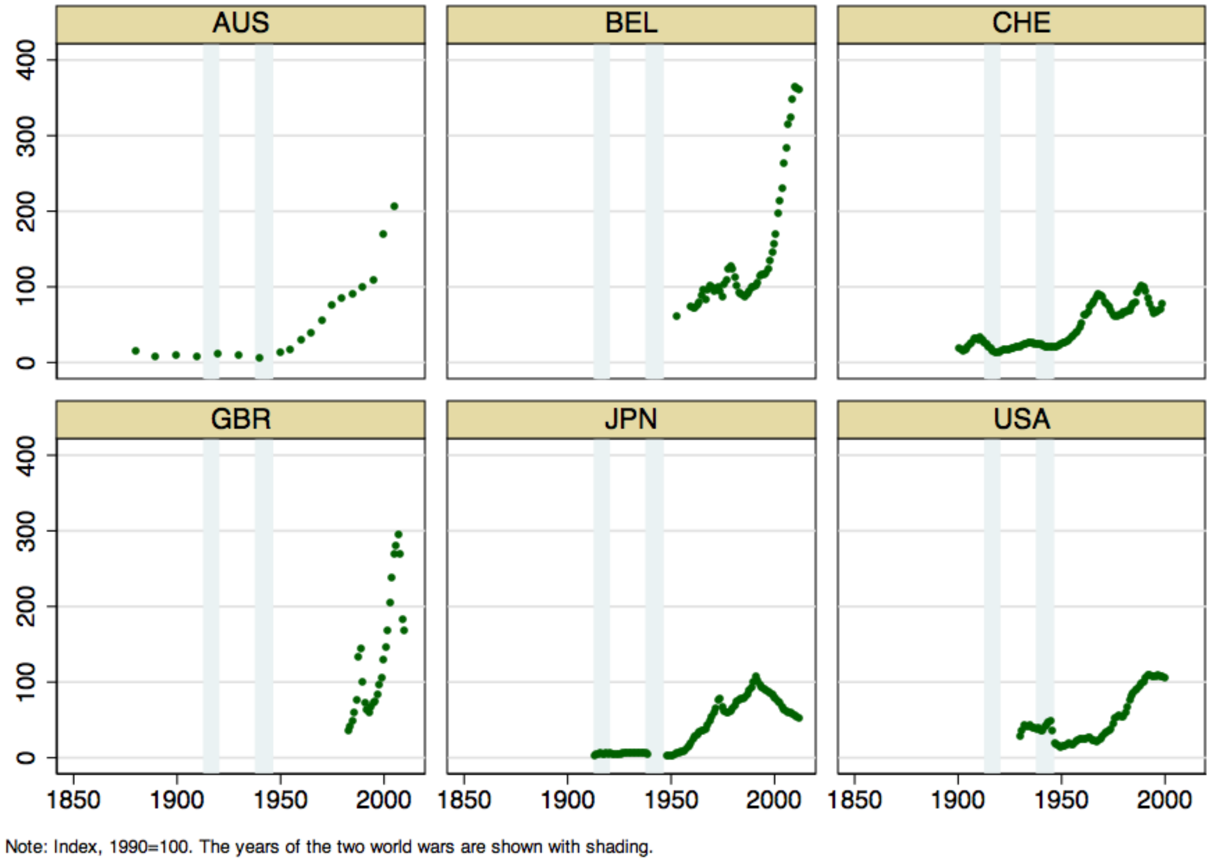


Figure 25: Real residential land prices, 6 countries.

5.2 Residential land prices

Primary historical data for the long-run evolution of residential land prices are extremely scarce. We were able to locate price information on residential land prices for six economies, mainly for the post-World War II era. The series are displayed in Figure 25. The figures show a substantial increase of residential land prices in recent decades, but the sample is clearly small.

To obtain a more comprehensive picture, we will use Equation 4 to impute long-run land prices using information on construction cost and the price of houses. For this accounting decomposition, we need to specify α, the share of land in the total value of housing. Table 5 in the appendix suggests that α averages to a value of about 0.5, but there is some variation both across time and countries. Yet changing α within reasonable limits does not change the qualitative conclusions, as Figure 32 in the appendix demonstrates.[8]

The average land price resulting from this accounting decomposition is shown in Figure 26 together with average house prices. Real residential land prices appear to have remained

[8]For a similar exercise and a more detailed discussion see Davis and Heathcote (2007).

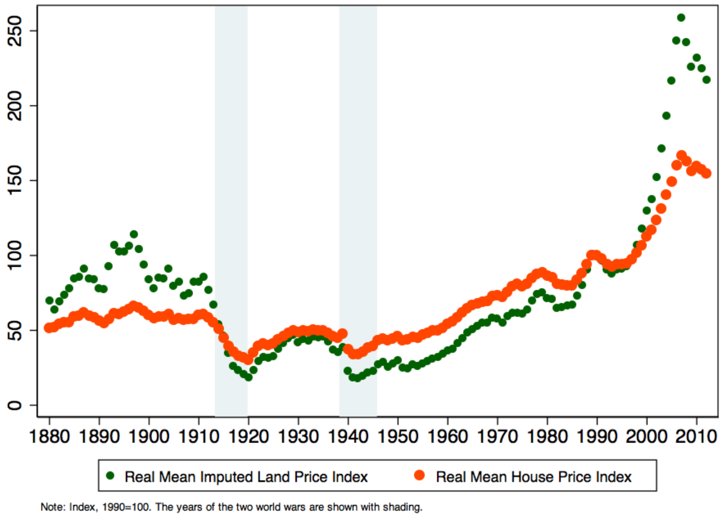


Figure 26: House prices and imputed land prices.

constant before World War I and fell substantially in the interwar period. It took until the 1970s before real residential land prices in advanced economies had, on average, recovered their pre-1913 level. Since 1980 residential land prices have doubled.

As a further plausibility check, we can even compare imputed land prices with observed land prices for a sub-sample of four countries for which we have independently collected residential land prices. Since our aim is to compare empirical and imputed data, we are forced to exclude the residential land price series for the U.S. (shown in Figure 25), which was imputed in a similar exercise by Davis and Heathcote (2007).[9] Country by country comparisons of imputed and observed land price data are shown in the appendix in Figure 33. In Figure 27, we display the average of the four countries for which historical land price series are available. It is clear from the graph that our imputed land price index correlates closely with the empirically observed price data.

5.3 Decomposition

How important is the land price increase relative to construction costs when it comes to explaining the surge in mean house prices during the second half of the 20th century? Noting Equation 4, the growth in global house prices between 1950 and 2012 may be expressed as follows

$$\frac{p^H_{2012}}{p^H_{1950}} = \left(\frac{p^Z_{2012}}{p^Z_{1950}}\right)^{\alpha} \left(\frac{p^X_{2012}}{p^X_{1950}}\right)^{1-\alpha}, \tag{5}$$

[9] We also exclude Japan (Figure 25) as the Japanese house price index is constructed to proxy the price change of urban residential land plots (see Appendix B).

where p_t^Z denotes the imputed mean land price in period t. During 1950 to 2012 house prices grew by a factor of $\frac{p_{2012}^H}{p_{1950}^H} = 3.4$. Setting $\alpha = 0.5$, we find that the share that can be attributed to the rise in (imputed) land prices amounts to 81 percent.[10] The remaining 19 percent can be attributed to the rise in real construction costs, reflecting a lower productivity growth in the construction sector as compared to the rest of the economy. At a country-by-country level we find that the contribution of land prices in explaining house price growth ranges from 74 percent (UK) to 96 percent (Finland), while the median is 83 percent (Sweden, Switzerland).[11] All things considered, the trajectory of residential land prices holds the key to the explanation of the long-run trends in house prices uncovered in the previous sections. Land price dynamics were the main driver of house prices in advanced economies in the second half of the 20th century.

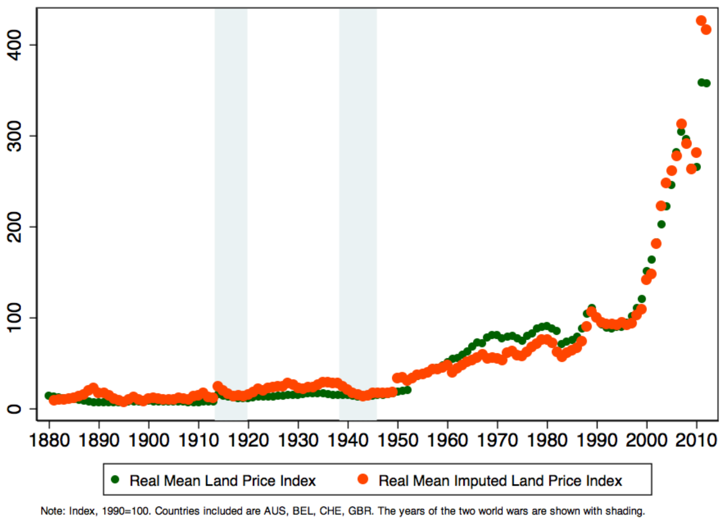


Figure 27: Land price index & imputed land prices.

Theoretical explanations for the path of house prices in advanced economies in the 20th century will have to map onto this key stylized fact: residential land prices in industrial countries

[10]Land prices increased by a factor of $\frac{p_{2012}^Z}{p_{1950}^Z} = 7.3$, while construction costs exhibited $\frac{p_{2012}^X}{p_{1950}^X} = 1.6$. Taking logs on both sides of Equation 5 and normalizing house price growth by dividing through by $\ln\left(\frac{p_{2012}^H}{p_{1950}^H}\right)$ one gets

$$\alpha \frac{\ln\left(\frac{p_{2012}^Z}{p_{1950}^Z}\right)}{\ln\left(\frac{p_{2012}^H}{p_{1950}^H}\right)} + (1-\alpha)\frac{\ln\left(\frac{p_{2012}^X}{p_{1950}^X}\right)}{\ln\left(\frac{p_{2012}^H}{p_{1950}^H}\right)} = 1.$$

The share of house price growth that can be attributed to land price growth may therefore be expressed as $0.5\frac{\ln(7.3)}{\ln(3.4)}$.

[11]The contribution of (imputed) land prices in explaining national house price growth is 74 percent for the UK, 77 percent for Denmark, 81 percent for Belgium, 82 percent for the Netherlands, 83 percent for Sweden and Switzerland, 87 percent for the U.S., 90 percent for Australia, 93 percent for France, 95 percent for Canada and Norway, and 96 percent for Finland. We again exclude Japan as the Japanese house price index is constructed to proxy the price change of urban residential land plots. We also exclude Germany since the German house price index for 1962–1970 reflects the price change of building land only (see Appendix B).

have not risen in real terms for almost a century, but increased substantially since the 1960s. In the next section, we will sketch a possible explanation for this important phenomenon.

6 Explaining the long-run evolution of land prices

While the stability of land prices in the first decades of modern economic growth is a novel result of our study, we are not the first to note the rise of land price in the second half of the 20th century. Among others, Davis and Heathcote (2007), Davis and Palumbo (2007) as well as Glaeser et al. (2005a) have all discussed the phenomenon. Moreover, the trend is not distinct to the U.S. It is also seen in Australia (Stapledon, 2007), Switzerland (Bourassa et al., 2011), the UK and the Netherlands (Francke and van de Minne, 2013). Why did land prices in the advanced economies remain largely constant before starting to increase strongly in the second half of the 20th century? The trajectory of land prices is noticeably puzzling. A standard assumption would be that in a growing economy land prices increase continuously as the competitive land rent increases. In this section, we will sketch an explanation for the hockey-stick pattern of land prices in modern economic history.

The explanation we propose here centers on the role of the transportation revolution in stifling land prices during the first decades of modern economic growth. A major reduction in transportation costs raised the land rent (net of transportation costs) and triggered an expansion of developed land. The increased supply of economically usable land suppressed land prices despite robust growth of income and population.

By contrast, the increase of residential land prices in the second half of the 20th century can be understood in the context of a standard neoclassical model. The second half of the 20th century has not seen a comparable decline in transportation costs. Available indicators show comparatively small decreases in transport costs (Hummels, 2007; Mohammed and Williamson, 2004). As a result, land increasingly behaved like a fixed factor. In addition, growing restrictions on land use and higher expenditures share for housing services exerted upward pressure on the price of land, as we will show.

In the remainder of this section, we will discuss these effects empirically and theoretically. It is important to note at the outset, complementary explanations for the particular shape of land prices are also possible but will have to be mapped onto the stylized facts uncovered here. For example, growing government involvement in housing finance increased the availability of mortgage finance. This in turn might have contributed to driving up demand for housing services and land (Jordà et al., 2014; Fishback et al., 2013).

6.1 The neoclassical model

Let us first examine what a simple neoclassical model suggests about long-run trends in land prices. Consider a simple one-sector economy under perfect competition. The production technology is given by $Y = K^{\alpha}Z^{1-\alpha}$, where Y denotes aggregate output, K a composite of accumulable input factors including capital and labor, Z the fixed factor land, and $0 < \alpha < 1$ a constant technology parameter, respectively. As the focus is on long-term developments, we can abstract from asset price bubbles. The price of one unit of land, in equilibrium, should therefore equal the present value of the stream of competitive land returns (Capozza and Helsley, 1989; Nichols, 1970)

$$p_t^Z = \int_t^{\infty} v_\tau^Z \mathrm{e}^{-r(\tau-t)}\mathrm{d}\tau, \tag{6}$$

where $v^Z = (1-\alpha)K^{\alpha}Z^{-\alpha}$ is the competitive land return, and r denotes the real interest rate, assumed to be constant for simplicity. The land price at any point in time t is accordingly given by a weighted average of current and future marginal productivities of land. This neoclassical textbook model implies that the competitive land return v^Z is a concave function of the stock of accumulable inputs factors K, as displayed by the solid curve in Figure 28, panel (a).[12] Hence, the market value of land should increase continuously as the economy grows, reflecting that the fixed factor land becomes increasingly scarce and valuable. Panel (b) displays the associated land price as a function of time t according to Equation 6, assuming that K increases at a constant growth rate of 3 percent (solid curve). An extended period of constant land prices followed by a take off in land prices later on, is undoubtedly at odds with this baseline model.

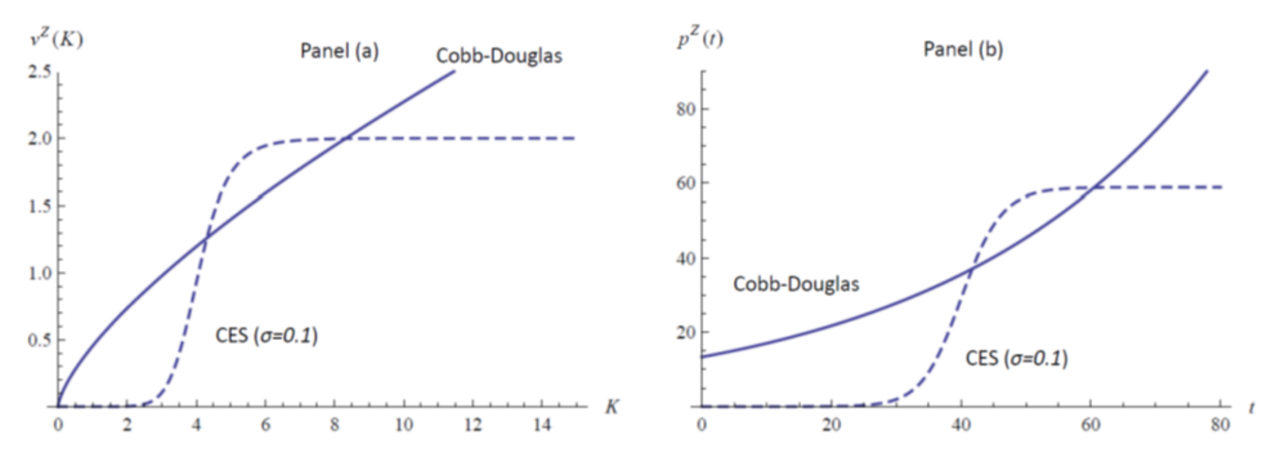


Figure 28: The land return as function of K and the land price as function of t under Cobb-Douglas and CES.

[12]This argument also applies if landowners receive a residual income and if the production technology does not exhibit constant returns to scale, as long as it is concave in the accumulable input.

Another possibility to explain this phenomenon could be a more general CES technology of the form $Y = \left(K^{\frac{\sigma-1}{\sigma}} + Z^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma-1}{\sigma}}$, where $\sigma > 0$ denotes the constant elasticity of substitution between the fixed factor land Z and the variable composite input K. Panel (a) in Figure 28 displays the competitive land return (dashed line), assuming that $\sigma = 0.1$. Panel (b) shows the associated time path of the land price, assuming that K increases at 3 percent (dashed line). But, again, this line of reasoning has significant shortcomings: the land price should approximately equal zero for an extended period of time and should then converge rapidly to a stationary value. These implications also appear at odds with the empirical data.

6.2 Transport revolution and land supply

What forces anchored land prices despite substantial population and productivity growth between 1870 and the mid-20th century? The explanation that we put forward emphasizes the effects of the transport cost revolution on land supply. We are not the first to note the important role of the transport revolution in enlarging land supply. The transport revolution of the late 19th century is a well-documented process and its trade-creating effects in the 19th century have been studied by Williamson and O'Rourke (1999). Economic historians have shown that before the construction of railways transportation costs were prohibitively high in wide parts of the Americas and Asia (Summerhill, 2006). The development of railway infrastructure opened up the American west, the Argentinian Pampas, and East and South Asia (Summerhill, 2006). Glaeser and Kohlhase (2004) calculate that the average cost of moving a ton a mile was 18.5 cents (in 2001 Dollars) in 1890 but had fallen to 2.3 cents at the beginning of the 2000s, with about half of the drop occurring between 1890 and World War I.

The length of the railway network can serve as a proxy for the opening up of new territories over time. For our 14 countries, the length of the railway network peaked in the interwar period and has not grown materially since then, as Table 3 and Figure 29 show.[13] By 1930, essentially the entire world had been made accessible. Subsequent expansions of the transportation network through highways did not lead to a comparable fall in transportation costs. Compared to the railway, trucking is about ten times more expensive per ton mile (Glaeser and Kohlhase, 2004).

[13]The data presented in Table 3 are not adjusted for changes in national borders by Mitchell (2013). Except for Germany, these changes are relatively small and should not systematically distort the picture. The substantial decline in the length of the German railway network after World War I and World War II can largely be attributed to the change in national borders. Yet even in the case of Germany, it is clear from the data that the length of the network has not increased in the second half of the 20th century, but growth petered out before World War II.

	AUS	BEL	CAN	CHE	DNK	DEU	FIN	FRA	GBR	JPN	NLD	NOR	SWE	USA	Total
1870	1.53	2.90	5.68	1.42	0.77	18.88	0.48	15.54	21.56	0.03	1.42	0.36	1.73	85.17	160.71
1880	5.85	4.11	15.68	2.57	1.58	33.84	0.85	23.09	25.06	0.16	1.84	1.06	5.88	150.09	285.46
1890	15.33	4.53	28.54	3.24	2.01	42.87	1.90	33.28	27.83	0.98	2.61	1.56	8.02	268.28	474.98
1900	21.29	4.56	38.33	3.87	2.91	51.68	2.65	38.11	30.08	1.62	2.77	1.98	11.30	311.16	569.56
1910	28.05	4.68	53.68	4.46	3.45	61.21	3.36	40.48	32.18	7.83	3.19	2.98	13.83	386.71	713.83
1920	41.77	4.94	84.23	5.08	4.33	57.55	3.99	38.20	**32.71**	10.44	3.61	3.29	14.87	**406.92**	804.68
1930	44.22	5.13	91.06	5.14	**5.29**	58.18	5.13	**42.40**	32.63	14.57	**3.68**	3.84	16.52	400.81	**832.22**
1940	**45.02**	5.04	91.01	**5.22**	4.92	**61.94**	4.59	40.60	32.09	18.40	3.31	3.97	**16.61**	376.06	811.91
1950	44.46	**5.05**	93.34	5.15	4.82	49.82	4.73	41.30	31.34	19.78	3.20	4.47	16.52	360.14	790.14
1960	42.24	4.63	95.26	5.12	4.30	52.19	5.32	39.00	29.56	20.48	3.25	**4.49**	15.39	350.12	771.78
1970	42.01	4.26	**95.96**	5.01	2.89	47.67	5.84	36.53	18.97	20.89	3.15	4.29	12.20	331.17	735.69
1980	39.46	3.98	93.36	5.00	2.94	45.75	**6.10**	34.36	17.64	**21.32**	2.76	4.24	12.01	288.00	677.73
1990	35.49	3.51	86.88	5.03	2.84	44.12	5.85	34.32	16.58	20.25	2.78	4.04	11.21	244.00	639.07
2000	39.85	3.44	73.13	4.49	2.86	40.83	5.87	31.94	16.88	20.05	2.80	4.01	12.82	205.00	572.01

Note: Dates are approximate. Bold denotes peak.
Sources: Mitchell (2013); Statistics Canada (various years,a); Statistics Japan (2012).

Table 3: Length of railway line (in 1000 km) by country.

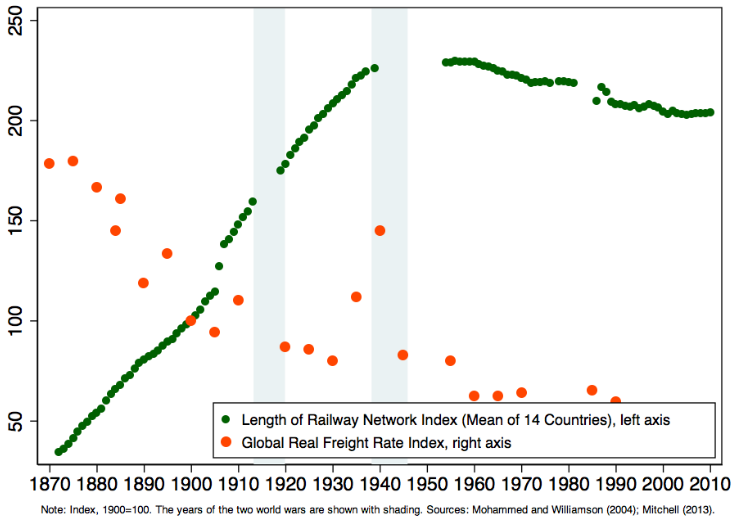


Figure 29: Length of railway network and real freight rates.

It is important to note that not only the extension of the global railway network petered out in the first half of the 20th century. The dramatic efficiency gains in maritime transportation were also realized in the late 19th and early 20th century (Mohammed and Williamson, 2004). The 19th century revolution in shipping rested on two developments: first, the fall of iron and steel prices that led to the introduction of metallic hulls; second, parallel advances in engine technology that led to much improved fuel efficiency (Harley, 1988, 1980; North, 1965, 1958). Between 1870 and 1914 shipping costs fell by about 50 percent relative to the prices of commodities (Jacks and Pendakur, 2010). By contrast, as Hummels (2007) has shown, commodity-deflated real freight rates barely fell after 1950. Figure 29 exhibits that international transport costs had fallen strongly until the mid-20th century. This is likely to have left its mark on land prices.

To analyze how a reduction in transport costs affects the land price, we set up a simple model with heterogeneous land in the spirit of Ricardo (1817) and von Thünen (1826). The land rent depends on land location, as measured by the distance to the marketplace. Falling transportation costs raise the land rent, net of transportation costs, and lead to an expansion of developed land.

Consider a perfectly competitive one-sector economy. There is a continuum of firms indexed by $i \in [0,1]$. There is also a continuum of land plots indexed by $i \in [0,1]$. Every firm i is connected to and owns a piece of land Z_i.[14] The size of each land plot is identical across firms and normalized to one, i.e. $Z_i = 1$ for all i. In equilibrium, there are active firms, indexed by $0 < i \leq i^*$, as well as inactive firms, indexed by $i^* < i \leq 1$. Active firms develop their land by incurring a fixed cost k and combine (developed) land Z_i and labor L_i to produce a final output good according to $Y_i = (L_i)^\alpha (Z_i)^{1-\alpha}$, where $0 < \alpha < 1$ denotes a constant technology parameter. In order to sell their output, firms have to transport their products to the marketplace. This activity is subject to iceberg transportation costs τ_i. We parametrize the transportation costs by $\tau_i = ai$, where $0 < a \leq 1$. Normalizing the output price to unity, $p^Y = 1$, the revenue net of transportation costs of firm $i \in [0, i^*]$ is given by $R_i = (1-ai)(L_i)^\alpha (Z_i)^{1-\alpha}$.

The analysis proceeds in two steps. The first step focuses on the labor market. Individual labor demand of firm $i \in [0, i^*]$ for any given wage rate, w, results from the usual first-order condition for profit-maximizing labor employment to read as follows $L_i^* = \left[\frac{\alpha(1-ai)}{w^*(i^*)}\right]^{\frac{1}{1-\alpha}}$, where we have set $Z_i = 1$. The equilibrium wage rate $w^*(i^*)$ is determined by the labor market clearing condition $\int_0^{i^*} L_i(w)\mathrm{d}i = L^S$, where L^S denotes exogenous labor supply. Notice that the equilibrium wage rate $w^*(i^*)$ increases with the number of active firms i^*. The amount of labor employed by any firm $i \in [0, i^*]$ in general equilibrium declines as more firms become economically active or, equivalently, as more pieces of land are being used economically. The second step focuses on the land market. Let $v_i^Z(\tau)$ denote the land return, which may be thought of as residual income accruing to the land owner, i.e. $v_i^Z := \frac{\partial R}{\partial Z_i} = (1-ai)(1-\alpha)(L_i)^\alpha$. The price p_i^Z of land plot $i \in [0, i^*]$ is given by the present value of the infinite stream of land returns, i.e. $p_i^Z = \int_t^\infty v_i^Z(\tau)\mathrm{e}^{-r(\tau-t)}\mathrm{d}\tau$. Given that v_i^Z is constant in equilibrium, the land price may be expressed as $p_i^Z = v_i^Z/r$, where r denotes the constant real interest rate. A specific land plot i is being developed if the land price exceeds the development costs, i.e. $p_i^Z \geq k$. Therefore, the number of developed land plots in equilibrium i^*, equal to the number of active firms, is determined by the following condition:

$$\frac{(1-ai^*)(1-\alpha)(L_{i^*}^*)^\alpha}{r} = k, \tag{7}$$

where $L_{i^*}^*$ is equilibrium labor demand of the marginal firm $i = i^*$.

What are the effects of radical innovations in the transportation sector, like those that occurred in the late 19th and early 20th century, with respect to land supply? The decline in

[14] Whether firms own a piece of land and reap land return (residual income), or rent the required land from landowners by paying a rental rate is not critical with respect to the implications. With regard to the land price, both institutional arrangements are equivalent.

transportation costs enlarged the present value of land returns net of transportation costs for any land plot i. Equation 7 then implies that the number of developed land plots rises. In other words, the drop in transportation costs triggers an expansion of economically used land. Figure 30 illustrates this reasoning. The dashed horizontal line shows the constant development costs k, while the two downward sloping curves display the value of developed land $p_i^Z = v_i^Z/r$ for alternative values of a.[15] Now, as a falls, the curve $p_i^Z = v_i^Z/r$ shifts outwards such that i^* increases, as displayed in Figure 30. The intermediate result therefore is that a reduction in transportation costs unequivocally increases the supply of economically used land.

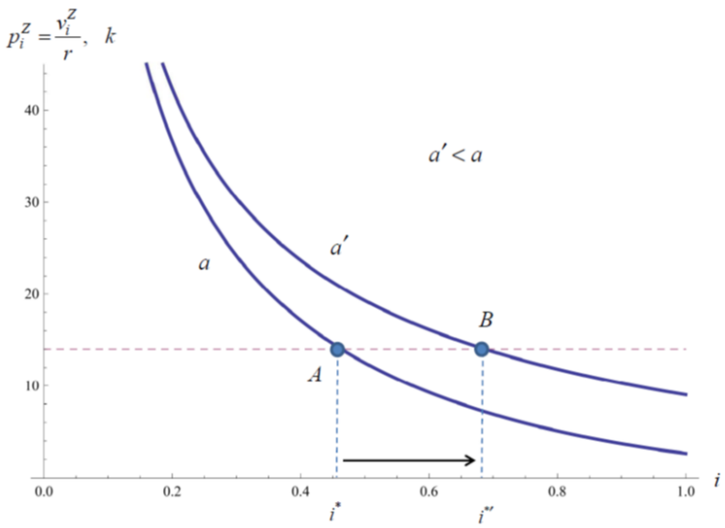


Figure 30: Land supply in response to reduction in transportation costs.

How does an increase in land supply, triggered by a reduction in transport costs, affect the aggregate land price, defined as $p^Z = \frac{1}{i^*}\int_0^{i^*} p_i^Z \mathrm{d}i$? The combination of reduced transportation costs and enhanced land supply unfolds three distinct mechanisms with respect to the aggregate land price p^Z, which can be summarized as follows (for details see Appendix A.1):

1. *Complementary-factor effect*: Additional land is developed and employed in output production. Every piece of land is combined with a lower amount of labor. This effect depresses the average land price.[16]

2. *Composition effect*: More distant and therefore less profitable pieces of land are being developed and used economically. This effect also reduces the average land price.

[15]These curves are downward sloping for two reasons: First, land plots are located further away from the marketplace as i increases, which implies higher transportation costs $\tau_i = ai$. Second, as i increases, the number of firms - hence aggregate labor demand - goes up such that each piece of land is combined with a lower amount of labor.

[16]There would be an additional effect in multi-sector models. As output of the land intensive sector increases, the goods' price falls, and the competitive land return should decline further.

3. *Revaluation effect*: Already developed pieces of land become more valuable because the competitive land return net of transportation costs v_i^Z increases. This effect increases the average land price.

The complementary-factor effect and the composition effect reduce the land price and this can dominate the revaluation effect such that the aggregate land price p^Z declines as a falls. In a growing economy the competitive land return can be expected to increase over time because land is in fixed supply. This drives up land prices. But if profit-maximizing firms endogenously determine the overall land use, a substantial decline in transportation costs triggers the development of additional land plots. As a result, land may effectively not represent a fixed factor for an extended period and the land price may remain constant or even fall despite continuous economic growth.

In our view, the interaction of transport cost declines and economic growth provides a novel and powerful explanation for the observed path of long-run land prices. The large-scale construction of the railway system during the 19th century and early 20th resulted in a substantial decline in transportation costs and likely suppressed land prices during the pre-World War II period. After World War II, these effects faded so that economic growth led to an increase in the land price. In the next section we will discuss two additional factors that may have reinforced this trend: higher expenditure shares for housing services and growing restrictions on land use (Glaeser et al., 2005a; Glaeser and Gyourko, 2003).

6.3 Land prices in the second half of the 20th century

As noted above, the trajectory of land prices in the second half of the 20th century is not as puzzling from the perspective of a standard neoclassical model. With continuous economic growth, the value of land could be expected to grow. However, two additional factors might have contributed to an even starker increase of land prices.

First, empirical data show that the mean housing expenditure share remained nearly constant in the pre-World War II period (average annual growth rate: 0.06 percent), whereas it grew by an average annual growth rate of 1.1 percent after World War II.[17] However, the increase in expenditure shares is not uniform across countries as Table 4 demonstrates. For instance, the expenditure share remained largely constant in the United States. As a result, the unweighted mean expenditure share shown in Figure 31 may be biased upwards.

How did the rising housing expenditure share after World War II impact the evolution of land prices? To answer this question, we set up a simple two-sector model with housing and

[17] The empirical findings on the (long-run) income elasticity of the demand for housing services is, however, inconclusive. For instance, Fernandez-Kranz and Hon (2006) review the literature and report values that range between 0.5 percent and 2.8 percent.

	AUS	BEL	CAN	CHE	DEU	DNK	FIN	FRA	GBR	ITA	JPN	NLD	NOR	SWE	USA
1870	0.12				0.14	0.17	0.14				0.15				
1880	0.13				0.14	0.19	0.13				0.10				
1890	0.14				0.13	0.18	0.12				0.12				
1900	0.11				0.14	0.17	0.11	0.19	0.14		0.11				
1913/1914	0.08			0.13	0.16	0.17	0.10	0.16	0.14		0.14				
1920	0.07			0.16		0.12	0.09	0.05	0.08		0.11				
1930	0.10		0.19		0.14	0.19	0.14	0.08	0.12		0.18			0.25	0.16
1940	0.09		0.19	0.23	0.15	0.19	0.13	0.09	0.15		0.18			0.22	0.13
1950				0.16	0.10	0.10	0.08		0.11					0.16	0.11
1960	0.11		0.19	0.16	0.13	0.13	0.18	0.11	0.13					0.19	0.14
1970	0.14		0.20	0.16	0.17	0.17	0.18	0.18	0.15	0.13	0.15		0.21	0.18	0.14
1980	0.18		0.21	0.15	0.19	0.25	0.19	0.19	0.16	0.13	0.16		0.21	0.18	0.14
1990	0.20		0.24	0.21	0.20	0.26	0.18	0.20	0.17	0.16	0.18		0.23	0.19	0.15
2000	0.20	0.23	0.23	0.23	0.23	0.26	0.25	0.23	0.19	0.18	0.23	0.09	0.19	0.21	0.15
2010	0.23	0.23	0.24	0.24	0.25	0.29	0.27	0.26	0.25	0.23	0.25	0.10	0.21	0.20	0.16

Note: Dates are approximate. Sources: See Appendix B.

Table 4: Share of housing expenditure in GDP.

manufacturing production, described in Appendix A.3, to study the quantitative implications of rising expenditure shares. The intuition is simple. As the production of housing services relies more heavily on land – the land cost share in production is higher – compared to the manufacturing sector, aggregate demand for land rises when the expenditure share for housing services rises. With fixed land supply, the land price increases. A back-of-the-envelope calculation on the basis of the model yields the following results. From the data, we observe an average increase in the expenditure share during the second half of the 20th century by a factor of about 1.65. Such an increase translates into an additional 42 percent of price appreciation relative to a scenario with constant expenditure shares. The contribution of rising expenditure shares on the land price is therefore substantial. Further details on this exercise can be found in Appendix A.3.

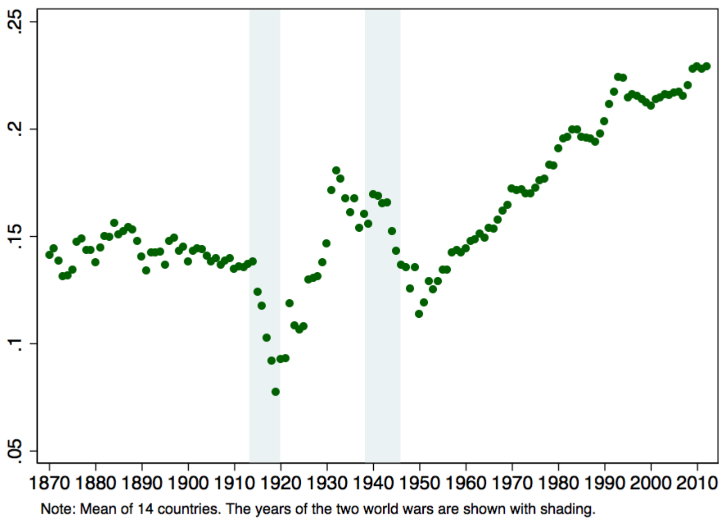


Figure 31: Share of residential service expenditure in GDP.

A second important reason for the steep increase of land prices in the second half of the 20th century has been pointed out by Glaeser and Ward (2009), Glaeser et al. (2005a), and Glaeser and Gyourko (2003). These studies point to growing restrictions on land supply driven by changes in the regulatory regime that make large-scale development increasingly difficult. More stringent and widespread land use and building regulation were introduced during the second half of the 20th century (MacLaughlin, 2012; Glaeser et al., 2006). As a result of land use restrictions on new home construction, housing supply could not increase in response to rising house prices which limited the supply of new homes (Glaeser et al., 2005a; Glaeser and Gyourko, 2003). For urban areas in the northeastern U.S., for example, Glaeser and Ward (2009) and Glaeser et al. (2005b) show that regulations substantially reduced the number of new construction permits. In the case of the Greater Boston area the total number building permits in the 2000s stood at less than 50 percent of its 1960s level (Glaeser and Ward, 2009). These studies further argue that there is a strong relation between house prices and land-use regulation. They estimate that in the mid-2000s, house prices might have been between 23 (in the case of Boston) and 50 percent (in the case of Manhattan) lower if regulation had not greatly stagnated new permits (Glaeser et al., 2006, 2005b). In the U.S., the impact of regulation may also explain some of the house price dispersion across American housing markets (Glaeser et al., 2005a). Similar effects have been documented for other countries, such as the UK (Cheshire and Hilber, 2008).

To summarize, the rise of residential land prices in the second half of the 20th century constitutes much less of a puzzle than their stability in the preceding eight decades. When the effects of the transport revolution faded, land increasingly became a fixed factor. Two additional factors are likely to have pushed up land prices even more: rising expenditures shares for housing services and growing restrictions on land use.

7 Conclusion

In *The Wizard of Oz*, Dorothy's house is transported by a tornado to a strange new plot of land. The story illuminates the fact that a home consists of both the structure of the house and the underlying land. The findings of our study illustrate that it is, in fact, the price of land that has been the most significant element for long-run trends in home prices.

We show that after a long period of stagnation from 1870 to the mid-20th century, house prices rose strongly in real terms during the second half of the 20th century, albeit with considerable cross-country heterogeneity. These patterns in the data cannot be explained with quality improvements or composition shifts in the index. Moreover, urban and rural house prices have risen in lockstep in recent decades and farmland prices have also increased.

The decomposition of house prices into the replacement cost of the structure and land prices reveals that land prices have been the driving force for the observed trends. Residential land prices have remained constant for almost the first hundred years of modern economic growth, from the late 19th century until the post-World War II decades, but increased strongly thereafter in most countries. Stated differently, explanations for the long-run trajectory of house prices must be mapped onto the underlying land price dynamics.

In this paper, we presented two explanations for the trajectory of land prices in modern economic history. The two explanations complement each other, but they are not exclusive. First, we demonstrated how the transport revolution in the late 19th and early 20th century led to a substantial drop in transport costs, which triggered an increase of land supply. This decline in transport costs petered out in the second half of the 20th century, so that land increasingly behaved like a fixed factor. Second, we revealed evidence that expenditure for housing services grew faster than income after World War II. In other words, housing appears to behave like a superior good.

In our view, the combination of both trends helps explain the cross-country trajectory of land prices in the 19th and 20th century. Additional explanations focusing, for instance, on growing government interventions in the housing market aimed at expanding home ownership or the easing of financial frictions would be complementary, as these factors would show up in a rising expenditure share. Moreover, additional explanations will have to align with the stylized facts presented here, in particular with the prominent increase of the price of land in the second half of the 20th century and the comparatively minor role of changes in the replacement value of the structure.

Research interest in housing markets has surged in the wake of the global financial crisis. Yet despite its importance for the discipline of macroeconomics, the study of housing market dynamics was hampered by the lack of comparable long-run and cross-country data from economic history. Our study closes this gap. We hope that with the data presented in this study, new avenues for empirical and theoretical research on housing market dynamics and their interactions with the macroeconomy will become possible.

Appendix

A Supplementary material

A.1 Land heterogeneity and transportation costs

This brief section demonstrates how to solve the land price model in the spirit of Ricardo and von Thünen, presented in section 6.2, for the land price. The notation is as explained in the main text. We start with the labor market equilibrium for a given number of active firms i^*. From the first-order condition for optimal labor demand, $w = (1 - ai)\alpha(L_i)^{\alpha-1}$ (recall $Z_i = 1$), the individual labor demand schedule reads

$$L_i(w) = \left[\frac{\alpha(1 - ai)}{w}\right]^{\frac{1}{1-\alpha}}. \tag{8}$$

The equilibrium wage rate w^* results from the labor market clearing condition which equates aggregate labor demand $\int_0^{i^*} L_i(w)\mathrm{d}i$ and aggregate labor supply L^S. Noting Equation 8 one gets

$$\int_0^{i^*} \left[\frac{\alpha(1 - ai)}{w^*}\right]^{\frac{1}{1-\alpha}} \mathrm{d}i = L^s, \tag{9}$$

where i^* denotes the number of active firms in equilibrium, which is treated as unknown at this stage. Determining the definite integral on the LHS of Equation 9 and solving with respect to w^* gives $w^* = w^*(i^*, a)$. At this stage, individual labor demand in equilibrium $L_i^*(w^*)$ can be determined for any given i^*.

Next we turn to the land market. The competitive land return is given by the marginal product of land in output production net of transportation costs, i.e.

$$v_i^Z := \frac{\partial(1 - ai)Y_i}{\partial Z_i} = (1 - ai)(1 - \alpha)(L_i)^\alpha. \tag{10}$$

The price p_i^Z of land plot $i \in [0, i^*]$ is given by the present value of the infinite stream of land returns, i.e. $p_i^Z = \int_t^\infty v_i^Z(\tau)\mathrm{e}^{-r(\tau-t)}\mathrm{d}\tau$. Given that v_i^Z is constant in equilibrium, the land price may be expressed as $p_i^Z = v_i^Z/r$. A specific land plot i is being developed if the land price exceeds the development costs, i.e. $p_i^Z \geq k$. Therefore, the number of developed land plots in equilibrium i^*, equal to the number of active firms, is determined by the following condition

$$\frac{(1 - ai^*)(1 - \alpha)\left[L_{i^*}^*(w^*)\right]^\alpha}{r} = k, \tag{11}$$

where $L_{i^*}^*(w^*)$ is equilibrium labor demand of the marginal firm $i = i^*$. The preceding equation, noting $w^* = w^*(i^*, a)$, determines the number of active firms as a function of a, i.e. $i^* = i^*(a)$.

The aggregate land price is defined as $p^Z = \frac{1}{i^*}\int_0^{i^*} p_i^Z \mathrm{d}i$. Noting $p_i^Z = v_i^Z/r$ and $v_i^Z = (1-ai)(1-\alpha)(L_i)^\alpha$, p_i^Z may be expressed as follows

$$p^Z = \frac{1}{i^*(a)} \int_0^{\overbrace{i^*(a)}^{(1)}} \frac{(1-\overbrace{a}^{(2)} i)(1-\alpha)[L_i^*(w^*(i^*(\overbrace{a}^{(3)})))]^\alpha}{r} \mathrm{d}i, \tag{12}$$

where (1) indicates the composition effect, (2) the revaluation effect, and (3) the complementary factor effect, respectively. The RHS of the preceding equation indicates how a change in a influences the equilibrium land price.

A.2 A brief review of the theoretical literature

This section provides a brief review of the theoretical literature on the housing market. Davis and Heathcote (2005) set up a multi-sector growth model with housing production. The focus is, however, not on the evolution of aggregate house prices but on stylized business cycle facts associated with residential and non-residential investments. Hornstein (2009b,a), following Davis and Heathcote, sets up a general equilibrium model that captures a housing market. The focus is on the surge in house prices in the U.S. between 1975 and 2005. The main driving force is the increasing relative scarcity of land, as measured by the difference between the growth rate of per capita income and the growth rate at which new land becomes available. Davis and Heathcote (2007, 2597) have found, based on empirical work for the U.S. over 1975 to 2005, that *"both trend growth in house prices and cyclical house price fluctuations are primarily attributable to changes in the price of residential land and not to changes in the price of structure."* Hornstein argues that this model has the clear potential to account for the trend in prices of new houses, although it cannot account for the differential price trends in the market for new and existing houses. Li and Zeng (2010) employ a two-sector neoclassical growth model with housing to explain a rising real house price driven by a comparably low technical progress in the construction sector. Poterba (1984) employs a dynamic model of the housing sector to study how inflation affects the real house price and the size of the housing stock. He argues that persistent high inflation rates reduces homeowners' user cost and may lead to an increase in house prices and the housing stock. Glaeser et al. (2005a) show that, focusing on the U.S. since the 1970s, changes in the housing-supply regulations caused house prices to increase. Glaeser and Gottlieb (2009, 44) stress that urbanization, induced by agglomeration economies, and inelastic housing supply in cities pushes the aggregate housing prices upwards.

A.3 Housing expenditure share

Consider a perfectly competitive and static economy with two sectors. In the manufacturing sector, labor L is combined with land Z^M to produce consumption goods M. Moreover, real estate development firms combine structures X and land Z^H to produce residential services. One house generates one unit of housing services. As the model describes a static economy, there is no stock of houses that may accumulate over time. The house price and the price for housing services therefore coincide. The sectoral production functions read as follows

$$M = (L)^{1-\alpha} \left(Z^M\right)^{\alpha}, \tag{13}$$

$$H = (X)^{1-\beta} \left(Z^H\right)^{\beta}, \tag{14}$$

where $0 < \alpha, \beta < 1$ denote constant technology parameters. Only the intersectoral allocation of land is endogenous, whereas L and X are fixed.[18] Aggregate income is given by $PY = p^M M + p^H H$, where $P = 1$ denotes the price level, p^M the (real) price of the manufacturing good and p^H the (real) price of residential services. Let $0 < \theta < 1$ denote the share of income devoted to housing services, i.e. $\theta := \frac{p^H H}{Y}$. Equilibrium in the market for residential services is then described by[19]

$$p^H H = \theta Y. \tag{15}$$

Total land supply is fixed and normalized to one. The land constraint reads $Z^M + Z^S = 1$. The intersectoral land allocation is determined by the equality of the competitive land returns across sectors, i.e.

$$p^M \alpha \frac{M}{Z^M} = p^H \beta \frac{H}{Z^H}. \tag{16}$$

The land return equals the land price in this static model, i.e. $p^Z = p^M \alpha \frac{M}{Z^M}$. The equilibrium share of land allocated to the housing sector turns out to read $\tilde{Z}^H = \frac{\beta\theta}{(\beta-\alpha)\theta+\alpha}$. Notice that, unsurprisingly, the share of land allocated to the housing sector increases with the housing expenditure share, i.e. $\frac{\partial \tilde{Z}^H}{\partial \theta} > 0$.

What is the consequence of a rising housing expenditure share θ with respect to the land price p^Z? The answer is provided by

Proposition 1. *The equilibrium land price p^Z reads as follows*

[18] One can easily modify this simplifying assumption without major implications.

[19] Due to Walras' law, the market for manufacturing goods clears as well.

$$p^Z = Y\left[(\beta - \alpha)\,\theta + \alpha\right].$$

Proof. Solving $Y = p^M M + p^H H$, Equations 15, 16, and $Z^M + Z^H = 1$ with respect to Z^H, p^M and p^H gives

$$\tilde{Z}^H = \frac{\beta\theta}{(\beta - \alpha)\theta + \alpha}, \tag{17}$$

$$\tilde{p}^H = \theta\frac{Y}{H}, \tag{18}$$

$$\tilde{p}^M = (1 - \theta)\,\frac{Y}{M}. \tag{19}$$

Combining $p^Z = p^M \alpha \frac{M}{1-Z^H}$ with Equations 17 and 19 proves proposition 1. The same result is, of course, obtained if one alternatively combines $p^Z = p^H \beta \frac{H}{Z^H}$ with Equation 17 and 18. ■

If $\beta > \alpha$, then an increase in the demand for housing services, as captured by an increasing θ, leads to a higher land price. The reason is simple. The production of housing services relies more heavily on land compared to manufacturing in the sense that the cost share of land in the production of housing services $\beta = \frac{p^Z Z^H}{p^H H}$ exceeds the cost share of land in manufacturing $\alpha = \frac{p^Z Z^M}{p^M M}$. An increase in θ means that the demand for housing services rises, while the demand for manufacturing goods falls. Because land is more important in housing services production than in manufacturing, the aggregate demand for land goes up. Given that the land supply is fixed, the land price increases.

A back-of-the-envelope calculation may be instructive. Real (mean) GDP grew by a factor of 7.2 from 1950 to 2012. For the expenditure share, we employ a factor of 1.65.[20] The land share in the housing sector is set to $\beta = 0.5$ (see Table 5). Unfortunately, long run data on the cost share of land in manufacturing α are not available. Nonetheless, it is instructive to notice that Equation 1 implies that p^Z should grow by a factor of 11.4 if $\alpha = 0.05$, whereas p^Z should grow by a factor of 9.1 if $\alpha = 0.3$. That is, the differential impact of a rising θ on the land price ranges between 26 percent ($\frac{9.1}{7.2} - 1$) and 58 percent ($\frac{11.4}{7.2} - 1$); the reported 42 percent increase in the main text represents an intermediate value. Notice that, for $\theta = const.$, the land price

[20] The expenditure share droped remarkably in the aftermath of World War I and World War II, by much more than GDP, and then recovered quickly within a couple of years back to its respective pre-war levels, cf. Figure 31. The value in 1950 marks the lower turning point after World War II and hence represents an unusually low number. We therefore consider the proportional increase between the expenditure share in 2012 and the average value before 1950.

increases by a factor of 7.2 due to GDP growth. Recall also that our imputed land price, as displayed in Figure 26, grew by a factor of 11.3.

A.4 Figures and tables

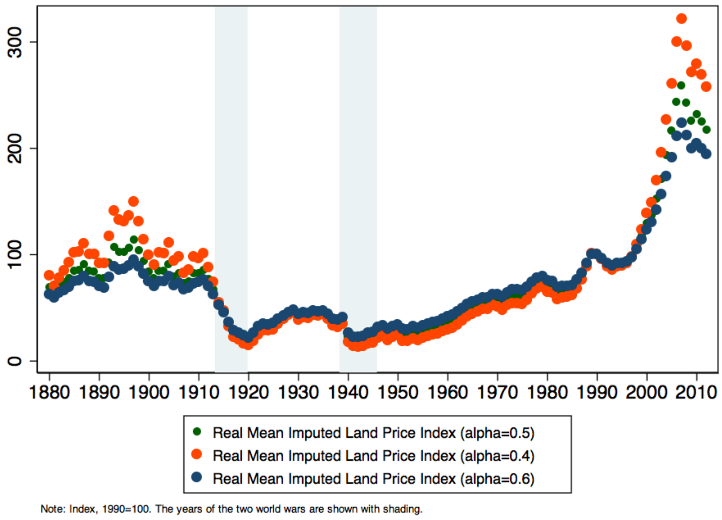


Figure 32: Imputed land prices - sensitivity analysis.

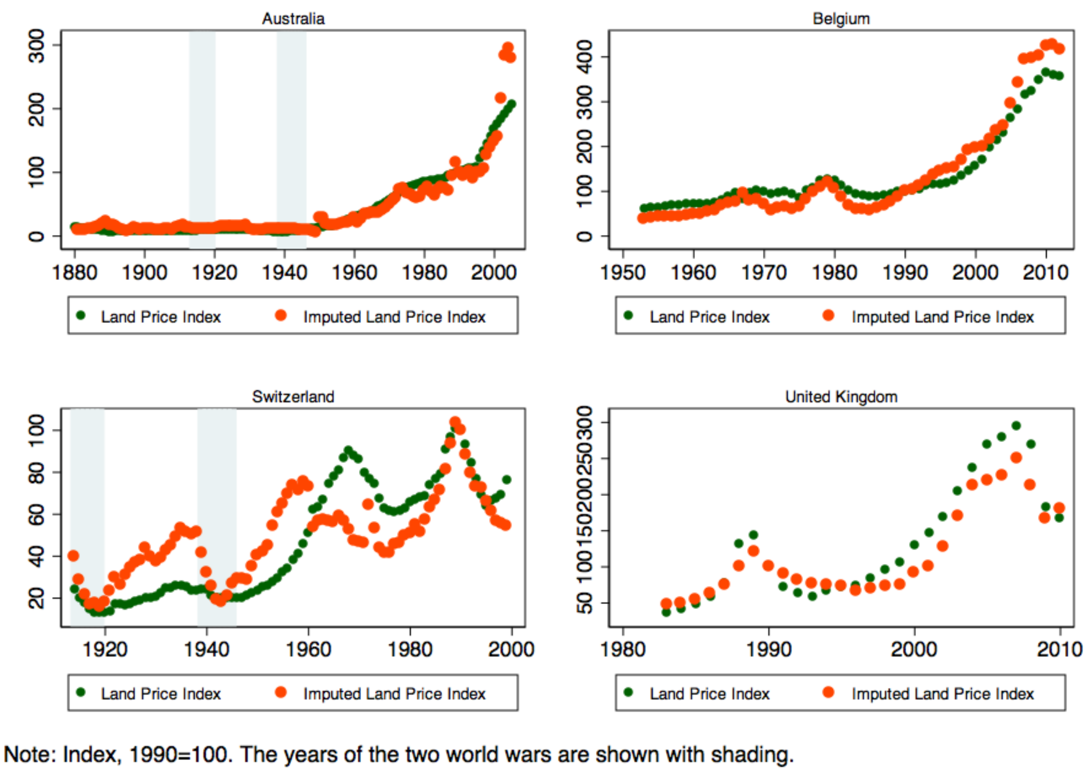


Figure 33: Imputed land prices - individual countries.

	AUS	CAN	CHE	DEU	DNK	FRA	GBR	ITA	JPN	NLD	NOR	SWE	USA
1870													
1880			0.75	0.13	0.52	0.25	0.74	0.20			0.30		
1890									0.40				
1900	0.54		0.70	0.18	0.51		0.62	0.23	0.40		0.29		0.48
1913/1914	0.43		0.73	0.20	0.52	0.30	0.40	0.28	0.43		0.31		0.51
1920													0.51
1930	0.40		0.61	0.17	0.46	0.30	0.23	0.31	0.52		0.34		0.49
1940			0.54	0.17	0.45		0.19	0.33	0.46		0.33		0.43
1950	0.49		0.56	0.17	0.28	0.32	0.17	0.25	0.65	0.15	0.29		
1960	0.40		0.52	0.17	0.32	0.30	0.12	0.26	0.85			0.31	0.46
1970		0.48	0.48	0.25	0.38	0.30	0.15	0.28	0.86		0.38	0.31	0.47
1980	0.40	0.52	0.48		0.30	0.41	0.11	0.26	0.81		0.38	0.32	0.47
1990	0.62	0.47		0.36		0.42			0.90				
2000	0.63	0.49		0.32		0.39			0.81	0.57			
2010	0.71	0.53		0.37		0.59			0.77	0.53			

Note: Dates are approximate. Sources: See Appendix B.

Table 5: Share of land in total housing value.

B Data appendix

This data appendix supplements our working paper, "No Price Like Home: Global House Prices 1870–2012." The main purpose of this appendix is to provide an overview about the data sources we had at our disposal and discuss all relevant details of the sources we finally used for constructing our long-run house price indices. We present residential house price indices for 14 advanced economies that cover the years 1870 to 2012.

A large number of researchers and statisticians offered advice, helped in locating data, and shared their data sources. We wish to thank Paul de Wael, Christopher Warisse, Willy Biesemann, Guy Lambrechts, Els Demuynck, and Erik Vloeberghs (Belgium); Debra Conner, Gregory Klump, Marvin McInnis (Canada); Kim Abildgren, Finn Østrup, and Tina Saaby Hvolbøl (Denmark); Riitta Hjerppe, Kari Leväinen, Juhani Väänänen, and Petri Kettunen (Finland); Jacques Friggit (France); Carl-Ludwig Holtfrerich, Petra Hauck, Alexander Nützenadel, Ulrich Weber, and Nikolaus Wolf (Germany); Alfredo Gigliobianco (Italy); Makoto Kasuya, and Ryoji Koike (Japan); Alfred Moest (The Netherlands); Roger Bjornstad, and Trond Amund Steinset (Norway); Daniel Waldenström (Sweden); Annika Steiner, Robert Weinert, Joel Floris, Franz Murbach, Iso Schmid, and Christoph Enzler (Switzerland); Peter Mayer, Neil Monnery, Joshua Miller, Amanda Bell, Colin Beattie, and Niels Krieghoff (United Kingdom); Jonathan D. Rose, Kenneth Snowden and Alan M. Taylor (United States). Magdalena Korb helped with translation.

B.1 Description of the methodological approach

Data sources

Most countries' statistical offices or central banks began only recently to collect data on house prices. For the 14 countries covered in our sample, data from the early 1970s to the present can be accessed through three principal internationally recognized repositories: the databases maintained by the Bank for International Settlements (2013), the OECD, and the Federal Reserve Bank of Dallas (2013). To extend these back to the 19th century, we used three principal types of country specific data.

First, we turn to national official statistical publications, such as the Helsinki Statistical Yearbook or the annual publications of the Swiss Federal Statistical office, and collections of data based on official statistical abstracts. Typically, such official statistics publications contained raw data on the number and value of real estate transactions and in some cases price indices. A second key source are published and unpublished data gathered by legal or tax authorities (e.g., the UK Land Registry) or national real estate associations (e.g., the Canadian Real Estate Association). Third, we can also draw on the previous work of financial historians and commercial data providers.

Selection of house price series

Constructing long-run data series usually involves a good many compromises between the ideal and the available data. This is also true for each of our 14 house price indices. Typically we found series for shorter periods and had to splice them to arrive at a long-run index. The historical data we have at our disposal vary across countries and time with respect to key characteristics (area covered, property type, frequency, etc.) and in the method used for index construction. In choosing the best available country-year-series we follow three guiding principles: constant quality, longitudinal consistency, and historical plausibility.

We select a primary series that is available up to 2012, refers to existing dwellings, and is constructed using a method that reflects the pure price change, i.e. controls for changes in composition and quality. When extending the series, we concentrate on within-country consistency to avoid principal structural breaks that may arise from changes in the market segment a country index covers. We therefore, while aiming to ensure the broadest geographical coverage for each of the 14 country indices, wherever possible and reasonable maintain the geographical coverage of the indices. Likewise we try to keep the type of house covered constant over time, be it single-family houses, terraced houses, or apartments. We examine the historical plausibility of our long-run indices. We heavily draw on country specific economic and social history literature as well as primary sources such as newspaper accounts or contemporary studies on the housing market to scrutinize the general trends and short-term fluctuations in the indices. Based on extensive historical research, we are confident that the indices offer a reasonably time-consistent picture of house price developments in each of our 14 countries.

Construct the country indices: step by step

The methodological decision tree in Figure 34 describes the steps we follow to construct consistent series by combining the available sources for each country in the panel. By following this procedure we aim to maintain consistency within countries while limiting data distortions. In all cases, the primary series does not extend back to 1870 but has to be complemented with other series.

Other housing statistics

We complement the house price data with three additional housing related data series: prices of farmland, construction costs, and estimates for the total value of the housing stock. For prices of farmland we again rely on official statistical publications and series constructed by other researchers. For benchmark data on the total market value of housing and its components (i.e. structures and land) we turn to the OECD database of national account statistics for the most recent period (with different starting points depending on the country). We consult the work of Goldsmith (1981, 1985) and also build on more recent contributions, such as Piketty and Zucman (2014) (for Australia, Canada, France, Germany, Italy, Japan, the U.S., and UK) and Davis and Heathcote (2007) (for the U.S.) to cover earlier years. For data on construction costs we mostly draw on publications by national statistical offices. In some cases, we also rely on the work of other scholars such as Stapledon (2012a), Maiwald (1954), and Fleming (1966), national associations of builders or surveyors (Belgian Association of Surveyors, 2013) or journals specializing in the building industry (Engineering News Record, 2013). For macroeconomic and financial variables, we rely on the long-run macroeconomic dataset from Schularick and Taylor (2012) and the update presented in Jordà et al. (2013).

B.2 Australia

House price data

Historical data on house prices in Australia is available for 1870–2012.

The most comprehensive source for house prices for the Sydney and Melbourne area is Stapledon (2012b). His indices cover the years 1880–2011. For the sub-period 1880–1943, they are computed from the median asking price for all residential buildings, indiscriminate of their characteristics and specifics; for 1943–1949, Stapledon (2012b) estimates a fixed prices;[21] for 1950–1970, he uses the median sales price.[22] For the sub-period 1970–1985, Stapledon (2012b)

[21] Price controls on houses and land were imposed in 1942 and were only removed in 1948 (Stapledon, 2007, 23 f.).

[22] The ask price series for residential houses (1880–1943) and the sales price series (1948–1970) are compiled

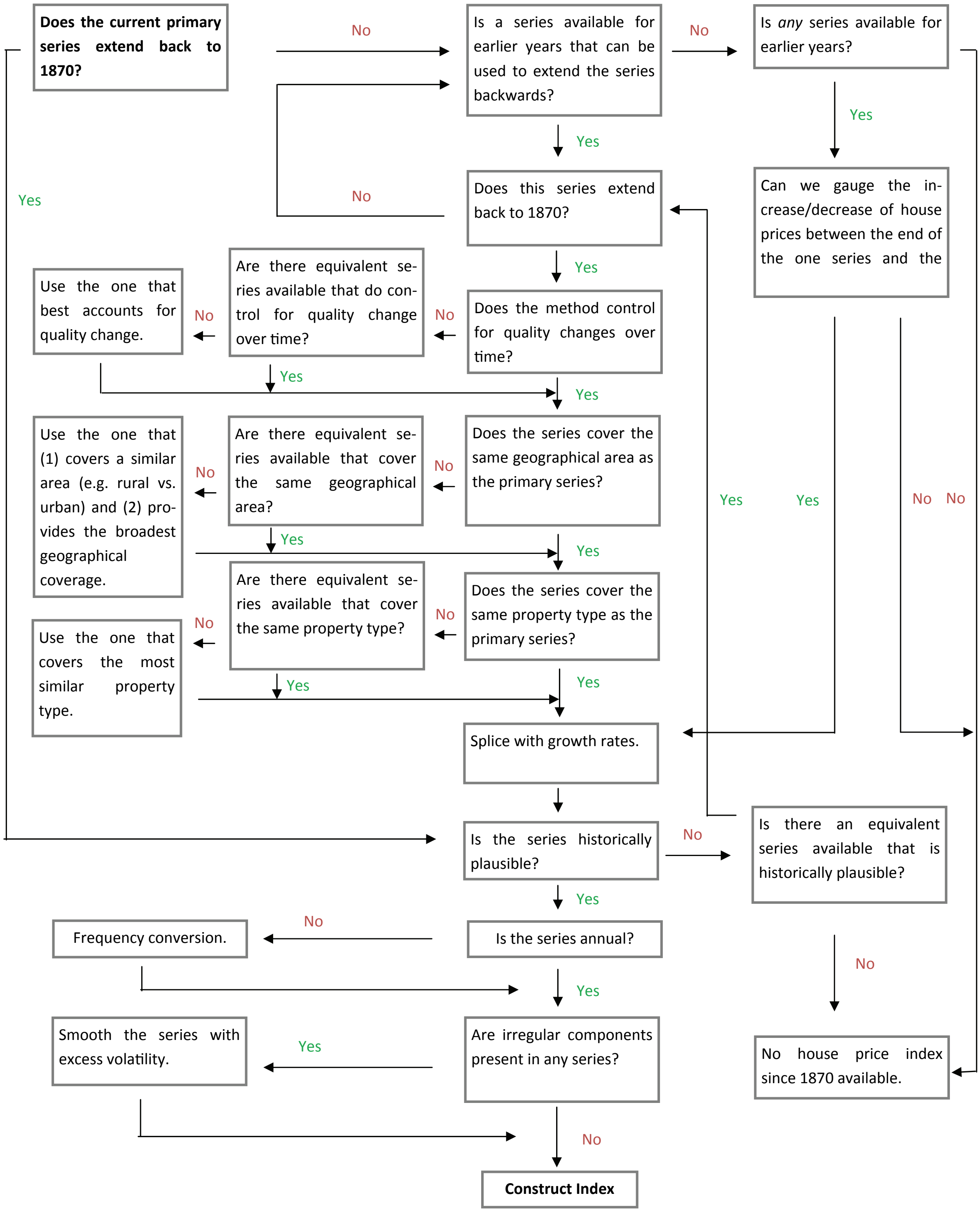


Figure 34: Methodological decision tree.

relies on estimates of median house prices by Abelson and Chung (2004) (see below); for 1986–2011, he uses the Australian Bureau of Statistics (2013b) (see below) index for established houses.

The median house price series compiled by Abelson and Chung (2004)[23] for Sydney and Melbourne are constructed from various data sources: for the Sydney series they rely on i) a 1991 study by Applied Economics and Travers Morgan which draws on sales price data from the Land Title Offices (for 1970–1989); and ii) on sales price data from the Department of Housing, i.e. the North South Wales Valuer-General Office (for 1990–2003). For the Melbourne series the authors rely on previously unpublished sales price data from the Productivity Commission drawing, in turn, on Valuer-General Office (for 1970–1979) and Victorian Valuer-General Office sales price data (for 1980–2003).

Besides the Sydney and Melbourne house price indices (see above), Stapledon (2007, 64 ff.) provides aggregate median price series for detached houses for the six Australian state capitals (Adelaide, Brisbane, Hobart, Melbourne, Perth, Sydney) for the years 1880–2006. As house price data is – with the exception of Melbourne and Sydney – not available for the time prior to 1973, the author uses census data on weekly average rents to estimate rent-to-rent ratios.[24] The rent-to-rent-ratios are then used to estimate mean and median price data for detached houses in the four state capitals (Adelaide, Brisbane, Hobart, Perth), based on the weighted mean price series for Sydney–Melbourne for the time 1901–1973.[25] For the years after 1972, Stapledon (2007, 234 f.) uses the Abelson and Chung (2004) series for the period 1973–1985 and the Australian Bureau of Statistics (2013b) series for 1986–2006 (see below).

In addition to Stapledon (2012b, 2007) and Abelson and Chung (2004), four early additional house price data series and indices for Sydney and Melbourne are available: i) Abelson (1985) provides an index for Sydney for 1925–1970[26]; ii) Neutze (1972) presents house price indices for four areas in Sydney (1949–1967)[27]; iii) Butlin (1964) presents data for Melbourne (1861–

from weekly property market reports in the *Sydney Morning Herald* and the *Melbourne Age*. The reports are for auction sales and private treaty sales.

[23]Abelson and Chung (2004) also present series for Brisbane (1973–2003), Adelaide (1971–2003), Perth (1970–2003), Hobart (1971–2003), Darwin (1986–2003), and Canberra (1971–2003). For details on the data sources used for these cities, see Abelson and Chung (2004, 10).

[24]The ratios are computed from average weekly rents for detached houses in the four state capitals (numerators) and a weighted weekly rent calculated from data for Sydney and Melbourne (denominators). Data is available for the years 1911, 1921, 1933, 1947, and 1954.

[25]The same method is applied to extend the series backwards, i.e. to the period 1880–1900. Each city's share of houses is applied for weighting.

[26]Abelson (1985) collects sales and valuation prices from the N.S.W. Valuer-General's records for about 200 residential lots in each of the 23 local government areas. He calculates a mean, a median, and a repeat valuation index.

[27]These areas are Redfern (1949–1969), Randwick (1948–1967), Bankstown (1948–1967) and Liverpool (1952–1967). He also calculates an average of these four for 1952–1967 (Neutze, 1972, 361). These areas are low to medium income areas. He relies on sales prices. In none of the years there are less than ten sales, in most years he includes data on more than 40 sales (Neutze, 1972, 363). Neutze does not further discuss the method he used. He argues, however, that his price series can be taken as being typical of all housing.

1890)[28]; and iv) Fisher and Kent (1999) compute series of the aggregate capital value of ratable properties covering the 1880s and 1890s for Melbourne and Sydney.

For 1986–2012 the Australian Bureau of Statistics (2013b) publishes quarterly indices for eight cities for i) established detached dwellings and ii) project homes. The indices are calculated using a mix-adjusted method.[29] Sales price data comes from the State Valuer-General offices and is supplemented by data on property loan applications from major mortgage lenders (Australian Bureau of Statistics, 2009).[30]

Figure 35 compares the nominal indices for 1860–1900, i.e. an index for Melbourne calculated from Butlin (1964), the Melbourne and Sydney indices by Stapledon (2012b), and the six capital index (Stapledon, 2007). For the years they overlap (1880–1890) the four indices provide considerable indication of a boom-bust scenario, albeit with peaks and troughs staggered between two to three years. For the 1890s the indices generally show a positive trend, which culminates between 1888 (Butlin, 1964, Melbourne) and 1891 (Stapledon, 2012b, Sydney). The six-capitals-index follows a pattern that is somewhat disjoint and inconsistent with that picture: While from 1880 to 1887 prices are stagnant, the boom period is limited to mere three years (1888–1891) during which the index reports a nominal increase of house prices in the six capitals amounting to 25 percent. This trajectory, however, not only differs from the Melbourne and Sydney indices but is also at odds with various accounts (Daly, 1982; Stapledon, 2012b).[31] Against this background, the stagnation of the six-capital-index during most of the

[28]According to Stapledon (2007), this series gives a general impression of house price movements after 1860. The series is based on advertisements of houses for sale in the newspapers *Melbourne Age* and *Argus*. Stapledon (2007, 16) reasons that by measuring the asking price in terms of rooms rather than houses, Butlin partially adjusted for quality changes and differences as the average amount of rooms per dwelling rose considerably between 1861 and 1890.

[29]The eight cities are Sydney, Melbourne, Brisbane, Adelaide, Perth, Hobart, Darwin, Canberra. 'Project homes' are dwellings that are not yet completed. In contrast, the concept of 'established dwellings' refers to both new and existing dwellings. Locational, structural and neighborhood characteristics are used to mix-adjust the index, i.e. to control for compositional change in the sample of houses. The series are constructed as Laspeyre-type indices. The ABS commenced a review of its house price indices in 2004 and 2007. Prior to the 2004 review, the index was designed as a price measure for mortgage interest charges to be included in the CPI. The weights used to calculate the index were thus housing finance commitments. As part of the 2004 review, the pricing point has been changed, the stratification method improved, and the relative value of each capital city's housing stock used as weights. In 2007 the stratification was again refined and the housing stock weights were updated. Due to the substantive methodological changes of 2004, the ABS publishes two separate sets of indices: 1986–2005 and 2002–2012 (Australian Bureau of Statistics, 2009). They move, however, closely together in the years they overlap.

[30]For 1960–2004, there also exists an unpublished index calculated by the Australian Treasury (Abelson and Chung, 2004). The index moves closely together with the one calculated by Abelson and Chung (2004) (correlation coefficient of 0.995 for the period 1986–2003 and 0.774 for 1970–1985). For the period 1970–2012, an index is available from the OECD based on the house price index covering eight capital cities published by the Australian Bureau of Statistics. For the period 1975–2012, the Federal Reserve Bank of Dallas splices together the index published by the Australian Bureau of Statistics (2013b) and the Treasury house price index.

[31]Daly (1982) provides a graphical analysis of land and housing prices in Sydney for the period 1860–1940 drawing on data from business records by Richardson and Wrench (at the time one of the largest real estate agents in Sydney), newspaper reports of sales, and advertisements. Daly (1982, 150) and Stapledon (2012b) describe a pronounced property price boom during the 1880s, followed by a bust in the 1890s. The surge in real estate prices was primarily spurred by a prolonged period of economic growth during the 1870s and 1880s

1880s appears rather implausible.

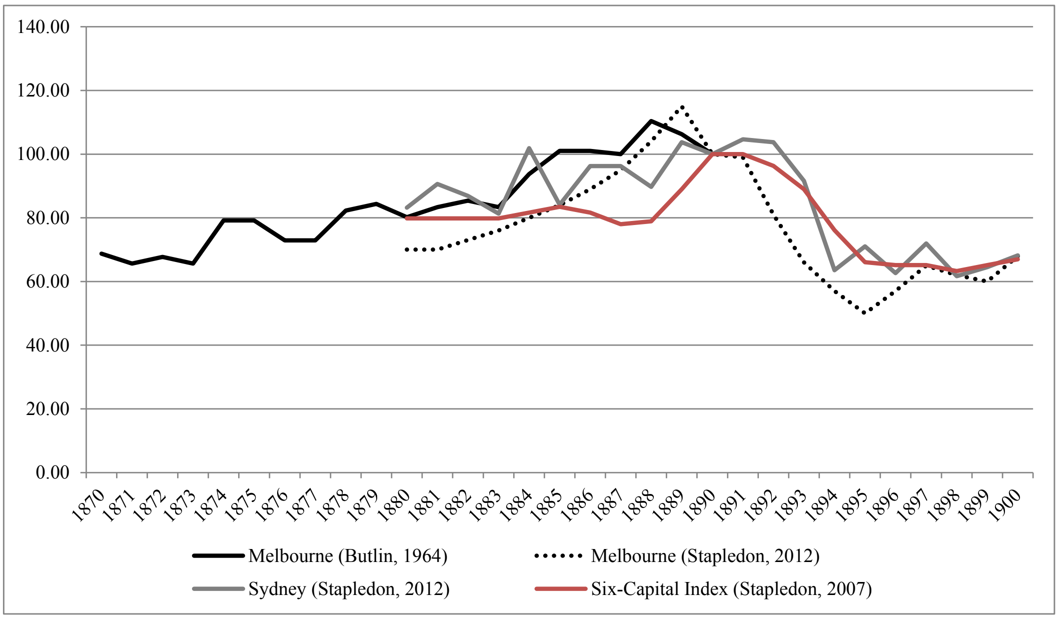


Figure 35: Australia: nominal house price indices 1870–1900 (1890=100).

Figure 36 compares the nominal indices for 1900–1970, i.e. the Melbourne and Sydney indices by Stapledon (2012b), the Sydney indices by Neutze (1972) and Abelson (1985), and the six capital index (Stapledon, 2007). Stapledon (2007) discusses the differences between his six-capital-index and the indices by Neutze (1972) and Abelson (1985) and concludes that they either almost fully correspond (in the case of Neutze (1972)) or at least show a very similar trend (in the case of Abelson (1985)) when compared to that of the six-capital-index. Reassuringly, these trends are also in line with narrative evidence on house price developments.[32]

following the gold rushes of the 1850s and 1860s. Also, the time from 1850–1880 was marked by substantial immigration and thus a significant increase in population particularly in the urban areas. For the case of Melbourne, where the house boom was most pronounced, the extensions of mortgage credit through thriving building societies during the 1870s and 1880s appears to have played a major role.

[32]The only very moderate rise in nominal house prices between the beginning of the 20th century and 1950 is striking. According to Stapledon (2012b, 305), this long period of weak house price growth may at least to some extent have been a result of the large volume of new urban land lots developed in the boom years of the 1880s). After a consolidation period following the depression of the 1890s that lasted to 1907, nominal property prices slowly but constantly increased. While house prices reached a high plateau during the 1920s, the consolidation that can be ascribed to the adverse effects of the Great Depression of the 1930s appears to have been only minor in size, particularly in comparison to the substantive house price slumps experienced in other countries. Daly (1982, 169) reasons that this soft landing was mainly due to the fact that prices had been less elevated at the onset of the recession, particularly when compared to the boom and bust cycle of the 1880s and 1890s. The post-World War II surge in house prices has been primarily explained with the lifting of wartime price controls in 1949 that had been introduced for houses and land in 1942. The low construction activity during the war years had also led to a substantive housing shortage in the post-war years. A surge in construction activity was the result (Stapledon, 2012b, 294). While postwar Australia began to prosper, entering a phase of low levels of unemployment and rising real wages, the government aimed to raise the level of homeownership by various means, for example, through the provision of tax incentives (Daly, 1982, 133). By the end of the 1950s, however, the federal government became increasingly uncomfortable with the expansion of consumer credit and the strong increase in property values. As a response, measures to restrict credit expansion were introduced in

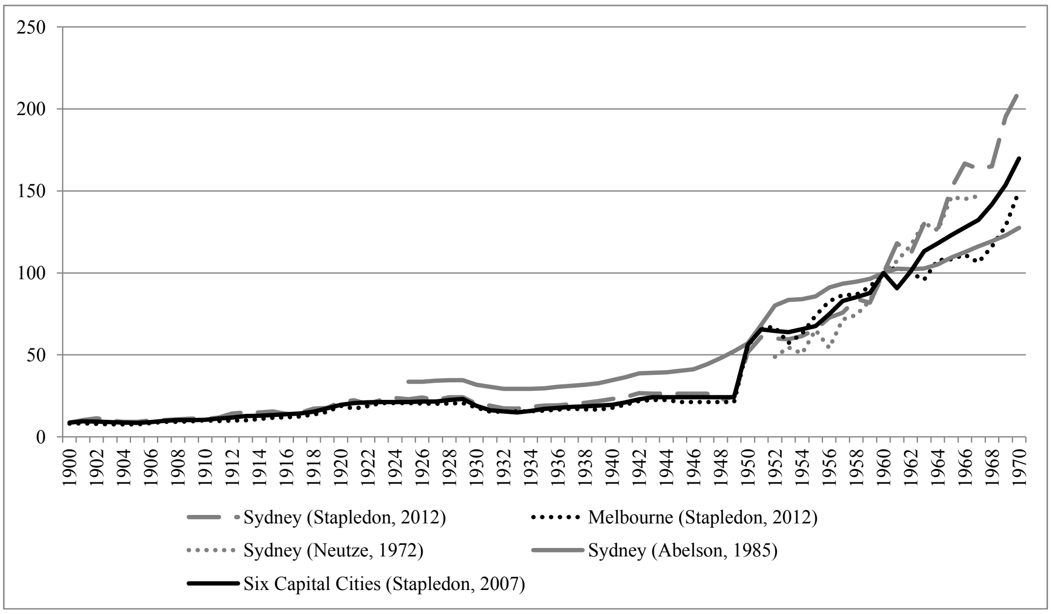


Figure 36: Australia: nominal house price indices 1900–1970 (1960=100).

Figure 37 shows the indices which are available for the period 1970–2012: the Sydney and Melbourne indices by Stapledon (2012b), indices calculated from the Sydney and Melbourne series by Abelson and Chung (2004), the six-capitals-index by Stapledon (2007), and the weighted index for eight cities for 1986–2012 by the Australian Bureau of Statistics (2013b).[33] Despite their different geographical coverage, all indices for the years from 1970–2012 follow a joint, almost identical path. It is only after 2004 that the increase in Melbourne property prices shows to be more pronounced compared to Sydney or the Eight Capital Index.

1960. The resulting credit squeeze had an immediate and sizable impact on both the real estate market and the economy as whole (Stapledon, 2007, 56). The recovery from this brief interruption was rapid and property prices continued to boom.

[33]The ABS series is spliced in 2003. As Stapledon (2012b) draws upon Abelson and Chung (2004) for 1970–1985, these series should therefore be identical for this period. As Stapledon (2012b) uses the Australian Bureau of Statistics (2013b) series for Sydney and Melbourne for 1986–2012, these, again, should be identical for this period. In addition, since Stapledon (2007) uses the Australian Bureau of Statistics (2013b) series for eight capital cities, these two indices are identical for post-1986. The Australian Bureau of Statistics (2013b) index only starts in 1986.

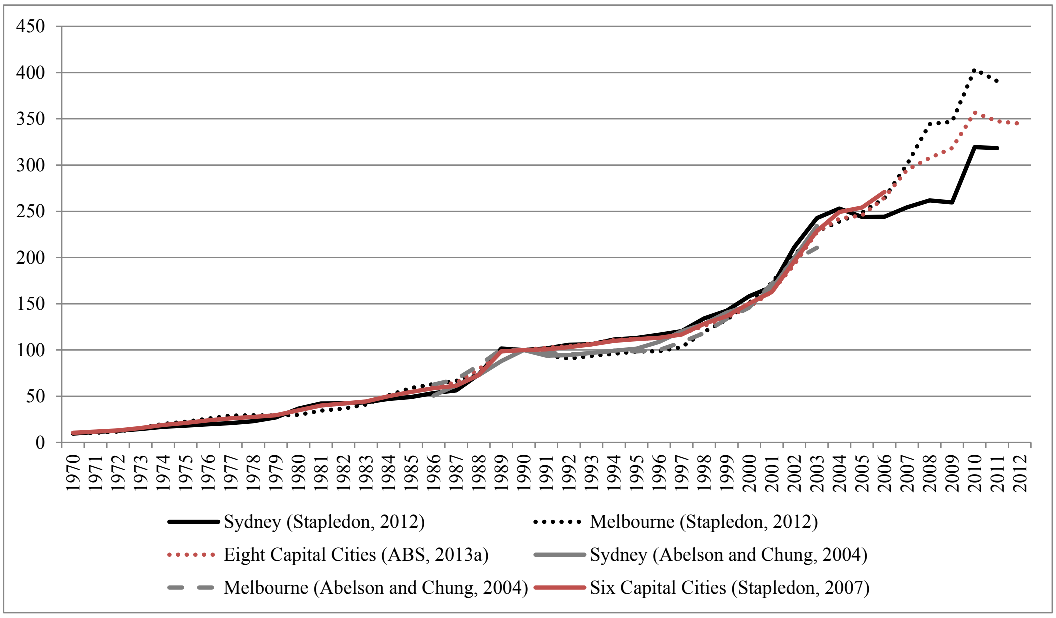


Figure 37: Australia: nominal house price indices 1970–2012 (1990=100).

As we aim to provide house price indices with the most comprehensive coverage possible, the series constructed by Stapledon (2007) for the six capitals constitutes the basis for the long-run index. Due to the above mentioned possible deficiencies of the index for the time of the 1880s boom and subsequent contraction, the Stapledon (2012b) index for Melbourne is used for 1880-1899. Therefore, the index may be biased upward to some extent since the boom of the 1880s was particularly pronounced in Melbourne when compared to, for example, Sydney. The index is extended backwards to 1870 using the index calculated from the Melbourne series by Butlin (1964). Hence, prior to 1900, our index only refers to Melbourne. Although we can say little about the extent to which house prices in the Melbourne area prior to 1900 are representative of house prices in the other Australian state capitals, the graphical evidence provided by Daly (1981) at least suggests that during the time prior to 1880 Sydney house prices showed a comparable upward trend. Beginning in 2003, the index is spliced with the Australian Bureau of Statistics (2013b) eight-cities-index.

The resulting index may suffer from three weaknesses: first, prior to 1943, the index is based on asking prices. These may differ from actual transaction prices and thus result in a bias of unknown size and direction. Second, the index does not explicitly control for quality changes, i.e. depreciation or improvement. Third, only after 1986 the index controls for quality changes. To gauge the extent of the quality bias we can rely on estimates provided by Stapledon (2007) according to which improvements, i.e. capital spending, adds an average of 0.95 percent per annum to the value of housing and changing composition of the stock subtracted 0.35 percent per annum from the median price. For the war years of 1914–1918 and 1940–1945 and

[34] The share of houses in the total dwelling stock is used as weights.
[35] The share of houses in the total dwelling stock is used as weights.

Period	Series ID	Source	Details
1870–1880	AUS1	Butlin (1964)	*Geographic Coverage*: Melbourne; *Type(s) of Dwellings*: All kinds of existing dwellings; *Data*: Advertisements in newspapers; *Method*: Median asking prices.
1881–1899	AUS2	Stapledon (2012b)	*Geographic Coverage*: Melbourne; *Type(s) of Dwellings*: All kinds of existing dwellings; *Data*: Advertisements in newspapers; *Method*: Median asking prices.
1900–1942	AUS3	Stapledon (2007)	*Geographic Coverage*: Six capital cities; *Type(s) of Dwellings*: All kinds of existing dwellings; *Data*: Advertisements in newspapers and Census estimates of average rents; *Method*: Median asking prices.
1943–1949	AUS4	Stapledon (2007)	*Geographic Coverage*: Six capital cities; *Type(s) of Dwellings*: All kinds of existing dwellings; *Data*: Estimate of the fixed price; *Method*: Estimate of fixed price.
1950-1972	AUS5	Stapledon (2007)	*Geographic Coverage*: Six capital cities; *Type(s) of Dwellings*: All kinds of existing dwellings; *Data*: Weekly property reports in newspapers and Census estimates of average rents; *Method*: Median sales prices.
1973–1985	AUS6	Abelson and Chung (2004), as used in Stapledon (2007)	*Geographic Coverage*: Six capital cities; *Type(s) of Dwellings*: All kinds of existing dwellings; *Data*: Data from Land Title Offices (LTOs); Productivity Commission data; Valuer-General Offices; *Method*: Weighted average of median prices.[34]
1986–2002	AUS7	Australian Bureau of Statistics (2013b) as used in Stapledon (2007)	*Geographic Coverage*: Six capital cities; *Type(s) of Dwellings*: New and existing detached houses; *Data*: Data from State Valuer-General Offices, supplemented by data on property loan applications from major mortgage lenders; *Method*: Weighted average of mix-adjusted house price indices.[35]
2003–2012	AUS8	Australian Bureau of Statistics (2013b)	*Geographic Coverage*: Eight capital cities; *Type(s) of Dwellings*: New and existing detached houses; *Data*: Data from State Valuer-General Offices, supplemented by data on property loan applications from major mortgage lenders; *Method*: Mix adjustment.

Table 6: Australia: sources of house price index, 1870–2012.

the depression periods 1891–1895 and 1930–1935, Stapledon (2007) assumes 0.55 percent per annum. These estimates are in line with Abelson and Chung (2004). If we adjust the growth rates of our long-run series downward accordingly, the average annual real growth rate over the period 1870–2012 of 1.68 percent becomes 1.11 percent in constant quality terms. As this is a rather crude adjustment, we use the unadjusted index (see Table 6) for our analysis.

Housing related data

Construction costs: 1881–2012: Stapledon (2012a, Table 2) - Construction costs of new dwellings and alterations and additions.

Residential land prices: 1880s–2005: Stapledon (2007, 29 ff.) - Real price series of lots at the urban fringe, period averages.

Building activity: 1956–2012: Australian Bureau of Statistics (2013a).

Homeownership rates: 1911–2006 (benchmark dates): Australian Bureau of Statistics (various years).

Value of housing stock: Goldsmith (1985) and Garland and Goldsmith (1959) provide estimates of the value of total housing stock, dwellings, and land for the following benchmark years: 1903, 1915, 1929, 1947, 1956, 1978. Data for 1988–2011 is drawn from OECD (2013). Piketty and Zucman (2014) present data on the value of household wealth in land and dwellings for 1959–2011.

Household consumption expenditure on housing: 1870–1939: Butlin (1985, Table 8); 1960–2012: Australian Bureau of Statistics (2014).

B.3 Belgium

House price data

Historical data on house prices in Belgium is available for 1878–2012.

The earliest available data on house prices in Belgium is provided by De Bruyne (1956). It covers the greater Brussels area for the period 1878–1952 and is reported as the annual median price per square meter of the interquartile range for four real estate categories: i) residential property[36] in the center of Brussels, ii) maisons de rentier,[37] iii) building sites (since 1885), and

[36]'Maisons d'habitation' are defined as houses of rather inferior quality. Some of them may be 'maisons de rentier' (see below) that have been downgraded because of the neighborhood or the age of the building. They are usually inhabited by workers or employees, small, and do not have electricity, central heating, gas or water (De Bruyne, 1956, 62).

[37]'Maisons de rentier' are defined as properties that are located in a good neighborhood, have usually more than one story, are well maintained, and serve as a single-family dwelling (De Bruyne, 1956, 61 f.).

iv) commercial properties[38] (since 1879).[39]

A second extensive source comprising two house price indices - one for 1919–1960 and the other for 1960–2003 - is Janssens and de Wael (2005). The first index, i.e. for 1919–1960, is based on two data sources: for 1919–1950 the index relies on a property price index for Brussels published by the Antwerpsche Hypotheekkas (1961) using sales price data for maisons de rentier. The AHK-index is computed as the annual median price of the interquartile range. For 1950–1960, the index is based on nationwide data for all public housing sales subject to registration rights gathered by Statistics Belgium. For these years the index reflects the development of the weighted mean sales price; weights are constructed from the share of total national sales in each of the 43 Belgian arrondissements (districts). The computational method for the second index from Janssens and de Wael (2005), covering the years 1960–2003, is identical to that applied to the sub-period 1950–1960. The sole difference lies in the coverage of the data provided by Statistics Belgium. While for the period 1950–1960 sales information is limited to public sales, the index for the time 1960–2003 is computed using price information for both public and private housing sales that were subject to registration rights.

In addition to these two principal sources, for the years since 1986, Statistics Belgium (2013a) on a quarterly basis publishes price indices for the following four types of real estate: i) building lots; ii) apartments; iii) villas; and iv) single-family dwellings. The indices are constructed using stratification and are available for the national, regional, district (arrondissements), and communal level.[40]

Figure 38 shows the nominal indices for the different property types (maisons d'habitation, maisons des rentier, commercial buildings, and building sites) based on the data from De Bruyne (1956). Three indices (maison d' habitation, maison de rentier, and maison de commerce) move closely together throughout the 1878–1913 period; only the building sites index shows a comparably higher degree of volatility particularly during the 1880s and 1890s. Nevertheless, all four indices depict a similar trend: nominal house prices trend downwards until the late

[38]Commercial properties are defined as all buildings for commercial use, i.e. hotels, restaurants, retail stores, warehouses, etc. (De Bruyne, 1956, 63).

[39]The data is drawn from accounts of public real estate sales published in the *Guide de l'Expert en Immeubles* (Real Estate Agents' Catalogue), a periodical of the Union des Géomètres-Experts de Bruxelles (Union of Surveyors of Brussels). The records include the more urban parts of the Brussels district, such as Brussels itself, Etterbeek, Ixelles, Molenbeek, Saint-Gilles, Saint-Josse, Schaerbeek, Koekelberg, and Laeken. De Bruyne (1956) also publishes separate house price series for the more rural areas, such as Anderlecht, Auderghem, Forest, Ganshoren, Jette, Uccle, Watermael-Boitsfort, Berchem-Ste-Agathe, Woluwe-St-Lambert, Woluwe-St-Pierre, Evere, Haeren, Neder over-Heembeck.

[40]Dwellings are stratified according to type and location. The stratification was refined in 2005 so that single-family dwellings are categorized according to their size (small, average, large) causing a break in the series between 2004 and 2005. The index is computed as a chain Laspeyre-type price index. It does not control for quality changes. Districts are aggregated according to the number of dwellings in the base period (2005). For the period 1970–2012, an index is available from the OECD based on the index compiled by the Bank of Belgium, which in turn is based on the data from Statistics Belgium (European Central Bank, 2013). For the period 1975–2012, the Federal Reserve Bank of Dallas also uses the data from Statistics Belgium (2013a) and Stadim (2013).

1880s and slowly recover afterwards. De Bruyne (1956) suggests that these trends are generally in line with the fundamental macroeconomic trends and narrative evidence on house price developments in Belgium.[41]

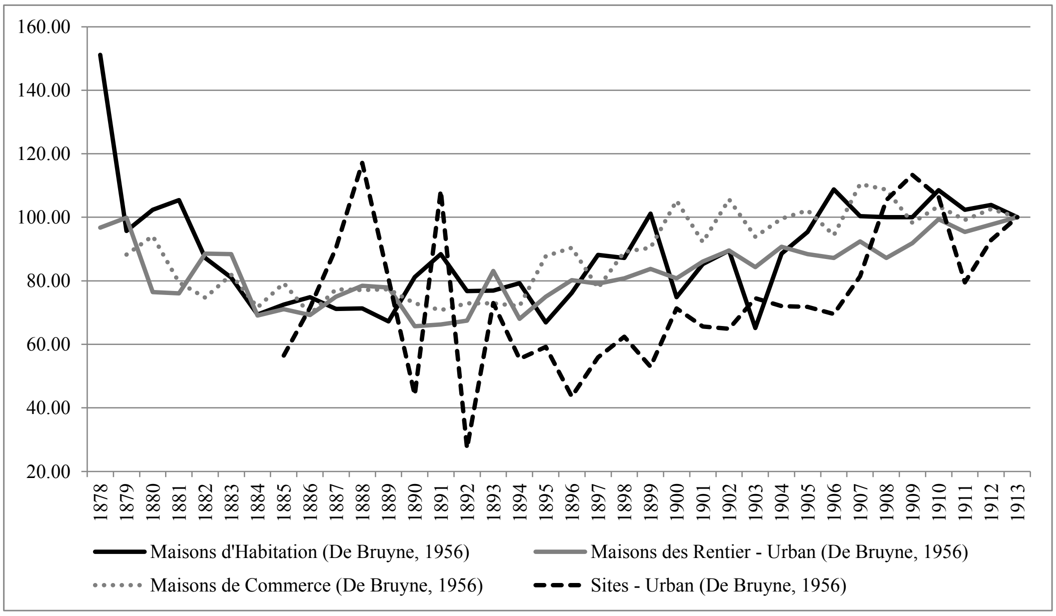


Figure 38: Belgium: nominal house price indices 1878–1913 (1913=100).

Figure 39 displays the nominal indices available for 1919–1960; i.e. the index calculated from the data by De Bruyne (1956) for the Brussels area, the indices from Janssens and de Wael (2005) for the Brussels area, and an index for Antwerp by Antwerpsche Hypotheekkas (1961). As Figure 39 shows, these nominal indices move closely together during the years they overlap, i.e. 1919–1952.[42] The indices accord with accounts of house price developments during this period.[43] Although all three indices only gauge price developments for maisons de rentier, we

[41]Since the 1880s, the Belgian economy had been in a recession. Recovery only began to take hold in the mid-1890s (Van der Wee, 1997). The housing act of 1899 through promoting reduced-rate loans and extending tax exemptions and tax reduction for homeowners may have further contributed to the slow upward trend in house prices (Van den Eeckhout, 1992). Following the economic resurgence in 1906, Belgium until the eve of World War I experienced years of prospering economic activity. De Bruyne (1956) notes that during this period the gap between prices for property in urban and more peripheral parts of the Brussels area began to close. He ascribes this convergence largely to improvements in transportation and communication systems during that time (Janssens and de Wael, 2005; Antwerpsche Hypotheekkas, 1961).

[42]Correlation coefficient of 0.995 for the two Brussels indices; correlation coefficient of 0.993 for the Antwerpen-index (Antwerpsche Hypotheekkas, 1961) and the Brussels index (De Bruyne, 1956).

[43]De Bruyne (1956) reasons that the increase in property prices between 1919 and 1922 was to a large extent caused by a general shortage of housing in the postwar years. While De Bruyne (1956) in this context diagnoses the house price boom to be primarily driven by speculation, the Antwerpsche Hypotheekkas (1961) attributes the price rise to the rapid economic growth during these years. House prices substantially decreased throughout the economic crisis of the 1930s. De Bruyne (1956), however, argues that the decrease was less pronounced in less expensive property categories, i.e. maisons d'habitation as opposed to maisons de rentier since with declining incomes many people were forced to relocate to either areas in which housing is less expensive or to lower quality housing. Prices appear to slightly recover in the end of the 1930s. Yet, the advent of World War II puts the property market back into decline. After the end of World War II, the Belgian economy entered

know from Figure 38 that their value should not develop in a fundamentally different way than the value of other property types. We may also assume that price trends across Belgian cities did not differ significantly. Figure 39 includes an index for maisons de rentier for Antwerp.[44] When comparing the index for Antwerp and the indices for Brussels, the latter seems not to show a singular development in house prices. Summary statistics of the indices by decade clearly confirm the similarity of general statistical characteristics of the series. This finding can be reinforced from another direction. Leeman (1955, 67) examines house prices in Brussels, Antwerp, Mechelen, Leuven, Bruges, Dinant, and Lier using records of a mortgage bank for the years 1914–1943. He, too, concludes that the trends in Brussels' house prices generally mirror the trends in other regions of Belgium during the interwar period.

For the years 1986–2003 also the index by Janssens and de Wael (2005) for 1960–2003 and the one by Statistics Belgium (2013a) show the same statistical characteristics.[45] Our long-run house price index for Belgium for 1878–2012 splices the available series as shown in Table 7.

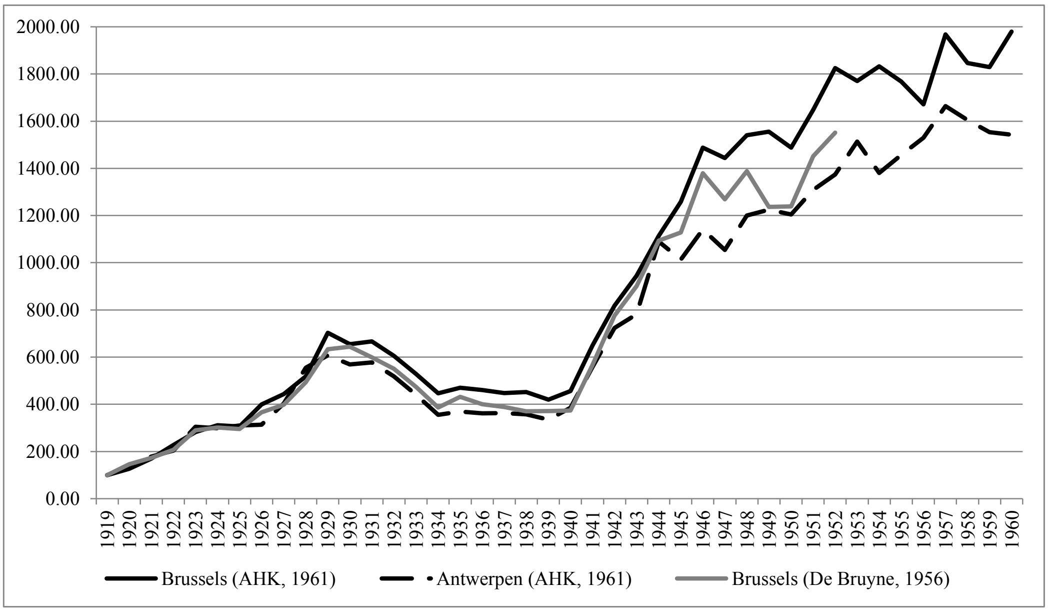


Figure 39: Belgium: nominal house price indices 1919–1960 (1919=100).

The most important limitation of the long-run series is the lack of correction for changing qualitative characteristics of and quality differences between the dwellings in the sample. To some extent the latter aspect may be less of a problem for 1878–1950 since for that period

three decades of substantive though non-linear growth which is clearly reflected in house prices. Also, as a result of the wartime destruction, Belgium faced a substantial housing shortage which further drove up prices (Antwerpsche Hypotheekkas, 1961).

[44]To the best of our knowledge, no other index for this property type is available for other parts of Belgium.

[45]This, however, is unsurprising since Stadim cooperated with Statistics Belgium in the creation of its index. Both, Janssens and De Wael are founding members of Stadim.

[46]The number of transactions in the respective arrondissement is used as weights.

[47]The number of transactions in the respective arrondissement is used as weights.

[48]The number of transactions in the respective arrondissement is used as weights.

Period	Series ID	Source	Details
1878–1913	BEL1	De Bruyne (1956)	*Geographic Coverage*: Brussels area; *Type(s) of Dwellings*: Existing maisons de rentier; *Data*: Guide de l'Export en Immeubles; *Method*: Median sales prices.
1919–1950	BEL2	Janssens and de Wael (2005); based on Antwerpsche Hypotheekkas (1961)	*Geographic Coverage*: Brussels area; *Type(s) of Dwellings*: Maisons de Rentier; *Data*: Antwerpsche Hypotheekkas (1961); *Method*: Median sales prices.
1951–1959	BEL3	Janssens and de Wael (2005)	*Geographic Coverage*: Nationwide; *Type(s) of Dwellings*: Small & medium-sized existing houses; *Data*: Transaction prices (public sales; gathered by Statistics Belgium); *Method*: Weighted average of mean sales prices.[46]
1960–1985	BEL4	Janssens and de Wael (2005)	*Geographic Coverage*: Nationwide; *Type(s) of Dwellings*: 1960–1970: Small & medium-sized existing houses; 1971 onwards: all kinds of existing dwellings (villas & mansions included); *Data*: Transaction prices (public and private sales) gathered by Statistics Belgium); *Method*: Weighted average of mean sales prices.[47]
1986-2012	BEL5	Statistics Belgium (2013a)	*Geographic Coverage*: Nationwide; *Type(s) of Dwellings*: Existing, single-family dwellings; *Data*: Transaction prices; *Method*: Weighted mix-adjusted index.[48]

Table 7: Belgium: sources of house price index, 1878–2012.

the index is confined to a certain market segment, i.e. maisons de rentier. Prior to 1950, the series is also adjusted for the size of the dwelling as it is based on price data per square meter. Moreover, despite the fact that the movements in prices for maisons de rentier closely mirror fluctuations in prices of other property types prior to 1913 (cf. Figure 38), it is of course possible that this particular market segment is not perfectly representative of fluctuations in prices of other residential property types for the whole 1878–1950 period. In an effort to gauge the size of the upward bias stemming from quality improvements we calculate the value of expenditures on alterations and additions as percentage in total housing value for benchmark years. If we downward adjust the real annual growth rates of our long-run index accordingly, the average annual real growth rate over the period 1878–2012 of 1.96 percent becomes 1.77 percent in constant quality terms. Yet, as this is a rather crude adjustment, we use the unadjusted index (see Table 7) for our analysis.

Housing related data

Construction costs: 1914–2012: Belgian Association of Surveyors (2013) - Construction cost index for new buildings and dwellings; 1890–1961 (additional): Buyst (1992) - Index for building material prices (excluding wages).

Farmland prices: 1953–2007: Vlaamse Overheid[49] - Price index for farmland; 2008–2009: Bergen (2011) - Sales prices for farmland in Vlaanderen per square meter.[50]

Residential land prices: 1953–2012: Stadim (2013) - Prices of building lots.

Building activity: 1890–1961: Buyst (1992); 1927-1950: Leeman (1955).

Homeownership rate: 1947–2009 (benchmark dates): Van den Eeckhout (1992).

Value of housing stock: Goldsmith (1985) provides estimates of the value of total housing stock, dwellings, and land for 1950 and 1978. Data for 2005–2011 is drawn from Poullet (2013).

Household consumption expenditure on housing: 1953–1959: Statistics Belgium (1994); 1960–1994: Statistics Belgium (1998); 1995–2012: Statistics Belgium (2013b).

B.4 Canada

House price data

Historical data on house prices in Canada is scarce even though real estate boards were already established in the early 20th century. Data on house prices in Canada is available for 1921–2012.

[49]Series sent by email, contact person is Els Demuynck, Vlaamse Overheid
[50]No data is available for 2010–2012.

The first available series is presented by Firestone (1951) and covers the years 1921–1949. The index is calculated using data on the average value of residential real estate (including land) and the number of existing dwellings and hence reflects the average replacement value of existing dwellings rather than prices realized in transactions.[51]

A dataset published by the Canadian Real Estate Association (1981, (CREA)) covers the time 1956–1981. It contains annual data on the average value and the number of transactions recorded in the Canadian Multiple Listing System (MLS) for all properties, i.e. it includes both residential and non-residential real estate. In addition, Subocz (1977) presents a mean price index for new and existing single-family detached houses covering an earlier period, i.e. 1949–1976. The index is based on price data collected from the records of the Vancouver and New Westminster Registry offices serving the Greater Vancouver Regional District.

CREA also publishes a second house price data series that solely draws on price data from secondary market residential properties transactions through MLS covering the years 1980–2012.[52] The series is computed as average of all sales prices in the residential property market.

The University of British Columbia index constitutes another source for the development of house prices in Canada. It covers the period 1975–2012 and is computed from price information for existing bungalows and two story executive detached houses in ten main metropolitan areas of Canada (Centre for Urban Economics and Real Estate, University of British Columbia, 2013, UBC Sauder).[53] For each of the cities, UBC Sauder uses a population weighted average of the price change in each neighborhood for which data is available. Subsequently, the index is weighted on changes in the price level of different housing types, i.e. detached bungalows and executive detached houses, according to their share in total units sold. The aim is to capture the within-metro-variation in house prices in proportion to the size of the housing stock and variation across housing types. The data is drawn from the Royal LePage house price survey.[54]

[51] Firestone (1951, 431 ff.) calculates the value of residential capital, i.e. the value of all existent dwellings, in 1921 by computing the average construction cost per dwelling, adjusting it for the proportion of the life of the dwelling already consumed and multiplying it with the number of available dwellings. The adjustment was made by subtracting 22/75 of the average cost of a non-farm home (the average age of a non-farm home in 1921 was 22 years, Firestone (1951) assumes an average life expectancy of a dwelling of 75 years) and 18/60 for farm homes (the average age of a farm home in 1921 was 18 years, Firestone (1951) assumes an average life expectancy of a farm dwelling of 60 years). The resulting value for 1921 may thus underestimate the value of an average residential structure in 1921 as it is not adjusted for improvements or alterations of the existing housing stock. Using these estimates of the value of structures and data on the ratio of land cost to construction costs, Firestone (1951) calculates the value of residential land in 1921. For the years 1922–1949, the 1921 value is revalued using average construction costs, deducting depreciation, deducting the value of destroyed and damaged dwellings, and adding gross residential capital formation in the respective year. The value of land put in use for residential use in the respective year is added and the value of land removed from residential use is deducted. The series for the total value of residential real estate is calculated as the sum of the series for the value of structures and the series for the value of land.

[52] Series sent by email, contact person is Gregory Klump, Canadian Real Estate Association (CREA).

[53] Bungalows are defined as detached, one-story, three-bedroom dwellings with living space of about 111 square meters.

[54] The way the house price survey is conducted ensures some degree of constant quality as Royal LePage standardizes each housing type according to several criteria, such as square footage, the number of rooms, etc.

In addition to that, Statistics Canada issues three house price indices for new developments. Data are disaggregated to the provincial level and currently cover the period 1981–2012. They measure price developments for i) buildings; ii) land; and iii) real estate (land and buildings) and are aggregated to nationwide indices and a separate index for the Atlantic region (Statistics Canada, 2013c). The indices are computed from sales prices of new real estate constructed by contractors based on a survey that is conducted in 21 metropolitan areas with the number of builders in the sample representing at least 15 percent of the total building permit value of the respective city and year. The construction firms covered mainly develop single unit houses. The survey data includes information on various characteristics of the units constructed and sold. The index is a matched-model index, i.e. a constant-quality index in the sense that the characteristics of the structures and the lots are identical between successive periods.

The index produced by Firestone (1951) is hence the only available source for house prices in Canada prior to the 1950s. We therefore have to rely on accounts of housing market developments as plausibility check. The nominal index suggests that house prices are fairly stable throughout the 1920s, fall in the wake of the Great Depression, and increase after 1935. Anderson (1992), discussing Canadian housing policies in the interwar period, also suggests that house prices fall during the early 1930s. He furthermore points toward policy measures introduced during the second half of the 1930s that aimed at stimulating housing construction which may explain a demand-driven increase in house prices during these years.[55] Overall, the trajectory of the Firestone (1951) appears plausible.

Figure 40 compares the nominal house price indices available for 1956–2012, i.e. the UBC Sauder index, the price index for new houses (including land) by Statistics Canada, and an index computed from the two CREA datasets (i.e. 1956–1981, and 1980–2012). As the graph suggests, all indices show a marked positive trend in the post-1980 period. However, the magnitude of the price increase varies between the four measures. The European Commission (2013, 120) suggests that the more pronounced growth of the CREA index since the mid-1980s is due to the fact that the series is calculated from a simple average of real estate secondary market prices. Hence, it is biased with respect to the composition (e.g. size, standard, quality, etc.) of the overall volume of secondary market transactions. As this second CREA index, due to the substantive coverage of MLS, includes about 70 percent of all marketed residential properties (European Commission , 2013, 119), it can despite these conceptual limitations be considered a fairly reliable measure for the overall evolution of house prices in Canada for the time from 1980 to present. In comparison to the CREA index, the Statistics Canada index for new houses points toward a less pronounced increase in house prices. However, this Statistics Canada index - as it is solely calculated from price information on new developments - may also be subject to some degree of bias. New residential developments are primarily built in the

(European Commission , 2013, 119).

[55] Anderson (1992) lists the 1935 Dominion Housing Act, the 1937 Home Improvement Loan Guarantee Act, and the 1938 National Housing Act.

suburban areas of larger agglomerations where prices and price fluctuations tend to be lower than in city centers (Statistics Canada, 2013a; European Commission , 2013). This may also be the reason for the different magnitude between the UBC Sauder index and the index by Statistics Canada. For the years since 1975 we use the UBC Sauder index as it is confined to a certain market segment (bungalows and existing two-story executive buildings) and thus should be less prone to composition bias than the CREA series.[56]

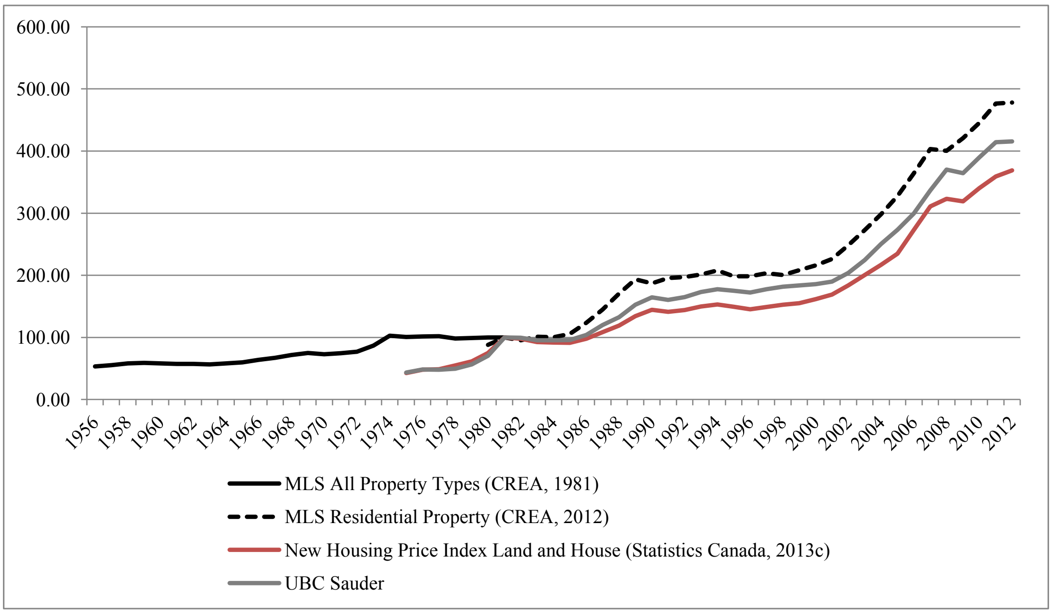


Figure 40: Canada: nominal house price indices 1956–2012 (1981=100).

Figure 41 compares the CREA index for 1956–1981 with the one presented by Subocz (1977). CREA argues that the MLS statistics covering residential and non-residential real estate for the time from 1956–1981 can be used to reliably proxy residential house price development. In addition to the CREA index and the Subocz index, two other sources discuss the development of Canadian house prices prior to the 1980s. The first is a report by Miron and Clayton (1987) which is commissioned by the Canada Mortgage and Housing Corporation and the housing agency of the Canadian government. The authors use scattered data from Statistics Canada to discuss developments in house prices in Canada between 1945 and 1986.[57] Their narrative suggests that house prices in the postwar period generally followed the development of the Canadian economy as a whole. According to the authors, postwar social policy schemes - even though not directly linked to housing policy - generated additional demand side effects as they enabled particularly low-income families to devote a larger disposable income to housing consumption. House prices strongly increased during postwar years, i.e. until the late 1950s,

[56]Figure 40 suggests that the CREA index for the time 1975–1980 follows a trend different from that of the UBC and Statistics Canada indices. While the latter for the period under consideration show a considerable positive trend, the former appears to be fairly stagnant. We therefore also use the UBC Sauder index for the years 1975–1980.

[57]Years included: 1941, 1946, 1951, 1956, 1961, 1966, 1971, 1976, 1981, 1984.

when economic growth declined creating a decline in house prices. In the economic resurgence starting in the mid-1960s, house prices also picked-up and *"increased at a frantic pace in the 1970s before tailing off again in the recession of the 1980s"* (Miron and Clayton, 1987, 10).[58] A second source is Poterba (1991) who also identifies a run-up in house prices during the 1970s that coincided with the recession of 1982. With the pattern of pronounced variation in the growth rates of real estate prices over time as diagnosed by Miron and Clayton (1987) and Poterba (1991), the first CREA index must be treated with caution. It shows that, different to the CREA-index, the Sobocz-index appears more consistent with narratives by Miron and Clayton (1987) and Poterba (1991) for the period 1949–1976. Yet, the Sobocz-index relies only on a rather small sample size and is confined to property sales in the Greater Vancouver area. Another sign of partial inconsistency is the fact that the Sobocz-index reports an increase in average real house prices of an astonishing 280 percent between 1956 and 1974. The CREA index for the same time reports an increase of approximately 87 percent. Therefore, despite its potential weaknesses, we rely on the CREA index to construct the long-run house price index for Canada.

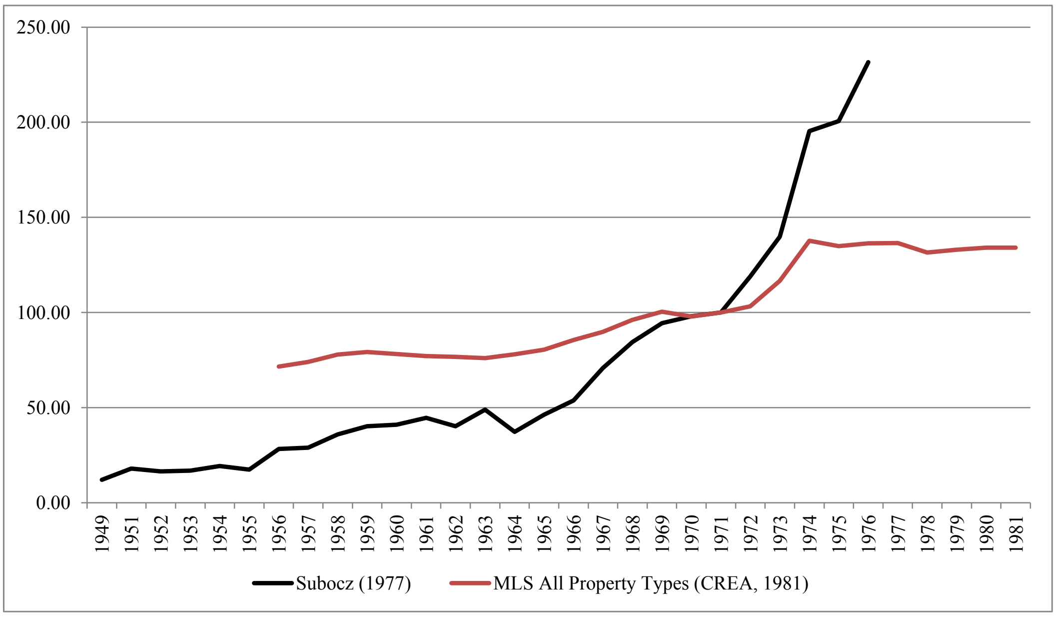


Figure 41: Canada: nominal house price indices 1949–1981 (1971=100).

Data on residential house prices is available for 1921–1949 and for 1956 onwards. For 1921–1949, the series on average value of existing farm and existing non-farm dwellings including land are highly correlated (Firestone, 1951, Tables 69 & 80).[59] Since no data on residential house prices is available for 1949–1956, we use the percentage change in the value of farm real

[58]Miron and Clayton (1987) argue that the house price surge during the 1970s was also associated with the baby boomers starting to buy residential properties. They also suggest that tax policies made homeownership more attractive after the tax reforms of 1972 introducing tax exemption of capital gains from sales of principal residences.

[59]Correlation coefficient of 0.856.

Period	Series ID	Source	Details
1921-1949	CAN1	Firestone (1951)	*Geographic Coverage*: Nationwide; *Type(s) of Dwellings*: All kinds of existing dwellings (farm and non-farm) ; *Data*: Estimates of the value of residential structures and the value of residential land as well as data on all available residential dwellings; *Method*: Average replacement values.
1949-1956		Urquhart and Buckley (1965)	*Geographic Coverage*: Nationwide; *Type(s) of Dwellings*: Farm real estate; *Method*: Value of farm real estate per acre.
1956-1974	CAN2	Canadian Real Estate Association (1981)	*Geographic Coverage*: Nationwide; *Type(s) of Dwellings*: All kinds of real estate (residential and non-residential); *Data*: Transactions registered in the MLS system; *Method*: Average sales prices.
1975-2012	CAN3	Centre for Urban Economics and Real Estate, University of British Columbia (2013)	*Geographic Coverage*: Five cities; *Type(s) of Dwellings*: Existing bungalows and two story executive dwellings; *Data*: Royal LePage real estate experts; *Method*: Average prices.

Table 8: Canada: sources of house price index, 1921–2012.

estate per acre to link the 1921–1949 and the 1956–1974 series (Urquhart and Buckley, 1965). Our long-run house price index for Canada 1921–2012 splices the available series as shown in Table 8.

The resulting long-run index has three drawbacks: first, data prior to 1949 is not based on actual list or transaction prices but calculated as the average replacement value of existing dwellings including land value (see data description above). This approach may result in a bias of unknown size and direction. Second, for 1956–1974, the index refers to both residential and non-residential real estate and is not adjusted for compositional changes. Third, the index is not adjusted for quality improvements for the years after 1956. The bias should be mitigated for the post-1975 years due to the way the Royal LePage survey is set up (see above). As a way to gauge the potential effect of quality changes, we calculate the value of expenditures on alterations and additions as percentage in total housing value for benchmark years and adjust the annual growth rates of the series downward for the years 1956–1974 using these estimates. The average annual real growth rate over the period 1921–2012 of 2.21 percent becomes 1.67 percent in constant quality terms. As this is a rather crude adjustment, we use the unadjusted index (see Table 8) for our analysis.

Housing related data

Construction costs: 1952–1976: Statistics Canada (1983, Tables S326-335) - Residential building construction input price index; 1977–1985: Statistics Canada (various years,b) - Residential building construction input price index; 1986–2012: Statistics Canada (2013b) - Price index of apartment construction (seven census metropolitan composite index).

Farmland prices: 1901–1956: Urquhart and Buckley (1965) - Value of farm capital (land and buildings) per acre; 1965–2009: Manitoba Agriculture, Food and Rural Initiatives (2010) - Value of farm real estate (land and buildings) per acre; 2010–2011: Province of Manitoba (2012) - Value of farm real estate (land and buildings) per acre.

Building activity: 1921–1949: Firestone (1951, Table 22); 1957–2012: Statistics Canada (2014).

Homeownership rates (benchmark dates): Miron (1988), Statistics Canada (1967), Statistics Canada (2011).

Value of housing stock: Goldsmith (1985) provides estimates of the value of total housing stock, dwellings, and land for the following benchmark years: 1950 and 1978. Data on the value of household wealth including the value of total housing stock, dwellings, and land for 1970-2011 is drawn from OECD (2013). Piketty and Zucman (2014) also present data on real estate wealth for benchmark years in the period 1895–1955.

Household consumption expenditure on housing: 1926–1946: Statistics Canada (2001); 1961–1980: Statistics Canada (2012); 1981–2012: Statistics Canada (2013d).

B.5 Denmark

House price data

Historical data on house prices in Denmark is available for 1875–2012.

The most comprehensive source for house prices in Denmark is Abildgren (2006). Abildgren (2006) provides a price index for single-family houses in Denmark for the period 1938–2005 and a price index for farms covering the time 1875–2005. The index for single-family houses reflects annual average sales prices and is computed using data from Økonomiministeret (1966, 1938–1965)[60], Danmarks Nationalbank (various years) and Statistics Denmark (various years,a, 1966–2005). The index for farms reflects the sales price per unit of land valuation based on estimated productivity[61] for 1875–1959, and average sales prices per farm for 1960–2005.[62]

[60]Økonomiministeret (1966) publishes an index on the average sales price of single-family houses for five different geographical areas: i) Copenhagen and Frederiksberg; ii) provincial towns; iii) Copenhagen area; iv) towns with more than 1500 inhabitants; and v) other rural communities. Until 1950 the indices refer to properties with a value of 20,000 Danish crowns or less. From 1951 onwards they are based on the average purchase price of properties containing one apartment. According to Økonomiministeret (1966), the break in the series may cause an upward bias for 1950–1951.

[61]Land was valued according to barrel of *hartkorn*, i.e. barley and rye, produced. Thus, the data refers to the price paid per barrel of *hartkorn*.

[62]The index is computed using sales price data for all farms for 1960–1967; for farms between 10 and 100

A second important source for property price development in Denmark is provided by the Danish Central Bank.[63] Drawing on data from the Ministry of Taxation (SKAT) and using the Sale-Price-Appraisal-Ratio (SPAR) as computational method, the bank publishes a quarterly house price series covering data for new and existing, single-family dwellings since 1971 (Danmarks Nationalbanken, 2003).

A third source is Statistics Denmark (2013a). The agency publishes a nationwide house price index for single-family houses as well as for several types of multifamily structures for the time 1992–2012. As in the case of the index by the Danish Central Bank, the index by Statistics Denmark is computed using the SPAR method (Mack and Martínez-García, 2012).

As shown in Figure 42, the property price indices for farms and for single-family houses are strongly correlated for the years they overlap, i.e. for the years since 1938.[64] Kristensen (2007, 12) estimates that at the end of World War II, about 50 percent of the Danish population lived in rural areas. Thus, farm property accounted for a significant share of total Danish property and may be used as a proxy for Danish house prices prior to 1938. Nevertheless, the series for 1875–1937 must be treated with caution when analyzing house price fluctuations in Denmark in this period.[65] Reassuringly, the farm price index for the time prior to World War I appears to coherently mirror the general development of the Danish economy during that period (Nielsen, 1933) and generally accords with accounts of developments in the housing market (Hyldtoft, 1992). Finally, as shown in Figure 43, when comparing the single-family house price indices for 1938–1965, the development of house prices in urban areas does not seem to systematically differ from house prices in rural areas. It is only in the 1960s that urban areas show substantively stronger house price growth compared to rural areas.

hectare for 1968–1975; and for farms between 15 and 60 hectare for 1976–2005. Data is drawn from Statistics Denmark (various years,a), Statistics Denmark (various years,b), Hansen and Svendsen (1968), and Statistics Denmark (1958).

[63] Series sent by email, contact person is Tina Saaby Hvolbøl, Danish Central Bank.

[64] Correlation coefficient of 0.996 for 1938–2005. See also Abildgren (2006, 31).

[65] In 1895 the Danish economy entered a ten year long boom period. During the boom years, many newly established banks extended credit to finance a building boom in Copenhagen that developed into a price bubble in the market for residential property. The optimism started to wane in 1905 and prices substantially contracted during the financial crisis of 1907 (Østrup, 2008; Nielsen, 1933; Hyldtoft, 1992). The price index for farms does, however, not reflect such a boom-bust pattern. There are two possible explanations that may have joint or partial validity: First, since the construction boom was centered in the residential real estate sector, the index for farm prices may not provide an adequate picture of developments in house prices. Second, as the construction boom was concentrated in Copenhagen, the boom and bust may not be visible on the national level.

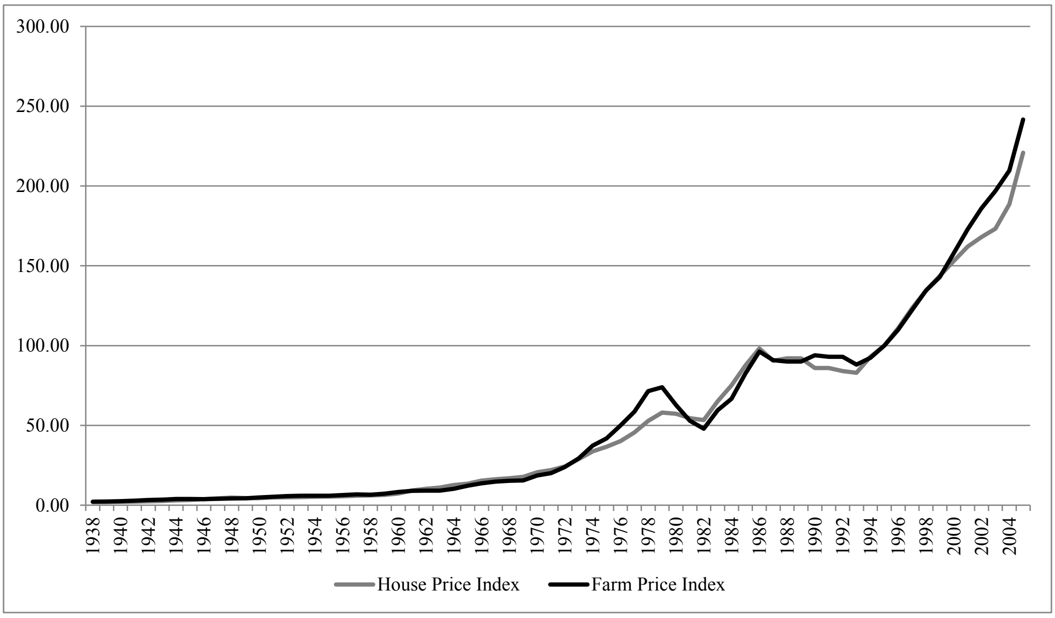


Figure 42: Denmark: nominal house and farm price indices 1938–2005 (1995=100).

The index for single-family houses by Abildgren (2006) and the index by Statistics Denmark (2013a) show to be highly correlated for the years they overlap (1992–2010).[66] This is also the case for the index by Danmarks Nationalbanken, the index by Statistics Denmark (2013a) and the one by Abildgren (2006).[67] To keep the number of data sources to construct an aggregate index to the minimum, the here composed long-run index relies on Danmarks Nationalbanken index for the period since 1971. Our long-run house price index for Denmark 1875–2012 splices the available series as shown in Table 9.

[66]Correlation coefficient of 0.971 for 1992–2010.

[67]The series constructed by Statistics Denmark (2013a) and Danmarks Nationalbanken have a correlation coefficient of 0.999 for 1992–2012. The series constructed by Abildgren (2006) and Danmarks Nationalbanken have a correlation coefficient of 0.999 for 1971–2005.

Period	Series ID	Source	Details
1875–1938	DNK1	Abildgren (2006)	*Geographic Coverage*: Nationwide; *Type(s) of Dwellings*: Existing farms; *Data*: Data from various sources (see text); *Method*: Average prices.
1939–1971	DNK2	Abildgren (2006)	*Geographic Coverage*: Nationwide; *Type(s) of Dwellings*: Existing single-family houses; *Data*: Data drawn from various sources (see text); *Method*: Average prices.
1972–2012	DNK3	Danmarks Nationalbanken	*Geographic Coverage*: Nationwide; *Type(s) of Dwellings*: New and existing single-family houses; *Data*: Ministry of Taxation (SKAT) *Method*: SPAR method.

Table 9: Denmark: sources of house price index, 1875–2012.

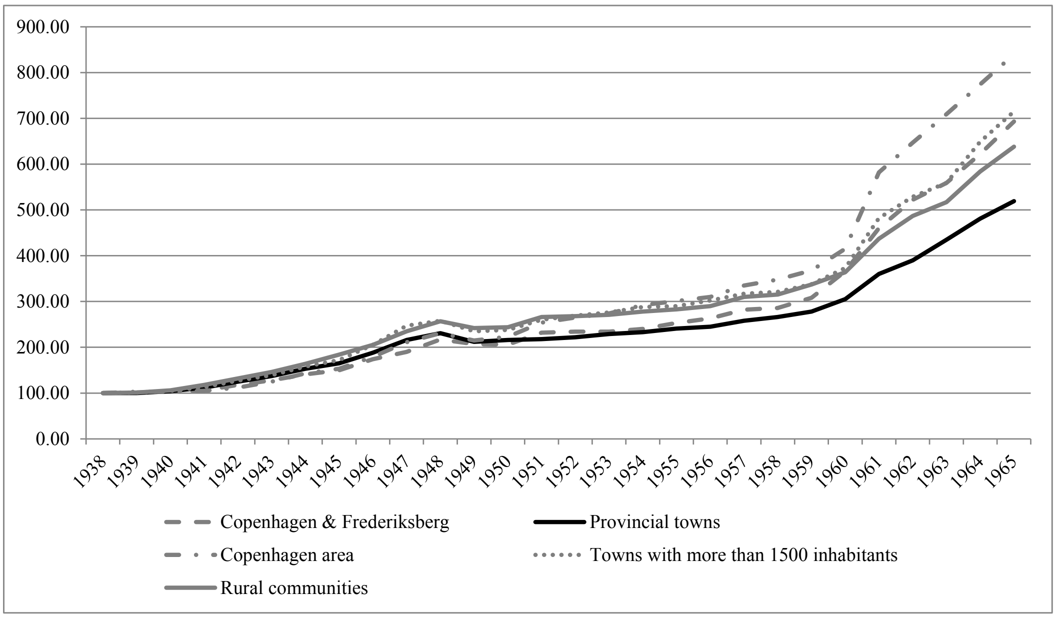


Figure 43: Denmark: nominal single-family house price indices 1938–1965 (1938=100).

The resulting long-run index has two weaknesses: first, the series used for 1875–1938 only reflects the price development of farm property which may deviate to some extent from price developments of other residential properties. Second, the series used for 1875–1970 is adjusted neither for compositional changes nor for quality changes. To gauge the extent of the quality bias we can rely on estimates of the quality effect by Lunde et al. (2013). If we adjust the real annual growth rates of our long-run index downward accordingly, the average annual real growth rate over the period 1875–2012 of 0.99 percent becomes 0.57 percent in constant quality terms. Yet, as this is a rather crude adjustment, we use the unadjusted index (see Table 9) for our analysis.

Housing related data

Construction costs: 1913–2012: Statistics Denmark (various years,b) - Building cost index.

Farmland prices: 1875–2005: Abildgren (2006) - Index for farm property prices; 1870–1912: O'Rourke et al. (1996) - Index for agricultural land values.

Land prices: 1938–1965: Økonomiministeret (1966) - Building sites below 2000 square meters.

Building activity: 1917–1980: Johansen (1985, Table 3.7b) - Number of new flats; 1950–2011: Statistics Denmark (various years,b) - Residential dwellings started.

Homeownership rates: 1930–2013 (benchmark years): Statistics Denmark (2013b).

Value of housing stock: Goldsmith (1985) provides estimates of the value of total housing stock, dwellings, and land for the following benchmark years: 1880, 1900, 1913, 1929, 1938, 1948, 1960, 1965, 1973, 1978.

Household consumption expenditure on housing: 1870–2012: Statistics Denmark (2014).

B.6 Finland

House price data

Historical data on house prices in Finland is available for 1905–2012.

The earliest series at our disposal covers the period 1904–1962. It reports average annual prices of building sites for dwellings per square meter offered for sale by the city of Helsinki (Statistical Office of the City of Helsinki, various years). Drawing on this data source, we construct a three-year-average price index for residential building sites for 1905–1961 to smooth out some of the year-to-year fluctuations stemming from variation in the number of transactions.

A second important source for property price development is Leväinen (1991). Leväinen (1991, 39) using data from different sources computes a building site price index comprising the period 1909–1989.[68] The index is primarily calculated from price data for sites for detached and terraced houses in Southern Finland, particularly in the Helsinki area. Recently, Leväinen (2013) has been able to update his original index such that it now covers the years 1910–2011. Data for the more recent period, 1989–2011, is taken from the National Land Survey of Finland statistics.

A third source that covers the more recent development of residential property prices (1985–

[68]The index is a chain index constructed from several indices for shorter sub-periods. He then calculates the ratios of every two successive years. The resulting index is calculated based on all the ratios between the years. For years for which several data sources are available, Leväinen uses a simple average.

2012) is Statistics Finland. The agency constructs a nationwide house price index for existing single-family dwellings and single-family house plots using a combination of hedonic regression and a mix-adjusted method.[69] Statistics Finland uses data from the real estate register of the National Land Survey containing all real estate transactions (Saarnio, 2006; Statistics Finland, 2013c). A second Statistics Finland index based on the same computational procedure (hedonic regression and mix-adjusted method) and covering the same time period (1985–2012) reports price development for existing dwellings in so-called housing companies, that is block of flats and terraced houses. The index is estimated from asset transfer tax statements of the Tax Administration (Saarnio, 2006; Statistics Finland, 2011).[70]

As one component of its index for dwellings in housing companies, Statistics Finland provides estimates for average prices per square meter of dwellings in old blocks of flats[71] in the center of Helsinki for the period 1947–2012 and for greater Helsinki[72] and Finland as a whole for the period 1970–2012.[73] For the years prior to 1987 Statistics Finland relies on data provided by real estate agencies. For the years since 1987 data is drawn from the asset transfer tax statements of the national Tax Administration.[74]

Figure 44 depicts the nominal HSY site price index and the site price index from Leväinen (2013) for the period 1904–1945 (1920=100). Both indices consistently show two major boom periods: the first occurs during the second half of the 1900s, peaking around 1910; the second, more dynamic one, begins in the early 1920s. Between the first and the second boom period, i.e. during World War I, residential construction declined rapidly; particularly in urban areas (Heikkonen, 1971, 289), as did real house prices. For the second boom period, i.e. for the time during the 1920s, the two indices provide a disjoint and inconsistent picture with respect to duration and turning points. While the Leväinen index insinuates a more than tenfold increase in real terms from trough to peak (1920–1931), the one based on the data in the Helsinki Statistical Yearbook (HSY) reports a sevenfold rise between the trough in 1921 and the

[69]Dwellings are stratified by type, number of rooms and location. A hedonic regression is then applied to estimate the price index for each stratum. The strata are combined using the value of the dwelling stock as weights. For details on the classification and the regression model see Saarnio (2006).

[70]Before February 2013 this price series was named 'Prices of Dwellings.' In Finland, dwellings are not classified as real estate but detached houses are. That is the reason there are two different series: one for dwellings and the other one for real estate.

[71]'Old' refers to blocks of flats that are not built in the year of the statistics and the year before (i.e. in the statistics for 2012, old dwellings are all dwellings built before 2011).

[72]Greater Helsinki includes the cities Helsinki, Espoo, Vantaa and Kauniainen. Series sent by email, contact person is Petri Kettunen, Statistics Finland.

[73]According to Statistics Finland, the data for the center of Helsinki quite well represents prices of dwellings in Finland before 1970 (email conversation with Petri Kettunen, Statistics Finland). Subsequently, however, the prices in Helsinki increased stronger than in the rest of the country.

[74]The structural beak observable between 1986 and 1987 is not only due to the above described adjustment of the database but is also, at least in parts, caused by methodological changes, where the year 1987 marks the transition from the fixed weighted Laspeyres-type unit value to the above mentioned combined hedonic and mix-adjusted computation method. For the period 1975–2012 the Federal Reserve Bank of Dallas splices together the nationwide house price index for existing, single-family dwellings (1985–2012) and the price series for existing flats (1975–1985).

peak in 1929. An even more pronounced divergence between the two indices can be identified for the post-Depression period: While the Leväinen-index continues to rise throughout the years of the Great Depression and the first years of World War II, the HSY-index declines by about 20 percent between 1929 and 1933, and only recovers around 1936 before collapsing again throughout the years of World War II. Against the background of partly inconsistent information the question arises, which of the two indices reflects a more plausible development of real estate prices in Finland between the mid-1920s and the end of World War II. In this context it is important to note that neither indicator covers Finland as a whole; instead both indices solely focus on the Helsinki area. While one may argue that a boom in site prices is unlikely to occur in a period of depression such as during the early 1930s, there are examples of stagnant (UK) or even increasing (Switzerland) house prices during that period. In Switzerland the positive trend in house prices and construction activity was primarily driven by low building costs and easy credit (cp. Section B.13). For the example of Britain, a quick recovery in construction activity after an initial fall in the early years of the depression is observable while house prices remained very stable (see Section B.14). In the case of Finland, construction activity - as indicated above - strongly re-bounced after 1933 and thus may have also contributed towards a stabilization of site prices. Construction activity peaked in 1937/38 and contracted thereafter making a continued increase in site prices until 1942, also in the wake of World War II, appearing unreasonable. Therefore, the empirical analysis undertaken here relies on the HSY-index for the period prior to 1947.

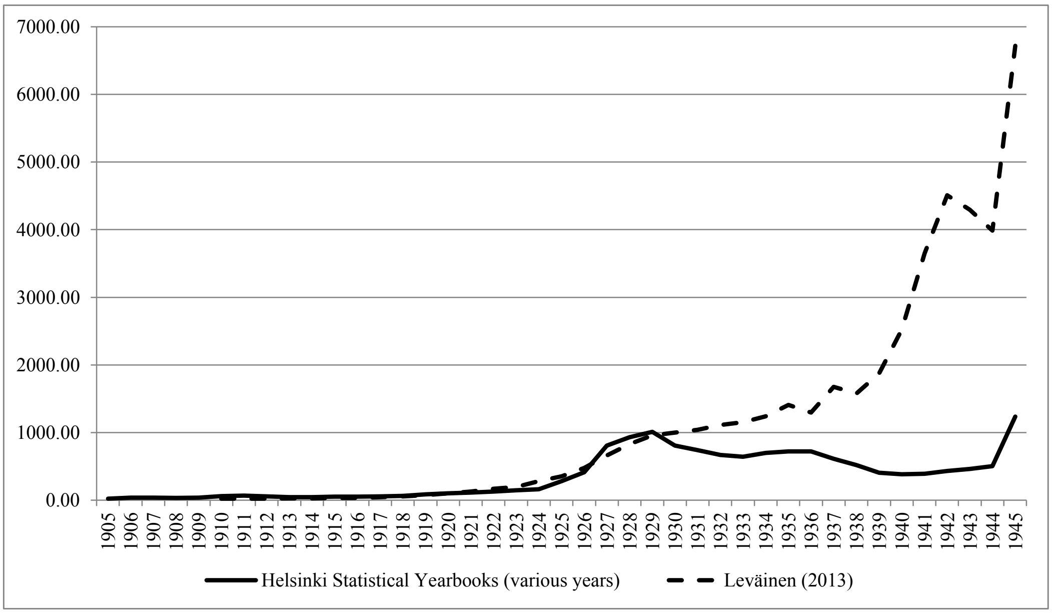


Figure 44: Finland: nominal house price indices 1905–1945 (1920=100).

Thus far, the present survey of Finnish property prices has focused on site prices in the Helsinki area, rather than house prices, since information on the latter is not available for the years prior to 1947. Yet, building site prices can be considered to be a good proxy for house prices as they tend to show similar developments. For example, the series for old blocks of flats in the center of Helsinki as published by Statistics Finland for 1947–2012 is highly correlated with Leväinen's site price index.[75] Nevertheless, there may be minor differences with regard to amplitudes and timing of house price cycles.

Figure 45 compares the nominal house price indices available for 1947–2012, i.e. the indices for dwellings in old blocks of flats (Helsinki, Greater Helsinki, Whole Country) and the indices for single-family dwellings (Helsinki, Greater Helsinki, Whole Country). All indices are available from Statistics Finland. Figure 45 indicates that all indices follow the same pattern for the period under consideration: a house prices boom that peaks in the early 1970s and is followed by a slump; a boom during the late 1980s with a subsequent recovery; a third contraction in the early 1990s followed by a strong rise from the mid-1990s until the onset of the Great Recession. The data only shows minor divergence in amplitudes and timing of house price cycles between old blocks of flats and single-family houses. For the sake of coherence with respect to property types, the long-run index uses the data for old blocks of apartments also for the post-1970 period. The index covering the center of Helsinki depicts the boom of the 1990s/2000s to be stronger than when considering Finland as a whole. Hence, for the years since 1970 we use the nationwide series for old blocks of flats. Our long-run house price index for Finland for 1905–2012 splices the available series as shown in Table 10.

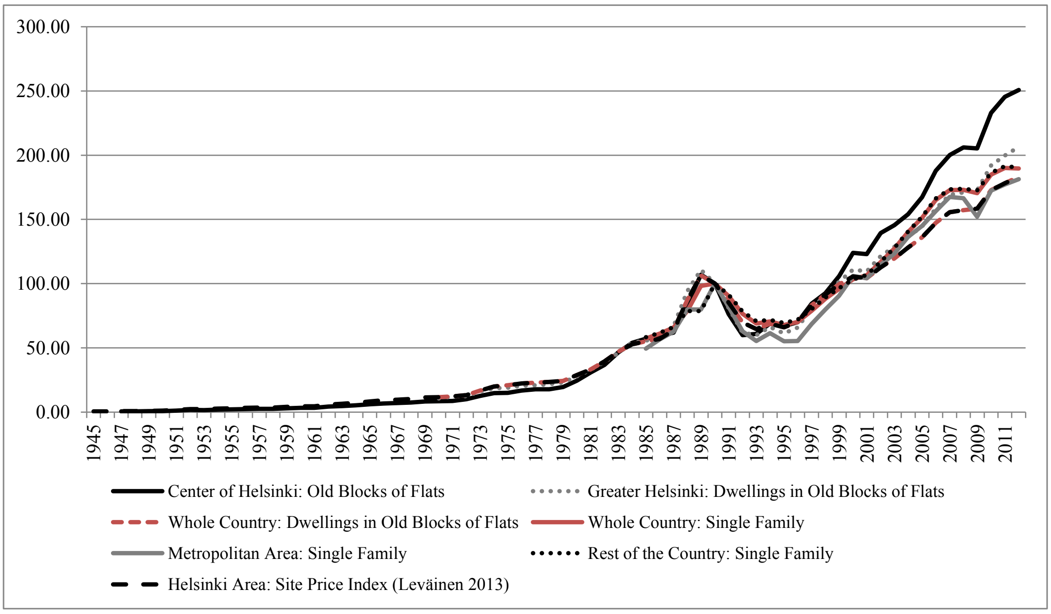


Figure 45: Finland: nominal house price indices 1945–2012 (1990=100).

Consequently, the long-run index controls for quality changes only after 1970. For 1905–1947, the index refers to building sites and thus should not be diluted by unobserved changes in quality. In contrast, since for 1947–1969 the index is only based on simple average prices, it

[75]Correlation coefficient of 0.96.

Period	Series ID	Source	Details
1905–1946	FIN1	Statistical Office of the City of Helsinki (various years)	*Geographic Coverage*: Helsinki; *Type(s) of Dwellings:* Residential building sites; *Data*: Sales prices; *Method*: Three year moving average of average prices.
1947–1969	FIN2	Statistics Finland	*Geographic Coverage*: Center of Helsinki; *Type(s) of Dwellings*: Dwellings in existing blocks of flats; *Data*: Data from Statistics Finland; *Method*: Average prices.
1970–2012	FIN3	Statistics Finland (2011)	*Geographic Coverage*: Nationwide; *Type(s) of Dwellings*: Dwellings in existing blocks of flats; *Data*: Data from Statistics Finland; *Method*: Hedonic mix-adjusted method.

Table 10: Finland: sources of house price index, 1905–2012.

may be biased due to quality changes in the structures that are not controlled for. Since the series is restricted to one very specific market segment (i.e. existing apartments in the center of Helsinki), compositional bias should not play a major role.

Housing related data

Construction costs: 1870–2012: Hjerppe (1989) and Statistics Finland (various years) - Building cost index.

Farmland prices: 1985–2012: National Land Survey of Finland[76] - Median transaction price of agricultural land per hectare.

Housing production: 1860–1965: Heikkonen (1971); 1952–1991: Statistics Finland (various years); 1990–2012: Statistics Finland (2013a).

Homeownership rates: 1970–2012 (benchmark years): Statistics Finland (2013b).

Household consumption expenditure on housing: 1870–1970: Statistics Finland (2014a), 1975–2012: Statistics Finland (2014b).

B.7 France

House price data

Historical data on house prices in France is available for 1870–2012

The most comprehensive single source for French house price data is the dataset provided by the Conseil General de l'Environnement et du Developpement Durable (2013b, CGEDD).

[76] Series sent by email, contact person is Juhani Väänänen, National Land Survey of Finland

It contains a national repeat sales index for all categories of existing residential dwellings, i.e. apartments and single-family houses, for the period 1936–2013.[77] Prior to 1999, the index is based on data drawn from two national notarial databases.[78] Even though these databases were only established in the 1980s, they also include information on earlier real estate transactions (Friggit, 2002). For the post-1999 period, CGEDD splices this index with a mix-adjusted hedonic index by the National Institute of Statistics and Economic Studies (2012, INSEE) for existing detached houses and apartments in France (see below).

In addition to the national index, Conseil General de l'Environnement et du Developpement Durable (2013b) also publishes a price index for residential property in the greater Paris area. Combining several different data sources the index has been extended back to 1200. For the time period analyzed in this paper (1870–2012), the Paris index has been composed from three different data series. The first part of the index (1840–1944) is based on a repeat sales index by Duon (1946) using data gathered from property registers of the national Tax Department. It covers apartment buildings such that commercial properties, single-family houses, or apartments sold by the unit remain excluded.[79] The second part of the index (1944–1999) is based on price data for apartments sold by the unit compiled by CGEDD from the notaries' database and calculated using the repeat sales method. As raw data, however, is only available for the time 1950–1999, the gap between the index by Duon (1946) and the one calculated by CGEED, i.e. the years 1945–1949, has been filled applying simple linear interpolation (Friggit, 2002). For the post-1999 period, the index is again spliced with an index by National Institute of Statistics and Economic Studies (2012) for existing apartments in Paris (Beauvois et al., 2005).

A second important source for French house prices is the National Institute of Statistics and Economic Studies (2012, INSEE). For the years since 1996, INSEE publishes a mix-adjusted hedonic nationwide house price index for all types of existing dwellings as well as two sub-indices for existing detached houses and apartments (Beauvois et al., 2005). In addition, the agency provides regional sub-indices for Paris, Provence-Alpes-Cote d'Azur, Rhone-Alpes, Mord-Pas-de-Calais, and Provence.[80] As CGEDD, also INSEE draws on sales price data from the two national notarial databases.

Figure 46 compares the nominal indices available for 1936–2012, i.e. the indices for France and Paris published by Conseil General de l'Environnement et du Developpement Durable (2013b), and the nationwide house price index published by National Institute of Statistics

[77]For more information, see Conseil General de l'Environnement et du Developpement Durable (2013b).

[78]The two databases are: The *BIEN base*, managed by the Chambre Interdépartmentale des Notaires de Paris (CINP) that covers the Paris region and the *Perval France base*, which is managed by Perval, a Conseil Supérieur du Notariat (CSN) subsidiary, that covers the provinces. For a detailed discussion of the notarial databases the reader is referred to Beauvois et al. (2005, 25 ff.).

[79]Prior to World War I, apartments could not be sold by the unit. There were few such transactions in the interwar period.

[80]For the period 1975–2012, the Federal Reserve Bank of Dallas splices together the CGEDD nationwide house price index for existing, single-family dwellings (1975–1995) and the INSEE price index for all types of existing dwelling (1996–2012).

and Economic Studies (2012). It shows that throughout the years 1936–1976 the Paris index is in cadence with the CGEDD France and the INSEE national indices. Considering also the broad macroeconomic trends prior to 1936 and narrative evidence on developments in the French housing market, the Paris index may serve as a fairly reliable measure for the trends in national house prices.[81] We have to keep in mind, however, that Parisian house prices may for some years not be a reliable proxy for house prices in France as a whole.[82] Friggit, for example, suggests that real house prices in Paris were more devalued during World War I than in other parts of France.[83] According to Friggit (2002), also the national index for the time prior to 1950 can only serve as a rough estimate of the true development of house prices in France. Moreover, the index may be biased upwards in the 1950s as there may be a substantial price difference between rented and vacant properties with rented properties having a lower price than vacant houses. Friggit (2002) emphasizes that the share of vacant properties sold particularly increased in the 1950s, thus diluting the quality of the index by overestimating the price increase during this decade (Friggit, 2002).

[81] The second half of the 19th century, particularly the time during the second phase of the industrial revolution, featured rapid population growth and urbanization that lead to an increase in rents, property prices, and construction activity (Price, 1981; Caron, 1979). In the wake of the Franco-Prussian war of 1870, this trend came to a temporary halt. To service its reparation obligations France heavily relied on domestic borrowing with adverse effects on interest rates: While the yield for government security substantively increased, the return from real estate due to higher financing cost declined, making it a relatively less attractive investment (Price, 1981; Friggit, 2002). In the second half of the 1870s building activity resumed despite the continuing Long Depression. An important factor in this building boom, according to Caron (1979, 66 f.), was what he calls *"rural exodus"* and the associated ongoing urbanization. The increase in the demand for housing in urban areas resulted in a substantive increase in the price of building land and rents (Lescure, 1992). The national rent index increased by 14 percent between 1876 and 1900, clearly outperforming the trend in general cost of living during that time. The boom that peaked in the years 1876–1882 was further fueled by optimistic expectations of investors. Following the Paris Bourse market crash and the failure of the Union General Bank in 1882, France went into the deepest and longest recession and financial crisis in the 19th century. With France's national income declining from 1882 to 1892 and less people leaving the rural areas to move into cities, construction activity stagnated until about 1906 (Caron, 1979, 66 f.). The effects of World War I on real house prices were quite severe and long-lasting. Wartime rent controls remained in place throughout the interwar period dampening the profitability of property investments (Lescure, 1992; Duclaud-Williams, 1978). Only by the mid-1920s, real house prices started to recover and subsequently also fared comparably well after the stock market crash in 1929. According to Friggit (2002), investors were – distrusting any kind of financial instrument – eager to substitute their stock and bond holdings for real estate.

[82] The house price index for Paris only refers to apartment buildings. Apartment buildings were, however, the most important part of the Parisian property market at the time since prior to World War I only about 3.3 percent of houses in Paris were owner occupied. As noted before, apartments could not be sold by the unit before World War I and there were only few such transactions in the interwar period.

[83] Email conversation with Jacques Friggit. Rent controls introduced during the war years reduced real returns from investment in residential real estate and hence its value (Friggit, 2002). Rent controls were not abandoned in the interwar period but alternately relaxed and tightened which may have depressed the value of apartment buildings vis-à-vis other real estate.

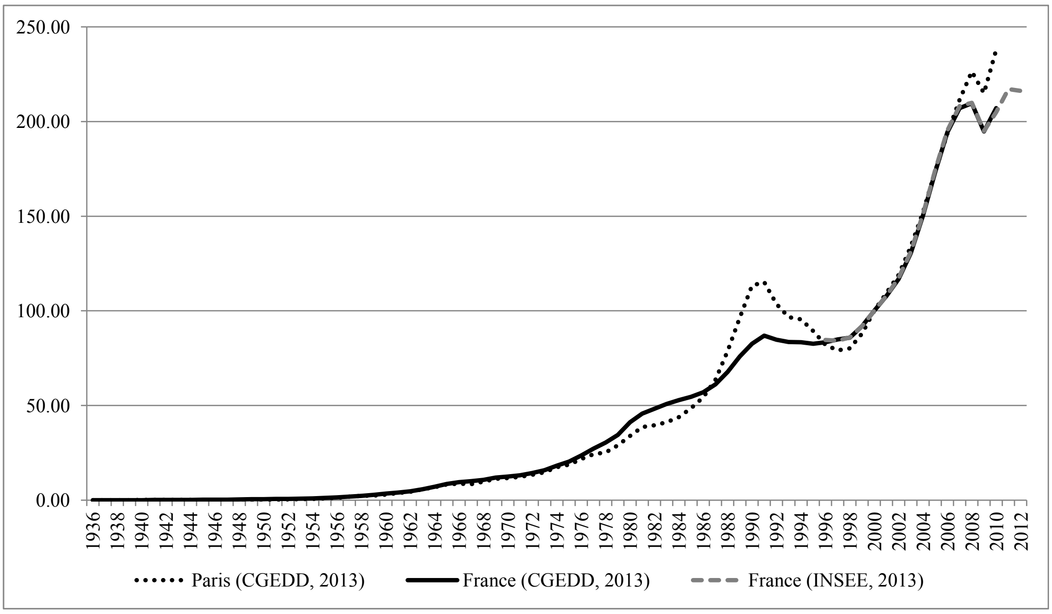


Figure 46: France: nominal house price indices 1936–2012 (1990=100).

When examining the three indices during the second half of the 20th century in Figure 46, it shows that the Paris index is lower than the national index for 1976–1986 but then surpasses the national index increasing strongly until 1991 before reverting to the national level. According to Friggit (2002), this boom and bust pattern was primarily a feature of the Paris region and a few other areas such that it is barely detectable in the national index. For the period 1996–2012, the INSEE and the CGEDD index show an almost identical development. Overall, French house prices rapidly increased since the late 1990s. The CGEDD Paris index moves in lock-step with the two national indices until 2008 and subsequently shows a comparably stronger increase.

Given the data availability, our long-run house price index for France 1870–2012 splices the indices as shown in Table 11. The long-run index has two major drawbacks: First, as no house price series for France as a whole is available for the years prior to 1936, we rely on the CGEDD Paris index instead. Second, despite the fact that by using the repeat sales method the effect of quality differences between houses is somewhat reduced, it does not control for all potential changes in the quality and standards of dwellings over time.

Housing related data

Construction costs: 1914–2012: Conseil General de l'Environnement et du Developpement Durable (2013a) - Construction cost index.

Building production: 1919–2012: Conseil General de l'Environnement et du Developpement Durable (2013a) - Building starts.

Homeownership rates: 1955–2011 (benchmark years): Friggit (2010).

Period	Series ID	Source	Details
1870–1935	FRA1	Conseil General de l'Environnement et du Developpement Durable (2013b)	*Geographic Coverage*: Paris; *Type(s) of Dwellings*: Apartment buildings; *Data*: Data from property registers of the Tax Department; *Method*: Repeat sales method.
1936–1996	FRA2	Conseil General de l'Environnement et du Developpement Durable (2013b); based on Antwerpsche Hypotheekkas (1961)	*Geographic Coverage*: Nationwide; *Type(s) of Dwellings*: All types of existing dwellings; *Data*: Notarial database; *Method*: Repeat sales method.
1997–2012	FRA3	National Institute of Statistics and Economic Studies (2012)	*Geographic Coverage*: Nationwide; *Type(s) of Dwellings*: All types of existing dwellings; *Method*: Hedonic, mix-adjusted index.

Table 11: France: sources of house price index, 1870–2012.

Value of housing stock: Goldsmith (1985) provides estimates of the value of total housing stock, dwellings, and land for the following benchmark years: 1880, 1913, 1929, 1950, 1960, 1972, 1977. Data on the value of household wealth including the value of total housing stock, dwellings, and land for 1978-2011 is drawn from OECD (2013). Piketty and Zucman (2014) also present data on real estate wealth for benchmark years in the period 1870–1954 and for 1970–2011.

Household consumption expenditure on housing: 1896–1936: Villa (1994); 1959–2012: National Institute of Statistics and Economic Studies (2013).

B.8 Germany

House price data

Historical data on house prices in Germany is available for 1870–1938 and 1962–2012.

Statistics Berlin (various years) in its yearbooks reports data on transactions of developed lots, i.e. lots including structures, in the city of Berlin for 1870–1918.[84] We compute an annual index from average transaction prices. As the source does not provide details on the lots sold, it is impossible to control for size, number of structures erected on the lot, and type or use of buildings (commercial or residential).

A second source for German house prices is Matti (1963). Matti (1963) presents data on the price of developed lots (number of transactions, average sales price per square meter in

[84]The yearbooks include the number of lots sold and the total value of all transactions. No data is available for 1911 and 1914.

German Mark) for the city of Hamburg for 1903–1935.[85] While it is, as in the case of the data for Berlin, impossible to account for the number of structures on the lot and the type or use of buildings in computing the index, we can at least control for the size of the lot. In addition to this series, Matti (1963) for 1955–1962 computed a lot price index for Hamburg using data on average sakes prices per square meter.

As a third source, the Statistical Yearbooks of German Cities (Association of German Municipal Statisticians, various years)[86] reports transaction data for developed lots for 1924–1935 and for building sites for 1935–1939.[87] For each year, information is available on the number of lots sold, the total size of lots sold, and the total value of all transactions in the city or municipality. No information on the type or use of property (residential or commercial) is included.[88]

A fourth source for real estate prices is the Federal Statistical Office of Germany (various years,b). The agency publishes nationwide data on average building site sales prices per square meter for the years since 1962.[89] For the years since 2000 the Federal Statistics Office produces a hedonic national house price index for new owner-occupied dwellings as well as three sub-indices for i) turnkey homes; ii) built to order homes; and iii) prefabricated homes (Dechent, 2006).[90] In addition, for the years since 2000, the Federal Statistics Office produces house price indices comprising both owner-occupied and rental properties for i) new and existing dwellings; ii) existing dwellings; and iii) new dwellings (Dechent and Ritzheim, 2012). The indices are computed using data compiled from the local Expert Committees for Property Valuation (Gutachterausschüsse für Grundstückswerte).

Finally, the German Central Bank produces two sets of house price indices: i) a set of indices covering 100 West- and 25 East-German agglomerations with a population above 100,000 since 1995; and ii) a set of indices covering only Western German agglomerations for 1975–2010. The first set includes house price indices for the following building types: i) all types of existing dwellings; ii) all types of new dwellings; iii) existing terraced single-family houses;[91] iv) new terraced single-family houses; v) existing flats; and vi) new flats (Deutsche Bundesbank, 2014).[92] The indices are computed using data collected by BulwienGesa AG.[93] Population is used as

[85] Data for the years of the German hyperinflation, i.e. 1923 and 1924, are missing.

[86] The Statistical Yearbook of German Cities was published until 1935 and succeeded by the Statistical Yearbook of German Municipalities.

[87] The series includes data on public and private transactions.

[88] Wagemann (1935) publishes an index computed from this data for 'representative cities' for 1925–1935.

[89] For years prior to 1991, the data only covers West-Germany. Since 1992 it includes all German federal states (Federal Statistical Office of Germany, various years,b).

[90] The hedonic regression controls for a variety of characteristics such as the size of the lot, living space, detached house, basement, parking space, and location (Dechent, 2006, 1292 f.). The aggregate index is weighted by the market share of the respective property type in a certain period (Dechent, 2006, 1294).

[91] Terraced houses are single-family dwellings with a living space of about 100 square meters (Bank for International Settlements, 2013).

[92] Series available from the Bank for International Settlements (2013, BIS).

[93] Data sources include the Association of German Real Estate Agents (Immobilienverband Deutschland);

weights (Bank for International Settlements, 2013; Mack and Martínez-García, 2012). The indices do not control for quality differences between houses or quality changes over time but only cover properties that provide *"comfortable living conditions"* and are located in *"average to good locations."* By confining the indices to this market segment, the effect of quality differences may be somewhat reduced (Bank for International Settlements, 2013; Deutsche Bundesbank, 2014). The second set of indices, for West-German agglomerations 1975–2012, also draws on data provided by BulwienGesa.[94] They cover 100 Western German towns since 1990 and 50 Western German towns in the years 1975–1989. Indices are available for the following types of property: i) all kinds of new dwellings; ii) new terraced houses; iii) new flats; and iv) building sites for detached single-family dwellings.[95] The indices are also weighted by population (Bank for International Settlements, 2013; Mack and Martínez-García, 2012), do not control for quality differences but are again confined to dwellings providing *"comfortable living conditions"* located in *"average to good locations"* (Bank for International Settlements, 2013; Deutsche Bundesbank, 2014). The index for new terraced houses (ii) has been extended back to 1970 (cf. OECD Database).[96]

Figure 47 depicts the nominal indices calculated from the data for Berlin and for Hamburg for 1870–1935. While the Berlin index is the only one available for 1870–1903, its development accords with narrative and scattered quantitative evidence on other German housing markets for the years prior to World War I, such as Carthaus (1917), Führer (1995), Rothkegel (1920), and Ensgraber (1913).[97] In the most general terms, these accounts describe the years of the German Empire as a period of a considerable, yet non-linear, upward trend. All urban areas discussed experienced boom years as well as years of crises that emanated from the macro-economic volatilities of the time (Führer, 1995). While the exact timing of troughs and peaks differed across cities, the local house price cycles nevertheless correspond. During the years of World War I and German hyperinflation, nominal house prices skyrocket across the board but lag inflation.[98] As we see in Figure 47, the indices for Berlin and Hamburg depict a similar trend for the years they overlap.

Chambers of Industry and Commerce, Building & Loan Associations, research institutions, own surveys, newspaper advertisements, and mystery shoppings (Bank for International Settlements, 2013).

[94]Series available from Bank for International Settlements (2013).

[95]The indices for flats and building sites for detached single-family dwellings are adjusted for size, i.e. refer to prices per square meter. The indices for all kinds of new dwellings and terraced houses refer to prices per dwelling (Bank for International Settlements, 2013).

[96]Mack and Martínez-García (2012) stress, however, that this index may also include existing dwellings.

[97]Rothkegel (1920) focuses on Mariendorf, a suburbian part of Berlin; Ensgraber (1913) on Darmstadt. Carthaus (1917) presents a more comprehensive description and covers developments in Dresden, Munich, and Berlin. Führer (1995) focuses in housing policy.

[98]A contributing factor to the collapse of real house prices may have been the introduction of rent controls and strong tenant protection during the war years. State control of rents and legal protection of tenants became permanent law during the 1920s (Teuteberg, 1992).

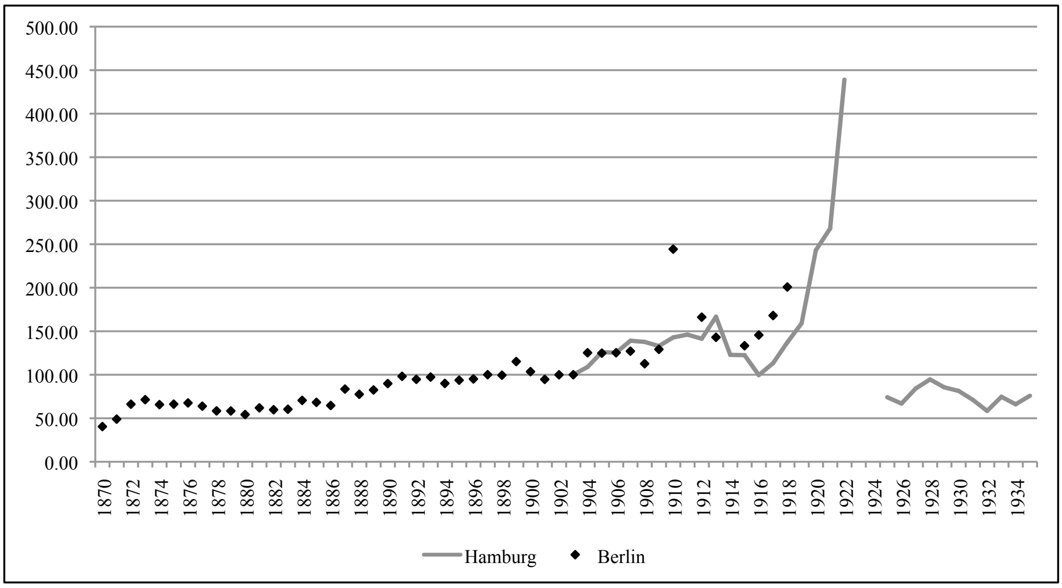


Figure 47: Germany: nominal house price indices 1870–1935 (1903=100).

Figure 48 compares the indices that are available for 1924–1938. For these years, the Statistical Yearbooks of German Cities and the Statistical Yearbooks of German Municipalities provide property price data with a wider geographic coverage (see above). With the information available, it is possible to calculate average transaction prices in German Mark per square meter of developed lots. Based on data for ten cities and municipalities for which data coverage is complete in the years from 1924–1938, we compute a weighted 10-cities index.[99] When comparing the index computed from data published by Matti (1963) and the index computed from average transaction prices for the ten German cities, it shows that - while far away from perfect lockstep - they generally follow the same trend.[100] This observation is somewhat reassuring as it supports the assumption that the index by Matti (1963) may also for the earlier years (i.e. 1903–1922) serve as a more or less reliable proxy for urban property prices in Germany in general. The two indices show that lot prices substantively increased after 1924 and peaked in 1928 (Matti, 1963) and 1929 (10 cities), respectively. During the first years of the Great Depression nominal property prices contracted and only started to recover in 1936.

[99]The number of transactions is used as weights.
[100]Correlation coefficient of 0.73.

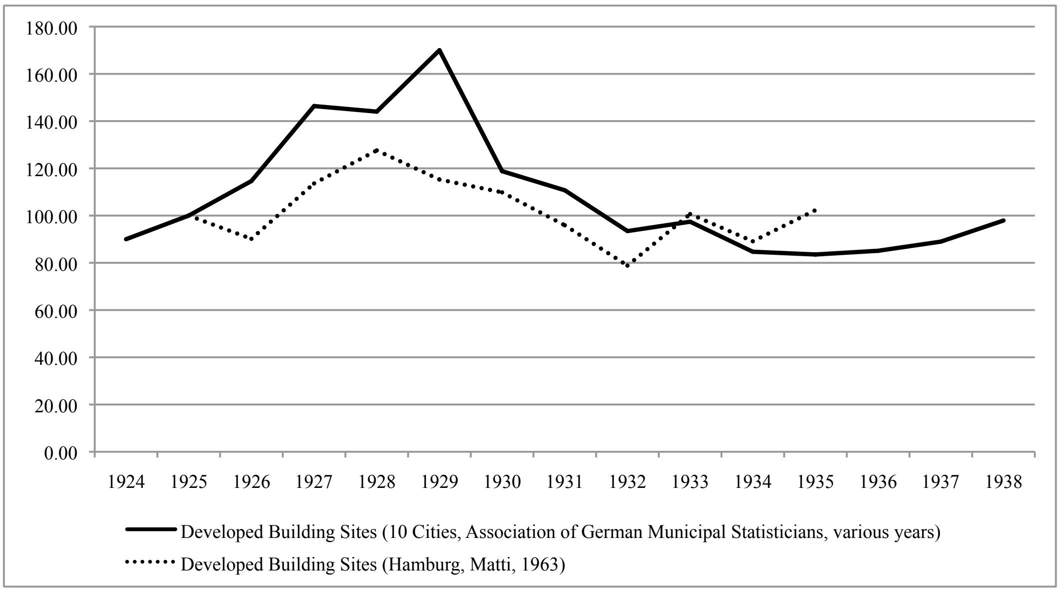


Figure 48: Germany: nominal house price indices 1924–1938 (1925=100).

For the years they overlap and only cover Western Germany, i.e. 1970–1991, the index computed from building site prices (Federal Statistical Office of Germany, various years,b) and the urban index for new terraced dwellings produced by the German Central Bank[101] are highly correlated.[102] Hence, we assume that prices for building land may serve a good approximation for house prices prior to 1970.

Our long-run index for Germany splices the available series as shown in Table 12. For 1870–1902 we use the index for Berlin but rely on the index for Hamburg for 1903–1923 mainly for two reasons: first, in contrast to the Berlin index, the Hamburg index controls for the size of the lots sold and may hence be considered a more reliable indicator of price developments. Second, the boom in Berlin between 1902 and 1906 was stronger and the recession preceding World War I started earlier than in most other German urban housing markets (Carthaus, 1917). For 1924–1938 we use the index for 10 cities due to its wider geographical coverage.

Unfortunately, price data for houses or building lots to the authors knowledge is not available for the period 1939–1954 such that a complete index for house prices can only be constructed for the period since 1955. For the years 1955–1962 the development of real estate prices could be approximated using the building site index for Hamburg (Matti, 1963). This index, however, reports a quintupling of prices between 1955–1962 (Matti, 1963). Although the 1950s and 1960s are generally described as a time of rising house and land prices (see below) such a tremendous price spike has not been acknowledged in the literature and therefore must be considered to either have been specific to the city of Hamburg or to have resulted from measurement errors. Accordingly, the index by Matti (1963) is not used for the construction of the long-run real

[101] Bank for International Settlements (2013); extended to 1970 as reported in the OECD database.
[102] Correlation coefficient of 0.992.

estate price index for Germany. Instead, the here constructed index only starts in 1962 and for the period from 1962 to 1970 relies on price data of building sites per square meter.[103] To obtain our long-run index, we link the two sub-indices, i.e. 1870–1938 and 1962–2012, assuming an average increase in prices of building sites of 300 percent based on the results of a survey conducted by Deutsches Volksheimstättenwerk (1959).

The index suggests that real estate prices more than doubled during the 1960s. Overall, a strong increasing trend in property values during the 1960s seems plausible for the following reasons: first, during the 1950s and 1960s, Germany experienced strong economic growth, also referred to as the 'Wirtschaftswunder' (economic miracle). Second and more importantly, price controls for building sites which had been introduced in 1936 were only fully abolished in the Bundesbaugesetz of 1960. Building site prices had, however, already increased tremendously during the years preceding the repeal of the price control. At the time this development was vividly discussed (DER SPIEGEL, 1961; Koch, 1961). According to Deutsches Volksheimstättenwerk (1959), building site prices in 1959, i.e. a year before the price controls had been officially repealed, stood at a level of 250 to 300 percent of the officially still binding price ceiling price established in 1936. After the repeal of the price controls, building site prices surged. Third, rent control and tenant protection laws were gradually relaxed in the 1950s and 1960s. By 1965, rent control had been with the exception of some larger cities been fully abolished. As a result, rents strongly increased during the 1960s making investment in new housing more profitable. For the time since 1971, we use the urban index for new terraced dwellings produced by the German Central Bank (as reported by Bank for International Settlements (2013)).

The index has, however, three flaws: First, while the Hamburg and Berlin indices appear to well reflect the developments in housing markets as discussed in the literature, it - due to the limited availability of property price data – remains uncertain to what extent they can be considered a fully reliable image of the national trend. A second limitation of the index prior to 1938 remains the lack of correction for changing structural characteristics of and quality differences between the developed lots as well as quality change in the structures built on these lots over time. Third, for 1970–2012, the extent to which the effect of quality differences are indeed reduced through confining the index to a certain market segment remains difficult to determine.

Housing related data

Construction costs: 1913–2012: Federal Statistical Office of Germany (2012a) - Wiederherstellungswerte für 1913/1914 erstellte Wohngebäude.

Farmland prices: 1961–2012: Federal Statistical Office of Germany (various years,a,v) -

[103] Actual coverage: 1962—2012; Federal Statistical Office of Germany (various years,b).

Period	Series ID	Source	Details
1870–1902	DEU1	Statistics Berlin (various years)	*Geographic Coverage*: Berlin; *Type(s) of Dwellings*: All kinds of existing dwellings; *Data*: Sales prices collected by Statistics Berlin; *Method*: Average transaction prices.
1903–1923	DEU2	Matti (1963)	*Geographic Coverage*: Hamburg; *Type(s) of Dwellings*: All kinds of existing dwellings; *Data*: Sales prices collected by Statistics Hamburg; *Method*: Average transaction prices.
1924–1938	DEU3	Association of German Municipal Statisticians (various years)	*Geographic Coverage*: Ten cities; *Type(s) of Dwellings*: All kinds of existing dwellings; *Data*: Sales prices collected by the city's statistical offices; *Method*: Weighted average transaction price index.
1939–1961		Deutsches Volksheimstättenwerk (1959)	*Geographic Coverage*: Western Germany; *Type(s) of Dwellings*: Building sites; *Data*: Data collected through survey; *Method*: Estimated increase in sales prices.
1962–1970	DEU4	Federal Statistical Office of Germany (various years,b)	*Geographic Coverage*: Western Germany; *Type(s) of Dwellings*: Building sites; *Data*: Sales prices collected by the Federal Statistical Office of Germany; *Method*: Average sales prices.
1971–1995	DEU5	Bundesbank as reported by OECD	*Geographic Coverage*: Urban areas in Western Germany; *Type(s) of Dwellings*: New terraced homes; *Data*: Various data sources collected by BulwienGesa *Method*: Weighted average sales price index.
1995–2012	DEU6	Bundesbank as reported by OECD	*Geographic Coverage*: Urban areas in Western Germany; *Type(s) of Dwellings*:New and existing terraced homes; *Data*: Various data sources assembled by BulwienGesa *Method*: Weighted average sales price index.

Table 12: Germany: sources of house price index, 1870–2012.

Selling price for agricultural land per hectare.

Homeownership rates: 1950–2006 (benchmark years): Federal Statistical Office of Germany (2011).

Value of housing stock: Goldsmith (1985) provides estimates of the value of total housing stock, dwellings, and land for the following benchmark years: 1875, 1913, 1929, 1950, 1978. Data on the value of household wealth including the value of dwellings, and underlying land for 1991-2011 is drawn from OECD (2013). Piketty and Zucman (2014) also present data on real estate wealth for benchmark years in the period 1870–2011.

Household consumption expenditure on housing: 1870–1938: Hoffmann (1965); 1950–1969: Federal Statistical Office of Germany (1990); 1970–1990; Federal Statistical Office of Germany (2012b); 1991–2012: Federal Statistical Office of Germany (2013).

B.9 Japan

House price data

Historical data on house prices in Japan are available for the time 1881–2012.

The earliest data is provided by the Bank of Japan (1970a) and reports prices for rural residential land (measured in Yen/10 are) for selected years during the period 1880–1915 in the Tokyo prefecture (today referred to as greater Tokyo metropolitan area) and for Japan as a whole (national average). The data is based on public surveys conducted for the purpose of land taxation assessments. Average prices at the national level and for the greater Tokyo area were originally published in the Teikoku Statistics Annual. The data indicates a structural break in prices for residential sites in 1913. Presumably, this break has been caused by the 1910 Residential Land Price Revision Law that was associated with a sharp increase in the valuation price of residential lots (Bank of Japan, 1970a).

For 1913–1930 the Bank of Japan (1986a) using data from the division of statistics of the city of Tokyo reports a land price index for urban land covering six cities.[104] The database also contains a paddy field price index for 1897–1942.

For 1936–1965 the Bank of Japan (1986b) reports four indices; i.e. an urban average land price index, an urban commercial land price index, an urban residential land price index, and an urban industrial land price index calculated from the all-cities and the-six-largest-cities sample, respectively. Furthermore, the database (Bank of Japan, 1986b) contains farm land prices for paddy fields for the period 1913–1965. The land prices are measured in Yen/10 are and are available for eleven districts and as average of all districts. These prices are prices realized in

[104] Tokyo, Kyoto, Osaka, Yokohama, Kobe, and Nagoya (Nanjo, 2002).

transactions where the farm land remained owner-operated (i.e. transactions in which the land was sold, for example, for road construction are excluded) and were collected through land assessors' surveys .(Bank of Japan, 1970b).

For the periods 1955–2004 and 1969–2012 urban land price indices are available from the Japan Real Estate Institute (Statistics Japan, 2012, 2013b). Each of the two indices is disaggregated by the form of land utilization (commercial, residential, and industrial use; as well as an average of these) and by location (nationwide, i.e. referring to 233 cities, six largest cities, and nationwide excluding the six largest cities). Data for index calculation is drawn from appraisals.

For the period 1974–2009 the Land Appraisal Committee of the Japanese Ministry of Land, Infrastructure, Transport, and Tourism (MLIT) publishes data on annual growth rates of appraised real estate prices for "standard" commercial and residential properties. The property is valued assuming a free market transaction (Ministry of Land, Infrastructure, Transport, and Tourism, 2009). In addition to the national price growth data MLIT provides sub-series for the following five geographic categories: i) three largest metropolitan regions, ii) the Tokyo region, iii) the Osaka region, iv) the Nagoya region, and v) other regions.

Figure 49 shows the nominal indices available for 1880–1942, i.e. the paddy field index, the rural residential land index, and the urban residential land index (Bank of Japan, 1970a, 1986a). The rural residential land index (Bank of Japan, 1970a) suggests that land prices continuously decreased between 1881 and 1913. The Meiji-era (1868–1912), however, was a time of considerable economic growth which makes the decrease in land values seem rather surprising. We can offer two explanations for this puzzle which may have joint or partial validity: first, data quality may be poor. The data is based on property valuation by public assessors and not on actual sales prices (Bank of Japan, 1970a). The taxable amount of land seems also not to be changed frequently or not adequately adjusted to the 'real' value.[105] There may hence be differences between trends in assessed values and actual sales prices. Second, the index is based on residential land values for rural areas. Since the last decades of the 19th century were a period of ongoing industrialization and urbanization, trends in rural land values may differ from trends in urban land values and thus not adequately reflect the general national trend during these years.

[105]Email conversation with Makoto Kasuya, Tokyo University.

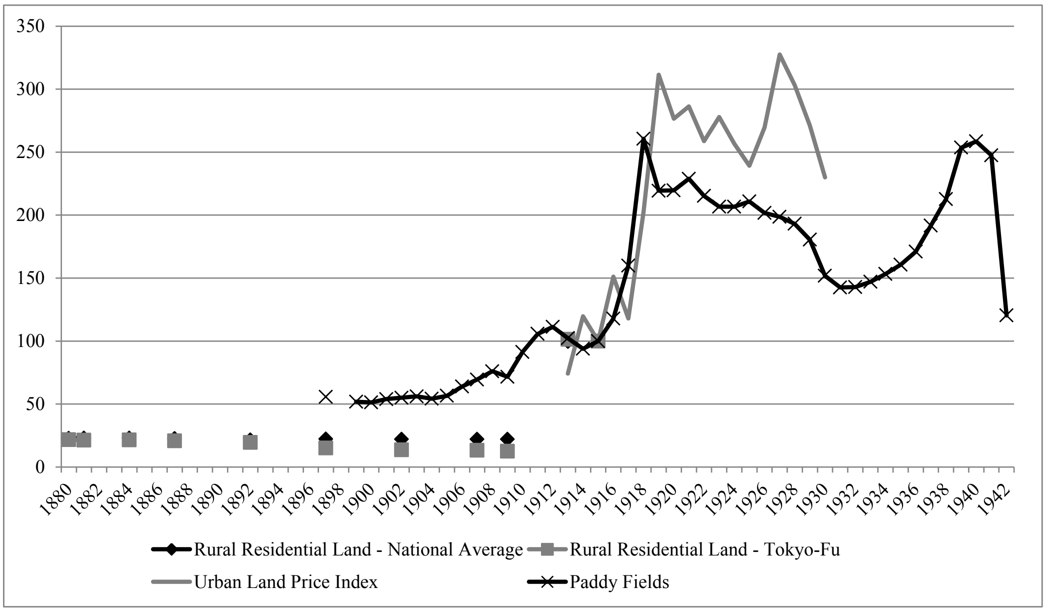


Figure 49: Japan: nominal house price indices 1880–1942 (1915=100).

For the immediate post-World War II decades there are two indices available for urban residential land indices: i) a nationwide index produced by the Bank of Japan (1986b) and ii) a nationwide index by Statistics Japan (2012, 2013b). For the years they overlap (1955–1965), they are perfect substitutes as they follow exactly the same trend.[106]

Figure 50 shows the indices produced by Ministry of Land, Infrastructure, Transport, and Tourism (2009) and Statistics Japan (2013b) for 1970–2012. The graphs indicate that both series closely follow the same trend during the period in which they overlap, i.e. 1975–2009.

[106] Correlation coefficient of 0.998.

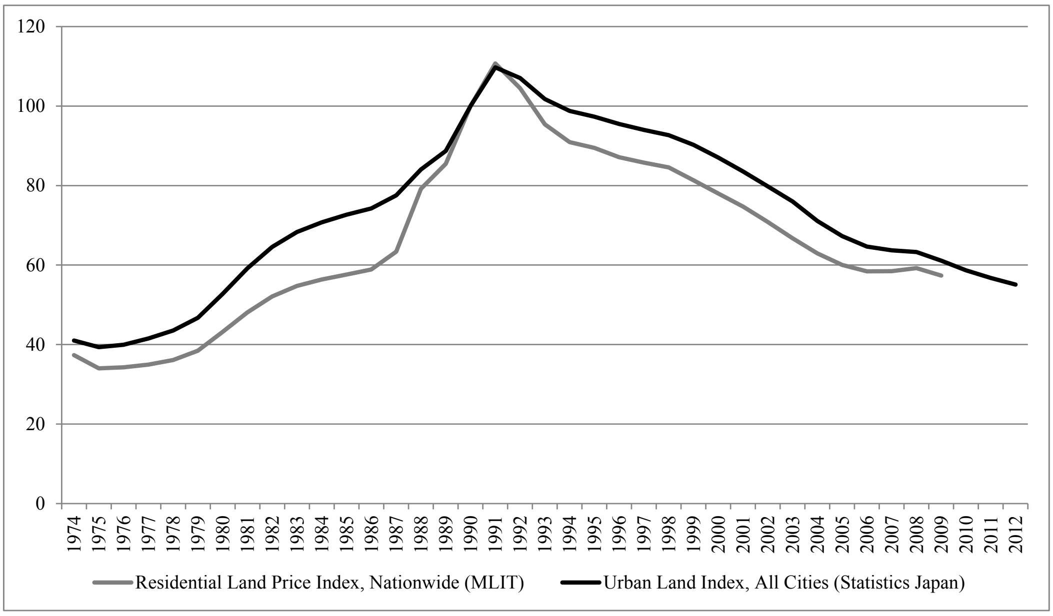


Figure 50: Japan: nominal house price indices 1974–2012 (1990=100).

Since the land price trend as suggested by Bank of Japan (1970a) seems partially implausible considering the economic environment, our long-run index for Japan only starts in 1913. No data for urban residential land prices, however, is available for 1931–1935.[107] The paddy field index and the urban residential land index, however, are strongly correlated for the years they overlap.[108] To obtain our long-run index we thus link the two sub-indices, i.e. 1913–1930 and 1936–2012 using the growth rate of the paddy field index 1930–1936. For 1936–1954 we rely on the urban land price index for all cities by Bank of Japan (1986b). The long-run index uses the Statistics Japan (2013b, 2012) index for the whole 1955–2012 period for two reasons: first, the index produced by Statistics Japan (2012) reflects appraised values rather than actual sales prices. Hence, the Statistics Japan (2013b, 2012) may better reflect real price trends. Second, to keep the number of data sources to construct an aggregate index to the minimum, we do not use the Ministry of Land, Infrastructure, Transport, and Tourism (2009) for the post-1970 period but rely on Statistics Japan (2013b, 2012) instead. Our long-run house price index for Japan 1880–2012 splices the available series as shown in Table 13.

Three aspects have to be considered when using the series on urban residential sites. First, the index only refers to sites for residential use, and thus does not include the value of the structures. However, as discussed above, particularly in urban areas the land price constitutes a large share of the overall real estate value. Fluctuations in property prices in such densely populated areas are often driven by changes in site prices (Möckel, 2007, 142). Second, Naka-

[107]Nanjo (2002) estimates that urban land prices decreased by more than 20 percent in 1931 but were stable 1932–1933.

[108]Correlation coefficient of 0.778 for 1913–1930 (Bank of Japan, 1986a) and correlation coefficient of 0.934 for 1936–1965 (Bank of Japan, 1986b).

Period	Series ID	Source	Details
1913–1930	JPN1	Bank of Japan (1986a)	*Geographic Coverage*: Tokyo; *Type(s) of Dwellings*: Urban residential land; *Method*: Average price index.
1931–1935		Bank of Japan (1986b)	*Geographic Coverage*: Kanto district; *Type(s) of Dwellings*: Paddy Fields; *Data*: Transaction data obtained through surveys; *Method*: Average price index.
1936–1954	JPN2	Statistics Japan (2012)	*Geographic Coverage*: Urban areas; *Type(s) of Dwellings*: Residential land; *Data*: Appraisal of land value as if vacant; *Method*: Average price index.
1955–2012	JPN3	Statistics Japan (2013b)	*Geographic Coverage*: Urban areas; *Type(s) of Dwellings*: Residential land; *Data*: Appraisal of land value as if vacant; *Method*: Average price index.

Table 13: Japan: sources of house price index, 1880–2012.

mura and Saita (2007) suggest that the land price series, i.e. the Urban Land Price Index published by the Japan Real Estate Institute and the series published by Ministry of Land, Infrastructure, Transport, and Tourism (2009) may actually underestimate the general development in site prices. Both indices are calculated as simple averages thus assigning the same weight to high priced plots and low priced lots. The authors, however, argue that the more pronounced fluctuations were particularly symptomatic for the high priced neighborhoods such as the Tokyo metropolitan area. Simple averages may hence underestimate the magnitude of these movements. Third, for 1936–1954, the index reflects appraised land values which may deviate from actual sales prices.

Housing related data

Construction costs: 1955–1980: Statistics Japan (2012) - National wooden house market value index; 1981–2009: Statistics Japan (2012) - Building construction cost index (standard index, net work cost, Tokyo), individual house.

Farmland prices: 1880–1954: Land price index for paddy fields (Bank of Japan, 1966); 1955-2012: Land price index for paddy fields (Statistics Japan, 2012, 2013b).

Homeownership rates: Statistics Japan (2012).

Value of housing stock: Goldsmith (1985) provides estimates of the value of total housing stock, dwellings, and land for the following benchmark years: 1885, 1900, 1913, 1930, 1940, 1955, 1965, 1970, 1977. Data for 1954–1998 is drawn from Statistics Japan (2013a). Data on the value of dwellings and land for 2001–2011 is drawn from OECD (2013).

Household consumption expenditure on housing 1874–1940: Shinohara (1967); 1970–1993: Cabinet Office. Government of Japan (1998); 1994–2012: Cabinet Office. Government of Japan (2012).

B.10 The Netherlands

House price data

Historical data on house prices in the Netherlands are available for the time 1870–2012.

The most comprehensive source is provided by Eichholtz (1994). Using transaction data for buildings at the Herengracht in Amsterdam, Eichholtz computes a biannual hedonic repeat sales index for the period 1628–1973.[109]

A second index covering the development of prices for all types of existing dwellings in the Netherlands during 1970–1994 is constructed by the Dutch land registry (Kadaster).[110] Though the index is not directly available, it is included in the international house price database maintained by the Federal Reserve Bank of Dallas (Mack and Martínez-García, 2012) and the OECD database. For the time 1970–1992 the index is computed from the median sales price of dwellings as reported by the Dutch Association of Real Estate Agents (Nederlandse Vereniging van Makelaars; NVM). For the years since 1992 the index is based on the Land Registry's records of sales prices of existing residential dwellings and computed using the repeat sales method (De Haan et al., 2008).

Besides the indices by Eichholtz (1994) and Kadaster (Mack and Martínez-García, 2012), a third source is available from Statistics Netherlands (2013d). The agency since 1995 on a monthly basis has published price indices for several types of property, such as all types of dwellings, single-family houses, and flats. The indices are computed using the Sales Price Appraisal Ratio (SPAR) method and rely on two separate sources of data: the Dutch land registry (Kadaster) records of sales prices and the municipalities' official value appraisals conducted for residential property taxation.

As indicated above, the only available source that covers the time prior to 1970 is the index

[109] Eichholtz (1994) notes that the buildings in his sample are of constant high quality as well as relatively homogeneous. For his hedonic regression he only includes one explanatory variable to control for changes in the buildings between transactions, that is use of the buildings. Most of the buildings had been built for residential use. Since the early 20th century, however, many of the properties along the Herengracht were converted into offices which, in turn, increased the value of the buildings. The data he uses to compute the index was published as part of a publication, *Vier eeuwen Herengracht*, at the occasion of Amsterdam's 750th anniversary in 1975. It contains the complete history of about 200 buildings along the Herengracht including all recorded transactions and transaction prices.

[110] The original index as published by the Dutch land registry is only available since 1976. However, a back-casted version of the index which covers the period 1970–2012 is available from the OECD.

by Eichholtz (1994). Even though the index only refers to real estate on one street in the city of Amsterdam (Herengracht), the series appears to be in line with the general trends in house prices as discussed in the literature (Elsinga, 2003; Van Zanden, 1997; Van Zanden and van Riel, 2000; Van der Heijden et al., 2006; Vandevyvere and Zenthöfer, 2012; Van der Schaar, 1987; De Vries, 1980).[111] To obtain an annual index we apply linear interpolation.

Figure 51 covers the development of real estate prices in the Netherlands for the more recent period and shows the Kadaster-index (available since 1970), the CBS-indices for all types of properties and for single-family houses (available since 1995). For the period in which the three indices overlap, i.e. the time from 1995–2012, the indices are perfect substitutes as they follow exactly the same trend and accord with the house price trends discussed in the literature (Vandevyvere and Zenthöfer, 2012).

[111] Real house prices are reported to have increased by about 70 percent between 1870 and 1886. According to Glaesz (1935) and Van Zanden and van Riel (2000), urbanization at the time fueled construction activity in the cities. The ensuing construction boom between 1866–1886 induced a substantive increase in residential investment (Prak and Primus, 1992). The boom faltered in the second half of the 1880s and only resumed in the 1890s. This second boom in house prices and construction activity continued until the crisis of 1907 (Glaesz, 1935; Van Zanden and van Riel, 2000). The enactment of a new housing law in 1901 to set structural and design standard requirements in the field of health, sanitation and safety at the same time fostered the improvement of the dwellings stock and hence further contributed to the construction boom (Prak and Primus, 1992; Van der Heijden et al., 2006). During World War I the Netherlands remained neutral. While the war nevertheless adversely affected Dutch economic development, real house prices remain fairly stable between 1914 and 1918. After years of economic growth in the 1920s, in 1929, the Dutch economy entered what Van Zanden (1997) calls the *"long stagnation"* that lasted until 1949. In line with the dire state of the Dutch economy, real house prices fell by 30 percent between 1930 and 1936 and remained depressed throughout the years of World War II. The German occupation from 1940 to 1945 had devastating effects on the Dutch economy. As many other countries, the Netherlands due to a virtual halt in construction and large scale destruction faced a severe housing shortage after 1945. The housing shortage was further aggravated by rapid population growth and family formation during the 1950s. Rent controls that had already been introduced during the German occupation remained in place until the end of the 1950s, but proved counterproductive to investment in residential real estate (Vandevyvere and Zenthöfer, 2012; Van Zanden, 1997; Van der Schaar, 1987). Not surprisingly considering the strict housing regulation, house price growth remains weak during the late 1940s and 1950s. It was only in 1959 that the government under Prime Minister Jan de Quay (1959–1963) began to liberalize the housing market, i.e. removed the rent controls and cut back social housing subsidization (Van Zanden, 1997; Van der Schaar, 1987). By the 1960s a high rate of homeownership had become a widely supported objective of Dutch housing policy (Elsinga, 2003).

Period	Source	Details	
1870–1969	NLD1	Eichholtz (1994)	*Geographic Coverage*: Amsterdam; *Type(s) of Dwellings*: All types of existing dwellings; *Data*: Sales prices published in *Vier eeuwen Herengracht*; *Method*: Hedonic repeat sales method.
1970–1994	NLD2	Kadaster Index, as published by OECD	*Geographic Coverage*: Nationwide; *Type(s) of Dwellings*: All types of existing dwellings; *Data*: Nederlandse Vereniging van Makelaars, Kadaster; *Method*: 1970–1991: median sales price; 1992–1994: repeat sales method.
1997–2012	NLD3	Statistics Netherlands (2013d)	*Geographic Coverage*: Nationwide; *Type(s) of Dwellings*: All types of existing dwellings; *Data*: Kadaster, officially appraised values determined by municipalities as basis for the residential property tax; *Method*: SPAR method.

Table 14: The Netherlands: sources of house price index, 1870–2012.

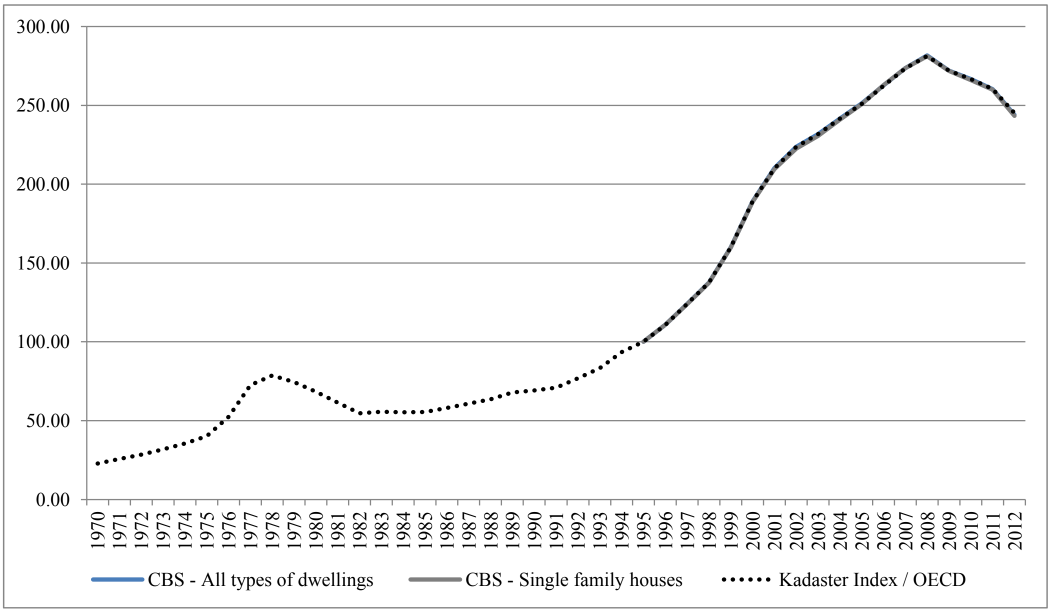


Figure 51: The Netherlands: nominal house price indices 1970–2012 (1995=100)

Our long-run house price index for the Netherlands 1870–2012 splices the available series as shown in Table 14. The long-run index has two weaknesses: first, as no house price series for the Netherlands as a whole is available for the years prior to 1970, we rely on the Herengracht index instead. The extent to which house prices at the Herengracht are representative of house prices in other urban areas or the Netherlands as a whole remains, however, difficult to determine. Second, despite the fact that by using the repeat sales method the effect of quality differences between houses is somewhat reduced, it does not control for all potential changes in the quality and standards of dwellings over time.

Housing related data

Construction costs: 1913–1996: Statistics Netherlands (2013a) - Prijsindexcijfers nieuwbouw woningen; 1997–2012: Statistics Netherlands (2013c) - New dwellings; input price indices building costs.

Farmland prices: 1963–1989: Statistics Netherlands (2013b) - Sales price index for farmland (without lease); 1990–2001: (Statistics Netherlands, 2009) - Sales price index for farmland (without lease).

Building activity: 1921–1999: Statistics Netherlands (2013a) - Building starts; 1953–2012: Statistics Netherlands (2012) - Building permits.

Homeownership rates: Vandevyvere and Zenthöfer (2012); Statistics Netherlands (2001); Kullberg and Iedema (2010).

Value of housing stock: The Statistics Netherlands (1959) provides estimates of the total value of land and the total value of dwellings for 1952. Data on the value of dwellings and land for 1996–2011 is drawn from OECD (2013).

Household consumption expenditure on housing: 1995–2012: Statistics Netherlands (2014).

B.11 Norway

House price data

Historical data on house prices in Norway are available for the time 1870–2012.

The most comprehensive source for historical data on real estate price in Norway is presented by Eitrheim and Erlandsen (2004). Their data set contains five house price indices; four for urban areas, i.e. for the inner city of Oslo, Bergen, Trondheim and Kristiansand as well as an aggregate index. With the exception of Trondheim, for which data is only available since 1897, the indices cover the period 1819–2003. The indices are constructed from two different sources:

For the years 1819–1985 the indices are computed from nominal transaction prices of real estate property (mostly residential). The data has been compiled from real property registers of the four cities and refers to property in city centers. The four city indices are computed using the weighted repeat sales method, for the aggregate index the hedonic repeat sales method is applied. However, the hedonic regression only controls for location (Eitrheim and Erlandsen, 2004, 358 ff.).

For the years since 1986 Eitrheim and Erlandsen (2004) rely on a monthly index jointly published by the Norwegian Association of Real Estate Agents (Norges Eiendomsmeglerforbund, 2012, NEF) and the Norwegian Real Estate Association (EFF), Finn.no, and Pöyry, a consulting firm. For the years 1986–2001 the index is based on sales price data voluntarily reported by NEF members. Since 2002 the index is based on all transactions managed by NEF and EFF member real estate agents. Reported NEF/EFF raw data is in prices per square meter. There are several sub-series available for various types of properties: all residential dwellings, detached houses, semi-detached houses, and apartments. The data series are disaggregated to county level. NEF/EFF use a hedonic regression method controlling for location and square meters (Eiendomsverdi, Eiendomsmeglerforetakenes forening, and Finn.no, 2013). Since 1986 the share of total property transactions covered by the NEF/EFF database has been steadily increasing and currently stands at about 70 percent.

Besides the indices by Eitrheim and Erlandsen (2004) and NEF/EFF, a third source that covers the more recent development of residential property prices (1991–2012) is provided by Statistics Norway (2013b). Statistics Norway (2013b) publishes house price indices on a quarterly basis for i) all houses; ii) detached houses; iii) row houses; and iv) multi-family dwellings. The indices are based on house sales registered with FINN.no AS. Statistics Norway follows the approach of a mix-adjusted hedonic index.[112]

Figure 52 shows the real house price indices based on the deflated nominal indices for Bergen, Kristiansand, Oslo, and Trondheim and the aggregate four-cities-index by Eitrheim and Erlandsen (2004) for 1870–2002. The four city indices appear to follow the same trends throughout the observation period and are in line with developments in the Norwegian housing market as discussed in the literature.[113]

[112]While the hedonic regression specification as currently applied by Statistics Norway controls for dwelling size and location, it ignores other important characteristics such as age of the property or other distinct quality characteristics. Statistics Norway uses mix-adjustment techniques to account for this limitation (Mack and Martínez-García, 2012).

[113]Norwegian house prices strongly increased throughout the last decade of the 19th century. While the underlying macroeconomics were not particularly favorable, strong population growth, and ongoing urbanization substantively fostered the demand for urban housing and thus put upward pressure on house prices. During those years, construction activity increased considerably (Grytten, 2010; Eitrheim and Erlandsen, 2004). The boom period abruptly came to an end in 1899 when the Norwegian building industry crashed causing a financial collapse. The following consolidation period lasted until 1905 (Grytten, 2010; Eitrheim and Erlandsen, 2004). Although Norway remained neutral during World War I, the war had a strong and depressing effect on the Norwegian economy, particularly due to the disruption in trade. While house prices substantially increased in nominal terms, they considerably lacked behind inflation. Rent controls introduced in 1916 lowered the rates of return from rented residential property and put additional downward pressure on house prices (Eitrheim and Erlandsen, 2004). Only after the war house prices begun to recover. During the 1920s the continuous rise in real estate prices was only briefly interrupted during the international postwar recession which in Norway was associated with a banking crisis. Interestingly, the literature provides different and partly contradictory explanations for the massive rise in real estate prices during the 1920s and the first half of the 1930s. Grytten (2010) reasons that the house price hike was primarily driven by relative changes in the nominal house prices and the general price level: while Norway during that time experienced a phase of general price deflation, nominal house prices remained relatively stable. Husbanken (2011) instead diagnoses a supply shortage to have been a principal price driver. During the years of German occupation (1940–1945) house prices collapsed. Although destructions were limited in comparison to most other European countries there was a perceptible housing shortage after the war. In response, the government in 1946 established the Norwegian State Housing Bank (*Husbanken*) to provide the required liquidity for residential construction (Husbanken, 2011). Throughout the years 1940–1969, however, strict housing market regulations were in place, with house prices essentially fixed until 1954. This may explain why real house prices continued to decrease after the war until mid-1950. In

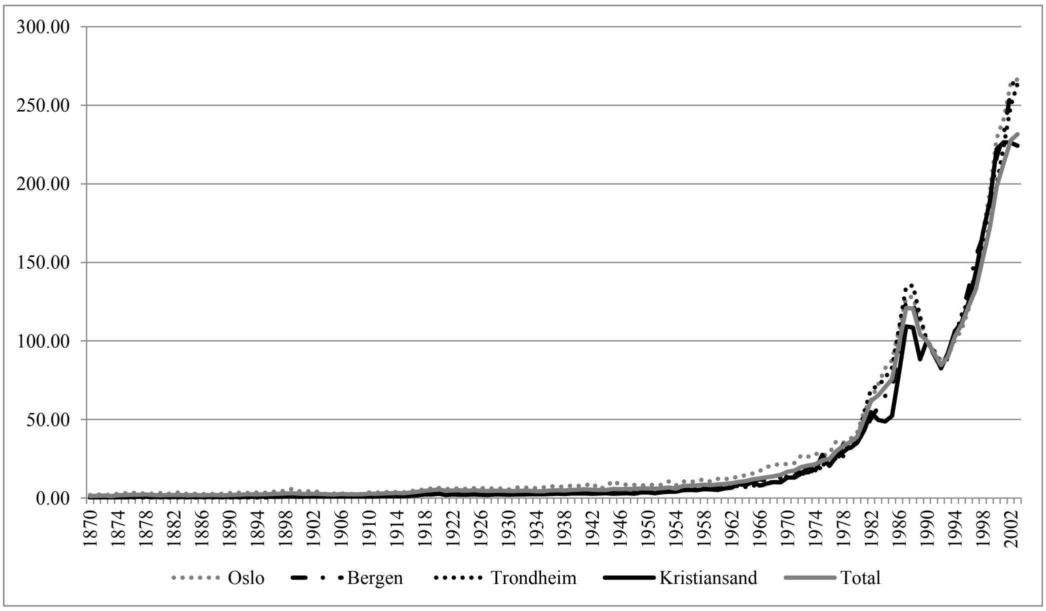


Figure 52: Norway: nominal house price indices 1870–2003 (1990=100).

Figure 53 compares the following four indices for the post-1985 period: the index by Eitrheim and Erlandsen (2004), the national NEF-index (all houses), a four-cities index calculated by averaging the NEF data for Bergen, Kristiansand, Oslo, and Trondheim (all houses), and the national index by Statistics Norway (all houses).[114] It shows that the four indices move in almost perfect lock-step. An analysis by Statistics Norway (2013) suggests that the minor differences between the nationwide index by Statistics Norway and the one by NEF primarily originate from the application of different weights for aggregation. Nevertheless, both the national NEF and the four-cities-index after 2000 follow an upward trend that is slightly more pronounced relative to the Statistics Norway-index. A comparison of the index specific summary statistics suggests that the index by Eitrheim and Erlandsen (2004) perfectly mirrors the level, trend, and volatility of the national NEF index for the time in which they overlap (1990–1999). In an effort to construct a coherent index for the period 1870–2012, splicing the Eitrheim and

subsequent years (1955–1960) regulations were gradually relaxed and house price started to rise (Eitrheim and Erlandsen, 2004). Liberalization of the tightly regulated banking sector which began in the late 1970s allowed for more flexibility in bank lending rates but also increased the cost of housing credit such that access to housing finance became more restricted. During these years the significance of the State Housing Bank decreased and private sector finance played an increasingly important role in Norwegian housing finance. In 1976 the State Housing Bank had financed about 87 percent of new dwellings. In 1984 its share had shrunk to about 53 percent (Pugh, 1987). The contractive monetary policy pursued by the Federal Reserve since 1979 and the subsequent global surge in interest rates also effected the Norwegian economy, particularly with respect to capital formation and thus also housing (Pugh, 1987). Starting in the mid-1980s a pronounced increase in house prices emerges fueled by credit liberalization and a considerable credit boom (Grytten, 2010). However, when oil prices declined at the end of the 1980s economic activity slowed considerably and Norway entered a recession that continued until 1991. During these years the private banking system entered a severe crisis during which borrowing activities remained restricted. House prices sharply contracted before in 1993 again entering a period of strong expansion (Eitrheim and Erlandsen, 2004).

[114] Since the index by Eitrheim and Erlandsen (2004) refers to all kinds of existing dwellings, the respective series for all houses from Norges Eiendomsmeglerforbund (2012) and Statistics Norway (2013b) are included.

Period	Series ID	Source	Details
1870–2003	NOR1	Eitrheim and Erlandsen (2004)	*Geographic Coverage*: Four cities; *Type(s) of Dwellings*: All types of existing dwellings; *Data*: Real Property Registers; *Method*: Hedonic weighted repeat sales method.
2004–2012	NOR2	Norges Eiendomsmeglerforbund (2012)	*Geographic Coverage*: Four cities; *Type(s) of Dwellings*: All types of existing dwellings; *Data*: Voluntary reports of real estate agents regarding sales of dwellings; *Method*: Hedonic regression.

Table 15: Norway: sources of house price index, 1870–2012.

Erlandsen (2004) and the NEF index appears recommendable. Nevertheless, this approach may result in slightly overestimating the increase in house prices in Norway as a whole in the years after 2000 as the NEF index for the whole of Norway indicates a more pronounced rise in house prices when compared to the other indices available (cf. Figure 53).

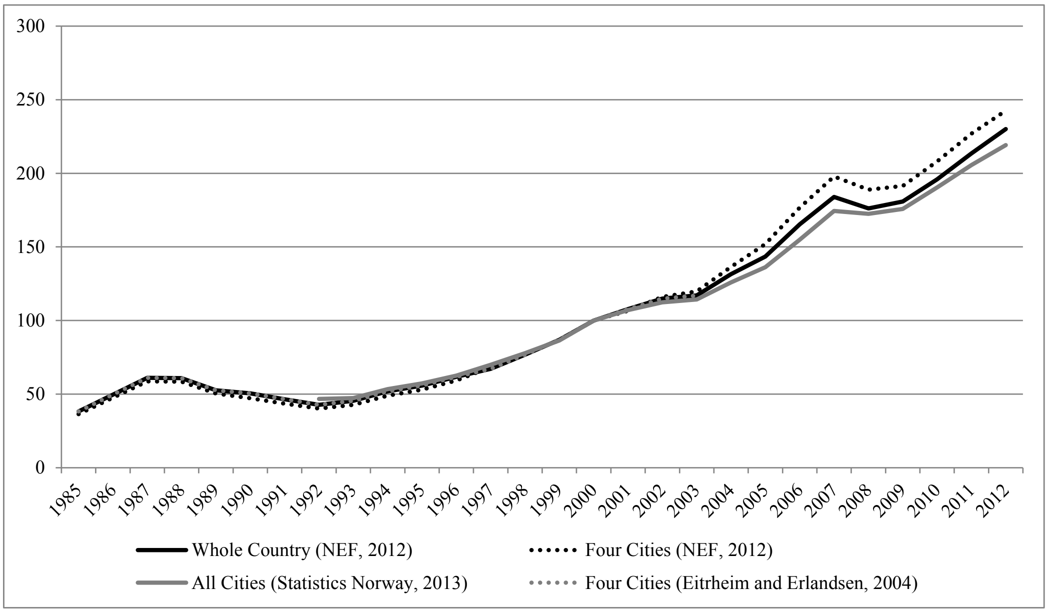


Figure 53: Norway: nominal house price indices 1985–2012 (1990=100).

Our long-run house price index for Norway 1870-2012 splices the available series as shown in Table 15. A drawback of the long-run index is that prior to 1986 it accounts for quality changes only to some extent. By using the repeat sales method the effect of quality differences between houses is somewhat reduced, but not all potential changes in the quality and standards of dwellings over time are controlled for.

Housing related data

Construction costs: 1935–2012: Statistics Norway (2013a) - Construction cost index for detached houses of wood.

Value of housing stock: Goldsmith (1985) provides estimates of the value of total housing stock, dwellings, and land for the following benchmark years: 1880, 1899, 1913, 1930, 1939, 1953, 1965, 1972, 1978.

Farmland prices: 1985–2005: Statistics Norway[115] - Average purchase price of agricultural and forestry properties sold on the free market; 2006-2010: Statistics Norway (2011) - Average purchase price of agricultural and forestry properties sold on the free market.

Building activity: 1951–2012: Statistics Norway (2014b).

Homeownership rate (benchmark years): Balchin (1996), eurostat (2013), Doling and Elsinga (2013).

Household consumption expenditure on housing: 1970–2012: Statistics Norway (2014a).

B.12 Sweden

House price data

Historical data on house prices in Sweden are available for the time 1875–2012.

The most comprehensive sources for historical data on real estate price in Sweden are presented by Söderberg et al. (2014) and Bohlin (2014). Bohlin (2014) presents an index for multifamily dwellings in Gothenburg for 1875–1957. The index is based on sales price data and tax assessments and constructed using the SPAR method (Söderberg et al., 2014; Bohlin, 2014). Söderberg et al. (2014) also uses the SPAR method to construct an index for multifamily dwellings in inner Stockholm 1875–1957.[116] In addition, the authors present indices gathered from different sources for Stockholm, Gothenburg, and Sweden for i) single- to two-family houses, and ii) multifamily dwellings for 1957–2012.[117]

A second major source for house prices is available from Statistics Sweden (2014c). The dataset contains a set of annual indices for new and existing one- and two-family dwellings for 12 geographical ares for 1975–2012.[118] The index is constructed combining mix-adjustment

[115] Series sent by email, contact person is Trond Amund Steinset, Statistics Norway.

[116] Both, Söderberg et al. (2014) and Bohlin (2014), also present a repeat sales index which depicts a similar increase in house prices in the long-run. Because the repeat sales analysis still requires further scrutiny, the authors regard the SPAR index as preferable.

[117] The authors combine price information presented by Sandelin (1977) and data collected by Statistics Sweden. For the years since 1975 they rely on Statistics Sweden (2014c).

[118] These areas are: Sweden as a whole, Greater Stockholm, Greater Gothenburg, Greater Malmö, Stockholm

techniques and the SPAR method using data from the Swedish real property register (Lantmäteriet).[119]

Figure 54 depicts the nominal indices available for 1875–1957, i.e. the index for Gothenburg (Bohlin, 2014) and the index for inner Stockholm (Söderberg et al., 2014). As it shows, the two indices generally move together.[120] The main difference between the two series is the comparably stronger increase in the Gothenburg index after the 1920s and more pronounced fluctuations during the 1950s.[121] The indices appear to by and large be in line with the fundamental macroeconomic trends and developments in the Swedish housing market (Söderberg et al., 2014; Bohlin, 2014; Magnusson, 2000).[122]

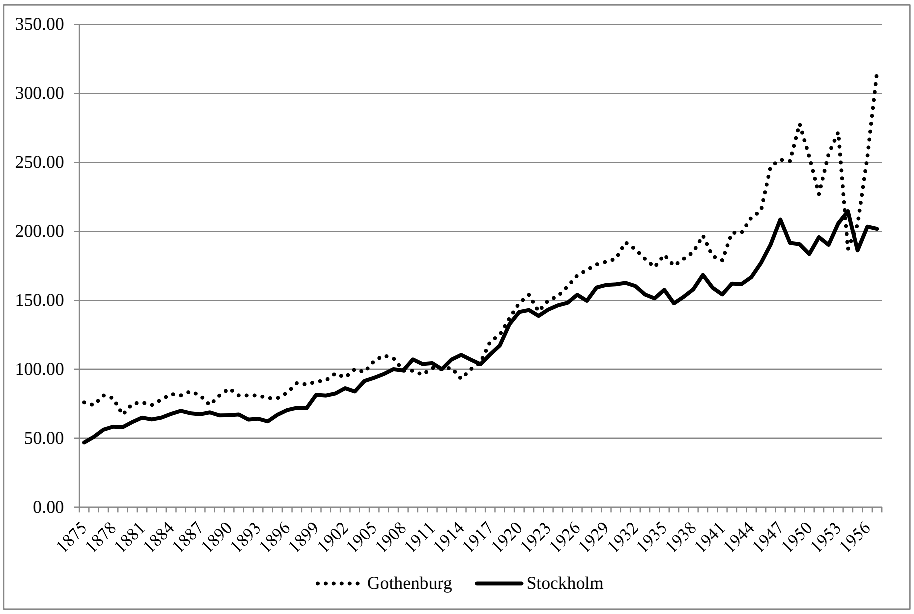


Figure 54: Sweden: nominal house price indices 1875–1957 (1912=100).

Figure 55 shows the nominal indices available for 1957–2012. Again, the indices for Gothenburg and Stockholm follow the same trajectory. The comparison nevertheless suggests that prices for apartment buildings increased less than prices for single- and two-family houses.

production county, Eastern Central Sweden, Småland with the islands, South Sweden, West Sweden, Northern Central Sweden, Central Norrland, Upper Norrland.

119 For the period 1970–2012 an index is available from the OECD based on Statistics Sweden (2014c). For the period 1975–2012 the Federal Reserve Bank of Dallas also relies on the index for single- and two-family dwellings by Statistics Sweden (2014c).

120 Correlation coefficient of 0.954.

121 The Stockholm index increases at an average annual nominal growth rate of 0.95 percent between 1920 and 1957 while the Gothenburg index increases at an average annual nominal growth rate of 2.05 percent.

122 Söderberg et al. (2014), however, also reason that the index may not adequately depict the exact extent of the crises and their aftermaths in 1885–1893 and 1907.

According to Söderberg et al. (2014), it was rent regulation introduced during the years of World War II that held down the prices for apartment buildings. Hence, they argue, the indices for single- and two-family houses better reflect market prices. The extent to which the increase in prices of apartment houses were already dampened in earlier years when compared to single-family houses, i.e. prior to 1957, however, cannot be determined (Söderberg et al., 2014).[123]

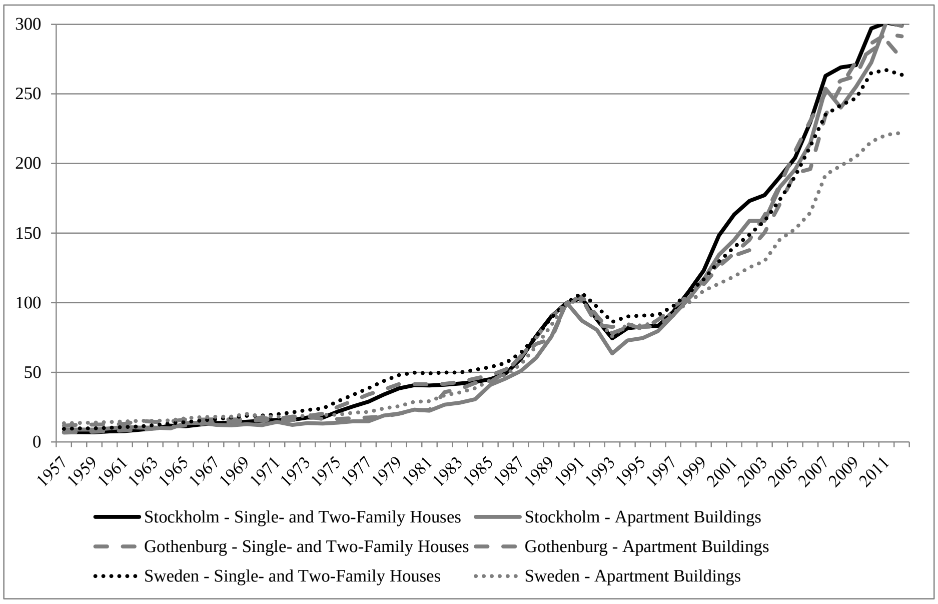


Figure 55: Sweden: nominal house price indices 1975–2012 (1990=100).

Our long-run house price index for Sweden 1875–2012 splices the available series as shown in Table 16. As we aim to provide house price indices with the most comprehensive coverage possible, we use a simple average of the index for Gothenburg and the index for Stockholm. While the index prior to 1957 refers to multifamily dwellings only, we nevertheless use the index for single- to two-family dwellings for 1957–2012 as the index for multifamily dwellings may underestimate the increase in house prices particularly during the 1960s and 1970s (see above).

[123]Rent controls were already introduced during World War I, but abolished in 1923. The 1917 law did not freeze rents at certain levels, but was mainly intended to prevent them from increasing in leaps and bounds (Stromberg, 1992). Rent regulation was re-introduced in 1942. Rents were frozen, detailed rent-controls for newly built dwellings introduced, and tenants protected. Tenant protection was further strengthened in the 1968 Rent Act. While the 1942 measures were initially planned to be effective until 1943, they were only fully abolished in 1975 (Magnusson, 2000; Rydenfeldt, 1981; Söderberg et al., 2014).

Period	Series ID	Source	Details
1875–1956	SWE1	Söderberg et al. (2014); Bohlin (2014)	*Geographic Coverage*: Stockholm and Gothenburg; *Type(s) of Dwellings*: Existing multi-family dwellings; *Data*: Tax assessment values from *Stockholms adresskalender* and *Göteborgs adresskalender*, sales price data from register of certificates of title to properties and other archival sources; *Method*: SPAR method.
1957–2012	SWE2	Söderberg et al. (2014)	*Geographic Coverage*: Stockholm and Gothenburg; *Type(s) of Dwellings*: New and existing single- and two-family houses; *Data*: Swedish real property register, Statistics Sweden; *Method*: Mix-adjusted SPAR index.

Table 16: Sweden: sources of house price index, 1875–2012.

Housing related data

Construction costs: 1910–2012: Statistics Sweden (2014a) - Construction cost index for multi-family dwellings.

Value of housing stock: Waldenström (2012).

Farmland prices: 1870–1930: Bagge et al. (1933); 1967–1987: Statistics Sweden (various years); 1988–2012: Statistics Sweden (2014b).

Homeownership rate (benchmark years): Doling and Elsinga (2013).

Household consumption expenditure on housing: 1931–1949: Dahlman and Klevmarken (1971); 1950–2012: Statistics Sweden.[124]

B.13 Switzerland

House price data

Historical data on house prices in Switzerland are available for the time 1901–2012.

For Switzerland, there are three principal sources for historical real estate price data. The first source is Statistics Switzerland (2013) which inter alia reports average sales prices per square meter for developed lots and building sites in several urban areas since the early 20th century. The most comprehensive coverage is available for the city of Zurich (1899–1990) due to extensive documentation of land transactions in the annual Statistical Abstracts of the city of Zurich. We compute an index based on the five year moving average of the average sales price per square meter of building sites and developed lots in Zurich to smooth out some of the

[124] Series sent by email, contact person is Birgitta Magnusson Wärmark, Statistics Sweden.

fluctuation stemming from year-to-year variation in the number transaction.

The second source is provided by Wüest and Partner (2012, 40 ff.). The consulting firm produces two price indices - one for multi-family houses and one for commercial property - covering the years since 1930. The index is computed applying a hedonic regression[125] on cross-sectional pooled data.[126] Data is pooled as the number of observations per years varies substantively and hence particularly in years of strong market frictions the single year sample size would be too small to generate reliable price estimates. For the years prior to 2011 the two indices by Wüest and Partner (2012) are constructed from a dataset containing information on 2900 arm's-length transactions of commercial and residential property that took place mostly in large and medium-sized urban centers. The raw data is collected from various insurance companies.[127]

A third important source on real estate prices covering the period 1970–2012 is provided by the Swiss National Bank (SNB) which on a quarterly basis publishes two mix-adjusted real estate price indices: an index for single-family houses and an index for apartments (sold by the unit). The indices are produced by Wüest and Partner using price information on new and existing properties (Swiss National Bank, 2013). Wüest and Partner rely on a database containing approximately 100,000 entries per year. Each entry provides information on the list prices (not sales prices), location, the size of the respective properties (number of rooms), and whether it at the time was newly constructed or existing stock (Wüest and Partner, 2013).[128]

Figure 56 depicts the nominal indices available for 1901–1975. For the time prior to 1930, it shows that the index computed using the data published by Statistics Switzerland (2013) accords with the general macroeconomic developments and accounts of housing market developments (Böhi, 1964; Woitek and Müller, 2012; Werczberger, 1997; Michel, 1927).[129] Reassuringly,

[125]The specification controls for quality of the local community (size, agglomeration, purchasing power, etc.), year of construction, square footage, and volume.

[126]The data is pooled such that the estimation for year N also includes the data on transaction of the two previous (N-1, and N-2) and two subsequent years (N+1, N+2).

[127]Such as Generali, Mobiliar, Nationale Suisse, Swiss Life and Zurich Insurance.

[128]For the period 1975–2012, the Federal Reserve Bank of Dallas also uses the Swiss National Banks' index, thus the one developed by Wüest and Partner (Mack and Martínez-García, 2012). The OECD also relies on this index.

[129]Several episodes are noteworthy: first, Switzerland experienced a pronounced building boom during the 1920s, a period of general economic expansion. Wartime rent controls were abolished in 1924. The subsequent increase in rents made homeownership or ownership of rented residential property become more attractive while low mortgage rates further spurred investment in housing (Werczberger, 1997; Böhi, 1964). Between 1930 and 1936 the Swiss economy contracted. While the recession was comparably mild it was rather long-lasting: recovery only began after the devaluation of the Swiss Franc in 1936/37 (Böhi, 1964). Strong private domestic consumption and the continuously high demand for residential housing played an important role to cushion the effect of the recession. While nominal wage rates declined between 1924 and 1933, the drop was less pronounced (minus 6 percent) than the decrease in the cost of living (minus 20 percent) hence increasing the purchasing power of workers. At the same time, building costs were low and credit was easy to obtain since Switzerland was considered a safe haven for capital from countries with unstable currencies (Böhi, 1964; Woitek and Müller, 2012). The outbreak of World War II constituted another major rupture to economic activity in Switzerland. Private investment in housing slumped while construction costs increased. Growth only resumed after the end

the index by Wüest and Partner (2012) for multifamily properties and the site price index for Zurich (Statistics Switzerland, 2013) consistently move together for the period 1930–1975 and are strongly correlated.[130]

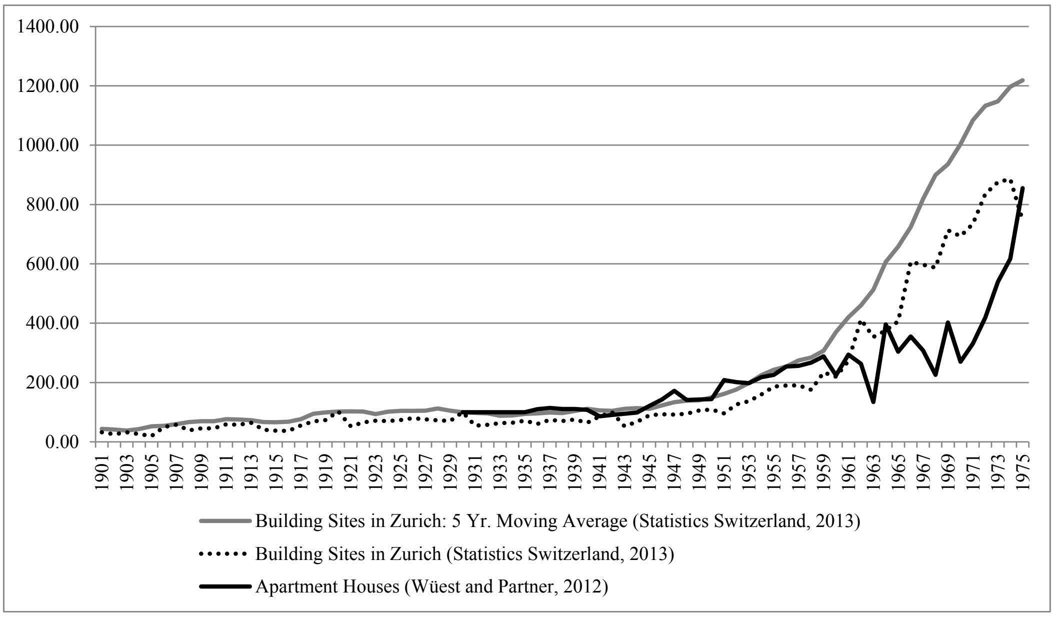


Figure 56: Switzerland: nominal house price indices 1901–1975 (1930=100).

For the 1960s, however, the two indices provide a disjoint and inconsistent picture. In the light of pronounced and uninterrupted economic growth during the 1960s (Woitek and Müller, 2012), the strong fluctuations of house prices as suggested by the Wüest and Partner (2012)-index are rather surprising. One explanation may be poor data quality. A second explanation may be that the index is based on price data for multifamily houses. In 1965, apartment ownership (i.e. purchased by the unit) was legalized for the first time. This, in turn, may have made rental arrangements less attractive and caused uncertainties about the future value of apartment houses as investment property (Werczberger, 1997). Hence, for the years after 1965 the index should not be viewed as depicting boom-bust developments in house prices in general but fluctuations specific to apartment houses. This hypothesis is supported by Statistics Switzerland (2013) index which for the years since 1965 shows and steady positive development for the broader residential property market. However, the index by Statistics Switzerland (2013) may be problematic for another reason: It appears that the index depicts an exaggerated growth trend as house prices are reported to have roughly tripled between 1960

of the war. During the war years construction activity had remained low. Consequently, the immediate post-war period was characterized by a housing shortage that was further intensified by increasing family formation, high levels of immigration, and generally rising incomes (Böhi, 1964; Werczberger, 1997). Rent controls introduced during the war were gradually abolished until 1954. As a result, rents increased by an impressive 160 percent between 1954 and 1972 and construction activity intensified. A housing shortage persisted, however, until the mid-1970s (Böhi, 1964; Werczberger, 1997).

[130]Correlation coefficient of 0.85.

and 1970. As there is no evidence, discussion or narrative in the literature that reflects such an extreme price development the reported increases appear implausible. While we cannot identify the exact magnitude of house price growth, we can nevertheless assume that Swiss house prices rose during the 1960s. For constructing our long-run index, we therefore rely on the index produced by Wüest and Partner (2012). To smooth out some of the irregular fluctuation, we use a five year moving average of the index.

Figure 57 compares the indices available for 1970–2012, i.e. the index for apartment houses (Wüest and Partner, 2012), the index for single-family houses, and the index for apartments (Swiss National Bank, 2013). As it shows, the three indices generally follow the same trend. For our long-run index, we rely on the index for apartments (Swiss National Bank, 2013) mainly for two reasons: First, the index for apartment houses fluctuates more widely when compared to the indices published by Swiss National Bank (2013). This may be ascribed to the fact that the index is based on a smaller number of observations than the indices by Swiss National Bank (2013). The indices published by Swiss National Bank (2013) may hence be a more reliable indicator of property price fluctuations. Second, we aim to provide house price indices that are consistent over time with respect to property type. As the index for 1930–1969 refers to apartment houses only, we also use the index for apartments for 1970–2012. Our long-run house price index for Switzerland 1901–2012 splices the available series as shown in Table 17.

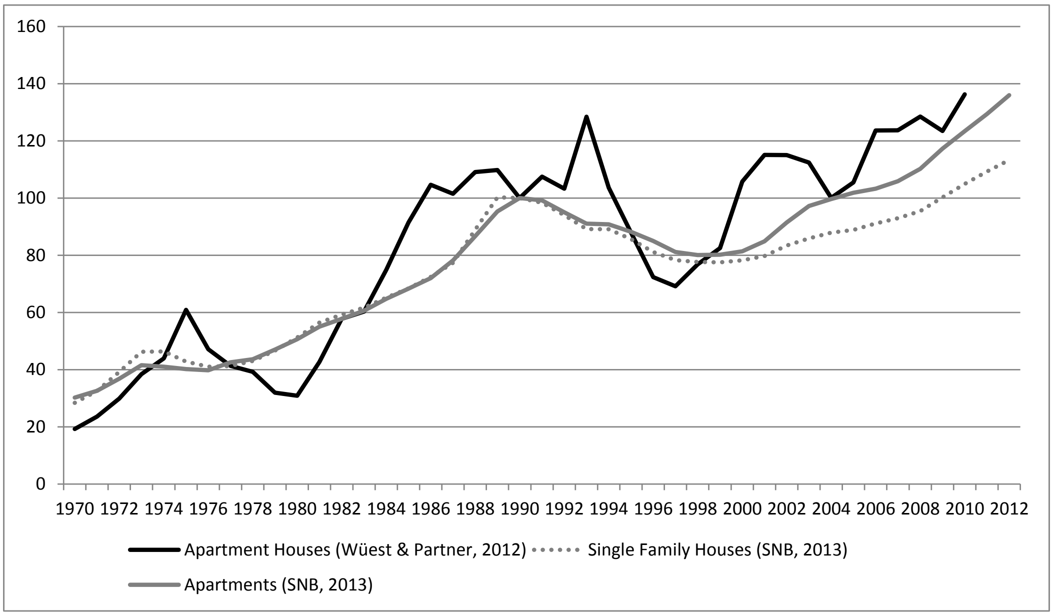


Figure 57: Switzerland: nominal house price indices 1970–2012 (1990=100).

Period	Series ID	Source	Details
1901–1929	CHE1	Swiss Federal Statistical Office (2013)	*Geographic Coverage* Zurich; *Type(s) of Dwellings*: Developed lots and building sites; *Data*: Sales prices collected by Statistics Zurich; *Method*: Five year moving average of average prices.
1930–1969	CHE2	Wüest and Partner (2012)	*Geographic Coverage*: Nationwide (predominantly large & medium-sized urban centers); *Type(s) of Dwellings*: Apartment houses; *Data*: Insurance Companies; *Method*: Hedonic index.
1970–2012	CHE3	Swiss National Bank (2013)	*Geographic Coverage*: Nationwide; *Type(s) of Dwellings*: Apartments; *Data*: List prices; *Method*: Mix-adjustment.

Table 17: Switzerland: sources of house price index, 1901–2012.

Housing related data

Construction costs: 1874-1913: Michel (1927) - Baukostenpreisindex Basel 1914-2012: Stadt Zürich (2012) - Züricher Index der Wohnbaupreise.

Farmland prices: 1953-2012: Swiss Farmers' Union (various years) - Average purchase price of farm real estate per hectare in canton Zurich and canton Bern.

Building activity: 1901–2011: Statistics Zurich (2014).

Homeownership rates: Werczberger (1997), Bundesamt für Wohnungswesen (2013).

Value of housing stock: Goldsmith (1985, 1981) provides estimates of the value of total housing stock, dwellings, and land for the following benchmark years: 1880, 1900, 1913, 1929, 1938, 1948, 1960, 1965, 1973, and 1978.

Household consumption expenditure on housing: 1912–1974: Statistics Switzerland (2014c); 1975–1988: Statistics Switzerland (2014b); 1990–2011: Statistics Switzerland (2014a).

B.14 United Kingdom

House price data

Historical data on house prices in the United Kingdom is available for 1899–2012.

The earliest available data has been collected by the UK Land Registry. In the years 1899–1955, price data were registered by the Land Registry at the occasion of first registrations or transfers of already registered commercial and residential estate in selected - so called compulsory - areas. The database contains information on the value and the number of buildings for both freehold and leasehold property. The value of the land and the number of buildings on it had to be reported by the respective owner.[131] For non-compulsory areas, data are available for the years 1930–1956.

Another early source for house prices covering the period 1920–1938 is provided by Braae (Holmans, 2005, 270 f.). For the years 1920–1927, Braae estimated property values from contract prices for newly constructed properties for local authorities. For the years 1928–1938, the series is based on estimated average construction costs for private dwellings as indicated on building permits issued by local authorities.

For the years since 1930 the Department of Communities and Local Government Department for Communities and Local Government (2013) has gathered house price data from various sources.[132] The data for 1930–1938 are from Holmans (2005, 128) who produces a hypothetical average house price for this period.[133] There is no data available for the years of World War II, i.e. 1939–1945. For the period 1946–1952 DCLG draws on a house price index for modern, existing dwellings constructed by the Co-operative Building Society.[134] For 1952–1965 data for the DCLG dataset were taken from a survey by the Ministry of Housing and Local Government (MHLG) on mortgage completions for new dwellings (*BS4 survey*).[135] For 1966–2005, data on average house prices were drawn from the so-called five percent survey of building societies. For the years 1966–1992 the *Five Percent Survey* has been conducted under the *Building Societies Mortgage (BSM) Survey.* It is based on a five percent sample drawn from the pool of completed building society house purchase mortgages.[136] The index is mix-adjusted so that changes in the mix of dwellings sold do not affect the average price (Holmans, 2005, 259 ff.). Since the BSM records prices at the mortgage completion state, the index refers to existing dwellings (Holmans, 2005, 259 ff.). For the periods 1993–2002 and 2003–2005 the five percent survey refers to the Survey of Mortgage Lenders. For 2005–2010 data come from the Regulated Mortgage Survey.[137]

[131] Data kindly provided by Peter Mayer, Land Registry. The Land Registry would take the price paid in a transfer as the market value. On transfers not for money the buying party has to provide an estimate of the market value.

[132] The DCLG index has been transferred to the Office for National Statistics (ONS) in March 2012.

[133] This hypothetical price is derived using data on the average value of new loans and Halifax Building Society's deposit percentages (Holmans, 2005, 272).

[134] The original index by the Co-operative Building Society covers 1946–1970. Holmans (2005) reasons that the price index for modern existing dwellings is likely to refer to houses that were built in the interwar period as there was only little new building for private owners during the war or in the immediate post-war years. The Co-Operative Permanent Building Society was renamed into Nationwide Building Society in 1970.

[135] The *BS4 survey*, conducted by the Ministry of Housing and Local Government (MHLG), is based upon data supplied by several building societies. The index reflects average house prices (Holmans, 2005). The index based on the BS4 survey and the one based on data from the Co-Operative Building Society essentially show the same trajectory for the years they overlap: an acceleration of house prices starting in the early 1960s (Holmans, 2005, Table I.5). This suggests that prices for new and existing dwellings did not vary at a statistically significant level during this period.

[136] Thus, the index calculated from the data (generally referred to as the Department of the Environment (DoE) mix-adjusted index) is not affected by changes in the respective market share of the building societies or changes in their mix of business.

[137] For the period 1970–2012 an index is available from the OECD using the mix-adjusted house price series from the Department for Communities and Local Government. For the period 1975–2012 the Federal Reserve Bank of Dallas also uses the mix-adjusted house price series from the Department for Communities and Local

Another house price index that, however, only covers more recent years (i.e. since 1995) is provided by the Land Registry. The index relies on the *Price Paid Dataset*, i.e. a record of all residential property transactions conducted in England and Wales. The index thus includes more observations than the one computed by DCLG. The index is calculated using a repeat sales method[138] and is adjusted for quality changes over time. Nevertheless, since the underlying *Price Paid Dataset* only reports few dwelling characteristics, the quality adjustment is rather simplistic.[139]

Furthermore, two indices compiled by two principal mortgage banks are available: the index by the Nationwide Building Society (2013) and the index by Halifax (Lloyds Banking Group, 2013). The Nationwide Building Society (2012, 2013) based on data on its own mortgage approvals produces indices for four different categories of houses: i) all houses; ii) new houses; iii) modern houses; and iv) old houses. The index covers the years from 1952 to 2012 and is published on a quarterly basis. Nationwide has changed the methodology of computation several times: the index for 1952–1959 is based on the simple average of the purchase price. For 1960–1973, this has been changed to an average weighted by the floor area of the houses in the sample. For 1974–1982, the average is weighted by ground floor area, property type and geographical region. Since 1983, a hedonic regression is applied.[140] The index by Halifax (since 2009 a subsidiary of the Lloyds Banking Group) is calculated from the company's own database of mortgage approvals, published on a monthly basis, and reaches back to 1983. Several regional sub-indices by types of buyers (all, first-time buyers, home-movers) and by type of property (all, existing, new) are available. The index is calculated using a hedonic regression.[141] Both, the index by Nationwide and by Halifax suffer from sample selection bias as they are solely based on price information from finalized and approved mortgages.[142]

Figure 58 compares the available nominal house price indices for the period prior to 1954. These are the indices calculated from data by the Land Registry (1899–1955) and Braae (1920–1938) and the index by DCLG (1930–2012). It shows that the DCLG and the Braae indices follow the same trend for the years they overlap but the Land Registry fluctuates comparably more. While, for example, the Land Registry index suggests an increase in nominal house prices during the first half of the 1930s, the other two series decrease. A possible explanation for this disjunct picture is that the data we use for the Land Registry index has to a very large

Government (Department for Communities and Local Government, 2013).

[138]The index therefore excludes new houses.

[139]Several sub-indices covering different property types (i.e. detached, semi-detached, terraced, flat) and different regions, counties, and boroughs are also available (Land Registry, 2013).

[140]The specification controls for several characteristics: location, type of neighborhood, floor size, property design (detached, semi-detached, terraced, etc.), tenure, number of bathrooms, type of garage, number of bedrooms, vintage of the property (Nationwide Building Society, 2012).

[141]The Halifax house price index controls for location, type of property (detached, semi-detached, terraced, bungalow, flat), age of the property, tenure, number of rooms, number of separate toilets, central heating, number of garages and garage spaces, land area, road charge liability, and garden.

[142]Whether any of property transaction enters into the database depends on the buyers' decision to apply for a mortgage by Halifax or Nationwide and the bankers' approval.

extent been collected for property in the London area.[143] Therefore, the data may vis-à-vis to the national trend provide a blurred picture, particularly as London during the 1930s recovered much faster from the Great Depression than most northern regions. Yet, for the years prior to the Great Depression, i.e. 1899–1929, house prices in London were comparably less elevated relative to the rest of the country (Justice, December 18, 1999).[144] Although the underlying data collected from the Registries of Deeds[145] is unfortunately not available, the graphical analysis of nominal hedonic house price indices for 15 towns in the county of Yorkshire for the years 1900–1970 in Wilkinson and Sigsworth (1977) can be used as a comparative to the index calculated from the Land Registry database.[146] Except for the 1930s, the Yorkshire indices generally follow a trend similar to the index calculated from the London centered Land Registry

[143]During the 1930s, registrations outside London were concentrated on property in southeast England. A 1934 government report found that 73 percent of first registrations outside London were undertaken in the four counties bordering London (see National Archives, TNA/LAR/1/50). The Land Registry also has details of the average number of new titles being created in short periods before May 1938. New titles are not just created on first registrations, but also when part of a title is sold or leased. There is only one northern county (Yorkshire) included in this data. Apart from that, even though Yorkshire is a large county, the number of registrations was small compared to Surrey and Kent for example.

[144]The trajectory of this series is confirmed by additional measures of property values prior to World War I: First, as a measure for house values in the period 1895–1913, Holmans (2005, Table I.20) calculated capital values of house prices combining data on capital values as multiples of annual rental income and data on rents. Second, Offer (1981, 259 ff.) presents data on property sales for the years 1892, 1897, 1902, 1907, 1912. Both series indicate an increase in real estate values throughout the 1890s, a peak early in the 1900s and then fall until the onset of World War I. This trend is also confirmed by contemporary accounts of the housing market (The Economist, 1912, 1914, 1918). Several developments are reported to have played a role in falling property prices: First, as discussed before, the crisis of 1907 contributed to falling property prices. After several years of *"marked depression in the property market"* (The Economist, 1914), the years from 1911 to 1913 marked a brief interlude of rising house prices, which was already reversed in 1913. The Economist (1914) provides several explanations for that: First of all, larger returns could be obtained from other forms of investment. This adversely affected prices in both the market for leasehold and for freehold properties. In all parts of the UK, builders complained about difficulties of selling particularly middle- and working-class property. In addition, also mortgages, even though readily available, were only offered at rates of about four percent which was considered to be quite high at the time. Furthermore, building and material costs had increased at higher annual rates than rents thereby lowering the return from residential property investment. Consequently, construction activity declined at such a pace that *The Economist* thus forecasted a housing shortage in industrial centers, i.e. in agglomeration of London, the North and Midlands. House prices remained surprisingly stable during the years of World War I, despite a virtual standstill of building activity and a rise in the price of building materials (The Economist, 1918; Needleman, 1965). In response to the increasing housing shortage and the stagnation in construction activities, the government in 1915 introduced rent controls which would remain a feature of the housing market for a long time (Bowley, 1945). The housing shortage that continued to persist after the end of World War I was large – both in absolute terms as also with regard to the capacity of the building industry. A substantive increase in building activity occurred as part of a general post-war boom but already came to a halt in the summer of 1920 (Bowley, 1945). During the ensuing postwar depression, property prices due to an increase in interest rates and a scarcity of credit fell further and remained depressed until 1922. Only real estate in the London area recovered somewhat faster (The Economist, 1923, 1927). Also for the 1920s, the trajectory of the Land Registry index seems plausible: Rising real incomes, the rise of building socieities and thus more favorable terms for mortgage financing, and changes in public attitudes toward homeownership as preferred housing tenure all contributed to an increase in demand for owner-occupied housing (Bowley, 1945; Pooley, 1992).

[145]At that time, only two counties had deed registries: Middlesex and Yorkshire. To the best of the authors' knowledge, the Middlesex registry, however, did not normally record the price paid.

[146]Wilkinson and Sigsworth (1977, 23) control for several characteristics such as plot size, square yardage of the land the property stands, sanitary arrangements, garage, age. The 15 towns are: Middlesborough, Redcar, Scarborough, Harrogate, Skipton, Leeds, Bradford, Halifax, Keighley, Dewbury, Barnsley, Doncaster, Hull, Bridlington, Driffield.

database. Accordingly, it seems that with the exception of the 1930s, the Land Registry data may provide a reasonable approximation of broad trends in national property markets.

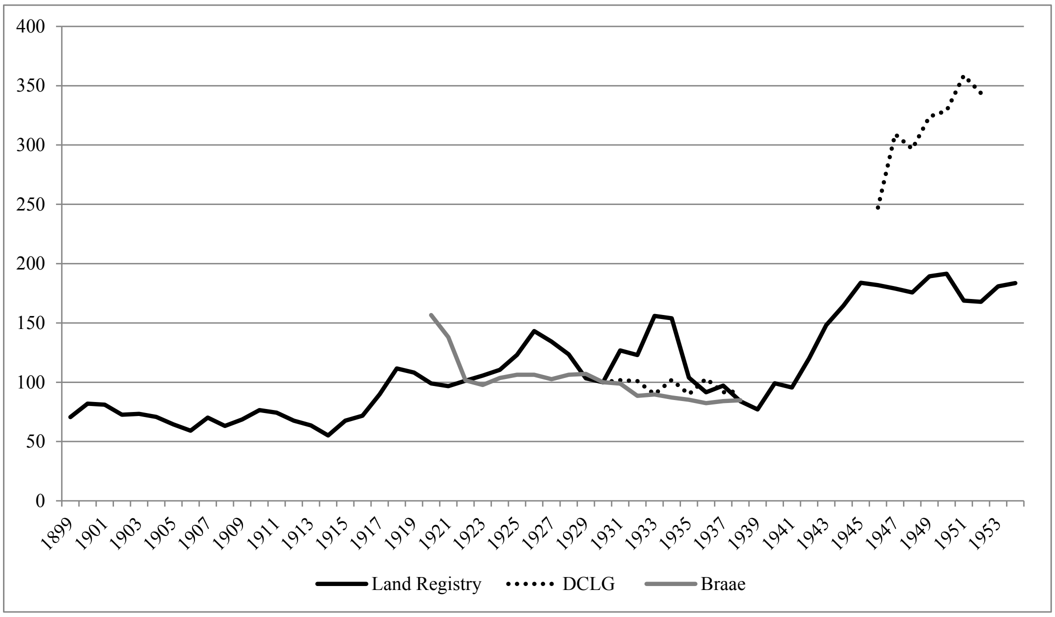


Figure 58: United Kingdom: nominal house price indices 1899–1954 (1930=100).

Figure 59 depicts the nominal indices for the time of the postwar period. The Halifax (all houses), the DCLG-index, the Nationwide index (all houses) and the index computed from the data by the Land Registry (available since 1995) generally follow the same trend during the periods in which they overlap. For the three decades succeeding World War II, the three available indices (Halifax, Nationwide and DCLG) show a marked increase that peaks in the late 1980s. While the Halifax and the Nationwide indices report a nominal price contraction for the early 1990s the DCLG index only shows a stagnant trend. For years since 1995 all four indices report an impressive acceleration of nominal house prices that continued until the onset of the Great Recession but differ with regard to the magnitude of the trends. In comparison to the other indices, the DCLG index shows a more pronounced increase in house prices since the mid-1990s. This can be explained by the fact that DCLG in the computation of its index uses price weights while the other three indices rely on transaction weights. As a result, the DCLG-index is biased toward relatively expensive areas, such as South England (Department for Communicities and Local Government, 2012). The Land Registry index generally shows a less pronounced increase in house prices when compared to the other three indices. This may be associated with by the fact that the index is calculated using a repeat sales method and therefore does not include data on new structures (Wood, 2005).

The long-run index is constructed as shown in the Table 18. For the period after 1930, we use the DCLG-index. As discussed above, this source is in comparison to the indices by Halifax and Nationwide considered least vulnerable for possible distortions and biases. For the period after 1995, the here constructed long-run index draws on the index by the Land Registry as it relies on the largest possible data source.

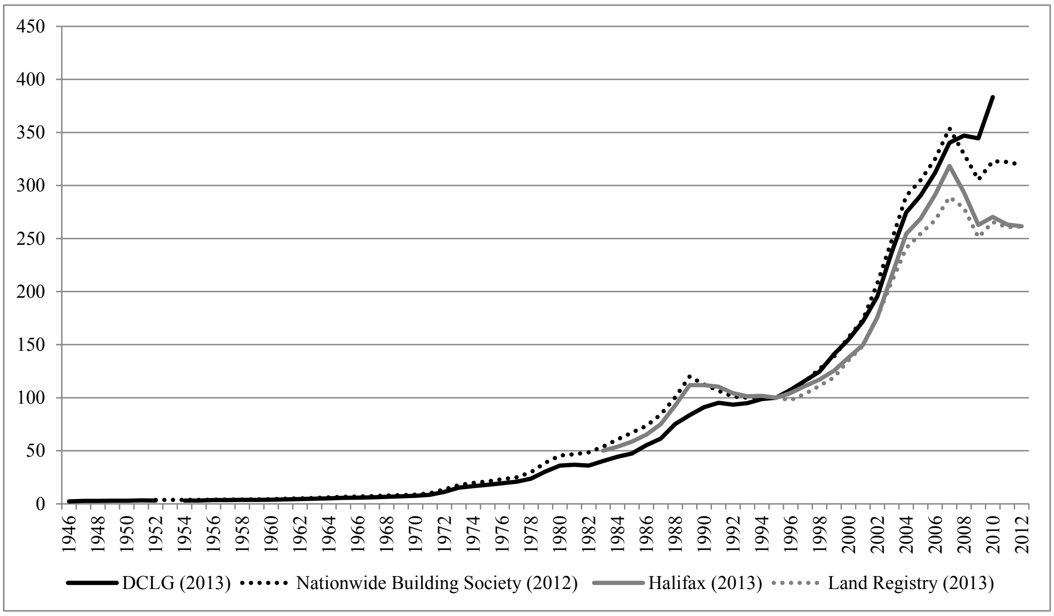


Figure 59: United Kingdom: nominal house price indices 1946–2012 (1995=100).

The resulting index may suffer from two weaknesses: First, before 1930, the index is only based on house prices in the London area and Southeast England. Hence, the exact extent to which the index mirrors trends in other parts of the country remains difficult to determine. Second, the index does not control for quality changes prior to 1969, i.e. depreciation and improvements. To gauge the extent of the quality bias, we can rely on estimates by Feinstein and Pollard (1988) of the changing size and quality of dwellings. If we adjust the growth rates of our long-run index downward accordingly, the average annual real growth rate 1899–2012 of 1.02 percent becomes 0.72 percent in constant quality terms. As this is a rather crude adjustment, however, we use the unadjusted index (see Table 18) for our analysis.

Housing related data

Construction costs: 1870–1938: Maiwald (1954) - Local authority house tender price index; 1939-1954: Fleming (1966) - Construction cost index; 1955–2012: Department for Business, Innovation and Skills (2013) - Construction output price index, private housing.

Farmland prices: 1870–1914: O'Rourke et al. (1996); 1915–1943: Ward (1960); 1944–2004: U.K. Department for Environment Food and Rural Affairs (2011) - Average price of agricultural land sales per hectare, 2005–2012: RICS[147] - RICS farmland price index.

[147]Series sent by email, contact person is Joshua Miller, Royal Institution of Chartered Surveyors.

Period	Series ID	Source	Details
1899–1929	GBR1	Land Registry	*Geographic Coverage*: Three cities; *Type(s) of Dwellings*: All kinds of existing properties (residential and commercial); *Data*: Land Registry; *Method*: Average property value.
1930–1938	GBR2	Department for Communities and Local Government (2013)	*Geographic Coverage*: Nationwide; *Type(s) of Dwellings*: All dwellings; *Data*: Holmans (2005) using data from Halifax Building Society; *Method*: Hypothetical average house price.
1946–1952	GBR3	Department for Communities and Local Government (2013)	*Geographic Coverage*: Nationwide; *Type(s) of Dwellings*: Modern, existing dwellings; *Data*: Co-operative Building Society.
1952–1965	GBR4	Department for Communities and Local Government (2013)	*Geographic Coverage*: Nationwide; *Type(s) of Dwellings*: New Dwellings; *Data*: BS4 survey of mortgage completions; *Method*: Average house prices.
1966–1968	GBR5	Department for Communities and Local Government (2013)	*Geographic Coverage*: Nationwide; *Type(s) of Dwellings*: Existing dwellings; *Data*: Building Societies Mortgage Survey (BSM); *Method*: Average house prices.
1969–1992	GBR6	Department for Communities and Local Government (2013)	*Geographic Coverage*: Nationwide; *Type(s) of Dwellings*: Existing dwellings; *Data*: Building Societies Mortgage Survey (BSM); *Method*: Mix-adjustment.
1993–1995	GBR7	Department for Communities and Local Government (2013)	*Geographic Coverage*: Nationwide; *Type(s) of Dwellings*: Existing dwellings; *Data*: Five Percent Survey of Mortgage Lenders; *Method*: Mix-adjustment.
1995–2012	GBR8	Land Registry (2013)	*Geographic Coverage*: England and Wales; *Type(s) of Dwellings*: Existing dwellings; *Data*: Land Registry; Method: Repeat sales method.

Table 18: United Kingdom: sources of house price index, 1899–2012.

Residential land prices: 1983–2010: Homes and Community Agency (2014).

Building activity: 1870–2001: Holmans (2005); 2002–2012: Department for Communities and Local Government (2014).

Homeownership rates: Office for National Statistics (2013b).

Value of Housing Stock: Goldsmith (1985) provides estimates of the value of total housing stock, dwellings, and land for the following benchmark years: 1875, 1895, 1913, 1927, 1937, 1948, 1957, 1965, 1973, 1977. Data on the value of housing wealth since 1957 is drawn from the Office of National Statistics.[148]

Household consumption expenditure on housing: 1900–1919: Mitchell (1988); 1920–1962: Sefton and Weale (2009); 1963–2012 Office for National Statistics (2013a).

B.15 United States

House price data

Historical data on house prices in the United States is available for 1890–2012.

Well-known to many, the most comprehensive source of historical house prices in the U.S. is provided by Shiller (2009). The Shiller-index for 1890–2012 is, however, computed from a set of individual indices that cover different time periods. For the years 1890–1934, Shiller (2009) relies on an index for new and existing owner-occupied single-family dwellings in 22 cities by Grebler et al. (1956). The index is calculated using an approach similar to the repeat sales method. The price data is drawn from the *Financial Survey of Urban Housing* conducted in 1934 (Grebler et al., 1956, 344 f.) for which owners were asked to indicate the year and the price of acquisition as well as the estimated value of their house in 1934.[149] This method of data collection poses the following problems: The value estimates for 1934 and – to a lesser extent – the purchase prices as indicated by the owners may be subject to systematic bias. Moreover, the index is not adjusted for quality changes over time.[150] Hence, to correct for

[148]Series sent by email, contact person is Amanda Bell. Even though the series includes data for the whole 1957-2012 period, a number of definitional changes occurred during the transition from the European System of Accounts (ESA) ESA1979 to ESA1995 in 1998. At the time, these series were not joined together and this is likely to indicate a definitional difference.

[149]The authors then calculate relatives for each year for each city, i.e. the ratio of the price of the house at time of acquisition and the value in 1934, determine median relatives for each year and convert the resulting index to a 1929 base. According to the authors, about 50 percent of the houses in the sample acquired in the 1890-1899 and the 1900-1909 decades were new houses and about a quarter in the remaining years.

[150]The authors consider two major sources of bias: First, the index does not control for any kind of depreciation. Second, the index does not control for structural additions (upgrading) or alterations (e.g. extensions). The authors argue that since value losses due to depreciation tend to outweigh value gains, their index may be downward-biased. To correct for this, they also provide a second, depreciation-adjusted index assuming a curvilinear rate of depreciation and applying an annual compound rate of depreciation of 1.374 percent (Grebler et al., 1956, 349 ff.). Shiller (2009), however, uses the index non-adjusted index.

depreciation gross of improvements, the authors also present a depreciation-adjusted index. Grebler et al. (1956) argue that due to the substantive geographical coverage (i.e. 22 cities) the index provides a good approximation of the overall movement in house prices in the U.S. In addition to the national index, Grebler et al. (1956) also provide an index for all types of single-family dwellings for Seattle and Cleveland.

Besides the Grebler et al. (1956) index used by Shiller (2009), a few more indices covering the decades prior to or the time of the Great Depression exist. Their geographical coverage is, however, rather limited. Garfield and Hoad (1937), also relying on the *Financial Survey of Urban Housing*, provide indices computed from three-year moving averages of prices for new owner-occupied six-room, single-family, farm houses in Cleveland and Seattle for 1907–1930. (Grebler et al., 1956) suggest that in comparison to their index, the series computed by Garfield and Hoad (1937) may be more consistent as they are based on more homogenous data, i.e. on price data for wooden dwellings of a similar size, most of which were built based on similar plans and also in similar locations. An index by Wyngarden (1927) is based on the median ask or list price from three districts in Ann Arbor, MI, for the period 1913-1925.[151] Wyngarden (1927) claims that although the level of list and ask prices is generally higher than the actual transaction price, the index consistently measures changes in actual transaction prices as it can be assumed that the listing price bears a generally constant relationship to the actual transaction price. The index by Wyngarden (1927) is computed using a repeat sales method and price data for all kinds of existing properties for 1918–1947.[152] Fisher (1951) provides an index for Washington, DC, based on ask price data for existing single-family houses from newspaper advertisements collected for an unpublished study by the National Housing Agency.[153]. A real estate price index for Manhattan (residential and commercial) covering the period 1920–1930 comes from Nicholas and Scherbina (2011).[154] They use data on real estate transactions from the Real Estate Record and Builders' Guide and apply a hedonic method controlling for type of property, i.e. tenements, dwellings, lofts, and an "other" category with the latter also including commercial buildings.

For the period 1934–1953, the Shiller-index is calculated as an average of five individual indices; for Chicago, Los Angeles, New Orleans, and New York as well as the index for Washington, D.C by Fisher (1951). The indices for Chicago, Los Angeles, New Orleans and New York are computed from annual median ask prices as advertised in local newspapers. For the period 1953–1975, Shiller (2009) relies on the home purchase component of the U.S. Consumer

[151] The raw data was provided by Carr and Tremmel, a local real estate agent at that time. These districts are the University District, the Old Town District, and the Western District Wyngarden (1927, 12).

[152] However, according to Wyngarden (1927, 12) "[r]esidential properties were far in the majority, and single-family dwellings were the predominant type."

[153] According to Fisher (1951, 52), the study was undertaken in 100 metropolitan areas. However, the series gathered for Washington, DC, represents the longest series with respect to the time period covered.

[154] According to the authors, even though Manhattan is geographically a small era having 1.5 percent of the total U.S. population in 1930, it contained about 4 percent of total U.S. real estate wealth at that time (Nicholas and Scherbina, 2011, 1).

Price Index. The CPI is calculated from price data for one-family dwellings purchased with FHA-insured loans and controls for age and square footage obtained from the Federal Housing Administration (FHA) by mix-adjustment.[155] Gillingham and Lane (June 1982, 10), however, suggest that *"the data represents a small and specialized segment of the housing market"* and hence may not be representative of general changes in real estate prices (Greenlees, 1982).[156] Davis and Heathcote (2007), too, conclude that the index may underestimate house price appreciation during the 1960s and 1970s.

For the period 1975–1987, Shiller (2009) uses the weighted repeat sales home price index originally published by the U.S. Office of Housing Enterprise Oversight (OFHEO).[157] The index is calculated from price data for individual single-family dwellings on which conventional conforming mortgages were originated and purchased by Freddie Mac (FHLMC) or Fannie Mae (FNMA).[158] Thus, while the index is calculated from a comprehensive dataset with respect to geographical coverage, it may be biased as it only reflects price developments of one sub-categories of real estate; single-family houses that are debt financed and comply with the requirements of a conforming loan by FNMA and FHLMC.[159]

For the years since 1987, Shiller (2009), for the construction of his long-run index, draws on the Case-Shiller-Weiss index (CSWI) and its successors.[160] The CSW national index is constructed from nine regional indices (one for the each of the nine census divisions) using the repeat sales method and price data for existing single-family homes in the U.S.[161]

Figure 60 shows the above presented nominal house price indices for various parts of the U.S and the time prior to World War II. The indices under consideration appear to follow the same trends: It shows that the years prior to World War I were a period of relative nominal price stability. Prices began to moderately increase after World War I. The period of rising prices was accompanied by an increase in general construction activity. A veritable real estate boom is described to have occurred in Florida and Chicago (White, 2009; Galbraith, 1955). However, even though the upswing was felt in in other regions across the country, it is hardly detectable

[155] For further details, see Greenlees (1982).

[156] In particular, Gillingham and Lane (June 1982, 11) argue that the data suffers from three major drawbacks that may result in a time lag and a downward bias of the house price index: "Processing delays often mean that several months elapse between the time a house sale occurs and the time it is used in the CPI. For some geographic areas, especially those in the Northeast, the number of FHA transactions is very small. In addition, the FHA mortgage ceiling virtually eliminates higher priced homes from consideration."

[157] Now published by the Federal Housing Finance Agency (2013).

[158] The index controls for price changes due to renovation and depreciation as well as for price variance associated with infrequent transactions.

[159] For the period 1975–2012, the Federal Reserve Bank of Dallas uses the OFHEO/FHFA index (Mack and Martínez-García, 2012). For the period 1970–2012, an index is available from the OECD using the all transaction index provided by the FHFA.

[160] These are the Fiserv Case-Shiller-Weiss index and the S&P/Case-Shiller Home Price Index (S&P Dow Jones Indices, 2013).

[161] Transactions that do not reflect market values, i.e. because the property type has changed, the property has undergone substantial physical changes, or a non-arms-length transaction has taken place, were excluded from the sample.

in the inflation-adjusted Shiller-index. White (2009) therefore argues that for the 1920s, the Shiller-index may have a substantial downward bias the size of which is difficult to assess. This notion is supported by the comparison of the various indices available for the 1920s (cf. Figure 60). Overall, the performance of U.S. real estate prices in the 1920s and 1930s continues to be debated. While the Shiller (2009)-index suggests a recovery of real house prices during the 1930s, a series constructed by Fishback and Kollmann (2012) indicates that during the Great Depression house prices fell back to their early 1920s level.

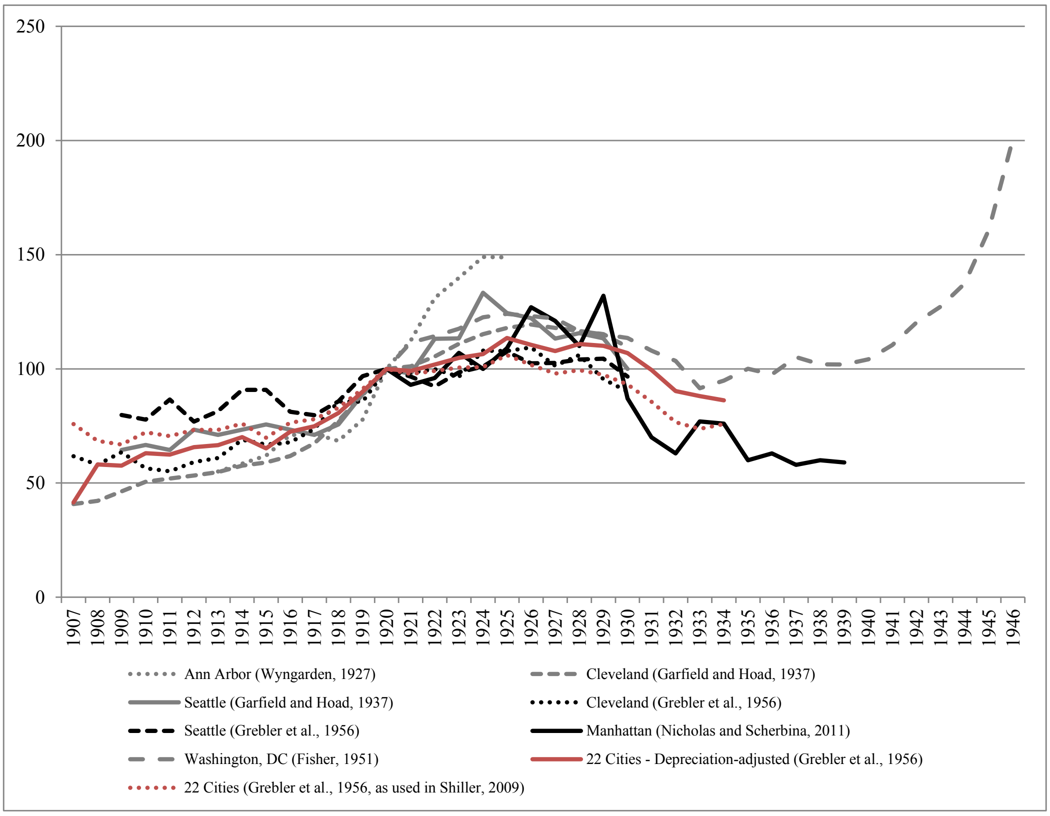


Figure 60: United States: nominal house price indices 1907–1946 (1920=100).

Immediately after the end of World War II, in the second half of the 1940s, the U.S. entered a brief but substantial house price boom. The index by Shiller (2009, 236 f.) clearly reflects this demand-driven price hike of the post-war years. However, for the period 1934–1953, the Shiller-index is, as discussed above, calculated from price data for only five cities and may thus not fully represent the broader national trends. This suspicion is countered by Shiller (2009) who – drawing on additional evidence collected from various sources – comes to the conclusion that the price boom in the after war years was not a geographically limited phenomenon but indeed represented a nationwide development even though the boom may have generally been weaker than the index suggests. While Glaeser (2013) confirms that the post-World War II decades were an ideal setting for a housing boom or even bubble due to changes in mortgage finance and an increase in household formation, he finds that prices did not trend upwards between the 1950s and 1970s since housing supply substantially increased. According to the index by Shiller (2009), house prices indeed remained by and large stable between the mid-1950s and the 1970s. Yet, as noted above, it has been suggested that the index may be downward biased during this period (Davis and Heathcote, 2007; Gillingham and Lane, June 1982).

When turning to Figure 61 that depicts the development of the nominal OFHEO and the CSW index, it shows that the two indices can due to their joint movement be considered as reasonable substitutes. However, the CSW index points toward a weaker growth of real estate prices during the first half of the 1990s but catches up until 2000. Moreover, while both indices indicate a remarkable acceleration of house prices for the years 2000-2006/7 the reported magnitudes vary: For this period the CSW index in comparison to the OFHEO index reports a more pronounced increase. The two indices also provide diverging turning point information; while the CSW index peaks in 2006 the OFHEO does so only in 2007. Shiller (2009, 235) suggests that these differences arise mainly due to the fact that the OFHEO-index is computed from data on actual sales prices as well as on refinance appraisals while the CSW-index for this period is solely based on sales data. Assuming that refinance appraisals generally are more conservative while at the same time having more inertia, it appears plausible that the OFHEO-index vis-à-vis the CSW-index may report very pronounced market movements with a minor delay. Leventis (2007) provides a different explanation and argues that the divergence between the CSW- and the OFHEO-index is caused by incongruent geographic coverage S&P Dow Jones Indices (2013, 29). In addition, Leventis (2007) points towards the differences in the weighting methods applied by CSW and OFHEO He argues that once appraisal values are removed from the OFHEO data set and geographical coverage and weighting methods are harmonized, the two indices behave almost identical for the years after 2000. Due to the broader geographical coverage of the OFHEO index vis-à-vis the CSW index the here constructed long-run index uses the OFHEO-index for the post-1987 period.

Period	Series ID	Source	Details
1890–1934	USA1	Grebler et al. (1956)	*Geographic Coverage*: 22 cities; *Type(s) of Dwellings*: Owner-occupied existing and new single-family dwellings; *Data*: Financial Survey of Urban Housing, assessment of home owners; *Method*: Repeat sales method.
1935–1952	USA2	Shiller (2009)	*Geographic Coverage*: Five cities; *Type(s) of Dwellings*: Existing single-family houses; *Data*: Newspaper advertisements and Fisher (1951); *Method*: Average of median home prices.
1953–1974	USA3	Shiller (2009)	*Geographic Coverage*: Nationwide; *Type(s) of Dwellings*: New and existing dwellings; *Data*: Federal Housing Administration data as used in the home purchase component of the CPI; *Method*: Weighted, mix-adjusted index.
1975–2012	USA4	Federal Housing Finance Agency (2013) (former OFHEO House Price Index)	*Geographic Coverage*: Nationwide; *Type(s) of Dwellings*: New and existing single-family houses; *Data*: FNMA and FHLMC; Method: Weighted repeat sales method.

Table 19: United States: sources of house price index, 1890–2012.

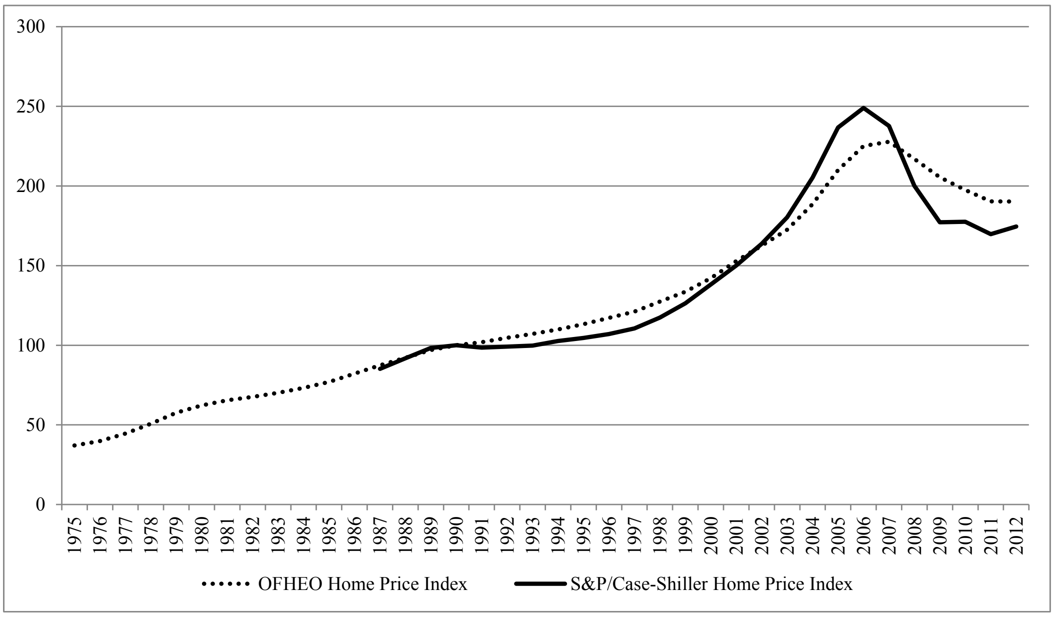


Figure 61: United States: nominal house price indices 1975–2012 (1990=100).

Our long-run house price index for the United States 1890–2012 splices the available series as shown in Table 19.

A drawback of the index is that it does not represent constant-quality home prices throughout the whole 1890–2012 period. This is particularly the case for 1934–1952 (see discussion above). For 1890–1934, we use the depreciation-adjusted index computed by Grebler et al.

(1956) to somewhat reduce the quality bias. The exact performance of U.S. real estate prices in the interwar period, however, is still debated (Fishback and Kollmann, 2012). Moreover, for 1934–1952, the index has a rather limited geographic coverage that may result in a bias of unknown size and direction. Finally, as suggested by Gillingham and Lane (June 1982) and Davis and Heathcote (2007), the index for 1953–1974 may suffer from a downward bias.

Housing related data

Construction costs: 1889–1929: Grebler et al. (1956) - Residential construction cost index, Table B-10; 1930–2012: Davis and Heathcote (2007) - Price index for residential structures.

Farmland prices: 1870–1985: Lindert (1988) - Farmland value per acre; 1986–2012: U.S. Department of Agriculture (2013) - Farmland value per acre.

Residential land prices: 1930–2000: Davis and Heathcote (2007).

Building activity: 1889–1984: Snowden (2014); 1959–2012: U.S. Census Bureau (2013).

Homeownership rates (benchmark years): Mazur and Wilson (2010).

Value of housing stock: Goldsmith (1985) provides estimates of the value of total housing stock, dwellings, and land for the following benchmark years: 1880, 1900, 1912, 1929, 1939, 1950, 1965, 1973, 1978. Davis and Heathcote (2007) provide estimates for the total market value of housing stock, dwellings and land for 1930–2000. Data on the value of household wealth including the value of housing, and underyling land for 2001–2012 is drawn from Piketty and Zucman (2014).

Household consumption expenditure on housing: 1921–1928: National Bureau of Economic Research (2008); 1929–2012: Bureau of Economic Analysis (2014).

B.16 Summary of house price series

The sources of the respective series are listed in tables 6–19.

Frequency

Country	**Series**	**Annual**	**Other**	**Adjustment**
Australia	AUS1	✓		
	AUS2	✓		
	AUS3	✓		
	AUS4	✓		
	AUS5	✓		
	AUS6	✓		

	AUS7	✓		
	AUS8		✓	Average of quarterly index
Belgium	BEL1	✓		
	BEL2	✓		
	BEL3	✓		
	BEL4	✓		
	BEL5	✓		
Canada	CAN1	✓		
	CAN2	✓		
	CAN3		✓	Average of quarterly index
Denmark	DNK1	✓		
	DNK2	✓		
	DNK3		✓	Average of quarterly index
Finland	FIN1	✓		Three year moving average of annual data
	FIN2	✓		
	FIN3		✓	Average of quarterly index
France	FRA1	✓		
	FRA2	✓		
	FRA3		✓	Average of quarterly index
Germany	DEU1	✓		
	DEU2	✓		
	DEU3	✓		
	DEU4	✓		
	DEU5		✓	Average of quarterly index
	DEU6		✓	Average of quarterly index
Japan	JPN1	✓		
	JPN2	✓		
	JPN3		✓	Average of semi-annual index
The Netherlands	NLD1		✓	Interpolate biannual index
	NLD2		✓	Average of monthly index
	NLD3		✓	Average of monthly index
Norway	NOR1	✓		
	NOR2	✓		
Sweden	SWE1	✓		
	SWE2	✓		
Switzerland	CHE1	✓		Five year moving average of annual data
	CHE2	✓		Five year moving average of annual index
	CHE3		✓	Average of quarterly data
United Kingdom	GBR1	✓		
	GBR2	✓		
	GBR3	✓		
	GBR4	✓		
	GBR5	✓		

	GBR6	✓		
	GBR7	✓		
	GBR8		✓	Average of monthly index
United States	USA1	✓		
	USA2	✓		
	USA3	✓		
	USA4		✓	Average of quarterly index

Covered area

Country	**Series**	**Nationwide**	**Other**	**Coverage**
Australia	AUS1		✓	Melbourne
	AUS2		✓	Melbourne
	AUS3		✓	Six capital cities
	AUS4		✓	Six capital cities
	AUS5		✓	Six capital cities
	AUS6		✓	Six capital cities
	AUS7		✓	Six capital cities
	AUS8		✓	Eight capital cities
Belgium	BEL1		✓	Brussels Area
	BEL2		✓	Brussels Area
	BEL3	✓		
	BEL4	✓		
	BEL5	✓		
Canada	CAN1	✓		
	CAN2	✓		
	CAN3		✓	Five cities
Denmark	DNK1	✓		Rural areas
	DNK2	✓		
	DNK3	✓		
Finland	FIN1		✓	Helsinki
	FIN2		✓	Helsinki
	FIN3	✓		
France	FRA1		✓	Paris
	FRA2	✓		
	FRA3	✓		
Germany	DEU1		✓	Berlin
	DEU2		✓	Hamburg
	DEU3		✓	Ten cities
	DEU4		✓	Western Germany
	DEU5		✓	Urban areas in Western Germany
	DEU6		✓	Urban areas in Western Germany
Japan	JPN1		✓	Six cities
	JPN2		✓	All cities

	JPN3		✓	All cities
The Netherlands	NLD1		✓	Amsterdam
	NLD2	✓		
	NLD3	✓		
Norway	NOR1		✓	Four cities
	NOR2		✓	Four cities
Sweden	SWE1		✓	Two Cities
	SWE2		✓	Two Cities
Switzerland	CHE1		✓	Zurich
	CHE2		✓	Nationwide, predominantly large & medium-sized urban centers
	CHE3	✓		
United Kingdom	GBR1		✓	Three cities
	GBR2	✓		
	GBR3	✓		
	GBR4	✓		
	GBR5	✓		
	GBR6	✓		
	GBR7	✓		
	GBR8		✓	England & Wales
United States	USA1		✓	22 cities
	USA2		✓	Five cities
	USA3	✓		
	USA4	✓		

Property type

Country	Series	Single-Family	Multi-Family	All Kinds of Dwellings	Other	Property Type
Australia	AUS1			✓		
	AUS2			✓		
	AUS3			✓		
	AUS4			✓		
	AUS5			✓		
	AUS6			✓		
	AUS7	✓				
	AUS8	✓				
Belgium	BEL1	✓				
	BEL2	✓				
	BEL3				✓	Small & medium sized dwellings
	BEL4				✓	Small & medium sized dwellings
	BEL5	✓				

Canada	CAN1			✓		
	CAN2				✓	All kinds of real estate (residential & non-residential)
	CAN3				✓	Bungalows and two story executive buildings
Denmark	DNK1				✓	Farms
	DNK2	✓				
	DNK3	✓				
Finland	FIN1				✓	Building sites for residential use
	FIN2		✓			
	FIN3		✓			
France	FRA1		✓			
	FRA2			✓		
	FRA3			✓		
Germany	DEU1				✓	All kinds of real estate (residential & non-residential)
	DEU2				✓	All kinds of real estate (residential & non-residential)
	DEU3				✓	All kinds of real estate (residential & non-residential)
	DEU4				✓	Land only
	DEU5	✓				
	DEU6	✓				
Japan	JPN1				✓	Land only
	JPN2				✓	Land only
	JPN3				✓	Land only
The Netherlands	NLD1				✓	All kinds of real estate (residential & non-residential)
	NLD2			✓		
	NLD3			✓		
Norway	NOR1			✓		
	NOR2			✓		
Sweden	SWE1		✓			
	SWE2				✓	Single- and two family houses
Switzerland	CHE1				✓	All kinds of real estate (residential & non-residential)
	CHE2		✓			
	CHE3				✓	Apartments

United Kingdom	GBR1			✓	All kinds of real estate (residential & non-residential)
	GBR2		✓		
	GBR3		✓		
	GBR4		✓		
	GBR5		✓		
	GBR6		✓		
	GBR7		✓		
	GBR8		✓		
United States	USA1	✓			
	USA2	✓			
	USA3		✓		
	USA4	✓			

Property vintage

Country	Series	Existing	New	New & Existing	Other
Australia	AUS1	✓			
	AUS2	✓			
	AUS3	✓			
	AUS4	✓			
	AUS5	✓			
	AUS6	✓			
	AUS7			✓	
	AUS8			✓	
Belgium	BEL1	✓			
	BEL2	✓			
	BEL3	✓			
	BEL4	✓			
	BEL5	✓			
Canada	CAN1	✓			
	CAN2	✓			
	CAN3	✓			
Denmark	DNK1	✓			
	DNK2	✓			
	DNK3			✓	
Finland	FIN1			✓	Land only
	FIN2	✓			
	FIN3	✓			
France	FRA1	✓			
	FRA2	✓			
	FRA3	✓			

Germany	DEU1	✓			
	DEU2	✓			
	DEU3	✓			
	DEU4			✓	Land only
	DEU5			✓	
	DEU6			✓	
Japan	JPN1			✓	Land only
	JPN2			✓	Land only
	JPN3			✓	Land only
The Netherlands	NLD1	✓			
	NLD2	✓			
	NLD3	✓			
Norway	NOR1	✓			
	NOR2	✓			
Sweden	SWE1			✓	
	SWE2			✓	
Switzerland	CHE1	✓			
	CHE2	✓			
	CHE3	✓			
United Kingdom	GBR1	✓			
	GBR2	✓			
	GBR3	✓			
	GBR4		✓		
	GBR5	✓			
	GBR6	✓			
	GBR7	✓			
	GBR8	✓			
United States	USA1		✓		
	USA2	✓			
	USA3			✓	
	USA4			✓	

Priced unit

Country	**Series**	**Per Dwelling**	**Per Square Meter**	**Other**	**Unit**
Australia	AUS1			✓	Per Room
	AUS2				
	AUS3				
	AUS4				
	AUS5				
	AUS6				
	AUS7				
	AUS8				

Belgium	BEL1		✓		
	BEL2		✓		
	BEL3	✓			
	BEL4	✓			
	BEL5	✓			
Canada	CAN1	✓			
	CAN2	✓			
	CAN3	✓			
Denmark	DNK1	✓			
	DNK2	✓			
	DNK3	✓			
Finland	FIN1		✓		
	FIN2		✓		
	FIN3		✓		
France	FRA1	✓			
	FRA2	✓			
	FRA3	✓			
Germany	DEU1	✓			
	DEU2		✓		
	DEU3		✓		
	DEU4		✓		
	DEU5	✓			
	DEU6	✓			
Japan	JPN1			✓	Cannot be determined from the source
	JPN2			✓	Cannot be determined from the source
	JPN3		✓		
The Netherlands	NLD1	✓			
	NLD2	✓			
	NLD3	✓			
Norway	NOR1	✓			
	NOR2			✓	Cannot be determined from the source
Sweden	SWE1	✓			
	SWE2	✓			
Switzerland	CHE1		✓		
	CHE2	✓			
	CHE3	✓			
United Kingdom	GBR1	✓			
	GBR2	✓			
	GBR3	✓			
	GBR4	✓			
	GBR5	✓			
	GBR6	✓			
	GBR7	✓			

	GBR8	✓
United States	USA1	✓
	USA2	✓
	USA3	✓
	USA4	✓

Method

Country	Series	Repeat Sales	Mix-Adjusted	Hedonic	SPAR	Mean/ Median	Other	Method
Australia	AUS1					✓		
	AUS2					✓		
	AUS3					✓		
	AUS4						✓	Estimate of Fixed Price
	AUS5					✓		
	AUS6					✓		
	AUS7		✓					
	AUS8		✓					
Belgium	BEL1					✓		
	BEL2					✓		
	BEL3					✓		
	BEL4					✓		
	BEL5		✓					
Canada	CAN1						✓	Estimated replacement value
	CAN2					✓		
	CAN3					✓		Based on price information of standardized dwellings
Denmark	DNK1					✓		Adjusted for size of property
	DNK2					✓		
	DNK3				✓			
Finland	FIN1					✓		
	FIN2					✓		
	FIN3		✓	✓				
France	FRA1	✓						
	FRA2	✓						
	FRA3		✓	✓				
Germany	DEU1					✓		
	DEU2					✓		
	DEU3					✓		

	DEU4					✓		
	DEU5		✓					
	DEU6		✓					
Japan	JPN1					✓		
	JPN2					✓		
	JPN3					✓		
The Nether-lands	NLD1	✓						
	NLD2	✓				✓		
	NLD3				✓			
Norway	NOR1	✓		✓				
	NOR2			✓				
Sweden	SWE1				✓			
	SWE2		✓		✓			
Switzerland	CHE1					✓		
	CHE2			✓				
	CHE3		✓					
United Kingdom	GBR1					✓		
	GBR2						✓	Hypothetical average price
	GBR3					✓		
	GBR4					✓		
	GBR5					✓		
	GBR6		✓					
	GBR7		✓					
	GBR8	✓						
United States	USA1	✓						
	USA2					✓		
	USA3		✓					
	USA4	✓						

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