Data from "The Rate of Return on Everything, 1870–2015"

The data on government bill, government bond, equity and housing returns are sourced from Jordà, Knoll, Kuvshinov, Schularick, and Taylor (2019). Please cite the paper as written below when using any of these data.

The data consist of the total return on each asset class, divided up into the capital gain and dividend or rental income components for equity and housing. Section 1 provides the overview of how each series is computed, and Section 2 details the sources for the data.

References

Jordà, Òscar, Katharina Knoll, Dmitry Kuvshinov, Moritz Schularick, and Alan M. Taylor. 2019. The Rate of Return on Everything, 1870–2015. *Quarterly Journal of Economics* forthcoming.

1. Overview of the methodology

1.1. Historical returns data

Bill returns The canonical risk-free rate is taken to be the yield on Treasury bills, i.e., short-term, fixed-income government securities. The yield data come from the latest vintage of the long-run macrohistory database (Jordà, Schularick, and Taylor, 2017).[1] Whenever data on Treasury bill returns were unavailable, we relied on either money market rates or deposit rates of banks from Zimmermann (2017). Since short-term government debt was rarely used and issued in the earlier historical period, much of our bill rate data before the 1960s actually consist of deposit rates.[2]

Bond returns These are conventionally the total returns on long-term government bonds. Unlike earlier cross-country studies, we focus on the bonds listed and traded on local exchanges and denominated in local currency. This focus makes bond returns more comparable with the returns of bills, equities, and housing. Moreover, this results in a larger sample of bonds, and on bonds that are more likely to be held by the representative household in the respective country. For some countries and periods we have made use of listings on major global exchanges to fill gaps where domestic markets were thin, or local exchange data were not available (for example, Australian bonds listed in New York or London). Throughout the sample we target a maturity of around 10 years. For the second half of the 20th century, the maturity of government bonds is generally accurately defined. For the pre-WW2 period we sometimes had to rely on data for perpetuals, i.e., very long-term government securities (such as the British consol).

Equity returns These returns come from a broad range of sources, including articles in economic and financial history journals, yearbooks of statistical offices and central banks, stock exchange listings, newspapers, and company reports. Throughout most of the sample, we aim to rely on indices weighted by market capitalization of individual stocks, and a stock selection that is representative of the entire stock market. For some historical time periods in individual countries, however, we also make use of indices weighted by company book capital, stock market transactions, or weighted equally, due to limited data availability.

[1] www.macrohistory.net/data

[2] In general, it is difficult to compute the total returns on deposits because of uncertainty about losses during banking crises, and we stick to the more easily measurable government bill and bond returns where these data are available. Comparisons with the deposit rate data in Zimmermann (2017), however, indicate that the interest rate differential between deposits and our bill series is very small, with deposit rates on average roughly 0.7 percentage points below bills—a return close to zero in real terms. The returns on government bills and deposits are also highly correlated over time.

Housing returns We combine the long-run house price series introduced by Knoll, Schularick, and Steger (2017) with a novel dataset on rents drawn from the unpublished PhD thesis of Knoll (2017). For most countries, the rent series rely on the rent components of the cost of living of consumer price indices constructed by national statistical offices. We then combine them with information from other sources to create long-run series reaching back to the late 19th century. To proxy the total return on the residential housing stock, our returns include both rented housing and owner-occupied properties.[3] Specifically, wherever possible we use house price and rental indices that include the prices of owner-occupied properties, and the imputed rents on these houses. Imputed rents estimate the rent that an owner-occupied house would earn on the rental market, typically by using rents of similar houses that are rented. This means that, in principle, imputed rents are similar to market rents, and are simply adjusted for the portfolio composition of owner-occupied as opposed to rented housing. Imputed rents, however, are not directly observed and hence less precisely measured than market rents, and are typically not taxed.

Composite returns We compute the rate of return on safe assets, risky assets, and aggregate wealth, as weighted averages of the individual asset returns. To obtain a representative return from the investor's perspective, we use the outstanding stocks of the respective asset in a given country as weights. To this end, we make use of new data on equity market capitalization (from Kuvshinov and Zimmermann, 2018) and housing wealth for each country and period in our sample, and combine them with existing estimates of public debt stocks to obtain the weights for the individual assets. Tables 1 and 2 present an overview of our four asset return series by country, their main characteristics and coverage. Section 2 specifies the sources we consulted and discusses the construction of the series in greater detail (see the Sections 2.2, 2.3, and 2.4 for housing returns, and Section 2.5 for equity and bond returns).

1.2. Calculating returns

The total annual return on any financial asset can be divided into two components: the capital gain from the change in the asset price P, and a yield component Y, that reflects the cash-flow return on an investment. The total nominal return R for asset j in country i at

[3] This is in line with the treatment of housing returns in the existing literature on returns to aggregate wealth—see, for example, Piketty et al. (2018) and Rognlie (2015).

time t is calculated as:

$$\text{Total return:} \quad R^j_{i,t} = \frac{P^j_{i,t} - P^j_{i,t-1}}{P^j_{i,t-1}} + Y^j_{i,t}\,. \tag{1}$$

In addition to individual asset returns, we also present a number of weighted "composite" returns aimed at capturing broader trends in risky and safe investments, as well as the "overall return" or "return on wealth."

For safe assets, we assume that total public debt is divided equally into bonds and bills since there are no data on their market shares (only for total public debt) over our full sample. As a result, we compute the safe asset return as:

$$\text{Safe return:} \quad R^{safe}_{i,t} = \frac{R^{bill}_{i,t} + R^{bond}_{i,t}}{2}\,. \tag{2}$$

The risky asset return is calculated as a weighted average of the returns on equity and on housing. The weights w represent the share of asset holdings of equity and of housing stocks in the respective country i and year t, scaled to add up to 1. We use stock market capitalization and housing wealth to calculate each share and hence compute risky returns as:

$$\text{Risky return:} \quad R^{risky}_{i,t} = R^{equity}_{i,t} \times w^{equity}_{i,t} + R^{housing}_{t} \times w^{housing}_{i,t}\,. \tag{3}$$

The "return on wealth" measure is a weighted average of returns on risky assets (equity and housing) and safe assets (bonds and bills). The weights w here are the asset holdings of risky and safe assets in the respective country i and year t, scaled to add to 1.[4]

$$\text{Return on wealth:} \quad R^{wealth}_{i,t} = R^{risky}_{i,t} \times w^{risky}_{i,t} + R^{safe}_{i,t} \times w^{safe}_{i,t}\,. \tag{4}$$

1.3. Constructing housing returns using the rent-price approach

This section briefly describes our methodology to calculate total housing returns. We construct estimates for total returns on housing using the rent-price approach. This approach starts from a benchmark rent-price ratio (RI_0/HPI_0) estimated in a baseline year ($t = 0$). For this ratio we rely on net rental yields from the Investment Property Database (IPD).[5] We can then construct a time series of returns by combining separate information

[4]For comparison, we also supply a series of the equally-weighted risky return, and the equally-weighted rate of return on wealth, both calculated as simple averages of housing and equity, and housing, equity and bonds respectively.

[5]These net rental yields use rental income net of maintenance costs, ground rent, and other irrecoverable expenditure. These adjustments are discussed exhaustively in the next section. We use net rather than gross

from a country-specific house price index series (HPI_t/HPI_0) and a country-specific rent index series (RI_t/RI_0). For these indices we rely on prior work on housing prices (Knoll, Schularick, and Steger, 2017) and new data on rents (Knoll, 2017). This method assumes that the indices cover a representative portfolio of houses. Under this assumption, there is no need to correct for changes in the housing stock, and only information about the growth rates in prices and rents is necessary.

Hence, a time series of the rent-price ratio can be derived from forward and back projection as

$$\frac{RI_t}{HPI_t} = \left[\frac{(RI_t/RI_0)}{(HPI_t/HPI_0)}\right]\frac{RI_0}{HPI_0}. \tag{5}$$

In a second step, returns on housing can then be computed as:

$$R_{t+1}^{housing} = \frac{RI_{t+1}}{HPI_t} + \frac{HPI_{t+1} - HPI_t}{HPI_t}. \tag{6}$$

Our rent-price approach is sensitive to the choice of benchmark rent-price-ratios and cumulative errors from year-by-year extrapolation. We verify and adjust rent-price approach estimates using a range of alternative sources. The main source for comparison is the balance sheet approach to rental yields, which calculates the rent-price ratio using national accounts data on total rental income and housing wealth. The "balance sheet" rental yield RY_t^{BS} is calculated as the ratio of total net rental income to total housing wealth:

$$RY_t^{BS} = \text{Net rental income}_t/\text{Housing Wealth}_t, \tag{7}$$

This balance sheet rental yield estimate can then be added to the capital gains series in order to compute the total return on housing from the balance sheet perspective. We also collect additional point-in-time estimates of net rental yields from contemporary sources such as newspaper advertisements. These measures are less sensitive to the accumulated extrapolation errors in equation (5), but are themselves measured relatively imprecisely.[6] Wherever the rent-price approach estimates diverge from these historical sources, we make adjustments to benchmark the rent-price ratio estimates to these alternative historical measures of the rental yield.

yields to improve comparability with other asset classes.

[6]We discuss the advantages and disadvantages of these different approaches in Jordà, Knoll, Kuvshinov, Schularick, and Taylor (2019). Broadly speaking, the balance sheet approach can be imprecise due to measurement error in total imputed rent and national housing wealth estimates. Newspaper advertisements are geographically biased and only cover gross rental yields, so that the net rental yields have to be estimated.

2. Data Sources

2.1. Data overview

Table 1: *Overview of bill and bond data*

Country	Bills		Bonds	
	Period	Type of rate	Period	Type of bond
Australia	1870–1928	Deposit rate	1900–1968	Long maturity, central gov't
	1929–1944	Money market rate	1969–2015	Approx. 10y, central gov't
	1948–2015	Government bill rate		
Belgium	1870–1899	Central bank discount rate	1870–1913	Perpetual
	1900–1964	Deposit rate	1914–1940	Long maturity, central gov't
	1965–2015	Government bill rate	1941–1953	Perpetual
			1954–2015	Approx. 10y, central gov't
Denmark	1875–2015	Money market rate	1870–1923	Perpetual
			1924–1979	Long maturity, central gov't
			1980–2015	Approx. 10y, central gov't
Finland	1870–1977	Money market rate	1870–1925	Long maturity, central gov't
	1978–2015	Interbank rate	1926–1991	Approx. 5y, central gov't
			1992–2015	Approx. 10y, central gov't
France	1870–1998	Money market rate	1870–1969	Perpetual
	1999–2015	Government bill rate	1970–2015	Long maturity, central gov't
Germany	1870–1922	Money market rate	1870–1878	Long maturity, local gov't
	1924–1944	Interbank rate	1879–1943	Long maturity, central gov't
	1950–2015	Money market rate	1948–1955	Mortgage bond
			1956–2015	Long maturity, central gov't
Italy	1870–1977	Money market rate	1870–1913	Perpetual
	1978–2015	Government bill rate	1914–1954	Long maturity, central gov't
			1955–2015	Approx. 10y, central gov't
Japan	1876–1956	Deposit rate	1881–1970	Long maturity, central gov't
	1957–2015	Money market rate	1971–2015	Approx. 10y, central government
Netherlands	1870–1957	Money market rate	1870–1899	Perpetual
	1958–1964	Central bank discount rate	1900–1987	Long maturity, central gov't
	1965–2015	Money market rate	1988–2003	$\geq$ 8y, central government
			2004–2015	Approx. 10y, central government
Norway	1870–2015	Deposit rate	1870–1919	Long maturity, central gov't
			1920–2015	Approx. 10y, central gov't
Portugal	1880–1914	Money market rate	1870–1974	Long maturity, central gov't
	1915–1946	Central bank discount rate	1975–2015	Approx. 10y, central gov't
	1947–1977	Deposit rate		
	1978–2015	Money market rate		
Spain	1870–1921	Money market rate	1900–1994	Long maturity, central gov't
	1922–1974	Deposit rate	1995–2015	7–8y, central government
	1975–2015	Money market rate		
Sweden	1870–1998	Deposit rate	1874–1918	Long maturity, central gov't
	1999–2015	Government bill rate	1919–1949	Perpetual
			1950–2015	Approx. 10y, central gov't
Switzerland	1870–1968	Deposit rate	1900–2006	Long maturity, central gov't
	1969–2015	Money market rate	2007–2015	Approx. 10y, central gov't
United Kingdom	1870–2015	Money market rate	1870–1901	Perpetual
			1902–1989	Approx. 20y, central gov't
			1990–2015	Approx. 15y, central gov't
United States	1870–2013	Deposit rate	1870–1926	Approx. 10y, central gov't
	2014–2015	Money market rate	1927–2015	Long maturity, central gov't

Table 2: *Overview of equity and housing data*

Country	Equity			Housing	
	Period	Coverage	Weighting	Period	Coverage
Australia	1870–1881	Listed abroad	Market cap	1901–2015	Urban
	1882–2015	Broad	Market cap		
Belgium	1870–2015	All share	Market cap	1890–1950	Urban
				1951–1961	Mixed
				1977–2015	Nationwide
Denmark	1873–1899	All share	Market cap	1876–1964	Mixed
	1900–1999	Broad	Market cap	1965–2015	Nationwide
	2000–2001	Blue chip	Market cap		
	2002–2015	All share	Market cap		
Finland	1896–1911	Broad	Book cap	1920–1964	Urban
	1912–1969	All share	Market cap	1965–1969	Mixed
	1970–1990	Broad	Market cap	1970–2015	Nationwide
	1991–2015	All share	Market cap		
France	1870–2015	Blue chip	Market cap	1871–1935	Urban
				1936–1948	Mixed
				1949–2015	Nationwide
Germany	1870–1889	Blue chip	Market cap	1871–1912	Mixed
	1890–1913	All share	Market cap	1913–1938	Urban
	1914–1959	Blue chip	Market cap	1939–1947	Mixed
	1960–2015	Broad	Market cap	1948–1970	Nationwide
				1971–2015	Mixed
Italy	1870–1887	Selected stocks	Book cap	1928–1998	Urban
	1888–2015	Broad	Market cap	1999–2015	Mixed
Japan	1882–1975	Broad	Transaction volume	1931–1946	Urban
	1976–2015	All share	Mix of equal and market cap	1947–2015	Mixed
Netherlands	1900–2003	Broad	Mostly market cap	1871–1969	Mixed
	2004–2015	All share	Market cap	1970–2015	Nationwide
Norway	1881–1920	All share	Market cap	1871–2015	Urban
	1921–1955	All share	Mix of equal and book cap		
	1956–2000	All share	Mix of book cap and company turnover		
	2001–2015	Most traded shares	Market cap		
Portugal	1871–2015	All share	Market cap	1948–2015	Mixed
Spain	1900–2015	All share	Market cap	1901–1957	Mixed
				1958–2015	Nationwide
Sweden	1871–2001	Broad	Market cap	1883-1959	Urban
	2002–2015	All share	Market cap	1960–2015	Mixed
Switzerland	1900–1925	All share	Market cap	1902–1930	Urban
	1926–1959	Broad	Equally weighted	1931–1940	Mixed
	1960–2015	Broad	Market cap	1941–2015	Nationwide
United Kingdom	1870–1928	All share	Market cap	1895–1899	Urban
	1929–1963	Blue chip	Market cap	1900–1913	Mixed
	1964–2015	All share	Market cap	1914–1929	Urban
				1930–1946	Mixed
				1947–2015	Nationwide
United States	1872–2015	Broad	Market cap	1891–1952	Urban
				1953–2015	Mixed

2.2. Housing returns

The total return on housing is a combination of the capital gain and rental income. The capital gain series are computed from the house price data in Knoll, Schularick, and Steger (2017). The rental indices are drawn from the unpublished PhD thesis of Knoll (2017), which also extended the dataset in Knoll et al. (2017) to cover three additional countries (Italy, Portugal and Spain). The sources for these new series are reproduced in Section 2.4. This section starts by describing the construction of the rental yield series. Section 2.3 then describes the general methodology for constructing the rental indices, and Section 2.4 details the sources of the rent data.

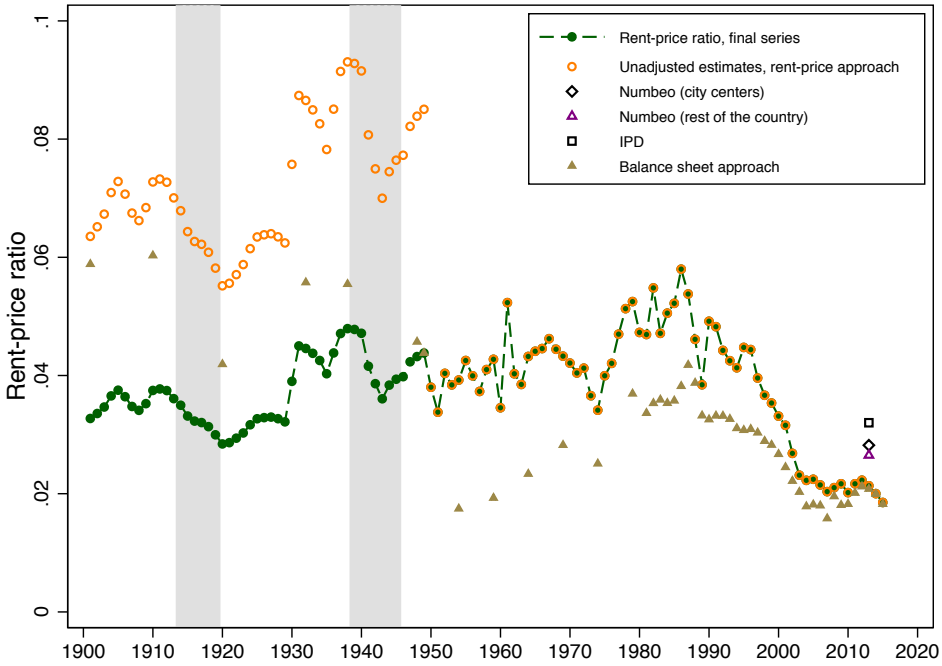
As described in Section 1.2, the baseline housing return series is constructed using the rent-price approach. To do this, we take a benchmark net rent-price ratio—adjusted down for maintenance and other costs—in the year 2012, 2013 or 2014, and extrapolate it back using growth in the house price and rent indices. We further check the rent-price approach estimates against various alternative historical benchmarks. These include the balance sheet approach constructed from National Accounts data, and independent estimates from books, journal articles and historical newspapers.

If the rent-price approach estimate differs substantially from those in the alternative sources, we adjust it so that the estimates are in line with each other. We do not adjust the series when these differences are small, or we have good reasons to doubt the quality of the alternative estimates. When we do adjust, we either benchmark our series to historical net rent-price ratios from alternative sources, or adjust the growth in the rental index by a multiplicative factor, such that the different estimates of historical rent-price ratios are broadly in line with each other.

In each of the Figures 1 to 16, the series that we use in the paper are the "Rent-price ratio, final series" estimates denoted as green circles. These incorporate any adjustments made to bring the data into line with historical sources. Alongside these, we also present the raw unadjusted rent-price approach series—orange circles—and the alternative historical estimates themselves. We also show alternative benchmark estimates for the present day to help assess the reliability of our baseline IPD rent-price ratio. These are generally sourced from data on rental expenditure and property values on `Numbeo.com`, for one- and three-bedroom apartments i). within city-centres and ii). in the rest of the country, and are adjusted down by us to proxy the impact of running costs and depreciation. For cases where data on running costs and depreciation were not available, we estimate these to be about one-third of gross rent, in line with the recent and historical experience in most countries (see Jordà, Knoll, Kuvshinov, Schularick, and Taylor, 2019, for further discussion). For Australia and US, we additionally make use of benchmark rent-price ratio estimates based on detailed transaction-level data. In two countries—Australia and Belgium—we judge one of these alternative modern-day benchmarks to be more reliable than the IPD ratio, and use it to construct our final baseline net rent-price ratio series.

Australia

Figure 1: *Australia: plausibility of rent-price ratio*



For 2014, Fox and Tulip (2014) report a gross rental yield of 4.2 per cent, running costs excluding taxes and utilities of 1.1 per cent, and depreciation rate of 1.1 per cent, using data covering almost all properties advertized for rent in major Australian cities. This gives us a benchmark net rent-price ratio of 0.02. Applying the rent-price approach to this benchmark gives us the unadjusted long-run net rent-price ratio series depicted as orange circles in in Figure 1. We make one adjustment to these series to correct for possible mismeasurement of rental growth when lifting the wartime price controls in 1949/50 (see below for details). This gives us the adjusted final rent-price ratio series—the green-circled line in Figure 1—used in this paper.

We obtain several scattered independent estimates of rent-price ratios in Australia. First, the IPD database (MSCI, 2016) reports a net rent-price ratio of 0.032 for the Australian residential real estate in 2013 (black square in Figure 1). Balance sheet approach estimates (brown triangles) are obtained using a variety of sources. OECD (2016a), Stapledon (2007), Australian Bureau of Statistics (2014) and Butlin (1985) provide estimates of gross rental expenditure and various maintenance and running costs, as well as depreciation, for present-day and historical periods. As with the benchmark yield calculation, we subtract all non-tax and non-utilities related running costs, plus depreciation, to calculate total net rental expenditure. We then combine it with the housing wealth data from Stapledon (2007) and Piketty and Zucman (2014) to calculate the net rental yield.

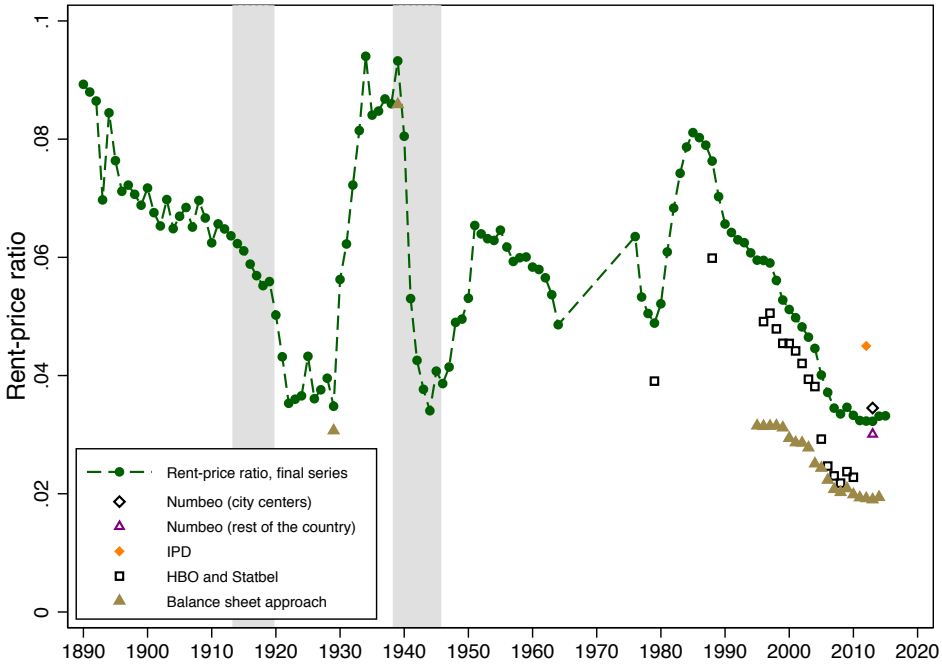
The historical balance-sheet approach estimates are broadly in line with the unadjusted rent-price approach series (orange circles) over recent decades, but below it for the earlier years. Note that the long-run rent-price ratio shows a structural break in 1949/1950 stemming from a surge in house prices after the lifting of wartime price controls in 1949 (price controls for houses and land were introduced in 1942). While the abandonment of price controls undoubtedly had an effect on house prices, it is unclear whether it also resulted in a single sudden shift in the relationship between

house prices and rents. To guard against measurement uncertainty, we benchmark our historical rent-price ratio to the balance sheet approach estimate in 1949. Figure 1 shows that the adjusted long-run rent price ratio—the green circle line—generally concords with the balance-sheet approach estimates, being on average slightly lower during 1900–1940, and higher during 1950–1980.

Finally, modern-day gross rental yield estimates are available from Numbeo.com for one- and three-bedroom apartments i). within city-centres and ii). in the rest of the country. We adjust these down using the cost estimates from Fox and Tulip (2014) to obtain a proxy of net yield. The resulting estimates fall in-between those of the MSCI (2016), and the other approaches.

Belgium

Figure 2: *Belgium: plausibility of rent-price ratio*



We construct the benchmark rent-price ratio using the rental yield data from Numbeo.com, taking the average of in- and out-of-city-centre apartments, and adjusting down one-third to account for running costs and depreciation. This gives us a benchmark net rent-price ratio of 0.033 for 2012. Applying the rent-price approach gives us the long-run net rent-price ratio series depicted as green circles in Figure 2, which are the estimates used in this paper. Please note that the benchmark rent-price ratio from the IPD (MSCI, 2016)—0.045 for 2012—is substantially higher than the alternative approaches, which is why we rely on estimates from Numbeo.com instead.

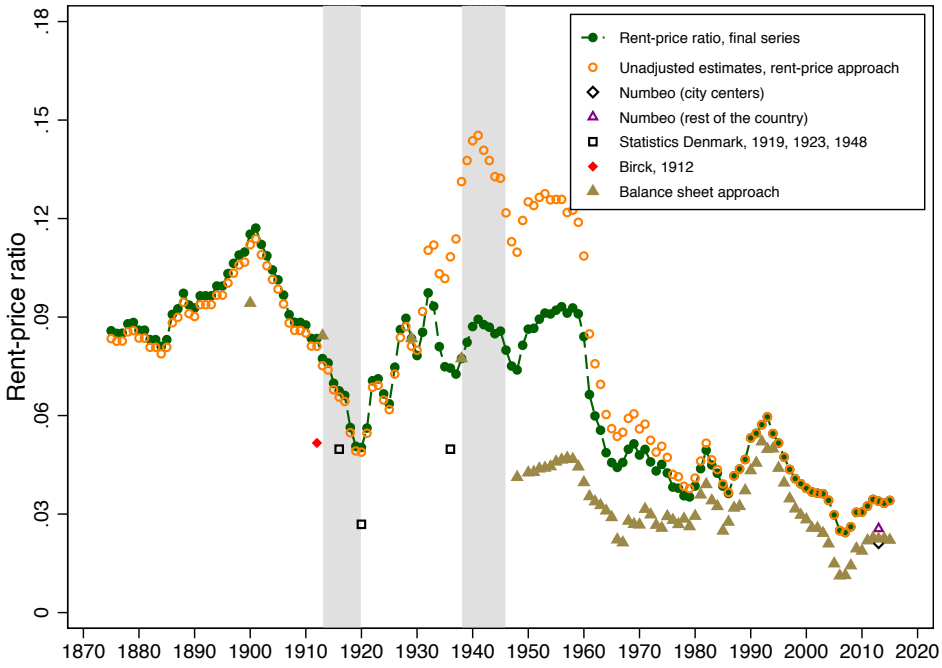
We construct four independent estimates of rent-price ratios. First, for 1978–2010, Statistics Belgium publish estimates of average rental expenditure and house prices (Statistics Belgium, 2013b, 2015). Assuming around one-third of gross rent is spent on maintenance, running costs and depreciation, this gives us a series of net rent-price ratios, depicted as square dots in Figure 2. The resulting series are consistent with both the level and the time trend in our baseline series constructed using the rent-price approach.

Second, we construct estimates of gross rent-price ratios using the balance-sheet approach, based on data on rental expenditure and housing wealth, and scale these down one-third to obtain the net yield proxy. For the modern period, Poullet (2013) provides estimates of housing wealth, and Statistics Belgium (2013a) and OECD (2016a) of rental expenditure. For historical series, Peeters, Goossens, and Buyst (2005) reports estimates of total gross and net rents on all dwellings, which we scale down to obtain an estimate of net rental expenditure on residential real estate. Goldsmith and Frijdal (1975) report estimates of housing wealth for 1948–1971, which we extend back to 1929 using data in Goldsmith (1985), and assuming a constant share of land to residential property value. The resulting net rental yield estimates are somewhat below our baseline rent-price ratio for the modern period, and broadly in line with its historical levels, falling within a reasonable margin of error given the substantial uncertainty in the Belgian housing wealth estimates.

We would like to thank Stijn Van Nieuwerburgh for sharing historical rent and house price data for Belgium.

Denmark

Figure 3: *Denmark: plausibility of rent-price ratio*



For 2013, the MSCI (2016) reports the rent-price ratio for Danish residential real estate of 0.034. Applying the rent-price approach to this benchmark gives us the unadjusted long-run net rent-price ratio series depicted as orange circles in in Figure 3. We make one adjustment to these series to correct for possible mismeasurement of rental growth around WW2 (see below for details). This gives us the final adjusted rent-price ratio series—the green-circled line in Figure 3—used in this paper.

We obtain several additional estimates of rent-price ratios in Denmark throughout the past century and a half. First, we construct estimates using the balance sheet approach using data on total rental expenditure (Hansen, 1976; OECD, 2016a; Statistics Denmark, 2017b) and housing wealth

(Abildgren, 2016). We estimate housing running costs and depreciation as fixed proportions of dwelling intermediate consumption, and depreciation of all buildings (Statistics Denmark, 2017a), and subtract these from gross rental expenditure to produce net rental yield estimates. The balance sheet approach yields are similar to the rent-price approach for the recent decades and in the early 20th century, but diverge somewhat in the 1940s and 50s. Both estimates are subject to measurement error, but the large difference suggests that some of the high levels of the rent-price approach ratio may be a result of the rental index underestimating the rent growth during this period. To guard against accumulation of errors in the rent-price approach, we benchmark the historical yield to the balance sheet approach estimates in 1938 and 1929, and adjust the rent-price ratio growth for the in-between years, with the final series (green circles) being somewhere in-between the balance-sheet and rent-price approaches. For earlier the historical period, the rent-price and balance-sheet approaches display similar levels and time trend.

Our baseline rent-price ratio estimates are also in line with two further historical sources. First, according to Birck (1912), at the time of his writing, housing values in Copenhagen typically amounted to 13 times the annual rental income. Second, in line with this estimate, Statistics Denmark (1919) reports that housing values in urban areas in 1916 were about 13.5 times the annual rental income (note that housing values reported in Statistics Denmark (1919, 1923, 1948, 1954) relate to valuation for tax purposes). These data imply a gross rent-price ratio of about 0.06–0.07, and a net rent-price ratio of around 0.04–0.05. For 1920, Statistics Denmark (1923) states that housing values in urban areas were about 25 times the annual rental income implying a gross rent-price ratio of roughly 0.04 (roughly 0.03 net). In 1936, rent-price ratios in urban areas had returned to pre-WW1 levels (Statistics Denmark, 1948). Finally, estimates of net rent-price ratios based on data from `www.Numbeo.com` are similar to the modern-day values for the balance-sheet and rent-price approaches.

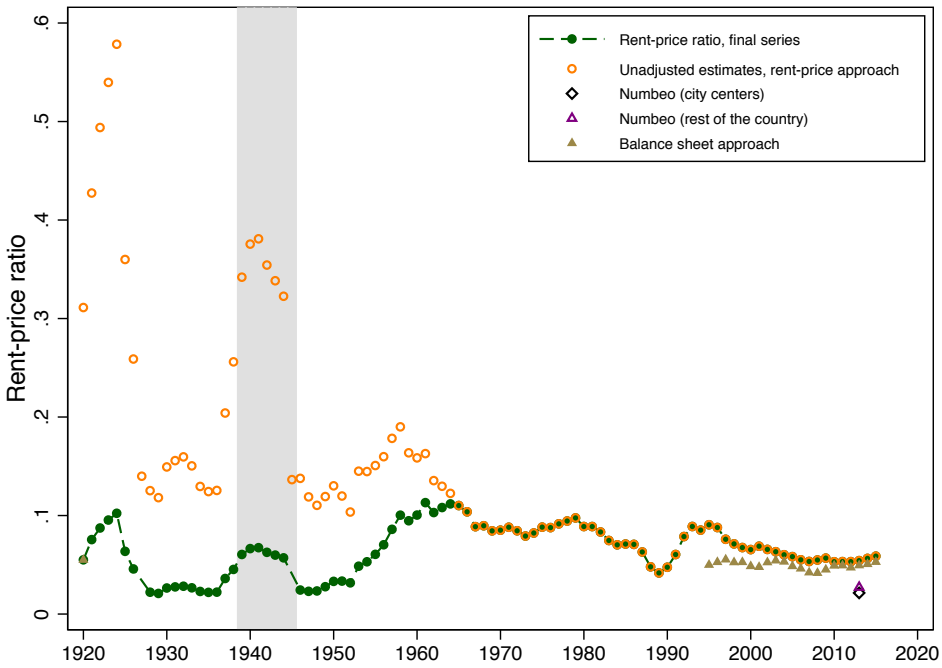
Finland

For 2013, the MSCI (2016) reports the rent-price ratio for Finnish residential real estate of 0.054. Applying the rent-price approach to this benchmark gives us the unadjusted long-run net rent-price ratio series depicted as orange circles in in Figure 4. We make one adjustment to these series to correct for possible mismeasurement of rental growth during the rent controls imposed in the early-to-mid 20th century (see below for details). This gives us the final adjusted rent-price ratio series—the green-circled line in Figure 4—used in this paper.

We obtain two alternative estimates of the net rent-price ratio for the modern period. First, we construct proxies of gross rental expenditure, running costs and depreciation, and total housing wealth back to 1995 using data from Statistics Finland and OECD. These are roughly the same as our benchmark rent-price ratio for the benchmark year, but are slightly lower in the late 1990s. Note, however, that data from Statistics Finland imply a housing depreciation rate of 3.5%, and running and maintenance costs of around 2%, which corresponds to an expected duration of the structure of less than 20 years. Therefore, the cost estimates are almost certainly too high, and adjusting these to more reasonable levels would leave the rent-price ratios on par, or above our baseline values. For 2013, we also obtain estimates of rent-price ratios for one- and three-bedroom apartments i) within city-centers and ii) in the rest of the country from `www.Numbeo.com`. Once adjusted for costs, these are somewhat lower than both the estimates using the rent-price and balance sheet approach.

We also construct an independent estimate of the rent-price ratio in Finland in 1920 using data on total housing value (Statistics Finland, 1920) and total expenditure on rents (Hjerppe, 1989), adjusted down by one-third to account for running costs and depreciation. Figure 4 shows that this estimate is significantly below the long-run rent price ratio in 1920. Similarly to the case of Spain,

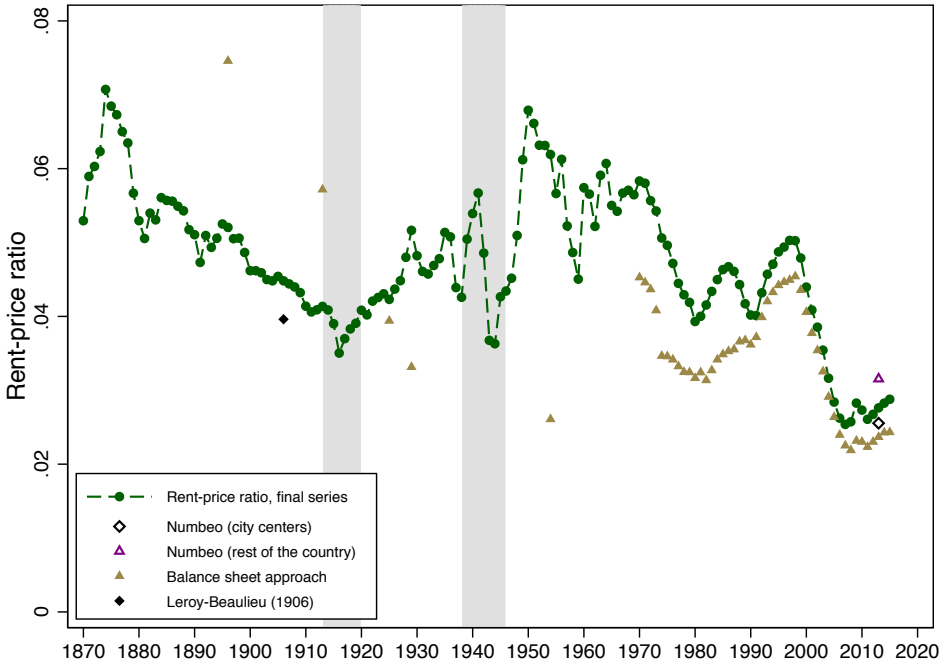
Figure 4: *Finland: plausibility of rent-price ratio*



the discrepancy between the rent-price approach and alternative estimates may reflect difficulties of the Finnish statistical office to construct a rent index after the introduction of wartime rent controls. Rent controls were introduced during WW2 and were only abolished under the *Tenancy Act* of 1961 (Whitehead, 2012). While this period of deregulation was rather short-lived—rent regulation was re-introduced in 1968 and parts of the private rental market were subject to rent regulation until the mid-1990s—the downward trend of the long-run rent-price ratio appears particularly remarkable. In other words, the data suggest that rents during the period of deregulation increased significantly less than house prices. To the best of our knowledge, no quantitative or qualitative evidence exists supporting such a pronounced fall in the rent-price ratio during the first half of the 1960s. We therefore conjecture that the rent index suffers from a downward bias during the period of wartime rent regulation and immediately thereafter. To mitigate this bias, we adjust the gross growth rate in rents between WW2 and 1965 up by a constant factor calibrated so that the adjusted long-run rent-price ratio concords with the independent estimate in 1920, which is a factor of 1.1. Figure 4 displays the resulting adjusted long-run rent-price ratio.

France

Figure 5: *France: plausibility of rent-price ratio*



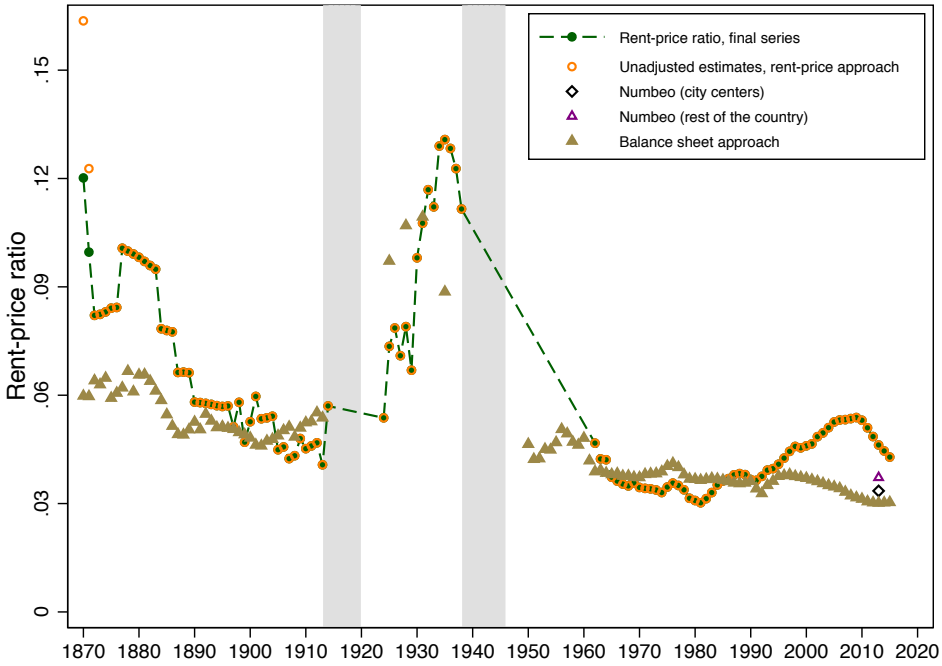
For 2013, the MSCI (2016) reports the rent-price ratio for French residential real estate of 0.028. Applying the rent-price approach to this benchmark gives us the long-run net rent-price ratio series depicted as green circles in in Figure 5, which are the estimates used in this paper.

We obtain several scattered independent estimates of rent-price ratios in France since 1870. First, we calculate rent-price ratios using the balance-sheet approach, based on the data on total housing value (Piketty and Zucman, 2014) and total expenditure on rents (Statistics France, 2016b; Villa, 1994) net of running costs and depreciation (Piketty and Zucman, 2014; Statistics France, 2016a,b). These estimates are in line with those using the rent-price approach, even though the balance-sheet approach rental yield estimates for 1900–1920 are somewhat higher, and for 1920–1960 somewhat lower. Second, `Numbeo.com` estimates of modern-day rent-price ratios are in line with the IPD benchmark.

A few additional scattered estimates on housing returns for the pre-WW2 period are available. For 1903, Haynie (1903) reports an average gross rental yield for Paris of about 4 percent. For 1906, Leroy-Beaulieu (1906) estimates a gross rental yield for Paris of 6.36 percent, ranging from 5.13 percent in the 16th arrondissement to 7.76 percent in the 20th arrondissement. Simonnet, Gallais-Hamonno, and Arbulu (1998) state that the gross rent of residential properties purchased by the property investment fund *La Fourmi Immobiliere* amounted to about 6 to 7 percent of property value between 1899 and 1913. These estimates are generally comparable with an average annual net rental yield of about 5 percent for 1914–1938 for the final series used in this paper.

Germany

Figure 6: *Germany: plausibility of rent-price ratio*



For 2013, the MSCI (2016) reports the rent-price ratio for German residential real estate of 0.047. Applying the rent-price approach to this benchmark gives us the unadjusted long-run net rent-price ratio series depicted as orange circles in in Figure 6. We make one adjustment to these series to correct for possible mismeasurement of rental growth in the early 1870s (see below for details). This gives us the final adjusted rent-price ratio series—the green-circled line in Figure 6—used in this paper.

We obtain three independent estimates of historical rent-price ratios in Germany. First, `Numbeo.com` estimates of modern-day rent-price ratios are broadly in line with the rent-price approach. Second, we calculate the balance sheet approach estimates for benchmark years based on data on total housing value and total expenditure on rents. The housing wealth series combines the data in Piketty and Zucman (2014), and various issues of *Statistik der Einheitswerte*. For the pre-WW1 period, we scale up the value of structures reported in Piketty and Zucman (2014) to obtain a proxy for total housing wealth. The rental expenditure data are from OECD (2016a) and Statistics Germany (2013) for the modern period, and (Hoffmann, 1965) for the period before WW2. Throughout we assume around one-third of gross rent is spent on costs and depreciation to obtain a proxy for net rental expenditure.

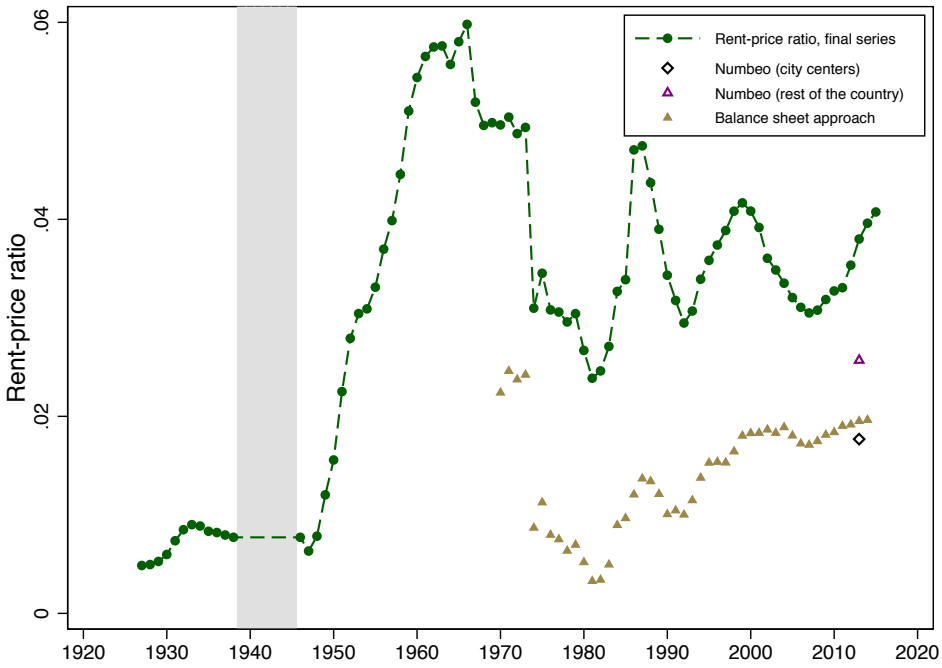
Figure 6 shows that the balance sheet approach estimates confirm the general level and historical time trend of the rent-price ratio: rents were high in the interwar period, and comparatively lower before WW1 and after WW2. The modern-day balance sheet approach estimates are somewhat below those in our final series, but within a reasonable margin of error, given the uncertainty in estimating housing wealth, imputed rents, running costs and depreciation. For the years 1870–1871, however, the balance sheet approach estimates of rental yield are relatively stable, whereas those using the rent-price approach are markedly high. It is likely that the rental index underestimated

the rental growth during years 1870–1871, when house prices grew sharply. However, the balance sheet approach net yield estimate is in itself highly uncertain, as housing wealth data may have been smoothed over time, and there is little data on the value of land underlying dwellings. We therefore adjust the rental yield down to the average of the rent-price figures, and an alternative rental yield series that extrapolates the growth of rents back using the balance sheet approach. This results in the green dots, our final series for 1870–1871, that suggests that rental yields fell during those years, but probably by less than suggested by the raw unadjusted series.

Finally, one additional series on housing returns is available for the pre-WW2 period. For 1870–1913, Tilly (1986) reports housing returns for Germany and Berlin. Average annual real net returns according to Tilly (1986) amount to about 8 percent—a figure similar to the circa 10 percent p.a. average annual real return calculated using the adjusted rent and house price data.

Italy

Figure 7: *Italy: plausibility of rent-price ratio*

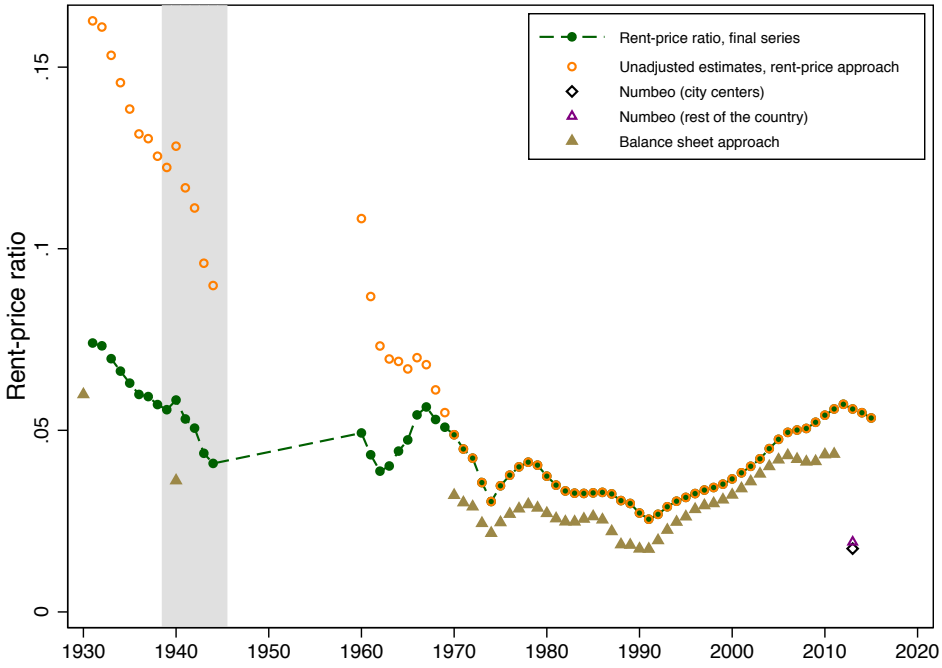


For 2013, the MSCI (2016) reports the rent-price ratio for Italian residential real estate of 0.038. Applying the rent-price approach to this benchmark gives us the long-run net rent-price ratio series depicted as green circles in in Figure 7, which are the estimates used in this paper.

To gauge the plausibility of historical rent-price ratios, we construct the balance-sheet approach rental yields as total rental expenditure net or running costs and depreciation, in proportion to total housing wealth (Istat, 2016; Piketty and Zucman, 2014). These are somewhat lower than the rent-price approach estimate, but confirm the general trend in the rent-price ratio from the 1970s onwards. Finally, `Numbeo.com` estimates of modern-day rent-price ratios are similar to the rent-price and balance sheet approach.

Japan

Figure 8: *Japan: plausibility of rent-price ratio*



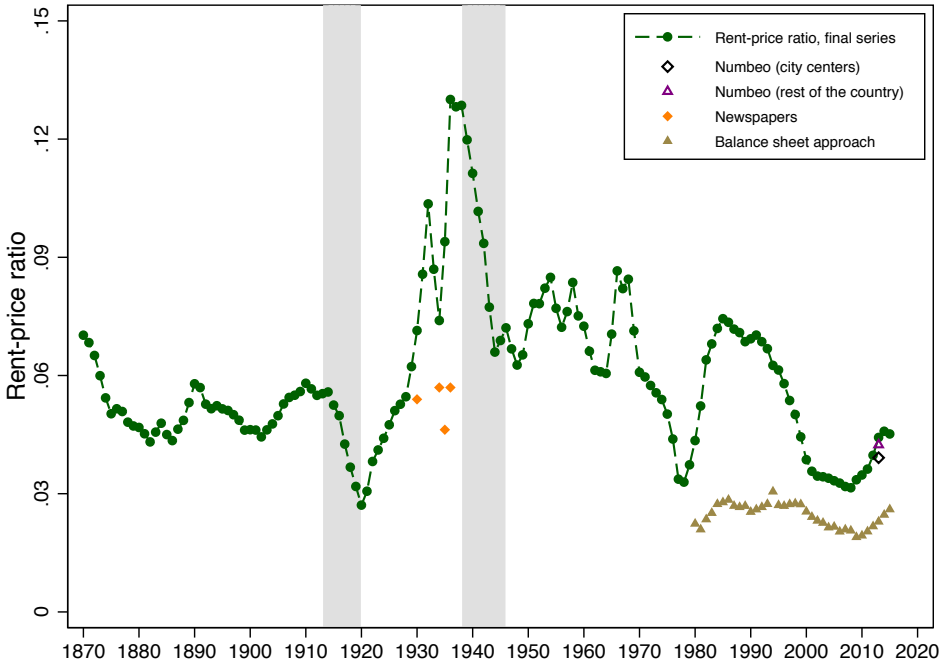
For 2013, the MSCI (2016) reports the rent-price ratio for Japanese residential real estate of 0.056. Applying the rent-price approach to this benchmark gives us the unadjusted long-run net rent-price ratio series depicted as orange circles in in Figure 8. We make one adjustment to these series to correct for possible mismeasurement of rental growth in the 1960s (see below for details). This gives us the final adjusted rent-price ratio series—the green-circled line in Figure 8—used in this paper.

We obtain two independent estimates for rent-price ratios in Japan. First, we calculate rent-price ratios for benchmark years (1930, 1940, 1970–2011) based on data on total housing value (Goldsmith, 1985; Piketty and Zucman, 2014) and total expenditure on rents (Cabinet Office. Government of Japan, 2012; Shinohara, 1967). To proxy the net rent-price ratio, we assume around one-third of gross rent is spent on running costs and depreciation. The resulting estimates are consistent with the long-run rent-price ratio for the period 1970–2011 (Figure 8). Yet, for 1930 and 1940 the estimates are much lower than those using the rent-price approach. This suggests that the rent index may have underestimated rent growth between 1940 and 1970, thus inflating the historical rental yield estimates. Indeed, the unadjusted series imply that the rent-price ratio fell dramatically during the 1970s, a trend not mirrored in any subsequent period, or in the balance-sheet approach data. To this end, we conjecture that the rental index understated the growth in rents by a factor of two during the 1960s. The resulting adjusted rent-price ratio (green circles) is then consistent with the historical estimates using the balance sheet approach.

Second, estimates of modern-day rent-price ratios from `Numbeo.com` are are somewhat below both the rent-price approach and balance-sheet approach estimates for the 2010s.

Netherlands

Figure 9: *Netherlands: plausibility of rent-price ratio*



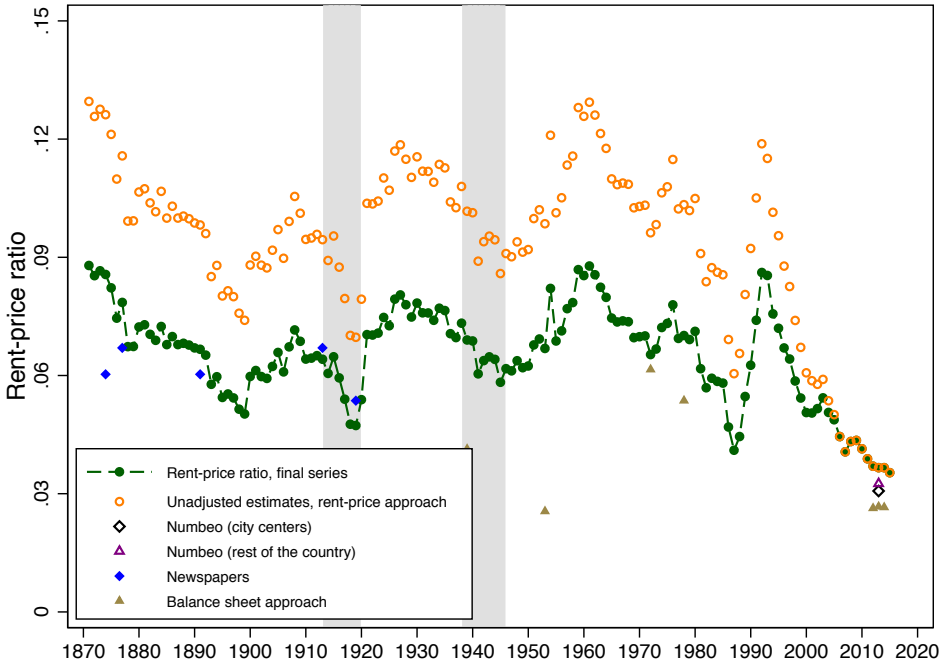
For 2013, the MSCI (2016) reports the rent-price ratio for Dutch residential real estate of 0.044. Applying the rent-price approach to this benchmark gives us the long-run net rent-price ratio series depicted as green circles in in Figure 9, which are the estimates used in this paper.

We obtain two independent estimates for rent-price ratios in the Netherlands. First, we calculate the rent-price ratio using the balance sheet approach, based on estimates of rental expenditure from OECD (2016a), and housing wealth estimated from non-financial balance sheet data in OECD (2016b) and Groote, Albers, and De Jong (1996) (brown trianges in Figure 9). We assume one-third of gross rental is spent on running costs and depreciation. The yields confirm the general trend in our benchmark series, although their levels are somewhat lower. It is worth noting that the estimates of housing wealth and running costs for the Netherlands are highly uncertain, hence we do not put too much weight on the level of the balance-sheet approach yields.

Second, a number of newspaper advertisements and articles in the mid-1930s report rent-price ratio levels of 0.07–0.09, which we conjecture are around 0.05 - 0.06 in net terms, once running costs and depreciation are taken out (Limburgsch Dagblaad, 1935; Nieuwe Tilburgsche Courant, 1934, 1936). These are somewhat lower than our baseline series, but similar to the levels observed in the early 1930s, with the remaining margin of error easily attributed to location specificity (the advertisements are for city-center properties, with the correspondingly lower yiedls). More generally, residential real estate was perceived as a highly profitable investment throughout the decade (De Telegraaf, 1939). Finally, estimates of the rent-price ratio based on data from `Numbeo.com` are almost identical to our baseline IPD benchmark (MSCI, 2016).

Norway

Figure 10: *Norway: plausibility of rent-price ratio*



For 2013, the MSCI (2016) reports the rent-price ratio for Norwegian residential real estate of 0.037. Applying the rent-price approach to this benchmark gives us the unadjusted long-run net rent-price ratio series depicted as orange circles in in Figure 10. We make one adjustment to these series to bring the estimates in line with alternative historical sources (see below for details). This gives us the final adjusted rent-price ratio series—the green-circled line in Figure 10—used in this paper.

We obtain several scattered independent estimates of rent-price ratios in Norway since 1871. First, we calculate rent-price ratios for benchmark years using the balance-sheet approach, based on data on total housing value (Goldsmith, 1985; OECD, 2016b) and total expenditure on rents (OECD, 2016a; Statistics Norway, 1954, 2014), and assuming one-third of gross rent is consumed by running costs and depreciation expenses to estimate the net rental yield. Note that for the historical expenditure series, we estimate rents as 80% of total housing expenditure, a proportion consistent with modern-day Norwegian data, and historical data for the US. We also collect scattered data from advertisements for Oslo residential real estate in *Aftenposten*, one of Norway's largest newspapers, with the gross advertised yield again adjusted down by one-third to proxy the net figure.

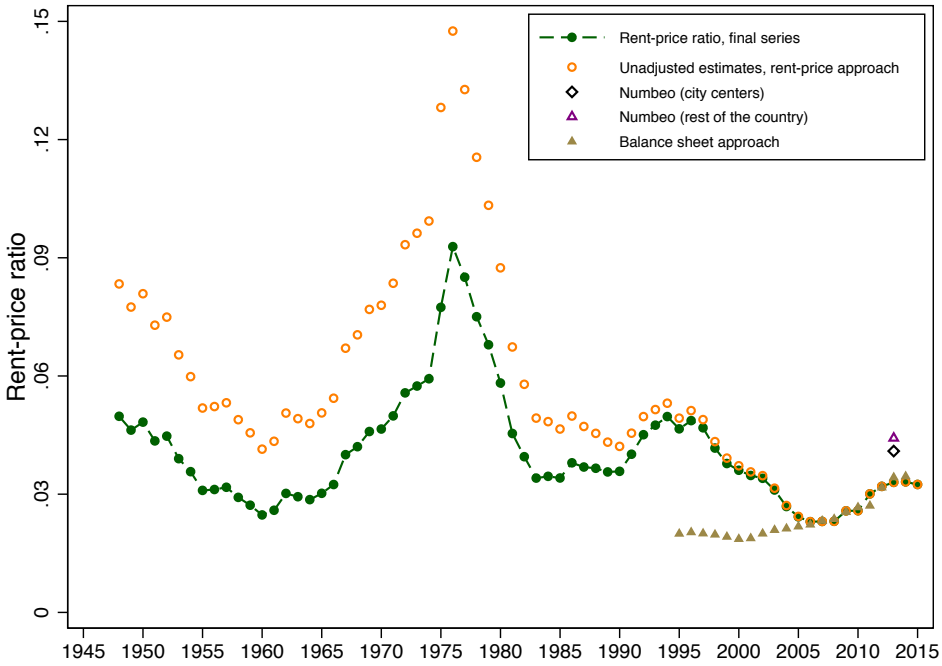
Both these sets of estimates confirm the general long-run trend in the rent-price ratio. The long-run rent-price ratio was essentially stable up until the early 2000s, with increases in early 20th century and late 1960s reversed by falls in WW1 and the 1980s, and is currently at a historical low. However the long-run level of the ratio is generally lower than the estimates using the rent-price approach (orange diamonds): around 6%–8% rather than 8%–12%, and this divergence is already apparent in the late 1970s. Based on this, we stipulate that the rental index during late 1990s and early 2000s—a period when house prices increased substantially—understated the growth of rents relative to prices, leading the rent-price approach to overstate the historical rental yields. To correct for this presumed bias, we adjust the growth in rents up by a factor of 1.5 for the years 1990 to 2005.

The resulting adjusted rent-price ratio (green circles) is in line with the historical estimates both in terms of levels and trend.

Lastly, estimates of the rent-price ratio based on data from www.Numbeo.com are in line with our baseline IPD benchmark (MSCI, 2016).

Portugal

Figure 11: *Portugal: plausibility of rent-price ratio*



For 2013, the MSCI (2016) reports the rent-price ratio for Portuguese residential real estate of 0.033. Applying the rent-price approach to this benchmark gives us the unadjusted long-run net rent-price ratio series depicted as orange circles in in Figure 11. We make one adjustment to these series to correct for potential biases arising from rent mismeasurement during the prolonged period of rent controls in the last quarter of the 20th century (see below for details). This gives us the final adjusted rent-price ratio series—the green-circled line in Figure 11—used in this paper.

We obtain several scattered independent estimates of rent-price ratios in Portugal. First, estimates of the rent-price ratio based on data from www.Numbeo.com are slightly above, but broadly in line with our baseline IPD benchmark (MSCI, 2016). Second, we compute the rental yield using the balance-sheet approach, based on data on total rental expenditure (OECD, 2016a) and total housing wealth (Cardoso, Farinha, and Lameira, 2008), scaled down one-third to adjust for running costs and depreciation. These are almost identical to the rent-price approach for the recent years, but diverge somewhat in the late 1990s. More generally, the historical growth in rents relative to house prices in Portugal may have been understated due to the imposition of rent controls in 1974, which remained in place in various forms until well into the 2000s. This seems likely given the high levels of the unadjusted rent-price approach yields in the 1970s and early 1980s (orange circles in Figure 11). Unfortunately, no alternative historical estimates of the rent-price ratio before 1995 are available for Portugal. Instead, we stipulate that the rent-price ratio in the 1940s and 50s, before the reported high

rent inflation of the 1960s (Cardoso, 1983) and the subsequent rent controls, was at levels similar to the 1980s and 1990s. To achieve that, we adjust rental growth up by a factor of 1.2 for years 1974–2005; the period for which rent controls were in place.

The resulting adjusted long-run rent-price ratio (green circles in Figure 11) concords with the narrative evidence on house prices and rent developments in Portugal. Real house prices in Portugal rose after the end of WW2 until the Carnation Revolution in 1974. After a brief but substantial house price recession after the revolution, real house prices embarked on a steep incline (Azevedo, 2016). By contrast, real rents remained broadly stable between 1948 and the mid-1960s as well as after 1990 but exhibit a pronounced boom and bust pattern between the mid-1960s and the mid-1980s. According to Cardoso (1983), the rapid growth of inflation-adjusted rents between the mid-1960s and the mid-1970s was the result of both rising construction costs and high inflation expectations. In 1974, new rent legislation provided for a rent freeze on existing contracts. Rent increases were also regulated between tenancies but unregulated for new construction. These regulations resulted in lower rent growth rates and rents considerably lagging behind inflation (Cardoso, 1983), and a consequent fall in the rent-price ratio.

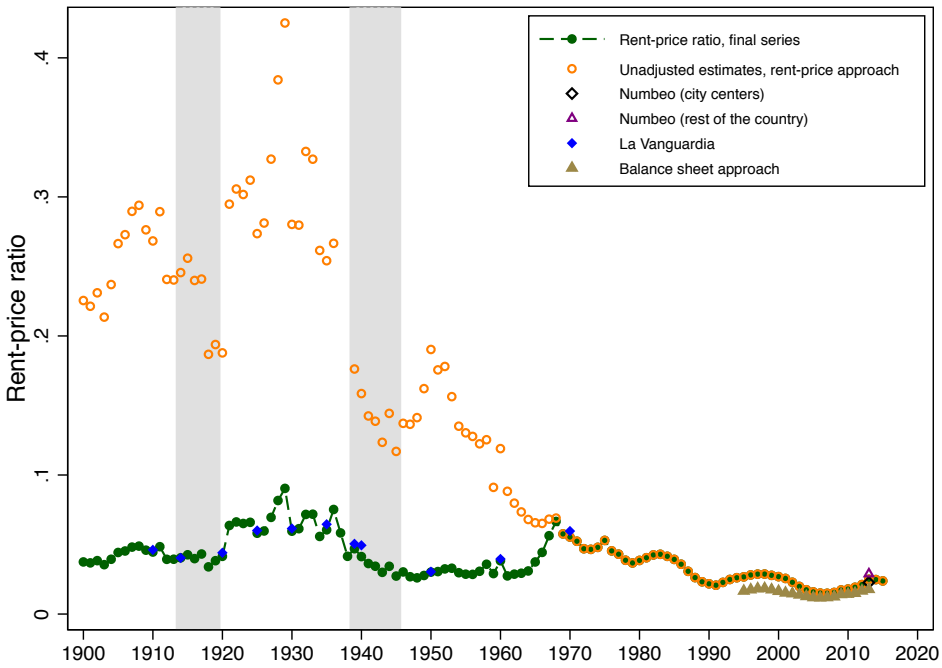
Spain

For 2013, the MSCI (2016) reports the rent-price ratio for Spanish residential real estate of 0.025. Applying the rent-price approach to this benchmark gives us the unadjusted long-run net rent-price ratio series depicted as orange circles in in Figure 12. We make one adjustment to these series to correct for possible mismeasurement of rental growth during the rent controls imposed in the early-to-mid 20th century (see below for details). This gives us the final adjusted rent-price ratio series—the green-circled line in Figure 12—used in this paper.

We obtain several scattered independent estimates of rent-price ratios in Spain. First, estimates of the rent-price ratio based on data from `www.Numbeo.com` are almost identical to our baseline IPD benchmark (MSCI, 2016). Second, we construct net rent-price ratios using the balance sheet approach, as total rental expenditure (OECD, 2016a) less running costs and depreciation (assumed to be one-third of gross rent), in relation to housing wealth (Artola Blanco, Bauluz, and Martínez-Toledano, 2017). These are slightly below but broadly in line with the rent-price approach for the overlapping years.

Finally, we collected scattered data on rent-price ratios from advertisements for Barcelona residential real estate in *La Vanguardia* for benchmark years (1910, 1914, 1920, 1925, 1930, 1935, 1940, 1950, 1960, 1970). For each of the benchmark years, we construct an average rent-price ratio based on between 25 and 46 advertisements. The gross ratios in the advertisements are adjusted down to exclude running costs and depreciation, calibrated at 2% p.a., around one-third of the advertized yields. Figure 12 shows that the newspaper estimates are significantly below the rent-price ratio for the benchmark years between 1910 and 1960. Yet it also suggests that rent-price ratios were generally higher before the mid-1950s. Similarly to Finland, this trajectory may reflect difficulties of the Spanish statistical office to construct a rent index after the introduction of rent freezes in the 1930s and during the years of strong rent regulation after WW2. While the rent freeze was lifted in 1945, these regulations remained effective until the mid-1960s. Specifically, the data suggest that rents between the end of WW2 and the mid-1960s increased substantially less than house prices. To the best of our knowledge, no quantitative or qualitative evidence exists supporting such a pronounced fall in the rent-price ratio in the immediate post-WW2 years or a generally higher level of rental yields prior to the 1960s. To mitigate this bias, we adjust the growth rate in rents between 1910 and 1960 so that the adjusted long-run rent-price ratio concords with the independent estimates obtained from *La Vanguardia*. Figure 12 displays the resulting adjusted long-run rent-price

Figure 12: *Spain: plausibility of rent-price ratio*



ratio (green circles), which is the final series we use in this paper.

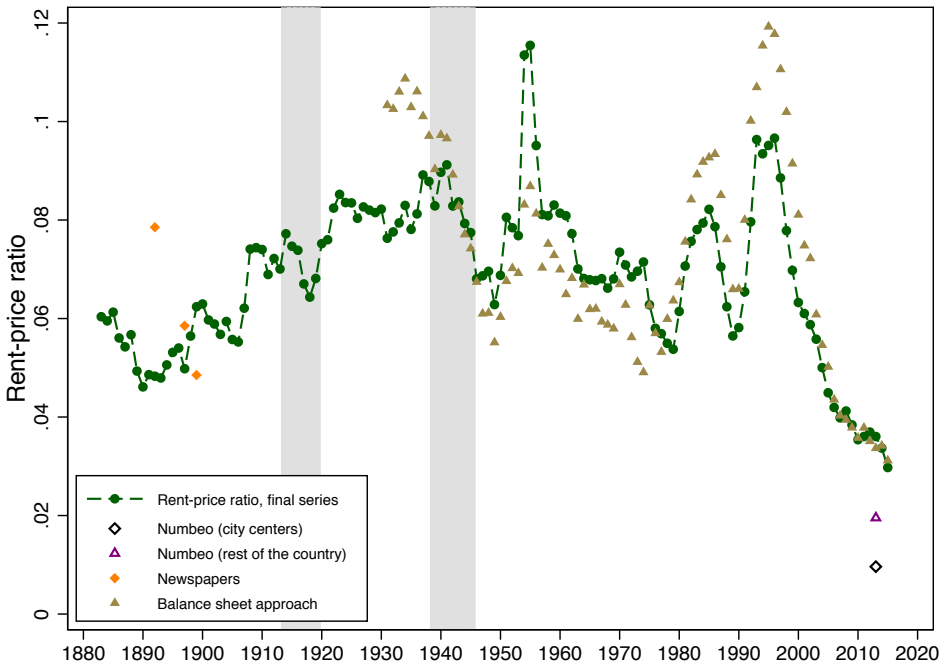
Sweden

For 2013, the MSCI (2016) reports the rent-price ratio for Swedish residential real estate of 0.036. Applying the rent-price approach to this benchmark gives us the long-run net rent-price ratio series depicted as green circles in in Figure 13, which are the estimates used in this paper.

We obtain three independent estimates of rent-price ratios for Sweden. First, we compute net rental yields based on the balance-sheet approach as total rental expenditure less running costs and depreciation, as a share of housing wealth, drawing on a variety of sources. The modern-day rental expenditure data are obtained from OECD (2016a), and further data back to 1969 were provided by Birgitta Magnusson Wärmark at Statistics Sweden. These are extrapolated back to 1931 using data on total housing expenditure from Dahlman and Klevmarken (1971). The data on running costs are a weighted average of total repairs of dwellings (data provided by Jonas Zeed at Statistics Sweden), and maintenance costs on rentals reported by (OECD, 2016a) scaled up to capture owner-occupied dwellings. Data on depreciation were provided by Jonas Zeed at Statistics Sweden, and were extrapolated back using dwellings depreciation in Edvinsson (2016). Before 1995, running costs are assumed to have evolved in line with depreciation. The long-run housing wealth data are sourced from Waldenström (2017). Both the level and the time trend in the resulting long-run rent-price ratio are in line with the historical balance-sheet approach estimates.

Second, the rent-price ratio in the late 19th / early 20th century is in line with those reported in several newspaper advertisements and articles. According to these sources, gross rent-price ratios were in the range of 0.07 to 0.1, and residential real estate was perceived as highly profitable investment (Dagens Nyheter, 1892, 1897, 1899). Given that running costs and depreciation amounted to around 2% p.a. of property value in Sweden during the period 1930–2015, this leads us to

Figure 13: *Sweden: plausibility of rent-price ratio*

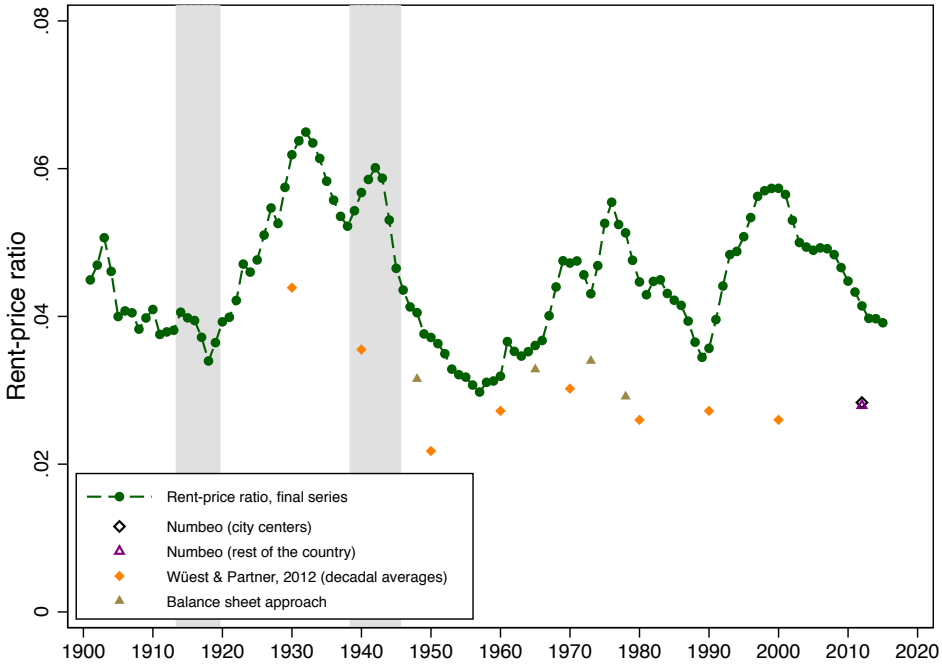


conjecture that net rent-price ratios were around 0.05–0.08, in line with our estimates.

Finally, estimates of modern-day rent-price ratios from Numbeo.com are somewhat below both our benchmark ratio and the balance sheet approach. However these are not based on a representative or matched sample of properties for sale and for rent, and are therefore less reliable than the alternative estimates.

Switzerland

Figure 14: *Switzerland: plausibility of rent-price ratio*



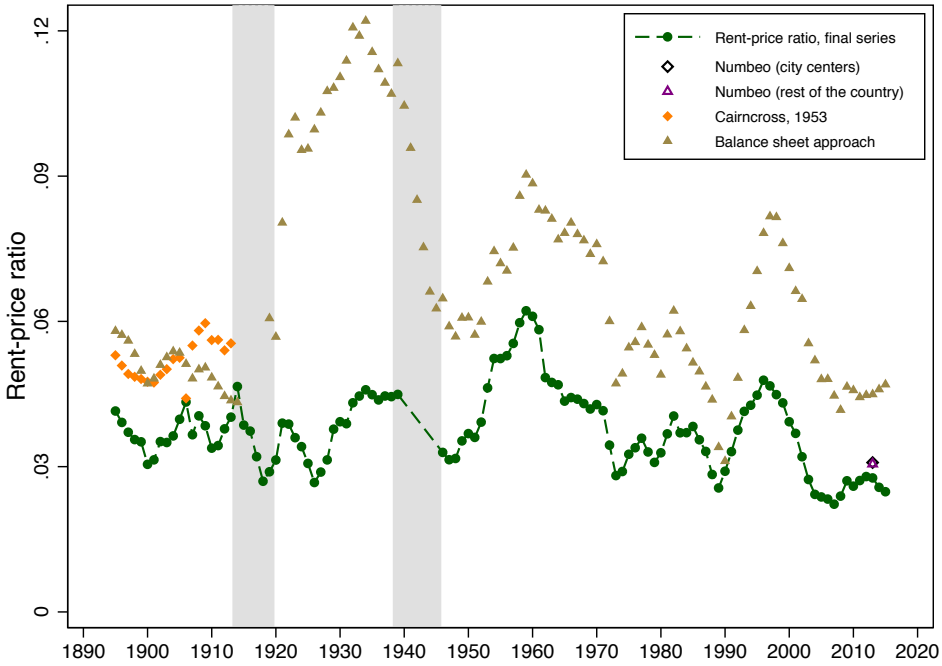
For 2013, the MSCI (2016) reports the rent-price ratio for Swiss residential real estate of 0.040. Applying the rent-price approach to this benchmark gives us the long-run net rent-price ratio series depicted as green circles in in Figure 14, which are the estimates used in this paper.

To check the plausibility of the long-run rent-price ratio, we obtain four independent estimates. First, Real (1950) reports real returns on residential real estate in Zurich of 6 percent in 1927 and 7.3 percent in 1933. These data are—by and large—in line with the estimates of housing returns constructed by merging the indices of house prices and rents. Second, Wüest and Partner (2012) estimate 10-year averages of real rental yields in Switzerland for 1920–2000. Assuming around one-third of gross rent goes to running costs and depreciation, the resulting net rental yield estiamtes are broadly consistent with the long-run rent-price ratio (Figure 14), taking into account the various estimation uncertainties. For the post-WW2 period, we calculate rent-price ratios using the balance sheet approach for benchmark years (1948, 1965, 1973, 1978) drawing on data on housing wealth from Goldsmith (1985), rental expenditure from Statistics Switzerland (2014), and assuming one-third of gross rent is taken up by runnign costs and depreciation. Again, the resulting estimates are broadly consistent with the long-run rent-price ratio (Figure 14).

Finally, estimates of rent-price ratios based on data from `Numbeo.com` are somewhat below, but within a reasonable error margin of the MSCI (2016) benchmark ratio.

United Kingdom

Figure 15: *United Kingdom: plausibility of rent-price ratio*



For 2013, the MSCI (2016) reports the rent-price ratio for U.K. residential real estate of 0.032. Applying the rent-price approach to this benchmark gives us the long-run net rent-price ratio series depicted as green circles in in Figure 15, which are the estimates used in this paper. Please note that for years 1947–1955, no rental index data were available, and we extrapolated the rent-price ratio series using the growth in the "balance sheet approach" measure, benchmarking against rental index values in 1946 and 1956.[7]

We construct several alternative estimates of the rent-price ratio for the period going back to 1900. First, we construct the net rental yield based on the balance-sheet approach using data on total rental expenditure less running costs and depreciation, in proportion to housing wealth, based on a variety of sources. For rents, we rely on historical series of housing and rental expenditure from Mitchell (1988), Sefton and Weale (1995) and Piketty and Zucman (2014), combined with recent Office for National Statistics (ONS) data, and historical data from the ONS shared with us by Amanda Bell. Estimates of costs and depreciation are available from the UK National Accounts, and housing wealth is taken from Piketty and Zucman (2014). It is worth noting that the estimates of rental expenditure for the UK are subject to large uncertainty: the ONS updated the methodology for rent imputation in 2016, resulting in large upward revisions to historical imputed rent estimates (by as large as a factor of three). It is possible that some of the historical data are subject to similar uncertainties, which helps explain why the rental yield levels using the balance sheet approach are so much higher than the extrapolated rent-price ratio, even though the time trend is similar.

[7]We assume that the 1956 index value is correct, but correct the 1946 rental index value for possible biases arising from the wartime rent controls, such that the trend in the rent-price ratios matches that in the balance sheet approach measure, and the 1956 rent-price approach estimate.

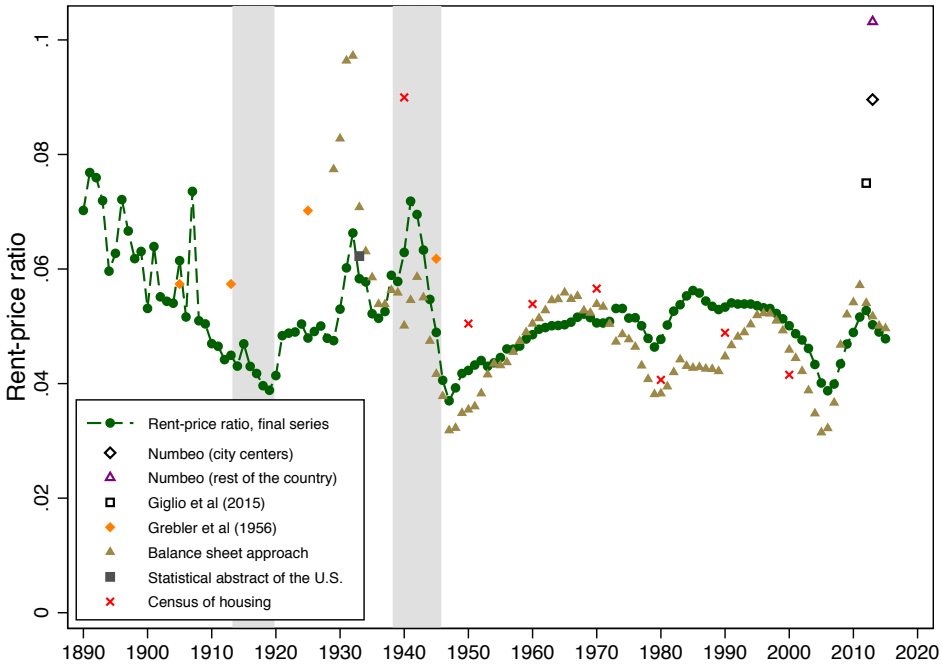
Some additional scattered data on rent-price ratios are available for the pre-WW2 period. For England, Cairncross (1975) reports an average gross rent-price ratio of 0.068 between 1895 and 1913, or around 0.05 in net terms. Offer (1981) estimates slightly higher rent-price ratios for selected years between 1892 and 1913 for occupied leasehold dwellings in London. As Figure 15 shows, these data are slightly higher, but broadly consistent with the our long-run rent-price ratio estimates (an average of 0.037 during 1900–1913). Tarbuck (1938) states that high-quality freehold houses were valued at 25 to 16 years purchase and lower quality freehold houses at 14 to 11 years purchase in the 1930s, again broadly consistent with our estimates.

Overall, these estimates suggest that our rental yields for the UK are somewhat conservative, but fit the time pattern and broad levels found in the alternative historical sources.

Concerning the modern period, estimates of the rent-price ratio based on data from `www.Numbeo.com` are very similar to the MSCI (2016) benchmark. Additionally, Bracke (2015) estimates a gross rental yield of 0.05 on central London properties over the period 2006–2012, based on a matched micro-level dataset of around 2000 properties. Again, these estimates are consistent with our data.

United States

Figure 16: *United States: plausibility of rent-price ratio*



For 2014, the MSCI (2016) reports the rent-price ratio for U.S. residential real estate of 0.049. Applying the rent-price approach to this benchmark gives us the long-run net rent-price ratio series depicted as green circles in in Figure 16, which are the estimates used in this paper.

We obtain independent estimates of U.S. rent-price ratios from five additional sources. First, decadal averages of gross price-rent ratios are available for 1899–1938 from Grebler, Blank, and Winnick (1956) ranging between 10.4 and 12.6. Second, estimates of gross rents paid and home values are available from various issues of the U.S. Census and Statistical Abstract, published by U.S. Census Bureau (1942, 2013). Once adjusted for estimates of running costs and depreciation, the

estimates from these sources are similar to the price-rent ratios resulting from merging the indices of house prices and rents (see Figure 16). Third, we calculate the rent-price ratio using the balance sheet approach, as total rental expenditure less housing running costs—estimated as 2/3 of total housing intermediate consumption—in proportion to total housing value, using expenditure data from Bureau of Economic Analysis (2014) and housing wealth estimates in Saez and Zucman (2016). Reassuringly, the resulting estimates are very close to the long-run rent-price ratio. Estimates of the rent-price ratio for 2012 are also available from the real estate portal Trulia, as used by Giglio, Maggiori, and Stroebel (2015). The resulting net rent-price ratio of 0.075 is higher than the figures from MSCI (2016) and the balance sheet approach. This may be because the Trulia ratios are not market cap weighted, and may overweigh the high-yield low-housing-wealth areas outside of cities. Alternatively, the MSCI (2016) IPD ratio could understate the rental yield because investor portfolios tend to be concentrated in cities. To be consistent with the balance sheet approach and to remain conservative, we use the IPD ratio as our benchmark.

Finally, estimates of the rent-price ratio based on data from `www.Numbeo.com` are higher than our benchmark estimate and similar to the Trulia transaction-level data. As with the Trulia data, these are not market-capitalization weighted, which may bias the rental yield estimates upwards. Given the similarity to the balance-sheet approach yields and the historical estimates from Grebler, Blank, and Winnick (1956), the rent-price approach estimates stemming from the MSCI (2016) benchmark should provide the most accurate picture of the historical rental returns on housing in the US. Still, given the higher alternative benchmark yield estimates of Trulia and `Numbeo.com`, our housing return series for the US should be viewed as conservative compared to other possible alternatives.

2.3. Rent indices: methodology

Rent indices measure the change in 'pure' rents for primary residences, i.e., net of house furnishings, maintenance costs, and utilities. For modern rent indices included in CPIs, data are usually collected by statistical offices through surveys of housing authorities, landlords, households, or real estate agents (International Labour Organization et al., 2004).

Rental units are heterogeneous goods.[8] Consequently, there are several main challenges involved when constructing consistent long-run rent indices. First, rent indices may be national or cover several cities or regions. Second, rent indices may cover different housing types ranging from high to low value housing, from new to existing dwellings. Third, rental leases are normally agreed to over longer periods of time. Hence, current rental payments may not reflect the current *market rent* but the *contract rent*, i.e., the rent paid by the renter in the first period after the rental contract has been negotiated.[9] Fourth, if the quality of rental units improve over time, a simple mean or median of observed rents can be upwardly biased. These issues are similar to those when constructing house price indices and the same standard approaches can be applied to adjust for quality and composition changes. For a survey of the different approaches, the reader is referred Knoll et al. (2017). Yet, as can be seen from the data description that follows, these index construction methods commonly used for house price indices have less often been applied to rents.

Another important question when it comes to rent indices is the treatment of subsidized and controlled rents. Rental units may be private or government owned and hence be subject to different levels of rent controls or subsidies. Since these regulations may apply to a substantial share of the rental market, rent indices typically cover also subsidized and controlled rents (International Labour Organization et al., 2004).[10] It is worth noting that not properly controlling for substantial changes in rent regulation may result in a mis-measurement of rent growth rates. More specifically, if the share of the rental market subject to these regulations suddenly increases—e.g., during wars and in the immediate post-war years—-the rent index can be downwardly biased.[11]

An additional challenge when constructing rent indices is the treatment of owner-occupied housing. Since a significant share of households in advanced economies are owner-occupants, rent indices typically cover changes in the cost of shelter for both renters and owner-occupiers.[12] The cost for owner-occupied shelter is an estimate of the implicit rent that owner-occupants would have to pay if they were renting their dwellings. Different approaches to estimate the change in implicit rents exist, each with advantages and disadvantages. Most statistical offices rely on the *rental equivalent approach*.[13] The resulting rent index is based on an estimate of how much owner-occupiers would have to pay to rent their dwellings or would earn from renting their home in a competitive market. Data either come from surveys asking owner-occupiers to estimate the

[8] Compared to owner-occupied houses, Gordon and van Goethem (2007) argue that rental units are, however, less heterogeneous in size at any given time and more homogenous over time. The authors provide also scattered evidence for the U.S. that rental units experience quality change along fewer dimensions than owner-occupied units.

[9] Typically, in times of low or moderate general inflation, the market rent will be higher than the contract rent. Yet, the introduction of rent controls or a temporary strong increase in the supply of rental units may result in the market rent being lower than the contract rent (Shimizu et al., 2015).

[10] Exceptions include, for example, the Canadian rent index where subsidized dwellings are excluded (Statistics Canada, 2015).

[11] For example, this has been the case for the Australia CPI rent index after WW2 (see Section 2.4).

[12] Imputed rents of owner-occupied housing are excluded in Belgium and France. In some countries, two rent indices are reported, one for renter-occupied and one for owner-occupied dwellings (International Labour Organization et al., 2004; OECD, 2002).

[13] The *rental equivalent approach* is currently used in the U.S., Japan, Denmark, Germany, the Netherlands, Norway, and Switzerland (OECD, 2002).

units' potential rent or are based on matching owner-occupied units with rented units with similar characteristics.[14] The *user cost approach* assumes that a landlord would charge a rent that at least covers repairs and maintenance, taxes, insurance, and the cost of ownership (i.e., depreciation, mortgage interest, opportunity costs of owning a house). The resulting rent index is a weighted average of the change in the price of these components.[15] The user cost approach is important in its own right (i.e., when the size of the rental market is relatively small, it is not possible to value the services of owner-occupied housing using the *rental equivalence approach*). Nevertheless, the user-cost and rental equivalence approach should, in principle, yield similar results given that capital market theory implies that the price of an asset should equal the discounted value of the flow of income or services (e.g., rents) that it provides over the lifetime of the asset. The *net acquisitions approach* measures the costs associated with the purchase and ongoing ownership of dwellings for own use. Hence it covers the costs of repair and maintenance, taxes, insurances and the change in the cost of the net acquisition of the dwelling, i.e., the change in the total market value (Diewert, 2009; International Labour Organization et al., 2004; OECD, 2002).[16] If rents of owner-occupants are included in rent indices, the combined rent index is a weighted average of rents for rented and owner-occupied dwellings. Weights are based on the share of owner-occupants and tenants in the respective housing market.

[14] This approach may result in a bias of unknown size and direction if i) owners' assessment of the rental value of their dwelling is unreliable, ii) if the rental market is small and the rental housing stock is not comparable to the owner-occupied housing stock, and ii) if rents set in rental markets are significantly affected by government regulation since subsidized and controlled rents should not be used in calculating an owners' equivalent rent index (Diewert, 2009; International Labour Organization et al., 2004; OECD, 2002).

[15] A (partial) *user cost approach* is currently used in Canada, Finland, Sweden, and the United Kingdom (OECD, 2002).

[16] Hence, a basic requirement of this method is the existence of a constant- quality house price index. The *net acquisitions approach* is currently used in Australia (OECD, 2002).

2.4. Data sources for the rental indices

To construct rent indices reaching back to the late 19th century, we rely on two main sources. First, we use the rent components of the cost of living or consumer price indices published by regional or national statistical offices such as Statistics Sweden (1961) and Statistics Norway (2015). The cost of shelter is a major component of household expenditure. Cost of living (COLIs) or consumer price indices (CPIs) therefore typically include a component for housing. In many advanced economies, the construction of COLIs/CPIs was initiated by governments during WW1 to calculate necessary wage adjustments in times of strongly rising price levels. Hence, most countries' statistical offices started to collect data on rents and calculate rent indices in the early 20th century.[17] The Yearbook of Labor Statistics (International Labour Organization, various years) serves as main repository for these data from national statistical offices. Second, to extend these indices back to the late 19th century, we draw on previous work of economic historians, such as Rees (1961) for the U.S., Lewis and Weber (1965) for the U.K., or Curti (1981) for Switzerland.

Australia

Rent data Historical data on rents in Australia are available for 1901–2015.

For Australia, there are two principal sources for historical rent data. First, the CPI rent component constructed by the Australian Bureau of Statistics covers the period 1901–2015. This rent index is based on data for urban areas and has historically been published in two versions, the *A* and the *C series*.[18]. For the years the two series overlap, the difference appears negligible (Stapledon, 2012). Since 1961, the CPI rent index is based on rent data for 8 capital cities. The sample of dwellings included is stratified according to location, dwelling type and dwelling size based on data from the most recent *Census of Population and Housing* (Australian Bureau of Statistics, 2011). Rent data are collected from real estate agents and state and territory housing authorities (Australian Bureau of Statistics, 2011).

The second source is Stapledon (2007) who presents an index of average rents per dwelling based on census estimates for 1901–2005. The author observes substantial differences between his series and the CPI rent index described above. While for the years prior to WW2, the rent index based on census data and the CPI rent index are highly correlated,[19] the CPI rent index increases much less than the index based on census data during the immediate post-WW2 decades (see Figure 17). Stapledon (2007) hypothesizes that this may reflect difficulties of the Australian statistical office to construct a rent index after the introduction of wartime rent controls.

Given this potential bias in the CPI rent index in the post-WW2 period, we rely on the series constructed by Stapledon (2007) for the years 1940–1989 and the CPI rent component before and after.[20]. For the pre-WW2 period, we rely on the *C series* whenever possible as it is based on a more homogeneous dwelling sample and may thus be less affected by shifts in the composition of the sample. The available series are spliced as shown in Table 3.

The most important limitation of the long-run rent series is the lack of correction for quality changes and sample composition shifts before 1990. As noted above, the latter aspect may be less of a problem for the years 1921–1939 since the index is confined to a specific market segment, i.e., 4-

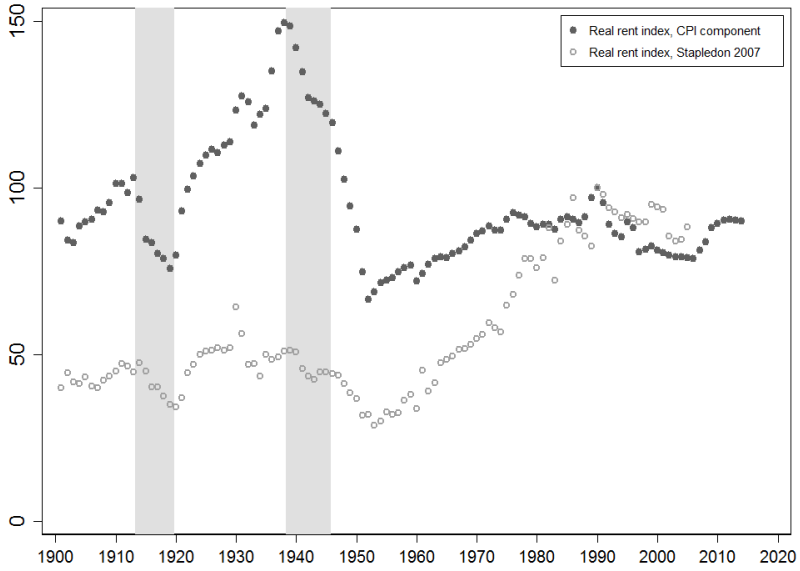
[17] One exception is Belgium where house rents were only added to the CPI basket in 1989.

[18] The *A series* starts in 1901 and refers to average rents of all kinds of dwellings in the 6 capital cities. The series was discontinued in 1938. The *C series* starts in 1920, covers 30 towns (including the 6 capital cities) and is based on rent data for 4- and 5-room houses (Australian Bureau of Statistics, 2011).

[19] Correlation coefficient of 0.75.

[20] Rent controls were introduced in 1939 and gradually lifted after 1949. According to Stapledon (2007), rent controls affected rent levels well into the 1960s.

Figure 17: *Australia: comparison of real rent indices*



Note: Indices, 1990=100

Table 3: *Data sources: rent index, Australia*

Period	Source	Details
1901–1920	Australian Bureau of Statistics, CPI A series as published in Stapledon (2012)	*Geographic Coverage*: Urban areas; *Type(s) of Dwellings*: All kinds of dwellings; *Method*: Average rents.
1921–1939	Australian Bureau of Statistics, CPI C series as published in Stapledon (2012)	*Geographic Coverage*: Urban areas; *Type(s) of Dwellings*: Houses with 4-5 rooms; *Method*: Average rents.
1940–1989	Stapledon (2007)	*Geographic Coverage*: Urban areas; *Type(s) of Dwellings*: All kinds of dwellings; *Method*: Average rents.
1990–2015	Australian Bureau of Statistics, CPI series	*Geographic Coverage*: Urban areas; *Type(s) of Dwellings*: All kinds of dwellings; *Method*: Stratification.

and 5-room dwellings. Note that matching the Australian house price and rent series in terms of geographical coverage has been—by and large—possible. Both series are based on data for capital cities since 1901. Yet, no information exists on the quality differences that may exist between the dwellings included in the house price and the dwellings included in the rent series. The matching of the series with respect to the exact type of dwelling covered may hence be imperfect and we need to assume that changes in rents of different types of houses are strongly correlated.

Belgium

Rent data Historical data on rents in Belgium are available for 1890–2015.

The long-run rent index relies on five different sources. First, for the years since 1984, we rely on the CPI rent index constructed by Statistics Belgium.[21] The index covers tenants' rents only, i.e., imputed rents of owner-occupiers are excluded. Second, for 1977–1983, we use the rent index published by the International Labour Organization (2014) which, in turn, is based on data provided by Statistics Belgium. The main characteristics of these two series are summarized in Table 4.

For earlier periods, data has been drawn from two major historical studies (Buyst, 1994; Segers, 1999) and an unpublished database by Anne Henau.[22] The rent index for seven cities[23] constructed by Segers (1999) for 1890–1920 is based on data from two public institutions for social welfare, the *Burelen van Weldadigheid* and the *Burgerlijke Godshuizen*. The individual city series are constructed as chain indices so as to at least partially account for changes in the underlying sample. The combined index is an unweighted average of the seven city indices. The rent index reported in Buyst (1994) for 1921–1938 is an unweighted average of five city indices[24] combining data drawn from studies by Leeman (1955) and Henau (1991) (see below). The unpublished index constructed by Henau for 1939–1961 covers four cities[25] using records of local Public Welfare Committees (OCMWs).

Three alternative series for the pre-WW2 period are available. Van den Eeckhout and Scholliers (1979) present a rent index for dwellings let by the OCMW in Brussels for 1800–1940. Henau (1991), also using records of local OCMWs, constructs rent indices for Leuven, Luik, Ghent, and Antwerp for 1910–1940. Leeman (1955) calculates city indices for a small sample of houses for Brussels, Gent, and Hoei for 1914–1939. As these series, however, are less comprehensive in terms of geographic coverage, we rely on the indices by Segers (1999) and Buyst (1994). The rent indices constructed by Van den Eeckhout and Scholliers (1979), Leeman (1955), Buyst (1994), and Segers (1999) follow a joint, almost identical path for the years they overlap.

The available series are spliced as shown in Table 4. Since no time series of rents is available for 1961–1977, the two sub-indices (1870–1961 and 1977–2013) are linked using scattered data on rent increases between 1963 and 1982 reported by Van Fulpen (1984).

The resulting index suffers from two weaknesses. The first relates to the lack of correction for quality changes and sample composition shifts. Second, for 1939–161, the series relies on dwellings let by Public Welfare Committees only. It is of course possible that this particular market segment does not perfectly mirror fluctuations in prices of other residential property types. Note further that the matching of the Belgian house price and rent series is imperfect for two reasons. First, the house price index is based on data for the Brussels area prior to 1950. Since the available rent data for the pre-1950 period relies on a rather mall sample, we opted for the indices with broader geographic coverage. Second, no information exists on the quality differences that may exist between the dwellings included in the house price and the dwellings included in the rent series. The matching of the series with respect to the exact type of dwelling covered may hence be imperfect and we need to assume that changes in rents of different types of houses are strongly correlated.

[21] Only in 1989, house rents were added to the CPI basket. Series sent by email, contact person is Erik Vloeberghs, Statistics Belgium.

[22] Series sent by email, contact person is Erik Buyst, KU Leuven.

[23] These are Antwerp, Brugge, Brussels, Gent, Kortrijk, Leuven, Luik.

[24] These are Brussels, Antwerp, Ghent, Leuven, and Luik.

[25] These are Leuven, Luik, Ghent, and Antwerp.

Table 4: *Data sources: rent index, Belgium*

Period	Source	Details
1870–1920	Segers (1999)	*Geographic Coverage*: 7 cities ; *Type(s) of Dwellings*: All kinds of dwellings; *Method*: Average rents.
1921–1938	Buyst (1994)	*Geographic Coverage*: 5 cities; *Type(s) of Dwellings*: All kinds of dwellings; *Method*: Average rents.
1939–1961	Unpublished database by Anne Henau.	*Geographic Coverage*: 4 cities; *Type(s) of Dwellings*: All kinds of dwellings let by Public Welfare Committees; *Method*: Average rents.
1977–1983	International Labour Organization (2014)	*Geographic Coverage*: Nationwide; *Type(s) of Dwellings*: Non-public housing; representative sample of 1,521 apartments and houses of various sizes; *Method*: Average rents.
1984–2013	Statistics Belgium	*Geographic Coverage*: Nationwide; *Type(s) of Dwellings*: Non-public housing; representative sample of 1,521 apartments and houses of various sizes; *Method*: Average rents.

Canada

House price data Historical data on house prices in Canada are available for 1921–2016. Data for 1921–1949 and 1956–2012 are from Knoll, Schularick, and Steger (2017) (see the Online Appendix of this publication for further details on the sources). Data for 2013–2016 are the chain-linked nominal house price index from OECD Statistics. Our data for Canada do not include statistics on rental yields or housing returns.

Denmark

Rent data Historical data on rents in Denmark are available for 1870–2015.

For 1870–1926, no rent series for Denmark as a whole exists. We therefore combine three series on rents in Copenhagen to proxy for development of rents in Denmark as a whole. First, for 1870–1911, we rely on an index of average rents for 3 room apartments—which can generally be considered working class or lower middle class dwellings—in Copenhagen (Pedersen, 1930). Second, for 1914–1917, the long-rent index is based on the increase in average rents of 1–8 room houses in Copenhagen as reported in Statistics Copenhagen (1906–1966). Third, for 1918–1926, we rely on the rent component of the cost of living index reported in Statistics Denmark (1925) and Statistics Copenhagen (1906–1966) referring to average rents of 1-5 room houses in Copenhagen.

For 1927–1955, we use the CPI rent index as reported in the Yearbook of Labor Statistics (International Labour Organization, various years) which for the years prior to 1947 is based on average rents in 100 towns and in 200 towns for the years thereafter.

For 1955–1964, to the best of our knowledge, no data on rents for Denmark as a whole are available. we therefore use the increase in average rents of 1–5 room houses in Copenhagen as reported in Statistics Copenhagen (1906–1966) as a proxy for rent increases in Denmark.

For 1965–2015, we rely on the CPI rent index as reported in Statistics Denmark (2003), Statistics Denmark (2015), and the yearbooks of the International Labour Organization (various years). The available series are spliced as shown in Table 5.

Table 5: *Data sources: rent index, Denmark*

Period	Source	Details
1870–1913	Pedersen (1930)	*Geographic Coverage*: Copenhagen; *Type(s) of Dwellings*: 3 room apartments; *Method*: Average rents.
1914–1917	Statistics Copenhagen (1906–1966)	*Geographic Coverage*: Copenhagen; *Type(s) of Dwellings*: 1-8 room houses; *Method*: Average rents.
1918–1926	Statistics Copenhagen (1906–1966); Statistics Denmark (1925)	*Geographic Coverage*: Copenhagen; *Type(s) of Dwellings*: 1-5 room houses; *Method*: Average rents.
1927–1954	International Labour Organization (various years)	*Geographic Coverage*: Danish towns; *Type(s) of Dwellings*: New and existing dwellings; *Method*: Average rents.
1955–1964	Statistics Copenhagen (1906–1966)	*Geographic Coverage*: Copenhagen; *Type(s) of Dwellings*: 1-5 room houses; *Method*: Average rents.
1965–2015	International Labour Organization (various years); Statistics Denmark (2003, 2015)	*Geographic Coverage*: Nationwide; *Type(s) of Dwellings*: New and existing dwellings; *Method*: Average rents.

The most important limitation of the long-run rent series is the lack of correction for quality changes and sample composition shifts. To some extent, the latter aspect may be less problematic for 1870–1913 since the index for these years is confined to a specific market segment, i.e., 3-room apartments. It is important to note that the matching of the Danish house price and rent series is imperfect. While the house price index relies on data for dwellings in rural areas prior to 1938, the rent index mostly covers urban areas. Moreover, no information exists on the quality differences that may exist between the dwellings included in the house price and the dwellings included in the rent series. The matching of the series with respect to the exact type of dwelling covered may hence be inaccurate and we need to assume that changes in rents of different types of houses are strongly correlated.

Finland

Rent data Historical data on rents in Finland are available for 1920–2015.

The long-run rent index relies on the rent component of the consumer price index as published by the Ministry for Social Affairs (1920–1929), the International Labour Organization (various years), and Statistics Finland (2009). The main characteristics of the rent series are summarized in Table 6.

The main weakness of the long-run rent series relates to the lack of correction for quality changes and sample composition shifts. These aspects may be somewhat less problematic for the post-1964 period since the index is adjusted for the size of the dwelling. Unfortunately, due to data limitations, the matching of the Finnish house price and rent series is imperfect. While the house price index relies on data for Helskinki prior to 1969, the rent index also covers more urban areas but is based on a larger city sample. In addition, no information exists on the quality differences that may exist between the dwellings included in the house price and the dwellings included in the rent series. The matching of the series with respect to the exact type of dwelling covered may hence be inaccurate and we need to assume that changes in rents of different types of houses are strongly correlated.

Table 6: *Data sources: rent index, Finland*

Period	Source	Details
1920–1926	Ministry for Social Affairs (1920–1929)	*Geographic Coverage*: 21 towns; *Type(s) of Dwellings*: All kinds of dwellings; *Method*: Average rents.
1927–1965	International Labour Organization (various years)	*Geographic Coverage*: 21 towns (1927–1936), 36 towns (1937–1965); *Type(s) of Dwellings*: All kinds of dwellings; *Method*: Average rents.
1964–2015	Statistics Finland (2009)	*Geographic Coverage*: Nationwide; *Type(s) of Dwellings*: All kinds of dwellings; *Method*: Average rents per sqm.

France

Rent data Historical data on rents in France are available for 1870–2015.

The long-run rent index relies on two main sources. For 1870–1948, we use an average rent index for Paris constructed by Marnata (1961). The index is based on a sample of more than 10,000 dwellings. Data come from lease management books from residential neighbourhoods in Paris and mostly refer to dwellings of relatively high quality. After 1949, we rely on national estimates, measured by the rent component of the CPI from the Statistics France (2015). The index covers tenants' rents only, i.e., imputed rents of owner-occupiers are excluded.

For the years prior to 1949, data on rents are also available for Paris (1914–1962) from the yearbooks of the International Labour Organization (various years). Reassuringly, the series by Marnata (1961) and the series published by the International Labour Organization (various years) are highly correlated for the years the overlap.[26] In addition, the International Labour Organization (various years) also presents a series for 45 departments for 1930–1937. For the years the series for Paris and the series for 45 departments overlap, they show similar rent increases. Note, however, that the house price index also relies on data for Paris only prior to 1936. For this reason, we use the Paris series throughout for the years prior to 1949 (Marnata, 1961). The available series are spliced as shown in Table 7.

Table 7: *Data sources: rent index, France*

Period	Source	Details
1870–1948	Marnata (1961)	*Geographic Coverage*: Paris; *Type(s) of Dwellings*: High-quality existing dwellings; *Method*: Average rents.
1949–2015	Statistics France (2015) as published in Conseil General de l'Environnement et du Developpement Durable (2013)	*Geographic Coverage*: Nationwide; *Type(s) of Dwellings*: All kinds of dwellings; *Method*: Average rents.

The most important drawback of the long-run rent series is again the lack of correction for quality changes and sample composition shifts. Both aspects may be less problematic for the pre-WW2 years since the rent index is confined to a specific market segment, i.e., high-quality existing dwellings in Paris. Note further that the matching of the French house price and rent series

[26] Correlation coefficient of 0.98.

in terms of geographical coverage has been generally possible. Both series are based on data for Paris prior to WW2 and on data for France as a whole for the second half of the 20th century. Yet, no additional information exists on the quality differences that may exist between the dwellings included in the house price and the dwellings included in the rent series. The matching of the series with respect to the exact type of dwelling covered may hence be imperfect and we need to assume that changes in rents of different types of houses are strongly correlated.

Germany

Rent data Historical data on rents in Germany are available for 1870–2015.

The earliest data on rents in Germany comes from Hoffmann (1965). Hoffmann (1965) presents a rent index for 1850–1959. For 1850–1913, Hoffmann (1965) calculates a rent index using data on long-term interest rates and the replacement value of residential buildings, hence assuming that rents only depend on replacement costs and interest rates.

There are two additional sources on rents prior to WW1, both providing data on average rents in (parts of) Berlin. Bernhardt (1997) presents data on average rents for 1- and 2-room apartments between 1890 and 1910, and for 1-6 room apartments (separately for each size) in Berlin-Wilmersdorf between 1906–1913. Kuczynski (1947) provides an average rent based on scattered data for a number of larger German cities[27] for 1820–1913. Both sources, however, only report data for some years, not for the full period. For the 1895–1913 period, Kuczynski (1947) suggests a substantially stronger rise in nominal rents (42 percent) when compared to the index constructed by Hoffmann (1965) (22 percent). According to Hoffmann (1965), this can be explained by the fact that the index by Kuczynski (1947) does not account for quality improvements and may hence be upwardly biased. To be precise, the same bias should be present in Bernhardt (1997) as the data also refers to average rents. Yet, during the period they overlap (1890–1910), the series by Hoffmann (1965) and Bernhardt (1997) show about the same increase in rents while Kuczynski (1947) again suggests a significantly steeper rise.

For the years after 1913, Hoffmann (1965) relies on the rent component of the consumer price index as published by the Statistics Germany (1924–1935) (for 1913–1934) and Statistics Germany (various years) (for 1934–1959). The CPI rent index is a weighted average of rents in 72 municipalities (with population used as weights) including small, medium, and large cities. It is based on data for working class family dwellings, typically 2 rooms with a kitchen. The index refers to existing dwellings, i.e., built prior to WW1, throughout. This, however, should not underestimate increases in rents given that dwellings built after WW1 only accounted for about 15 percent of all rental dwellings in 1934 (Statistics Germany, 1925, 1934).

Statistics Germany (various years) reports the CPI rent index for the years since 1948. The index relies on a survey of households and landlords and covers 3-4 room apartments in more than 100 German municipalities. Subsidized apartments are included. The index is calculated as a matched-models index and adjusts for major renovations (Angermann, 1985; Kurz and Hofmann, 2004).[28]

The long-run index is constructed as shown in the Table 8. For 1870–1912, we use the rent index constructed by Hoffmann (1965). For the years since 1913, we rely on the rent component of the consumer price index as published in Statistics Germany (1924–1935) and Statistics Germany

[27] These include Berlin, Halle, Hamburg, Leipzig, Breslau, Dresden, Magdeburg, Barmen, Chemnitz, Jena, Lübeck, Magdeburg, Strassburg, and Stuttgart.

[28] The matched models method aims to control for quality changes by matching rents collected for a sample of models (or varieties of selected apartments) in a baseline period with rents of these same matched models in subsequent periods (Kurz and Hofmann, 2004).

Table 8: *Data sources: rent index, Germany*

Period	Source	Details
1870–1912	Hoffmann (1965)	*Geographic Coverage*: Nationwide; *Type(s) of Dwellings*: All kinds of dwellings; *Method*: Imputed rent based on long-term rates and replacement values of residential buildings.
1913–1947	Statistics Germany (1924–1935, various years)	*Geographic Coverage*: 72 municipalities; *Type(s) of Dwellings*: Working class dwellings; *Method*: Weighted average rents.
1948–2015	Statistics Germany (various years)	*Geographic Coverage*: Nationwide; *Type(s) of Dwellings*: 3-4 room apartments; *Method*: Matched models index.

(various years).

The long-run rent index has two main weaknesses. First, for the years prior to WW2, the index neither controls for quality changes nor for sample composition shifts. The latter aspect may be less of a problem for the interwar period ince the index is confined to a specific and presumably relatively homogeneous market segment, i.e., working class dwellings. Second, data prior to WW1 are not based on actual observed rents but have been estimated using data in replacement values and long-term interest rates.

Matching the German house price and rent series in terms of geographical coverage has been largely possible for the post-WW2 period. In both cases, data refers to Germany as a whole or at least covers a substantial share of the German housing market. This is unfortunately not the case for the pre-WW2 period. House price data for the pre-WW1 years only reflects trends in Berlin and Hamburg but the rent index covers all of Germany. For the interwar period, the house price index refers to urban real estate while the rent index provides a somewhat broader coverage. Moreover, no information on differences between the characteristics of the dwellings in the house price and the dwellings included in the rent index exist. The matching of the series with respect to the exact type of dwelling covered may hence be imperfect and we need to assume that changes in rents of different types of houses are strongly correlated.

Italy

House price data Historical data on house prices in Italy are available for 1927–2015.

We rely on the long-run house price index constructed by Cannari and D'Alessio (2016) throughout. For 1927–1941, Cannari and D'Alessio (2016) rely on a series published in Statistics Italy's statistical yearbooks which, in turn, are based on house price indices constructed by the *Federazione Nazionale Fascista di Proprietari di Fabbricati*. The series is based on data for existing dwellings and reflects average transaction prices per room. For the years since 1966, the index relies on average transaction prices per square meter of new and existing dwellings in provincial capitals before 1997 and average transaction prices per square meter of new and existing dwellings in municipal districts after 1998. Data are drawn from publications of the *Consulente Immobiliare*.

Unfortunately, no price data are available for the period 1941–1961. To obtain a long-run index, Cannari and D'Alessio (2016) link average prices per room in eight cities (Turin, Genoa, Milan, Trieste, Bologna, Rome, Naples and Palermo) in 1941 with average transaction prices per room in these cities in 1966 assuming an average room size of 18 square meters. To obtain an annual house price series for 1941–1966, Cannari and D'Alessio (2016) interpolate using data on year-to-year

Table 9: *Data sources: rent index, Italy*

Period	Source	Details
1927–1937	International Labour Organization (various years)	*Geographic Coverage*: Milan; *Type(s) of Dwellings*: All kinds of dwellings; *Method*: Average rents.
1938–1955	International Labour Organization (various years)	*Geographic Coverage*: 62 cities; *Type(s) of Dwellings*: All kinds of dwellings; *Method*: Average rents.
1956–2015	International Labour Organization (various years)	*Geographic Coverage*: 92 cities; *Type(s) of Dwellings*: All kinds of dwellings; *Method*: Average rents.

increases in construction costs.

Rent data Historical data on rents in Italy are available for 1927–2015. The long-run index relies on the CPI rent component throughout and spliced as shown in Table 9. Data are drawn from International Labour Organization (various years) and reflect average rents. The index covers tenants' rents only, i.e., imputed rents of owner-occupiers are excluded. Due to data availability, geographic coverage varies over time. The series reflects average rents in Milan (pre-1938), in 62 cities (1938–1955), and 92 cities (post-1955). The series has a gap between 1939 and 1945. Since, to the best of the author's knowledge, no data on rents are available for this period, we link the pre-1939 and post-1945 series assuming that rents increased in lockstep with house prices, i.e., by a factor of about 1.6 adjusted for inflation.

The single most important drawback of the long-run rent series is again the lack of correction for quality changes and sample composition shifts. Moreover, the matching of the Italian house price and rent series is unfortunately imperfect. While the rent index is only based on data for Milan before 1937 and for urban areas more generally thereafter, the house price index offers a more comprehensive geographic coverage. Second, no additional information exists on the quality differences that may exist between the dwellings included in the house price and the dwellings included in the rent series. The matching of the series with respect to the exact type of dwelling covered may hence be inaccurate and we need to assume that changes in rents of different types of houses are strongly correlated.

Japan

Rent data Historical data on rents in Japan are available for 1931–2015.

The long-run rent index relies on the rent component of the consumer price index throughout. For 1931–1946, the CPI rent index is reported in the yearbooks of the International Labour Organization

Table 10: *Data sources: rent index, Japan*

Period	Source	Details
1931–1946	International Labour Organization (various years)	*Geographic Coverage*: Urban areas; *Type(s) of Dwellings*: Wooden houses; *Method*: Average rents.
1947–2015	Statistics Japan (2012)	*Geographic Coverage*: Nationwide; *Type(s) of Dwellings*: Small and medium-sized wooden houses, non-wooden houses; *Method*: Average rents per sqm.

(various years). The index covers 13 cities through 1936 and 24 cities thereafter and refers to average rents of wooden houses.

For the years since 1947, the rent component of the CPI is published by Statistics Japan (2012). Data are collected as part of the *Retail Price Survey* in more than 1200 districts. The rent index covers small and medium-sized wooden houses as well as non-wooden houses and refers to the average rent per sqm. Subsidized dwellings are included. Imputed rents for owner-occupiers are included since 1970 (International Labour Organization, 2013; Shiratsuka, 1999). The available series are spliced as shown in Table 10.

The most important limitation of the long-run rent index is the lack of correction for quality improvements and sample composition shifts. Particularly the latter aspect may be somewhat less problematic for the post-WW2 years since the series controls for the size of the dwelling. Matching the Japanese house price and rent series in terms of geographical coverage has been partly possible. For the pre-WW2 years both series are based on data for urban dwellings only. Yet for the second half of the 20th century, the rent index offers a somewhat broader coverage. In addition, the house price index reflects residential land prices inly whereas the rent index naturally is based on rents for dwellings.

Netherlands

Rent data Historical data on rents in the Netherlands are available for 1870–2015.

We rely on the long-run rent index constructed by Ambrose et al. (2013) throughout. The series is based on two main sources. For 1870–1913, it uses the rent component of the cost of living index calculated by Van Riel (2006). This pre-WW1 series refers to imputed rents of owner-occupied houses. Data comes from tax authorities and are estimated relying on average rents of comparable renter-occupied dwellings in the vicinity. For the post-WW1 period, Ambrose et al. (2013) draw data from various publications of Statistics Netherlands. Statistics Netherlands collects data through annual rent surveys and covers more than two thirds of Dutch municipalities. The nationwide index is a weighted average of rent changes by region. It is adjusted for the effect of major renovations (Statistics Netherlands, 2010, 2014). The main characteristics of the series are summarized in 11.

Table 11: *Data sources: rent index, Netherlands*

Period	Source	Details
1870–1913	Van Riel (2006) as published in Ambrose et al. (2013)	*Geographic Coverage*: Nationwide; *Type(s) of Dwellings*: All kinds of dwellings; *Method*: Average rents.
1914–2015	Statistics Netherlands as published in Ambrose et al. (2013)	*Geographic Coverage*: Nationwide ; *Type(s) of Dwellings*: All kinds of dwellings; *Method*: Weighted average rents.

One alternative series for the pre-WW2 period is available which can be used as comparative to the index presented by Ambrose et al. (2013). For 1909–1944, Statistics Amsterdam (1916–1944) reports average rents of working class in Amsterdam that have not undergone significant alteration or renovation.[29] Both series, i.e., the index constructed by Ambrose et al. (2013) and the series published

[29]For 1909 to 1928, Statistics Amsterdam (1916–1944) provides only scattered evidence, i.e., data on 1909, 1912, 1918. The series are continuous after 1928. Statistics Amsterdam (1916–1944) also presents data on average rents of middle class dwellings. Yet, this series is based on a significantly smaller sample compared to the one for working class dwellings. According to the 1936–37 yearbook, for example, the data covers 1719 working class dwellings but only 110 middle class dwellings.

Table 12: *Data sources: rent index, Norway*

Period	Source	Details
1871–1978	Rent index underlying by the price to rent ratio reported in Jurgilas and Lansing (2012)	*Geographic Coverage*: Urban areas; *Type(s) of Dwellings*: All kinds of dwellings; *Method*: Weighted average rents.
1979–2013	Statistics Norway (2015)	*Geographic Coverage*: Urban areas; *Type(s) of Dwellings*: All kinds of dwellings; *Method*: Weighted average rents.

in the Statistics Amsterdam (1916–1944) are strongly correlated for the years they overlap.[30] This is reassuring since the long-run house price index only relies on data for Amsterdam prior to 1970 (Knoll et al., 2017).

The main weakness of the long-run rent series is again the lack of correction for quality changes and sample composition shifts. Moreover, it is important to note that the matching of the Dutch rent and house price series is unfortunately imperfect. This is mainly for two reasons. First, while the house price index relies on data for Amsterdam only prior to 1970, the rent index offers a broader geographical coverage. Yet, the evidence suggests that at least during the first half of the 20th century, rents in Amsterdam and the rest of the country moved closely together. Second, no information exists on the extent to which characteristics of the dwellings included in the house price index differ from those included in the rent index. The matching of the series with respect to the exact type of dwelling covered may hence be inaccurate and we need to assume that changes in rents of different types of houses are strongly correlated.

Norway

Rent data Historical data on rents in Norway are available for 1871–2015.

For the period 1871–1978, the long-run index relies on a rent index presented by Jurgilas and Lansing (2012).[31] The series uses the rent component of the consumer price index since 1914[32] which for the years since 1920 is based on data for 26 towns and 5 industrial centers across Norway and on data for Oslo only for 1914–1919. For the pre-WW1 period, the index is constructed as a weighted average of average rents in 32 cities and towns.[33] Data comes from consumption surveys conducted by Statistics Norway.

For the years prior to WW1, an additional series is available in Statistics Oslo (1915) covering average expenditures for rents of a family of four in Oslo for 1901–1914. Both series, i.e., the rent index by Jurgilas and Lansing (2012) and the data published in Statistics Oslo (1915), depict a similar trend for the years they overlap. For 1979–2015, the long-run rent index relies on the rent component of the consumer price index as published by Statistics Norway (2015). The series is based on a sample of about 2000 rented dwellings that are classified according to their age. The aggregate index is calculated as a weighted average rent index (Statistics Norway, 1991). The available series are spliced as shown in Table 12.

[30] Correlation coefficient of 0.92 for 1909–1940.

[31] The series were constructed by Ola Grytten, Norwegian School of Economics, and sent by email. Contact person is Marius Jurgilas, Norges Bank.

[32] See for example the rent index for 1914–1948 as reported in Statistics Norway (1949, Table 185) and for 1924–1959 as reported in Statistics Norway (1978, Table 287) for comparison.

[33] Population is used as weights.

The main weakness of the long-run rent series is the lack of adjustment for quality changes and sample composition shifts. On the upside, the matching of the Norwegian house price and rent series in terms of geographic coverage has been generally possible. Both series rely on data for urban areas. Yet the coverage of the rent series is relatively more comprehensive. Unfortunately, no information exists on the quality differences that may exist between the dwellings included in the house price and the dwellings included in the rent series. The matching of the series with respect to the exact type of dwelling covered may hence be imperfect and we need to assume that changes in rents of different types of houses are strongly correlated.

Portugal

House price data Historical data on house prices in Portugal are available for 1931–2015.

We rely on the long-run house price index constructed by Azevedo (2016). The author relies on the total number and value of transactions of new and existing real estate as reported to the land registry and collected by the Ministry of Justice to construct a weighted average house price index.[34] The number of transactions is used as weights. The data cover Portugal as a whole and are published in yearbooks and monthly bulletins by Statistics Portugal.[35]

Rent data Historical data on rents in Portugal are available for 1948–2015.

The long-run rent index is based on the rent component of the consumer price index as published in International Labour Organization (various years). Data are collected by personal or phone interviews. The index covers tenants' rents only, i.e., imputed rents of owner-occupiers are excluded. The main characteristics of the series are summarized in Table 13.

The main weakness of the long-run rent series is again the lack of correction for quality changes and sample composition shifts. Moreover, the matching of the Portuguese house price and rent series is unfortunately imperfect. While the rent index is only based on data for urban areas throughout, the house price index consistently offers a more comprehensive geographic coverage. Second, no additional information exists on the quality differences that may exist between the dwellings included in the house price and the dwellings included in the rent series. The matching of the series with respect to the exact type of dwelling covered may hence be inaccurate and we need to assume that changes in rents of different types of houses are strongly correlated.

Table 13: *Data sources: rent index, Portugal*

Period	Source	Details
1948–2015	International Labour Organization (various years)	*Geographic Coverage*: 1948–1950: Lisbon, 1951–1953: Lisbon and Porto, 1954–1961: 5 cities, 1962–1976: 6 cities, 1976–2015: 41 cities; *Type(s) of Dwellings*: All kinds of dwellings; *Method*: Average rents.

[34] While the data also includes commercial real estate, Azevedo (2016) argues based on evidence presented by Evangelista and Teixeira (2014) that commercial property transactions only account for a small share of all transactions recorded.

[35] Sources are the various issues of the *Annuário estatístico de Portugal*, the *Estatísticas Monetárias e Financeiras*, and the *Boletins Mensais de Estística*.

Spain

House price data Historical data on house prices in Spain are available for 1900–2015.

We rely on the long-run house price index constructed by Amaral (2016) throughout. The author combines data from various sources to arrive at a long-run index. For 1900–1904, the series are based on average transaction prices of new and existing dwellings in Madrid and Barcelona. Data are collected from newspaper advertisements.[36] For 1905–1933, Amaral (2016) uses an average transaction price index constructed by Carmona et al. (2017) based on data for all kinds of existing dwellings drawn from the *Registrars Yearbooks*. For 1934–1975, Amaral (2016) uses transaction price data for new and existing dwellings collected from the *Registrars Yearbooks* to construct a weighted average house price index covering Spain as a whole. For 1976–1986, the authors relies on a series of average transaction prices per square meter of new dwellings in Madrid constructed by the real estate agency *Tecnigrama*. For 1987–1994, the series is based on weighted average transaction prices per square meter of new and existing dwellings collected by the Spanish Ministry of Housing covering Spain as a whole. For the years after 1995, he relies on a nationwide index published by the Spanish Ministry of Public Works and Transports which reflects average transaction prices per square meter for new and existing dwellings.

Rent data Historical data on rents in Spain are available for 1870–2015.

The earliest source for data on rents in Spain is Maluquer de Motes (2013) covering average rents of all kinds of dwellings in Catalunya between 1870 and 1933. Data are drawn from archival records and from the *Registrars Yearbooks*. For the years since 1935, the long-run rent index is based on the CPI rent index as published in the yearbooks of the International Labour Organization (various years) and Statistics Spain (2016). The index covers tenants' rents only, i.e., imputed rents of owner-occupiers are excluded. The available series are spliced as shown in Table 14.

The single most important drawback of the long-run rent series is again the lack of correction for quality changes and sample composition shifts. Moreover, the matching of the Spanish house price and rent series is unfortunately imperfect. While the rent index is only based on data for urban areas before 1976, the house price data covers the whole of Spain. The opposite is true for the years between 1987 and 1994. After 1994, both series provide nationwide coverage. Second, no additional information exists on the quality differences that may exist between the dwellings included in the house price and the dwellings included in the rent series. The matching of the series with respect to the exact type of dwelling covered may hence be inaccurate and we need to assume that changes in rents of different types of houses are strongly correlated.

Table 14: *Data sources: rent index, Spain*

Period	Source	Details
1870–1936	Maluquer de Motes (2013)	*Geographic Coverage*: Catalunya; *Type(s) of Dwellings*: All kinds of dwellings; *Method*: Average rents.
1937–1976	International Labour Organization (various years)	*Geographic Coverage*: 1937–1956: 50 cities; 1957–1976: Nationwide; *Type(s) of Dwellings*: All kinds of dwellings; *Method*: Weighted average rents.
1977–2015	Statistics Spain (2016)	*Geographic Coverage*: Nationwide; *Type(s) of Dwellings*: All kinds of dwellings; *Method*: Weighted average rents.

[36] On average, more than 120 observations per year were collected.

Table 15: *Data sources: rent index, Sweden*

Period	Source	Details
1882–1913	Myrdal (1933)	*Geographic Coverage*: Stockholm; *Type(s) of Dwellings*: All kinds of dwellings; *Method*: Average rents per room.
1914–1931	Myrdal (1933)	*Geographic Coverage*: Urban areas; *Type(s) of Dwellings*: All kinds of dwellings; *Method*: Average rents per room.
1932–1959	Statistics Sweden (1933, 1961)	*Geographic Coverage*: Urban areas; *Type(s) of Dwellings*: All kinds of dwellings; *Method*: Average rents.
1960–2015	International Labour Organization (various years)	*Geographic Coverage*: Nationwide; *Type(s) of Dwellings*: All kinds of dwellings; *Method*: Average rents.

Sweden

Rent data Historical data on rents in Sweden are available for 1883–2015.

The earliest source for data on rents in Sweden is Myrdal (1933). For 1883–1913, Myrdal (1933) reports an index of average rents per room in Stockholm based on data published in the *Stockholm list of houses to let (Stockholms hyreslista)*, a publication advertising dwellings to let edited by the *Stockholms Intecknings Garanti Aktiebolag*. For 1913/14–1931, Myrdal (1933) reports the rent component of the cost of living index of the Social Board based on housing surveys and covering working or lower middle class dwellings in more than 40, predominantly urban, municipalities (Statistics Sweden, 1933).

For the years since 1932, the long-run rent index is based on the rent component of the consumer price index as published in International Labour Organization (various years); Statistics Sweden (1961) and Statistics Sweden (1933). The main characteristics of this series are summarized in Table 15. The available series are spliced as shown in Table 15.

The most important drawback of the long-run rent series is again the imperfect of correction for quality changes and sample composition shifts. Both aspects may be less problematic for years prior to 1931 since the rent index reflects average rents per room. Note further that the matching of the Swedish house price and rent series in terms of geographical coverage has been largely possible. For the years prior to 1960, both series are based on for urban areas. For the years after 1960, however, the rent index provides a more comprehensive geographical coverage compared to the house price series. Moreover, no additional information exists on the quality differences that may exist between the dwellings included in the house price and the dwellings included in the rent series. The matching of the series with respect to the exact type of dwelling covered may hence be imperfect and we need to assume that changes in rents of different types of houses are strongly correlated.

Switzerland

Rent data Historical data on rents in Switzerland are available for 1890–2015.

The earliest source for rent data in Switzerland is Curti (1981). Curti (1981) separately calculates indices of rents for 3-room apartments for five cities (Zurich, Winterthur, Bern, Biel, and Basel) and the Zurich highlands for 1890–1910. Data are collected from newspaper advertisements.[37]

[37]The author collects about 30 advertisements per year from *Tagblatt der Stadt Zürich*.

Table 16: *Data sources: rent index, Switzerland*

Period	Source	Details
1890–1919	Curti (1981)	*Geographic Coverage*: Zurich; *Type(s) of Dwellings*: 3 room apartment; *Method*: Average rent.
1920–1939	Statistics Zurich (1946–1962)	*Geographic Coverage*: Zurich; *Type(s) of Dwellings*: 3 room apartment; *Method*: Average rent.
1940–2015	Statistics Switzerland (2015)	*Geographic Coverage*: Nationwide; *Type(s) of Dwellings*: New and existing 1-5 room apartments; *Method*: Weighted average rent, adjusted for quality changes.

For 1908–1920, Curti (1981) relies on data from the city of Zurich housing authority (as collected by Statistics Zurich). Curti (1981) adjusts the 3-year moving average of the spliced series so as to conform with the average rents of 3 room apartments according to the housing censuses of 1896, 1910 and 1920. Since for the years prior to 1930 the house price index for Switzerland is based on data for Zurich only (Knoll et al., 2017), we use the city index for Zurich for 1890–1910 to construct a long-run rent index.

For 1920–1939, we rely on the index of average rents for 3 room apartments in six working class neighborhoods as published by Statistics Zurich (1946–1962).[38]

For 1940–2015, the long-run index is based on the rent component of the consumer price index as published by Statistics Switzerland (2015). The series refers to new and existing 1-5 room apartments in 89 municipalities. Data are collected through surveys of households and the index is calculated as a weighted average.[39] The index is adjusted for major quality changes. The index covers tenants' rents only, i.e., imputed rents of owner-occupiers are excluded. The available series are spliced as shown in Table 16.

The main weakness of the long-run rent series is the lack of adjustment for quality changes for the pre-WW2 period. Sample composition shifts are unlikely to affect the index since data reflects the rent of 3-room apartments only. Note further, that matching the rent and the house price series with respect to geographic coverage has been largely possible. Both series before the 1930s are based on data for Zurich and for the whole of Switzerland after 1940. Yet, no additional information exists on the quality differences that may exist between the dwellings included in the house price and the dwellings included in the rent series. The matching of the series with respect to the exact type of dwelling covered may hence be imperfect and we need to assume that changes in rents of different types of houses are strongly correlated.

United Kingdom

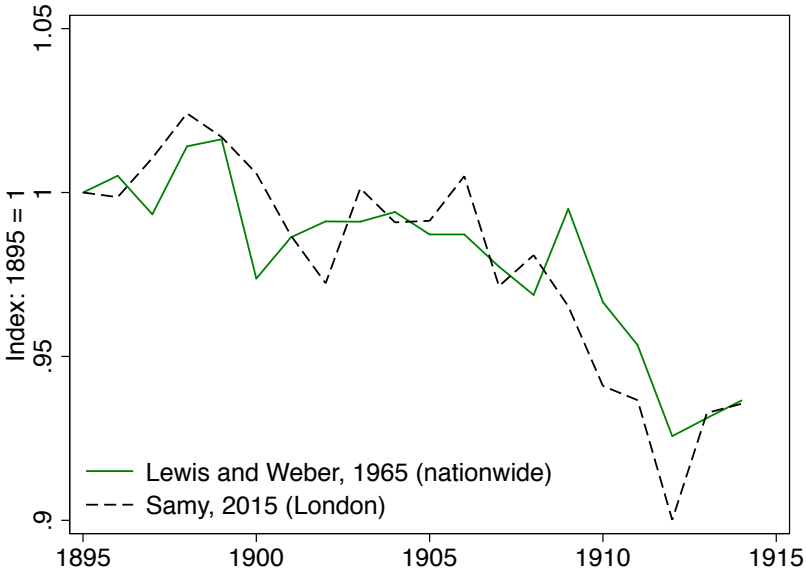
House price data We extend the historical house price series in Knoll et al. (2017) back to 1895 using the new house price index for London constructed by Samy (2015). The index is based on transaction-level data from the London Auction Mart, and constructed using a hedonic regression controlling for quality changes over time.

Rent data Historical data on rents in the United Kingdom are available for 1895–2015. For 1895–1899, we rely on the rental index from the London Auction Mart data constructed by Samy

[38] These are Aussersihl, Industriequartier, Wiedikon, Wipkingen, and Unter- and Oberstrass.

[39] The number of the different kinds of apartments (new and existing) is used as weights.

Figure 18: *Comparison of pre-WW1 rental indices for the UK*



Note: Real rental indices. The index in Lewis and Weber (1965) has nationwide coverage, but potentially does not control for quality adjustments. The index in Samy (2015) is for London only, but controls for quality changes.

(2015), to be consistent with the house price series. For 1900–1914, we rely on an index of average rents by Lewis and Weber (1965).[40] The series is based on property valuations for the *Inhabited House Duty*, a tax applied to residential houses with an annual rental value of 20 GBP or more. The index may hence include an element of quality increase as well as a true increase in rents, but comparison with the Samy (2015) quality-adjusted index for London, shown in Figure 18 suggests that the differences are very small.

For 1914–1938, the long-run rent index is based on the rent component of the official cost of living index compiled by the Ministry of Labor (as reported by Holmans (2005) and International Labour Organization (various years)). The series refers to average rents of working class dwellings in more than 500 towns. It is worth noting that the index reflects not only increases in rent proper but also in domestic rates.[41] The index lacks annual rental data during WW1, so we interpolate the annual rental changes during WW1 using the London-only index in Samy (2015), for years 1915–1919.

For the post-WW2 period, we use the rent component of the consumer price index as published in the yearbooks of the International Labour Organization (various years). Data are collected through surveys and cover also subsidized dwellings. For the years since 1956, the series includes expenditures on maintenance and repair. To the best of our knowledge, no data on rents exist between 1946 and 1954. To link the pre- and post-WW2 series, we use scattered data on average rents of houses and flats let by local authorities 1936–1957 presented by Holmans (2005). The available

[40] In principle, the Lewis and Weber (1965) series is available back to 1874, and closely tracks the London index assembled by Samy (2015) from the Auction Mart data.

[41] According to Holmans (2005), in the housing market for working class families, dwellings were generally let at a rent that included domestic rates. Landlords recouped the rates they paid to local authorities through the rents they charged. While the dwellings may have thus been subject to rent controls according to the Rent Restriction Acts, increases in total rents to recoup increases in domestic rates were not limited according to these acts.

Table 17: *Data sources: rent index, United Kingdom*

Period	Source	Details
1895–1899	Samy (2015)	*Geographic Coverage*: London; *Type(s) of Dwellings*: All kinds of dwellings; *Method*: Hedonic regression.
1900–1913	Lewis and Weber (1965)	*Geographic Coverage*: Nationwide; *Type(s) of Dwellings*: All kinds of dwellings; *Method*: Average rents.
1914–1946	Rent component of official consumer price index as published in Holmans (2005) and International Labour Organization (various years)	*Geographic Coverage*: Urban areas; *Type(s) of Dwellings*: Working class dwellings; *Method*: Average rents. *Note:* We interpolate annual changes during 1915–1919 using the London index in Samy (2015).
1954–2013	Rent component of official consumer price index as published in International Labour Organization (various years)	*Geographic Coverage*: Nationwide; *Type(s) of Dwellings*: All kinds of dwellings; *Method*:

series are spliced as shown in Table 17.

The most important limitation of the long-run rent series is the lack of correction for quality changes and sample composition shifts. As noted above, the latter aspect may be less of a problem for the years 1914–1946 since the index is confined to a specific and presumably relatively homogeneous market segment, i.e., working class dwellings. The matching of the U.K. house price and rent series in terms of geographical coverage has been largely possible. Both series are based on data for the whole of the U.K. after WW2. The house price series reflects urban developments prior to 1930 as does the rent index during the interwar period. Yet, the rent series provides a more comprehensive coverage prior to WW1 compared to the house price series. Moreover, to the best of our knowledge, no information exists on the quality differences that may exist between the dwellings included in the house price and the dwellings included in the rent series. The matching of the series with respect to the exact type of dwelling covered may hence be imperfect and we need to assume that changes in rents of different types of houses are strongly correlated.

United States

Rent data Historical data on rents in the United States are available for 1890–2015.

For the 1890–1914, the long-run rent index relies on the rent component of the NBER cost of living index for manufacturing wage earners constructed by Rees (1961). The index is based on newspaper advertisements in six cities[42] and is confined to working class dwellings. The aggregate series is a simple average of the city indices. The index controls for differences in size but not for other potential sources of quality differences.

Data for 1915–1940 is available from U.S. Bureau of Labor Statistics (2015) which, in turn, are based on the Bureau of Labor Statistics' rental survey of landlords. The index is based on data on average rents for working class dwellings in 32 shipbuilding and other industrial centers for 1915–1935 and 42 cities with population over 50,000 thereafter. The series is based on comparisons of average rents for identical housing units (Bureau of Labor Statistics, 1966). Yet, several authors made the case for a downward bias of the historical U.S. Bureau of Labor Statistics (2015) rent series

[42]These are New York, Chicago, Philadelphia, Boston, Cincinnati, St. Louis.

Table 18: *Data sources: rent index, United States*

Period	Source	Details
1890–1914	Rees (1961)	*Geographic Coverage*: Urban areas; *Type(s) of Dwellings*: All kinds of working class dwellings; *Method*: Stratification.
1915–1940	U.S. Bureau of Labor Statistics (2015), adjusted using estimates by Gordon and van Goethem (2007)	*Geographic Coverage*: Urban areas; *Type(s) of Dwellings*: Working class dwellings; *Method*: Average rents.
1941–1995	Crone et al. (2010)	*Geographic Coverage*: Urban areas; *Type(s) of Dwellings*: All kinds of dwellings; *Method*: Stratification.
1996–2015	U.S. Bureau of Labor Statistics (2015)	*Geographic Coverage*: Urban areas; *Type(s) of Dwellings*: All kinds of dwellings; *Method*: Stratification.

(Crone, Nakamura, and Voith, 2010; Gordon and van Goethem, 2007), e.g., due to aging bias or omission of new units. To adjust for the downward bias for 1915–1940, we use estimates by Gordon and van Goethem (2007).[43]

For 1941–1995, the long-run index relies on the revised CPI for tenant rents constructed by Crone et al. (2010). Crone et al. (2010) argue that for the post-1995 period, tenant rents should be correctly calculated in the original U.S. Bureau of Labor Statistics (2015) series. For the post-1995 years, we therefore use the CPI rent index as published by U.S. Bureau of Labor Statistics (2015). The available series are spliced as shown in Table 18.

Compared to data for other countries, the U.S. rent series is relatively well adjusted for quality changes and sample composition shifts. Also, matching the house price and rent series with respect to geographical coverage has been largely possible. Both series rely on data for urban areas prior to WW2. Yet, while this is still true for the post-WW2 rent series, the house price index provides a more comprehensive coverage during that period. Apart from that, to the best of our knowledge, no information exists on the quality differences that may exist between the dwellings included in the house price and the dwellings included in the rent series. The matching of the series with respect to the exact type of dwelling covered may hence be imperfect and we need to assume that changes in rents of different types of houses are strongly correlated.

[43] Gordon and van Goethem (2007) estimate a CPI bias of -0.86 percent per year for 1914–1935 and of -1.04 percent for 1935–1960.

2.5. Equity and bond returns

This section details the sources used to construct the total equity and bond return series in this paper.

Australia

Table 19: *Data sources: equity and bond returns, Australia*

Year	Data source
Equity returns:	
1870–1881	Sum of capital gains, dividends and gains or losses from stock operations for Australian shares listed in London, weighted by market capitalization. Constructed from *Investor Monthly Manual* (IMM) data, various issues (`http://som.yale.edu/imm-issues`).
1882–2008	With-dividend return from Brailsford, Handley, and Maheswaran (2012). Note: we use these series rather than the alternative from NERA Economic Consulting (2015) due to greater consistency with the IMM historical series.
2009–2013	Total equity return from NERA Economic Consulting (2015).
2014–2015	ASX 200 total return index, from RBA Statistics Table F7.
Bond returns:	
1900–1925	Total return on Australian government bonds listed in Sydney from Moore (2010b). Converted from pound sterling to Australian Dollar.
1926–1968	Total return on Australian bonds listed in London. Data for 1926–1929 are from Meyer, Reinhart, and Trebesch (2015), shared by Josefin Meyer. Data for 1930–1968 were constructed by the authors.
1969–1987	Implied capital gain + yield from the 10-year government bond yield series published by the Reserve Bank of Australia. Capital gain estimated from movements in yields, using monthly yield data. Spliced with London listings data over 1968–1969.
1988–2015	Average of total returns on individual Australian government bonds, targeting 10-year maturity.

We are grateful to Josefin Meyer and Christoph Trebesch for sharing historical bond return data for Australia.

Belgium

Table 20: *Data sources: equity and bond returns, Belgium*

Year	Data source
Equity returns:	
1870–2015	Total return on all common stocks of Belgian companies listed on the Brussels stock exchange, provided by Frans Buelens. Market capitalization weighted. See Annaert, Buelens, Cuyvers, De Ceuster, Deloof, and De Schepper (2011) for further details.
Bond returns:	
1870–1913	Total return on the 3% rente; price and yield data from Drappier (1937), Table II.
1914–1937	Data from the SCOB database shared by Frans Buelens; total return on long-term government bonds, aggregated from individual bond data.
1938–1995	Total return on long-term government bonds, from various issues of National Bank of Belgium *Economic Summaries* and Ten-year Statistics, calculated from monthly data. 1938–1953: 4% perpetual bonds. Spliced with the SCOB data over the period 1938–1940. 1954–1963: 5-20 year 4.5% bond issued before 1962; price changes estimated using movements in yields. 1963–1970: Weighted average of 5-20 year bonds issued before 1962 and 5+ year bonds issued after 1962. 1971–1989: 5+ year maturity bonds, price changes estimated from movements in yields. 1989–1995: basket of 6+ maturity bonds, mean maturity approximately 10 years, price changes estimated from movements in yields.
1996–2015	Total return on 10-year government bonds, National Bank of Belgium online database, price changes estimated from movements in yields.

We are grateful to Frans Buelens for sharing the historical equity and bond return series from the SCOB database of the Brussels stock exchange.

Canada

The data for Canada include the capital gain component only, not the dividend yield or total returns. Sources for the capital gain series are specified below.

Table 21: *Data sources: equity capital gains, Canada*

Year	Data source
1871–1914	Capital gains on Canadian shares listed in London, weighted by market capitalization. Constructed from *Investor Monthly Manual* (IMM) data, various issues (http://som.yale.edu/imm-issues), adjusted for stock splits.
1915–1955	Capital gain on the stock price index in Buckley and Urquhart (1993).
1956–2016	Capital gain on the nominal equity price index from the International Monetary Fund International Financial Statistics (IFS).

Denmark

Table 22: *Data sources: equity and bond returns, Denmark*

Year	Data source
Equity returns:	
1873–1900	Total return on all shares of Danish firms listed on Danish stock exchanges, market cap weighted. Computed from microdata in *Green's Dankse Fonds og Aktier*, various years.
1901–1922	Total return on a broad selection of Danish shares, market cap weighted. We take all shares listed in the statistical yearbooks (Statistisk aarbog, years 1896–1927). For years 1914–1922, we combine the all-share price index in the statistical yearbook with the market cap weighted dividend series based on the smaller selection of stocks.
1923–1999	Combination of dividend yields from Nielsen and Risager (2001) (market-cap weighted, circa 100 companies), and the share price index from Jordà, Schularick, and Taylor (2017), which is compiled from League of Nations, UN and IMF data.
2000–2001	Returns on the MSCI total return index.
2002–2015	Total return on the OMXCGI index.
Bond returns:	
1870–1990	Total return on long-term government bonds from Statistics Denmark (1969) and various issues of the Danmarks Nationalbank's *Monetary Review*. Perpetuals up to 1923, 10-40 year bonds for 1924–1980, 10-year maturity bonds from 1980 onwards.
1991–2015	Statistics Denmark, total return on the 10-year bullet loan

We are grateful to Kim Abildgren for helpful advice about the historical Danish stock return series.

Finland

Table 23: *Data sources: equity and bond returns, Finland*

Year	Data source
Equity returns:	
1895–1912	Total return index from Poutvaara (1996), based on several banks.
1913–1990	Total return index from Nyberg and Vaihekoski (2014), from the data shared with us by Mika Vaihekoski.
1991–2015	OMX Helsinki all-share total return index
Bond returns:	
1870–1925	Total return on long-term Finnish government bonds listed abroad, constructed from individual bond data in Arola (2006) (data from the online appendix of Nyberg and Vaihekoski (2011)).
1926–1991	Total return on approximately 5-year maturity government bonds from Nyberg and Vaihekoski (2011), using price movements implied by changes in market yield.
1992–2016	Average of total returns on individual Finnish government bonds, targeting 10-year maturity.

We are grateful to Mika Vaihekoski for sharing data and assisting with numerous queries regarding the Finnish stock and bond return series.

France

Table 24: *Data sources: equity and bond returns, France*

Year	Data source
Equity returns:	
1870–2010	Total return index from Le Bris and Hautcoeur (2010). Index constructed to mirror the methodology of the CAC-40: returns on largest 40 listed French firms weighted by market cap, with a continuously updated sample, market cap weighted.
2011–2015	Total return on the CAC-40 index.
Bond returns:	
1870–1969	Total return on 4% and 5% rente (perpetual bonds). Data provided by David LeBris, from Le Bris and Hautcoeur (2010).
1970–2015	Total return on a representative basket of long-term government bonds. Assume 10-year maturity before 1990 and 30-year after; as in Le Bris and Hautcoeur (2010). Price movements estimated from changes in yields at monthly frequency. Data provided by David LeBris, from Le Bris and Hautcoeur (2010).

We are grateful to David Le Bris for sharing data, assisting with numerous queries and providing helpful comments on the paper.

Germany

Table 25: *Data sources: equity and bond returns, Germany*

Year	Data source
Equity returns:	
1870–1889	Total return on the value-weighted top-30 blue-chip index from Ronge (2002)
1890–1913	All-share value-weighted performance index from Eube (1998).
1914–1959	Total return on the value-weighted top-30 blue-chip index from Ronge (2002).
1960–1990	Total return index from Gielen (1994), value-weighted, broad coverage. We use the "net" performance index, which excludes the adjustment for dividend income tax credit.
1991–1995	Total return on the DAX index.
1996–2016	Total return on the CDAX index.
Bond returns:	
1870–1903	Total return on listed long-term government bonds, arithmetic average of returns on individual bonds, with price and yield data collected from Homburger (1905) For early years we use regional bonds to fill gaps.
1904–1930	Total return on listed government bonds from the *Berliner Börsenzeitung*. Arithmetic average of individual bond returns. Average maturity generally 5-15 years. No data for the hyperinflation period of 1923–25.
1931–1943	total return on 4.5–6% government bonds (6% until 1935, then converted to 4.5%), aggregated using individual bond data from Papadia and Schioppa (2016), Deutsche Bundesbank (1976) and *Statistisches Jahrbuch für das Deutsche Reich*, various issues. Spliced with the *Berliner Börsenzeitung* series over 1928–1930.
1948–1955	Total return on mortgage bonds (Pfandbriefe, 4% and 5% coupons, from Deutsche Bundesbank (1976) and *Statistisches Jahrbuch für die Bundesrepublik Deutschland*, various issues.
1956–1967	Total return on public bonds from Deutsche Bundesbank (1976), using an average of bond returns for different issue yields. For years where the sample composition changes we use the return implied by yield movements, otherwise we use actual price changes.
1969–2015	REX government bond total return index, Bundesbank database series BBK01.WU046A.

We are grateful to Ulrich Ronge for sharing data and assisting with a number of queries, and to Carsten Burhop for helpful advice. We would also like to thank Andrea Papadia for sharing data.

Italy

Table 26: *Data sources: equity and bond returns, Italy*

Year	Data source
Equity returns:	
1870–1887	Capital gain + dividend return on stocks listed on the Genova stock exchange. Caclulated using indices in Da Pozzo and Felloni (1964), which are a book capital weighted average of returns on individual shares.
1888–1912	Total return on shares listed at the Milan Stock Exchange from Baia Curioni (2001). Market cap weighted.
1913–1954	Capital gain + dividend return on a broad index of Italian shares from Rosania (1954). Market cap weighted.
1955–1969	Capital gain on a broad index of Italian shares from Mondani (1978) (capitalization-weighted), plus dividend returns computed using total dividends paid and market capitalization data (as total dividends in lira / market cap), covering the vast majority Italian listed firms. Data sourced from *Mediobanca: indici e dati*, various years.
1970–2015	Total return on the main *Mediobanca* index, from Mediobanca (2013) and Mediobanca (2016).
Bond returns:	
1870–1913	Sum of lagged current yield and capital gain on the 5% perpetual bond (Rendita), computed from data in Bianchi (1979).
1913–1954	Sum of lagged current yield and capital gain on a representative basket of long-term government bonds, computed from data in Rosania (1954).
1955–1987	Total return on listed government bonds using data in various years of *Mediobanca: indici e dati*, targeting a maturity of 10 years. For the 1980s, only data on 3-5 year maturity bonds were used since longer dated government bonds were not typically listed on the stock exchange.
1988–2015	Average of total returns on individual Italian government bonds, targeting 10-year maturity. For 1988–1991, maturity is generally shorter than 10 years since almost all the bonds traded had relatively short maturities.

We are grateful to Stefano Battilossi for helpful advice about the historical series, and Giovanni Pellegrino for help with translating historical sources. We are also grateful to Massimo Caruso, Giuseppe Conte and Roberto Violi at Banca d'Italia for helpful advice and help in accessing historical publications.

Japan

Table 27: *Data sources: equity and bond returns, Japan*

Year	Data source
Equity returns:	
1882–1940	Sum of capital gain (Laspeyres index, base 1934–36), dividend return and gain/loss from stock operations, weighted by clearing transaction volumes, from Fujino and Akiyama (1977).
1941–1945	Capital gain from Bank of Japan (1966) + dividend return estimated using 1940 dividend yield, growth in nominal dividends paid by Japanese businesses from Bank of Japan (1966), and share price growth from Bank of Japan (1966) (chain linked).
1946–1947	Stock exchange closed; no data.
1948	Capital gain from Unted Nations' *Monthly Bulletin of Statistics* + dividend return estimated using growth in nominal dividends paid by Japanese businesses, as above.
1949–1951	Capital gain from *Bureau of Statistics Japan*, Table 14-25-a "Transactions and Yields of Listed Stocks, Tokyo Stock Exchange 1st Section" + dividend return from Fujino and Akiyama (1977) + gain/loss from stock operations from Fujino and Akiyama (1977).
1952–2015	Capital gain and dividend return from *Bureau of Statistics Japan* Tables 14-25-a and Table 14-25-b, covering Tokyo Stock Exchange 1st and 2nd section, + gain/loss from stock operations from Fujino and Akiyama (1977) (note: the Fujino and Akiyama (1977) series stop in 1975).
Bond returns:	
1880–1940	Lagged current yield + capital gain on central government bonds, from Fujino and Akiyama (1977). Price index used: Laspeyres, base 1934–36.
1941–1965	Secondary markets for government debt were shut down for a prolonged time after WW2, hence we use government bond yield data (not total returns) for this period. Sources are Homer and Sylla (2005) for 1941–1963 (long-term government bond yield), and IMF's IFS database for 1964–65 (Section "Interest rates", Series "Government Bonds").
1966–1970	Lagged current yield + capital gain on central government bonds, from Fujino and Akiyama (1977). Price index used: Laspeyres, base 1969–71.
1971–1987	Total return on long-term government bonds; 9-10 year maturity, from Hamao (1991).
1988–2015	Average of total returns on individual Japanese government bonds, targeting 10-year maturity.

We are grateful to Ryoji Koike for helpful advice, and to Yuzuru Kumon and Kaspar Zimmermann for assisting with collecting and interpreting the data.

Netherlands

Table 28: *Data sources: equity and bond returns, Netherlands*

Year	Data source
Equity returns:	
1900–1995	Total stock return index from Eichholtz, Koedijk, and Otten (2000), based on a selection of Dutch stocks, using data kindly shared with us by Roger Otten. The stock exchange was closed from from August 1944 to April 1946, so the 1945 return covers the period August 1944–April 1946.
1996–2003	CBS total equity return reinvestment index, from *CBS Statline*.
2004–2015	AEX all-share index.
Bond returns:	
1870–1900	Total return on the 2.5% perpetual bond, using data in Albers (2002).
1901–1987	Total return on long-term government bonds from Eichholtz, Koedijk, and Otten (2000), using data kindly shared with us by Roger Otten.
1988–2003	CBS total bond return reinvestment index, bonds of 8 years and above maturity, from *CBS Statline*.
2004–2015	Average of total returns on individual Dutch government bonds, targeting 10-year maturity.

We are grateful to Roger Otten for sharing the data on historical stock and bond returns in the Netherlands.

Norway

Table 29: *Data sources: equity and bond returns, Norway*

Year	Data source
Equity returns:	
1881–1920	Total return on all stocks listed on the Oslo stock exchange, market cap weighted. Constructed from share-level microdata collected from the following publications: *Kurslisten over Vaerdipapier* (the stock listing), *Farmand* magazine, and *Kierulfs haandbok over aktier og obligationer*, various years.
1921–1969	Capital gain from Klovland (2004b) plus dividend return from various issues of Norway's historical statistics and statistical yearbooks (*Historisk Statistikk*, *Statistisk Årbok*).
1970–1983	Capital gain from Klovland (2004b) plus dividend return constructed using the MSCI Norway total return and price return indices.
1984–2000	Capital gain from Klovland (2004b) plus dividend return constructed as total dividends paid by listed firms in proportion to total market capitalization.
2001–2015	Total return on the OSEBX index.
Bond returns:	
1870–1919	Total return on long-term government bonds listed on the Oslo Stock Exchange and major foreign exchanges. We use Oslo data unless there are few bonds being traded, in which case we rely on foreign exchanges. Oslo data come from *Kurslisten over Vaerdipapier*, *Farmand* magazine, and *Kierulfs haandbok over aktier og obligationer*. London data are from the *Investor Monthly Manual* (`http://som.yale.edu/imm-issues`), various issues. Other major markets' data are from Klovland (2004a), with price movements estimated from changes in yields.
1920–1992	Total return on 10-year government bonds, with price changes estimated from movements in monthly yields in Klovland (2004a).
1993–2015	Average of total returns on individual Norwegian government bonds, targeting 10-year maturity.

We are grateful to Jan Tore Klovland for answering numerous queries and helpful advice, and to the staff at the Oslo Nasjonalbiblioteket for help in locating the historical data sources.

Portugal

Table 30: *Data sources: equity and bond returns, Portugal*

Year	Data source
Equity returns:	
1870–1987	Total return on all shares listed on the Lisbon stock exchange, market capitalization weighted. Own calculations using share price, dividend and balance sheet information in the following publications: *Diario do Governo*, *Boletim da Bolsa* and annual reports of public companies, various years. For years 1900–1925, capital for a large number of companies had to be estimated using the trend in capital of a small number of firms. For year 1975, the stock exchange was closed because of the Carnation Revolution. We assumed no dividends were paid, and interpolated the stock prices of firms listed both before and after the closure to compute returns.
1988–2015	Total return on the PSI all-share index.
Bond returns:	
1870–1993	Total return on central government bonds listed on the Lisbon stock exchange. Average maturity around 15–30 years. Computed from bond listings data in *Diario do Governo* and *Boletim da Bolsa*. Weighted by the capitalization of individual bonds. During 1975 the stock exchange was closed, and we used yield data from the Bank of Portugal Statistics, series "Yield on fixed rate treasury bonds—10 years (monthly average)", and estimated price movements from changes in yields.
1994–2015	Average of total returns on individual Portuguese government bonds, targeting 10-year maturity.

We are grateful to Jose Rodrigues da Costa and Maria Eugenia Mata for help and advice in finding and interpreting the data sources for the historical Portuguese data. We are also grateful to staff at the Banco do Portugal archive for helpful advice and sharing data.

Spain

Table 31: *Data sources: equity and bond returns, Spain*

Year	Data source
Equity returns:	
1900–1940	Total return on all Spanish ordinary shares listed at the Madrid Stock Exchange, weighted by market capitalization. Data for 1900–1926 were kindly shared with us by Lyndon Moore (see Moore, 2010a,b). Data for 1926–1936 were collected at the archive of the Banco de España, using stock exchange listings in various issues of the *Boletin de Cotization Oficial* of the Madrid stock exchange. The stock exchange was closed during the Spanish Civil war years 1937–1939. For these years, we calculated the returns using the average return on shares listed both before and after the exchange was closed, and assumed no dividends were paid (this seems reasonable since even in 1940, very few companies paid our dividends).
1940–2015	IGBM and Historical IGBM total return index for the Madrid stock exchange. Sources: López, Carreras, and Tafunell (2005), Chapter 10, "Empresa y Bolsa", Table 10.33; Fernandez, Carabias, and Miguel (2007), European Federation of Exchanges. All shares, market capitalization weighted.
Bond returns:	
1900–1936	Total return on long-term government bonds listed on the Madrid Stock Exchange, market capitalization weighted, average maturity around 25 years. Data for 1900–1926 were kindly shared with us by Lyndon Moore (see Moore, 2010a,b).
1940– 1972	Total return on long-term government bonds from various issues of statistical bulletins, *Anuario Estadístico da España* (`http://www.ine.es/inebaseweb/25687.do`).
1973–1990	Total return on government bonds traded on the Barcelona stock exchange, from the *La Vanguardia* newspaper, various issues. Spliced with the series from statistical bulletins over years 1973–1975.
1989–2015	Total return on medium- and long-term government bonds from various issues of the *Banco de España Statistical Bulletin*. 1988–1994: maturity of less than 5 years; 1995–2015: maturity of 7–8 years.

We are grateful to Lyndon Moore for sharing data and providing helpful advice. We would also like to thank Stefano Battilossi for help with locating the historical data sources, and staff at the Banco de España archive for assisting with our queries.

Sweden

Table 32: *Data sources: equity and bond returns, Sweden*

Year	Data source
Equity returns:	
1871–2002	Total equity return index from Waldenström (2014).
2003–2015	OMXSGI total return index.
Bond returns:	
1870–1874	Total return on 4% and 5% perpetuals, using individual bond data in the online appendix of Waldenström (2014).
1874–2015	Holding period return on long-term government bonds from Waldenström (2014), generally targeting 10-year maturity. Extended to 2015 using own data.

We are grateful to Daniel Waldenström for helpful advice regarding the historical Swedish returns data.

Switzerland

Table 33: *Data sources: equity and bond returns, Switzerland*

Year	Data source
Equity returns:	
1900–1925	Total return on all Swiss stocks listed in Zurich, capitalization-weighted. Calculated using individual stock price and dividend data kindly shared with us by Lyndon Moore (see Moore, 2010a,b). The stock exchange closed from mid-1914 to mid-1916, and the 1915 return covers the period July 1914 to July 1916.
1926–1959	Total return on Swiss equities from Pictet and Cie (1998).
1960–1983	SBC total return index from Pictet and Cie (1998) and Swiss National Bank's *Kapitalmarkt* statistics.
1984–2015	SPI total return index from Pictet and Cie (1998), Swiss National Bank's *Kapitalmarkt* statistics and the SIX stock exchange statistics (six-group.com).
Bond returns:	
1899–1926	Total return on all Swiss government bonds listed on the Zurich stock exchange, capitalization-weighted. Calculated using individual bond price and yield data kindly shared with us by Lyndon Moore (see Moore, 2010a,b).
1927–1995	Total return on Swiss bonds from Pictet and Cie (1998).
1996–2015	SBI total bond return index from the SIX stock exchange statistics (six-group.com). 7+ year maturity before 2007 and 7–10 year maturity afterwards.

We are grateful to Lyndon Moore for sharing data and providing helpful advice, and to Rebekka Schefer for hepling us locate the historical sources.

United Kingdom

Table 34: *Data sources: equity and bond returns, United Kingdom*

Year	Data source
Equity returns:	
1870–1907	Total return on all UK stocks listed on the London stock exchange, capitalization weighted, from Grossman (2002).
1908–1963	Blue-chip market capitalization weighted index based on the largest 30 stocks listed on the London stock exchange, from Barclays (2016).
1964–2015	FTSE Actuaries all-share index, from Barclays (2016).
Bond returns:	
1870–1901	Total return on 3% and 2.75% consols from the *Statistical abstract for the UK*, various issues.
1902–2015	Total return on gilts (price change + lagged yield) from Barclays (2016). Targetting 20-year maturity before 1990 and 15-year maturity afterwards.

We are grateful to Richard Grossman and John Turner for helpful advice regarding historical UK stock and bond return data.

United States

Table 35: *Data sources: equity and bond returns, United States*

Year	Data source
Equity returns:	
1870–2015	Capital gain + dividend return from Shiller (2000) (up-to-date data from http://www.econ.yale.edu/~shiller/data.htm)
Bond returns:	
1870–1926	Total return on a basket of central government bonds around 10-year maturity. Calculated from prices of individual bonds in the *Commercial and Financial Chronicle*, various issues.
1927–1928	Total return on 10-year government bonds, price changes imputed from yields. Source: Aswath Damodaran database (http://pages.stern.nyu.edu/~adamodar/New_Home_Page/datafile/histretSP.html).
1929–2015	Total return on US long-term government bonds, from Barclays (2016).

We are grateful to Josefin Meyer for helpful advice concerning the historical bond return data for the US.

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