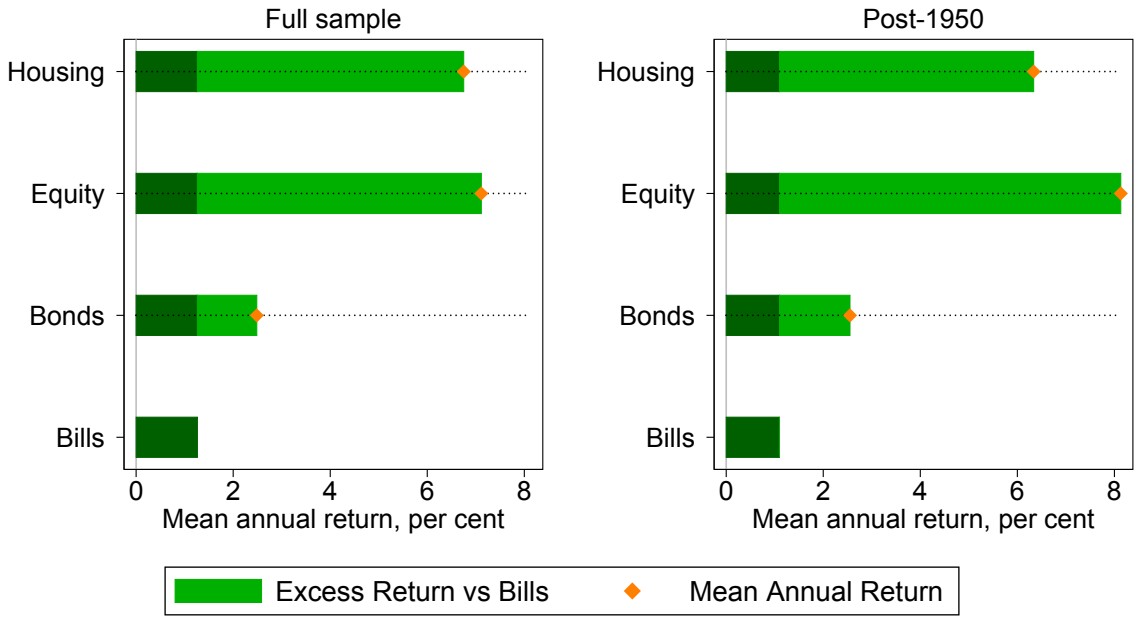
Online Appendix

The Rate of Return on Everything, 1870–2015

A. The effect of GDP weighting

Figure A.1: *GDP-weighted returns*



Notes: Arithmetic avg. real returns p.a., weighted by real GDP. Consistent coverage within each country.

This chart shows global average returns for the four asset classes weighted by country GDP, effectively giving greater weight to the largest economies in our sample, namely the U.S., Japan, and Germany. The overall effects are relatively minor. For the full sample, returns on equity and housing are similar at around 7% in real terms. For the post-1950 period, equities outperform housing by about 2pp. on average. The post-1990 housing bust in Japan and the underperformance of the German housing market contribute to this result.

B. More on sample consistency

Throughout the paper, we always use a sample that is consistent within each table and graph, that is, for any table that shows returns on bills, bonds, equity, and housing, each yearly observation has data for all four asset returns. For tables showing bonds versus bills only, each yearly observation has data on both bonds and bills, but may be missing data for equities or housing. At the same time, returns for different countries generally cover different time periods.

Here we investigate whether adjusting for sample consistency affects our results. First, Figure A.2 plots returns for samples that are consistent both within and across countries, starting at benchmark years. The later the benchmark year, the more countries we can include. The resulting return patterns confirm that the basic stylized facts reported earlier continue to hold even under these more stringent sampling restrictions, and regardless of the time period under consideration.

Next, we consider whether going to a fully "inconsistent" sample —that is, taking the longest time period available for each asset, without within-country consistency— would change the results. Table A.1 thus shows returns for the maximum possible sample for each asset. Table A.2, on the contrary, shows returns for a sample that is consistent within each country, across all four asset classes. The results in this table can be compared to Table 3 in the main text. On balance, the choice of the sample makes almost no difference to our headline results.

Figure A.2: *Consistent samples*

Note: Average real returns p.a. (unweighted). Consistent coverage across and within countries.

Table A.1: *Returns using longest possible sample for each asset*

Country	Bills	Bonds	Equity	Housing
Australia	2.02	2.17	8.41	6.37
Belgium	1.62	3.01	5.89	7.89
Denmark	2.98	3.59	7.22	8.22
Finland	0.64	3.22	9.37	9.58
France	-0.47	0.83	3.25	6.38
Germany	1.49	3.12	8.62	7.82
Italy	1.20	2.11	6.13	4.77
Japan	0.63	2.54	9.69	6.54
Netherlands	1.37	2.71	7.09	7.22
Norway	1.10	2.55	5.95	8.33
Portugal	-0.01	2.76	3.98	6.31
Spain	0.70	1.34	5.41	5.21
Sweden	1.77	3.25	7.96	8.30
Switzerland	1.64	2.41	6.70	5.63
UK	1.16	2.29	7.10	5.36
USA	2.17	2.79	8.34	6.03
Average, unweighted	1.17	2.61	6.99	7.17
Average, weighted	1.32	2.46	7.36	6.66

Note: Average annual real returns. Longest possible sample used for each asset class, i.e. returns are not consistent across assets or within countries. The average, unweighted and average, weighted figures are respectively the unweighted and real-GDP-weighted arithmetic averages of individual country returns.

Table A.2: *Returns using the full within-country-consistent sample*

Country	Bills	Bonds	Equity	Housing
Australia	1.29	2.26	7.75	6.54
Belgium	0.70	2.87	6.78	8.64
Denmark	2.64	3.24	7.20	8.17
Finland	0.08	4.25	9.98	9.58
France	-0.48	1.44	4.06	7.34
Germany	2.65	4.03	6.85	7.82
Italy	1.37	3.19	7.32	4.77
Japan	0.39	2.18	6.09	6.54
Netherlands	0.78	1.85	7.09	7.28
Norway	0.90	2.29	5.95	8.03
Portugal	-0.48	1.37	4.37	6.31
Spain	-0.03	1.39	5.93	5.09
Sweden	1.56	3.14	7.98	8.30
Switzerland	0.81	2.33	6.90	5.77
UK	1.15	1.96	7.20	5.36
USA	1.45	2.26	8.39	6.03
Average, unweighted	1.15	2.62	6.65	7.32
Average, weighted	1.26	2.49	7.11	6.75

Note: Average annual real returns. Returns consistent within countries, i.e. each yearly observation for a country has data on each of the four asset classes. The average, unweighted and average, weighted figures are respectively the unweighted and real-GDP-weighted arithmetic averages of individual country returns.

C. Returns during world wars

Table A.3: *Real returns on risky assets during world wars*

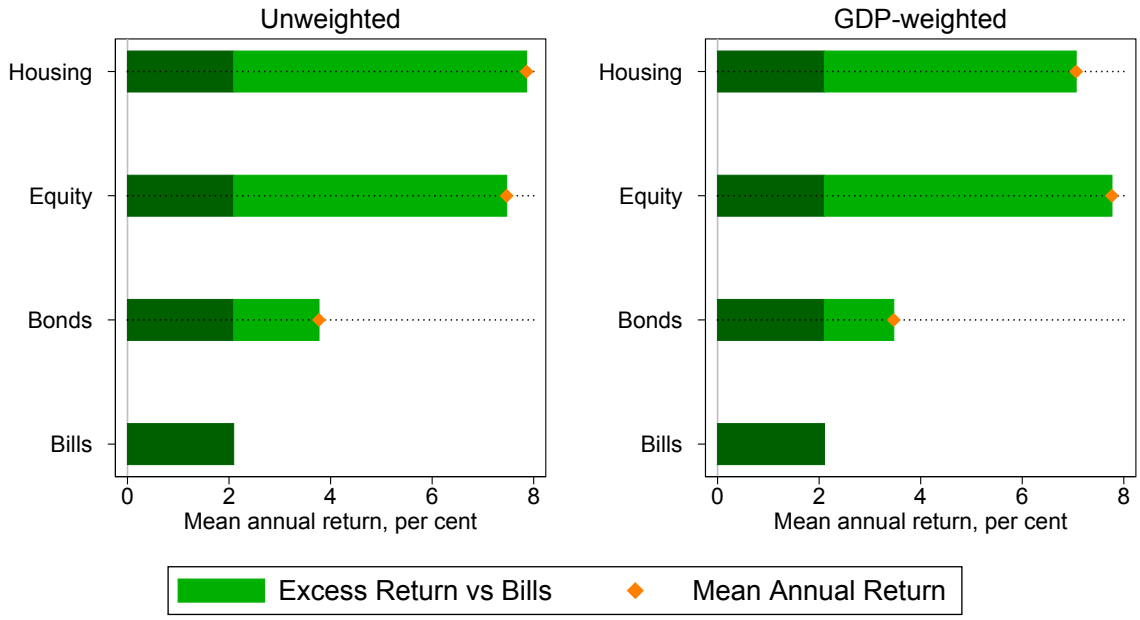
Country	World War 1		World War 2	
	Equity	Housing	Equity	Housing
Australia	0.20	1.22	4.86	4.12
Belgium	-3.75	-5.84	3.12	8.69
Denmark	4.98	4.35	2.85	11.75
Finland	4.68		0.55	-9.79
France	-12.48	-9.37	-4.05	-1.51
Germany	-12.37	-26.53	3.82	
Italy	-6.11			
Japan	15.88			
Netherlands	-0.20	5.07	5.71	9.10
Norway	3.88	-1.38	0.62	2.54
Portugal	-3.99		3.96	
Spain	-5.77	-0.71	-0.73	-4.56
Sweden	-15.72	-3.93	5.56	7.89
Switzerland	-11.19	-4.46	1.32	3.08
UK	-4.04	-0.73	4.56	
USA	0.96	0.06	4.90	8.47
Average, unweighted	-3.03	-1.84	2.65	3.86
Average, weighted	-3.26	-2.02	5.39	6.89

Note: Average annual real returns. We include one year from the immediate aftermath of the war, such that World war 1 covers years 1914—1919, and World War 2 – 1939—1946. Period coverage differs across and within countries. We exclude World War 2 periods for Italy and Japan because of hyperinflation. The average, unweighted and average, weighted figures are respectively the unweighted and real-GDP-weighted arithmetic averages of individual country returns.

The performance of different assets during the major wars is an important issue for asset pricing models that argue that high risk premiums on equities reflect the risk of economy-wide disasters. This argument rests on the work of Barro (2006), developed further in collaboration with Emi Nakamura, John Steinsson and Jose Ursua (Barro and Ursua, 2008; Nakamura, Steinsson, Barro, and Ursúa, 2013). Table A.3 shows the returns of housing and equity markets during World War 1 and World War 2. The data confirm large negative returns in different countries, especially during World War 1. In both wars, housing markets tended to outperform equity, making it potentially more difficult to explain the large housing risk premium that we find. This being said, the positive returns in various countries during World War 2 are in some cases influenced by price controls affecting our CPI measure and direct government interventions into asset markets that aimed at keeping prices up (see Le Bris, 2012, for the case of France). Further, as we do not adjust our return series for changes in the housing stock, the series here underestimate the negative impact of wartime destruction on housing investments. As a result, the war time returns shown here likely mark an upper bound, and wars can still be seen as periods with typically low returns on risky assets.

D. Returns excluding world wars

Figure A.3: *Returns excluding world wars, full sample*



Note: Average real returns p.a., excluding world wars. Consistent coverage within each country.

In Figure A.3 we exclude World War 1 and 2 from the calculation of aggregate returns, but maintain the within country consistency of the sample, as before. As expected, excluding the wars pushes up aggregate returns somewhat, but overall risk premiums and the relative performance of the different assets classes remain comparable.

Table A.4: *Real returns on bonds and bills, including and excluding world wars*

Country	Full Sample		Excluding wars	
	Bills	Bonds	Bills	Bonds
Australia	1.29	2.24	1.73	2.65
Belgium	1.16	3.01	1.77	3.65
Denmark	3.08	3.58	3.80	4.39
Finland	0.64	3.22	2.17	5.34
France	-0.47	1.54	0.89	3.11
Germany	1.51	3.15	2.46	4.06
Italy	1.20	2.53	2.63	4.23
Japan	0.68	2.54	1.85	3.80
Netherlands	1.37	2.71	2.22	3.70
Norway	1.10	2.55	1.91	3.56
Portugal	-0.01	2.23	0.94	3.30
Spain	-0.04	1.41	1.17	2.73
Sweden	1.77	3.25	2.59	4.39
Switzerland	0.89	2.41	1.67	3.47
UK	1.16	2.29	2.03	3.22
USA	2.17	2.79	2.93	3.54
Average, unweighted	1.13	2.61	2.18	3.83
Average, weighted	1.31	2.49	2.24	3.50

Note: Average annual real returns. Returns excluding wars omit periods 1914—1919 and 1939—1947. Period coverage differs across countries. Consistent coverage within countries. The average, unweighted and average, weighted figures are respectively the unweighted and real-GDP-weighted arithmetic averages of individual country returns.

Table A.4 displays country returns for bills and bonds including and excluding war periods. The effect on returns on bonds and bills, both weighted and unweighted, is substantial. The rate of return on bills almost doubles in real terms when the two war windows are excluded, and returns on bonds jump by about 1 percentage point.

Table A.5: *Real returns on equity and housing, including and excluding world wars*

Country	Full Sample		Excluding wars	
	Equity	Housing	Equity	Housing
Australia	7.81	6.37	8.50	6.95
Belgium	6.23	7.89	7.47	8.73
Denmark	7.22	8.10	7.71	7.91
Finland	9.98	9.58	11.66	11.31
France	3.25	6.54	4.87	8.00
Germany	6.85	7.82	7.01	8.13
Italy	7.32	4.77	6.67	4.51
Japan	6.09	6.54	6.85	6.79
Netherlands	7.09	7.28	7.53	7.22
Norway	5.95	8.03	6.39	8.85
Portugal	4.37	6.31	4.37	6.31
Spain	5.46	5.21	6.49	6.41
Sweden	7.98	8.30	9.48	8.97
Switzerland	6.71	5.63	8.25	6.44
UK	7.20	5.36	8.03	5.57
USA	8.39	6.03	9.20	6.14
Average, unweighted	6.60	7.25	7.45	7.87
Average, weighted	7.04	6.69	7.75	7.06

Note: Average annual real returns. Returns excluding wars omit periods 1914—1919 and 1939—1947. Period coverage differs across countries. Consistent coverage within countries. The average, unweighted and average, weighted figures are respectively the unweighted and real-GDP-weighted arithmetic averages of individual country returns.

In Table A.5 we look at the performance of risky assets for the full sample and excluding war periods. The effects are visible, but less strong than in the case of bonds and bills before. Excluding war years pushes up returns on equity and housing by 50 to 80 basis points. These effects are largely independent of the GDP-weighting.

Table A.6: *Real risky and safe asset returns, including and excluding world wars*

Country	Full Sample		Excluding wars	
	Risky return	Safe return	Risky return	Safe return
Australia	6.97	1.77	7.47	2.20
Belgium	8.31	1.78	8.53	2.58
Denmark	8.15	2.94	8.01	3.78
Finland	10.79	2.16	12.60	3.55
France	6.69	0.48	7.60	2.01
Germany	7.86	3.34	8.14	3.36
Italy	5.28	2.28	4.97	2.94
Japan	6.79	1.29	7.11	2.08
Netherlands	7.23	1.31	7.31	2.39
Norway	8.01	1.59	8.81	2.55
Portugal	6.32	0.45	6.32	0.45
Spain	5.30	0.68	6.18	1.96
Sweden	8.51	2.35	9.49	3.41
Switzerland	6.57	1.57	7.43	2.50
UK	6.39	1.56	6.84	2.44
USA	6.99	1.85	7.33	2.65
Average, unweighted	7.44	1.88	8.07	2.93
Average, weighted	7.16	1.88	7.59	2.79

Note: Average annual real returns. Returns excluding wars omit periods 1914—1919 and 1939—1947. Real risky return is a weighted average of equity and housing, and safe return - of bonds and bills. The weights correspond to the shares of the respective asset in the country's wealth portfolio. Period coverage differs across countries. Consistent coverage within countries. The average, unweighted and average, weighted figures are respectively the unweighted and real-GDP-weighted arithmetic averages of individual country returns.

Table A.6 underlines the outperformance of risky assets once we exclude the wars. Average safe returns are about 1 percentage point lower in the full sample, relative to the sample that exclude war years. By contrast, risky returns only rise by between 40 and 60 basis points when we exclude wars. As discussed above the measurement of returns in wars is problematic and we are inclined not to read too much into the relative outperformance of risky assets in war times.

Table A.7: *Return on capital and GDP growth, including and excluding world wars*

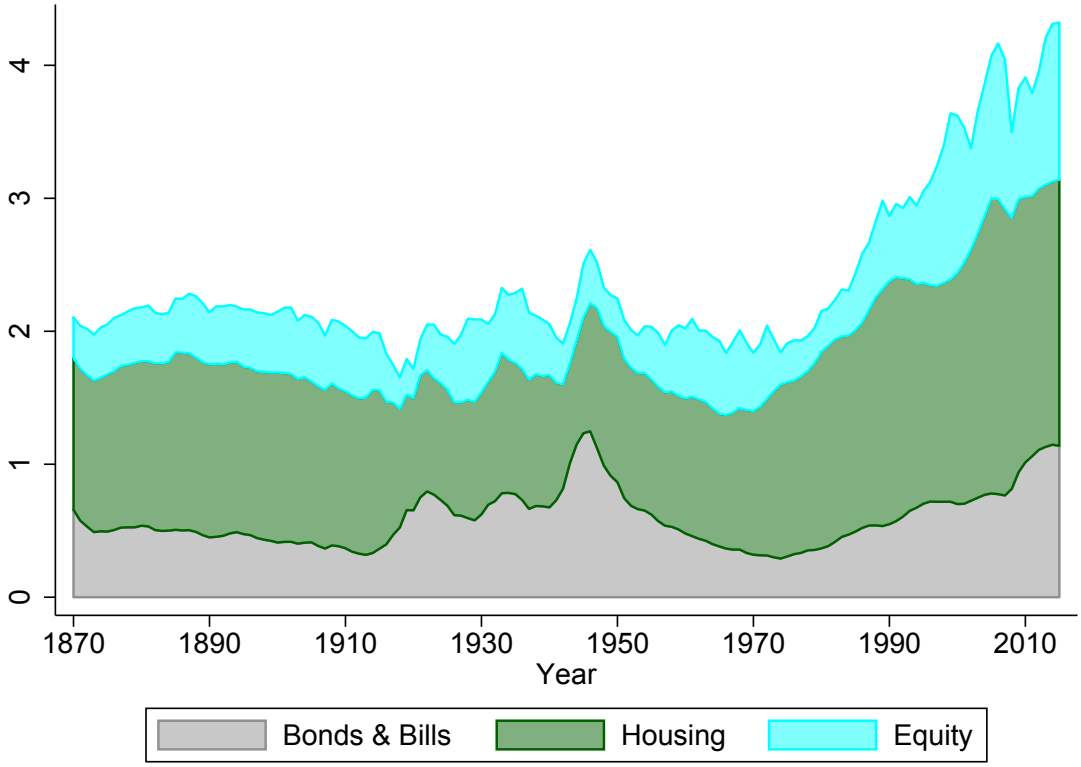
Country	Full Sample		Excluding wars	
	Return on wealth	GDP growth	Return on wealth	GDP growth
Australia	5.91	3.58	6.49	3.73
Belgium	6.37	2.31	6.76	2.49
Denmark	7.50	2.78	7.46	2.84
Finland	9.70	3.58	11.57	3.73
France	5.01	2.61	6.19	2.83
Germany	6.95	2.84	7.18	3.00
Italy	5.05	3.81	4.91	3.22
Japan	5.58	4.15	6.29	4.28
Netherlands	5.27	3.16	5.82	3.16
Norway	6.91	3.06	7.69	3.13
Portugal	5.76	3.39	5.76	3.39
Spain	4.50	3.21	5.61	3.44
Sweden	7.40	2.88	8.43	2.96
Switzerland	5.67	2.33	6.62	2.54
UK	4.70	2.04	5.41	2.18
USA	5.91	3.38	6.52	3.18
Average, unweighted	6.28	2.87	7.09	2.94
Average, weighted	5.89	3.05	6.59	2.97

Note: Average annual real returns. Returns excluding wars omit periods 1914—1919 and 1939—1947. Real return on wealth is a weighted average of bonds, bills, equity and housing. The weights correspond to the shares of the respective asset in each country's wealth portfolio. Period coverage differs across countries. Consistent coverage within countries. The average, unweighted and average, weighted figures are respectively the unweighted and real-GDP-weighted arithmetic averages of individual country returns.

Table A.7 looks at the effects of war periods on the aggregate return on capital and GDP growth on a country level and for the global sample. The aggregate return on capital is about 75 basis points higher outside world wars, while GDP growth rates are barely affected as the war effort boosted GDP in many countries in the short term.

E. The global asset portfolio

Figure A.4: *Assets considered in this study as a share of GDP*



Note: Average of asset-to-GDP shares in individual countries, weighted by real GDP. Equity is the total stock market capitalization. Housing is the stock of housing wealth. Bonds and bills are the stock of public debt.

This section briefly presents the asset portfolio data used to calculate the weighted risky and safe asset returns, and the overall rate of return on capital. As outlined in Section 2.3, we weight the individual asset returns within each country according to the market-capitalization shares of the respective asset types in the country's investible wealth portfolio, to arrive at these composite return measures. (Thus, by this choice of method, significant non-market asset weights are not included, notably non-traded equity wealth.)

We measure equity wealth as the stock market capitalization of the specific country, using the newly collected data from Kuvshinov and Zimmermann (2017). These data strive to measure the total size of the domestic stock market, excluding foreign-owned companies, and aggregating across multiple stock exchanges within the country, excluding cross listings, at each year in the historical sample. Due to data limitations we have had to rely on data for individual markets for a number of countries and historical periods (e.g., only counting the Lisbon listings, but not the Porto listings for Portugal), and rely on interpolation to construct some of the early annual estimates. The stock market capitalization data are sourced from a wide variety of publications in academic journals, historical statistical publications, and disaggregated data on stock listings and company reports of listed firms.

To measure the value of housing wealth for each country, we went back to the historical national wealth data to trace the value of buildings and the underlying land over the past 150 years.

We heavily relied on the national wealth estimates by Goldsmith (Garland and Goldsmith, 1959; Goldsmith, 1962, 1985) as well as the on the collection of national wealth estimates from Piketty and Zucman (2014) for the pre-WW2 period. We also drew upon the work of economic and financial historians, using the national wealth estimates of Stapledon (2007) for Australia, Abildgren (2016) for Denmark, Artola Blanco, Bauluz, and Martínez-Toledano (2017) for Spain, Waldenström (2017) for Sweden, and Saez and Zucman (2016) for the US. For the postwar decades, we turned to published and unpublished data from national statistical offices such as the U.K. Office of National Statistics or Statistics Netherlands (1959). Particularly for the earlier periods, many of the sources provided estimates for benchmark years rather than consistent time series of housing wealth. In these cases, we had to use interpolation to arrive at annual estimates.

We use total public debt from the latest vintage of the long-run macrohistory database (Jordà, Schularick, and Taylor, 2016) as a proxy for the stock of bonds and bills, and divide public debt equally between these two financial instruments.

The broad patterns in the asset holdings show that housing has been the dominant asset in the countries' portfolios throughout the sample. Public debt, and returns on bonds and bills, have tended to increase in size after wars, and most recently after the Global Financial Crisis. The stock market has tended to be small relative to housing, but has increased in size during the last several decades. The last four decades have also seen a marked increase in the aggregate stock of assets pictured in Figure A.4, in line with the findings of Piketty and Zucman (2014), who cover a broader selection of assets, but have fewer countries and observations in their sample.

F. Equally-weighted portfolio returns

Table A.8: *Equally-weighted portfolio returns*

Country	Portfolio weights		Equal weights	
	Risky return	Return on wealth	Risky return	Return on wealth
Australia	6.97	5.91	7.14	5.51
Belgium	8.31	6.37	7.71	6.10
Denmark	8.15	7.50	7.69	6.21
Finland	10.79	9.70	9.78	7.94
France	6.69	5.01	5.70	4.28
Germany	7.86	6.95	7.33	6.23
Italy	5.28	5.05	6.04	5.09
Japan	6.79	5.58	6.31	4.94
Netherlands	7.23	5.27	7.18	5.40
Norway	8.01	6.91	6.99	5.42
Portugal	6.32	5.76	5.34	4.02
Spain	5.30	4.50	5.51	4.14
Sweden	8.51	7.40	8.14	6.48
Switzerland	6.57	5.67	6.33	5.00
UK	6.39	4.70	6.28	4.84
USA	6.99	5.91	7.21	5.56
Average, unweighted	7.44	6.28	6.99	5.53
Average, weighted	7.16	5.89	6.93	5.45

Note: Average annual real returns for the full sample. The portfolio-weighted averages use country-specific stocks of housing, equity, bonds and bills as weights for the individual asset returns. Portfolio-weighted risky return is a weighted average of housing and equity, using stock market capitalization and hosuing wealth as weights. Portfolio-weighted real return on wealth is a weighted average of equity, housing, bonds and bills, using stock market capitalization, housing wealth and public debt stock as weights. Equally-weighted risky return is an unweighted average of housing an equity. Equally-weighted return on wealth is an unweighted average of housing, equity and bonds. Period coverage differs across countries. Consistent coverage within countries. The average, unweighted and average, weighted figures are respectively the unweighted and real-GDP-weighted arithmetic averages of individual country returns.

Table A.8 assesses the impact of portfolio weighting on our return estimates. The weighting has a relatively small impact on the risky rates, because returns on housing and equity are generally similar. It raises the return on capital by around one percentage point, because the outstanding stock of public debt is substantially smaller than that of risky assets. The basic stylized facts of $r \gg g$, and high long-run risky returns continue to hold regardless of the weighting, both on average and across the individual countries in our sample.

G. US Dollar returns

Table A.9: *Global real returns for a US-Dollar investor*

	Real returns				Nominal Returns			
	Bills	Bonds	Equity	Housing	Bills	Bonds	Equity	Housing
Full sample:								
Mean return p.a.	1.87	3.44	7.84	8.11	4.44	5.98	10.54	10.91
Std.dev.	12.12	15.60	25.08	15.83	11.70	14.91	25.35	16.19
Geometric mean	1.08	2.23	4.94	6.91	3.71	4.90	7.68	9.70
Mean excess return p.a.	0.23	1.80	6.20	6.47				
Std.dev.	11.30	14.71	24.72	15.82				
Geometric mean	-0.46	0.73	3.37	5.28				
Observations	1739	1739	1739	1739	1739	1739	1739	1739
Post-1950:								
Mean return p.a.	2.13	3.99	9.45	8.91	5.74	7.61	13.20	12.75
Std.dev.	10.59	13.78	26.15	14.92	10.97	13.90	26.67	15.36
Geometric mean	1.59	3.10	6.36	7.93	5.18	6.74	10.13	11.74
Mean excess return p.a.	0.80	2.66	8.12	7.58				
Std.dev.	10.58	13.82	25.91	15.03				
Geometric mean	0.25	1.74	5.05	6.56				
Observations	1016	1016	1016	1016	1016	1016	1016	1016

Note: Global average US-Dollar returns, equally weighted. Real returns subtract US inflation. Excess returns are over US Treasury bills. Period coverage differs across countries. Consistent coverage within countries.

Table A.9 shows nominal and real returns from the perspective of a US-Dollar investor. The Table can be directly compared to Table 3 in the paper. Overall, calculating returns in dollars increases their volatility, since returns now also fluctuate with nominal exchange rate movements. It also adds up to 1 percentage point to the local currency returns reported in Table 3. The higher average return is, for the most part, driven by the higher volatility—exchange rate movements amplify both positive and negative returns, but because returns are on average positive, the average return increases. The effects are stronger after World War 2, going hand-in-hand with the greater exchange rate volatility after the collapse of the Bretton Woods system.

Table A.10: *USD returns by country*

Country	Bills	Bonds	Equity	Housing
Australia	1.69	2.51	8.48	7.20
Belgium	0.81	3.19	7.29	8.83
Denmark	3.41	4.00	7.87	8.94
Finland	1.83	6.39	11.93	11.90
France	1.05	3.04	5.21	9.10
Germany	4.25	5.74	8.41	9.61
Italy	2.74	4.70	8.64	6.26
Japan	2.25	4.03	7.84	8.61
Netherlands	1.79	2.86	7.94	8.60
Norway	1.58	2.98	7.05	8.81
Portugal	0.10	1.98	5.71	6.96
Spain	0.85	2.28	6.87	6.30
Sweden	2.02	3.58	8.56	8.81
Switzerland	1.97	3.55	7.74	7.06
UK	1.87	2.72	8.02	6.15
USA	1.45	2.26	8.39	6.03
Average, unweighted	2.00	3.53	7.60	8.33
Average, weighted	1.98	3.25	7.84	7.57

Note: Average annual real US-Dollar returns. Calculated as nominal US-Dollar return minus US inflation. Period coverage differs across countries. Consistent coverage within countries. The average, unweighted and average, weighted figures are respectively the unweighted and real-GDP-weighted arithmetic averages of individual country returns.

In Table A.10 we display Dollar returns for individual asset classes and individual countries for the full sample. For US-Dollar based fixed income investors, Germany and Finland offered the highest returns. In housing markets, Germany and Finland again stand out, and high returns are seen in Belgium, France, Netherlands and the Scandinavian countries. In equity markets, Finland, Italy and Sweden were the best performing markets.

H. Risky returns ranked by country

Table A.11: *Risky returns ranked by country*

Country	Full sample	Post-1950	Post-1980
Finland	10.79	12.99	12.87
Sweden	8.51	10.21	11.37
Belgium	7.60	8.72	7.99
Denmark	8.09	7.86	6.86
Norway	8.01	9.26	10.53
Germany	7.86	5.81	5.18
Average, unweighted	7.44	8.07	7.60
Netherlands	7.23	8.79	7.45
USA	6.99	6.88	7.07
Australia	6.97	8.45	7.74
Japan	6.79	7.04	4.81
France	6.69	9.68	7.29
Switzerland	6.57	7.13	7.96
UK	6.39	7.88	7.73
Portugal	6.32	6.06	7.15
Spain	5.30	6.03	5.27
Italy	5.28	5.80	5.13

Note: Average annual real risky returns. Real risky return is a weighted average of equity and housing. The weights correspond to the shares of the respective asset in the country's wealth portfolio. Period coverage differs across countries. Consistent coverage within countries. The figure is the unweighted arithmetic average of individual country returns.

In Table A.11 we rank risky returns in the different countries. We calculate risky returns as a combination of equity and housing weighted by the share of each asset in the country's total wealth portfolio. North-western Europe—essentially the Scandinavian countries plus Germany and Belgium—stands out as the region with the highest aggregate returns on risky assets. The U.S. returns are about average, while the southern European countries have comparatively low long-run returns.

I. Returns before the Global Financial Crisis

Table A.12: *Asset returns before the Global Financial Crisis*

Country	Bills	Bonds	Equity	Housing
Australia	1.30	1.95	8.28	6.49
Belgium	1.32	2.86	6.07	8.22
Denmark	3.31	3.56	6.81	8.67
Finland	0.76	3.10	10.64	9.96
France	-0.46	1.17	3.14	6.68
Germany	1.64	3.13	6.94	7.80
Italy	1.30	2.24	8.26	5.32
Japan	0.74	2.51	6.20	6.88
Netherlands	1.48	2.50	7.11	7.77
Norway	1.14	2.41	6.15	8.14
Portugal	-0.00	1.64	5.71	7.19
Spain	0.01	0.95	5.84	5.89
Sweden	1.86	3.09	7.87	8.32
Switzerland	0.99	2.17	6.81	5.40
UK	1.32	2.16	7.52	5.67
USA	2.36	2.65	8.47	6.22
Average, unweighted	1.23	2.42	6.73	7.49
Average, weighted	1.43	2.34	7.14	6.90

Note: Average annual real returns excluding the Global Financial Crisis (i.e. sample ends in 2007). Period coverage differs across countries. Consistent coverage within countries. The average, unweighted and average, weighted figures are respectively the unweighted and real-GDP-weighted arithmetic averages of individual country returns.

This Table cuts the sample off in 2007, i.e., before the Global Financial Crisis. Comparing this table to Tables 4 and 5 in the main text shows that the effects are relatively minor. The crisis only shaves off about 10-20 basis points from equity and housing returns, and adds about 10 basis points to bills and bonds.

Table A.13: *Risky and safe returns, including and exluding the GFC*

Country	Full Sample		Excluding the GFC	
	Risky return	Safe return	Risky return	Safe return
Australia	6.97	1.77	7.18	1.63
Belgium	8.31	1.78	8.58	1.77
Denmark	8.15	2.94	8.39	3.04
Finland	10.79	2.16	11.36	2.19
France	6.69	0.48	6.80	0.39
Germany	7.86	3.34	7.86	3.49
Italy	5.28	2.28	5.89	2.18
Japan	6.79	1.29	7.01	1.28
Netherlands	7.23	1.31	7.58	1.19
Norway	8.01	1.59	8.15	1.52
Portugal	6.32	0.45	7.24	-0.26
Spain	5.30	0.68	5.97	0.47
Sweden	8.51	2.35	8.46	2.30
Switzerland	6.57	1.57	6.50	1.49
UK	6.39	1.56	6.72	1.57
USA	6.99	1.85	7.09	1.84
Average, unweighted	7.44	1.88	7.65	1.84
Average, weighted	7.16	1.88	7.32	1.86

Note: Average annual real returns excluding the Global Financial Crisis (i.e. sample ends in 2007). Real risky return is a weighted average of equity and housing, and safe return - of bonds and bills. The weights correspond to the shares of the respective asset in the country's wealth portfolio. Period coverage differs across countries. Consistent coverage within countries. The average, unweighted and average, weighted figures are respectively the unweighted and real-GDP-weighted arithmetic averages of individual country returns.

This Table recalculates risky and safe returns including and excluding the Global Financial Crisis on a country level and for the global average. As noted before, the effects are quantitatively small. Excluding the crisis boosts risky returns by 10-20 basis, and lower safe returns by no more than 5 basis points. In light of the long time horizon of nearly 150 years, asset performance in the recent crisis plays a minor role for the returns presented here.

Data appendix

J. Data overview

Table A.14: *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	1988–2015	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	1900–1990	Long maturity, central gov't
	1922–1974	Deposit rate	1991–2015	Approx. 10y, 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	1900–1984	Long maturity, central gov't
	1969–2015	Money market rate	1985–2015	Approx. 10y, central gov't
United Kingdom	1870–2015	Money market rate	1870–1901	Perpetual
			1902–1979	Long maturity, central gov't
			1980–2015	Approx. 10y, 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 A.15: *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	1893–1914	Broad	Book cap	1876–1964	Mixed
	1915–1999	Broad	Market cap	1965–2015	Nationwide
	2000–2015	Blue chip	Market cap	1965–2015	Nationwide
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	1870–1913	All share	Market cap	1871–1912	Mixed
	1914–1959	Blue chip	Market cap	1913–1938	Urban
	1960–2015	Broad	Market cap	1939–1947	Mixed
				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
	1976–2004	All share	Mix of equal and market cap	1947–2015	Mixed
	2005–2015	Broad	Market cap		
Netherlands	1900–2015	Broad	Mostly market cap	1871–1969	Mixed
Norway	1881–1914	All share	Market cap	1871–2015	Urban
	1915–1955	All share	Mix of equal and book cap		
	1956–2000	All share	Mix of book cap and company turnover		
	2001–2015	Blue chip	Market cap		
Portugal	1871–1987	All share	Market cap	1948–2015	Mixed
	1988–2015	Blue chip	Market cap		
Spain	1900–1969	All share	Market cap	1901–1957	Mixed
	1970–1987	Blue chip	Market cap	1958–2015	Nationwide
	1988–2015	All share	Market cap		
Sweden	1871–2015	Broad	Market cap	1883-1959	Urban
				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	1900–1913	Mixed
	1929–1963	Blue chip	Market cap	1914–1929	Urban
	1964–2015	All share	Market cap	1930–1946	Mixed
				1947–2015	Nationwide
United States	1872–2015	Broad	Market cap	1891–1952	Urban
				1953–2015	Mixed

K. Housing returns

This section details construction of the rental yield series for each country. For details on the house price data, please see Knoll, Schularick, and Steger (2017).

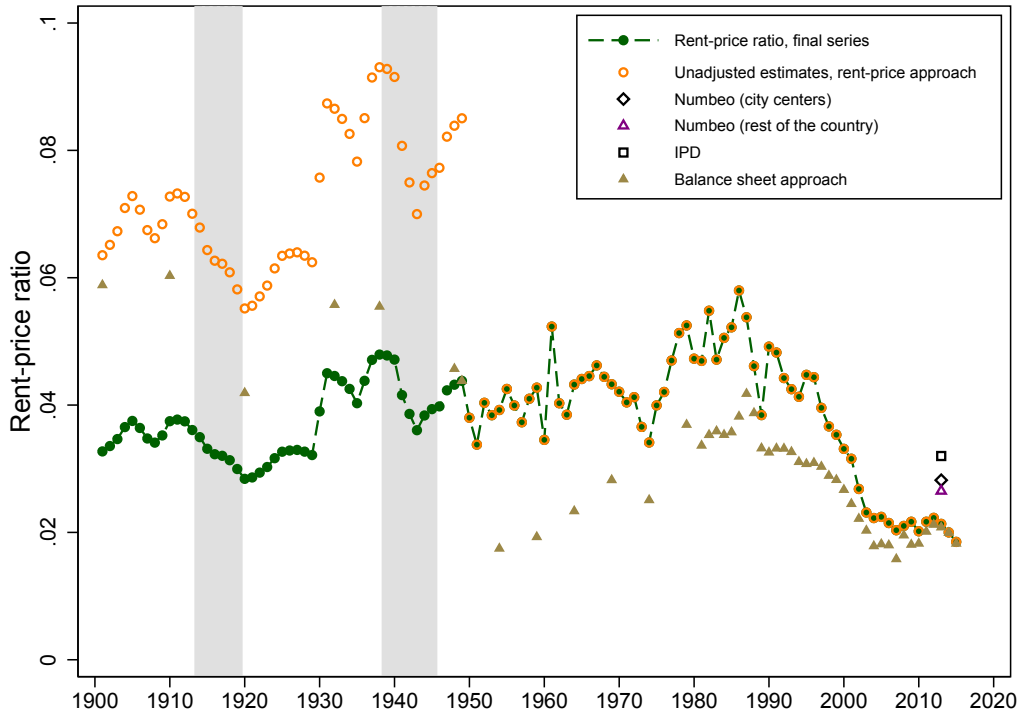
As described in Section 2.3, the baseline housing return series is constructed using the rent-price approach. To do this, we take a benchmark net rent-price ratio—adjusted down for maintenance and other costs—in the year 2012, 2013 or 2014, and extrapolate it back using growth in the house price and rent indices. For this purpose, we use the house price index presented by Knoll, Schularick, and Steger (2017) and the rent index introduced in Knoll (2016). We further check the rent-price approach estimates against various alternative historical benchmarks. These include the balance sheet approach constructed from National Accounts data (see Section 6.2 for more detail on this method), 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 Appendix Figures A.5—A.20, 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 Figure 9). For Australia and USA, 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 A.5: *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 A.5. 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 A.5—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 A.5). Balance sheet approach estimates (brown triangles) are obtained using a variety of sources. OECD (2016b), 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.

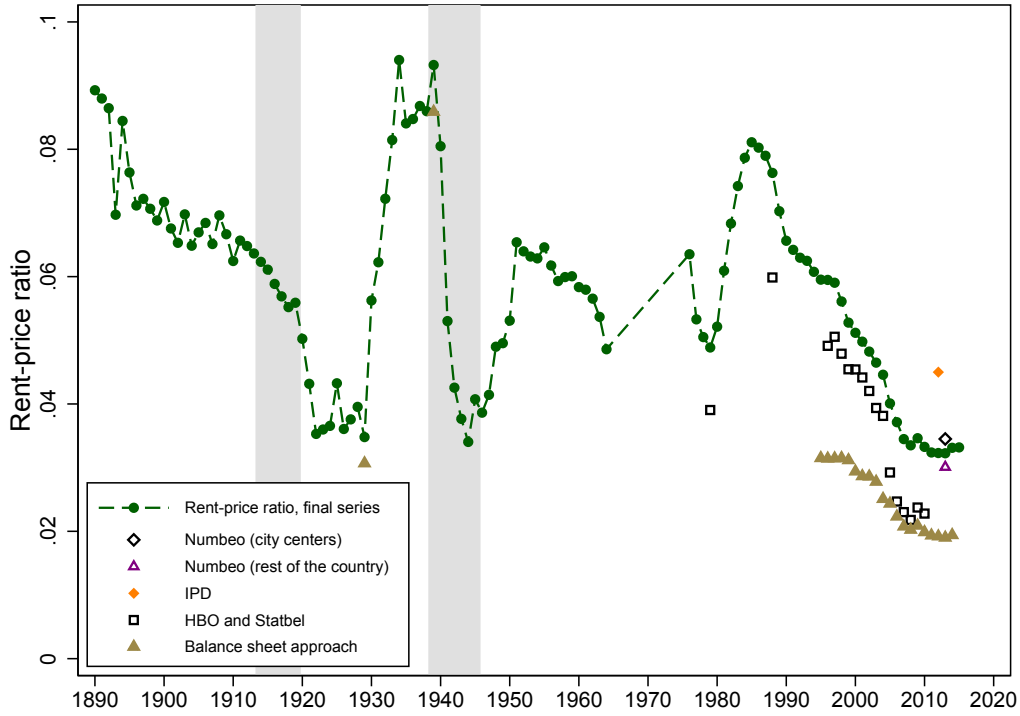
The historical balance-sheet approach estimates are broadly in line with the unadjusted rent-price approach series (orange circles) over recent decades, but below it for the earlier years. Note that the long-run rent-price ratio shows a structural break in 1949/1950 stemming from a surge in house prices 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 A.5 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 A.6: *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 A.6, 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 A.6.

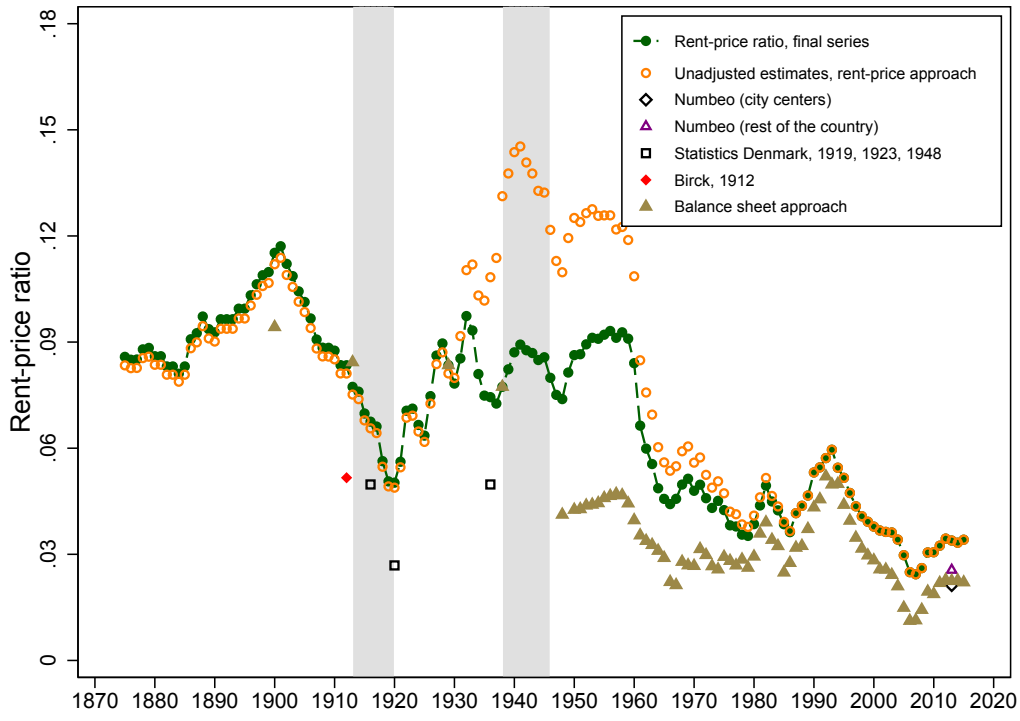
The resulting series are consistent with both the level and the time trend in our baseline series constructed using the rent-price approach.

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 (2016b) 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 A.7: *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 A.7. We make one adjustment to these series to correct for possible mismeasurement of rental growth around World War 2 (see below for details).

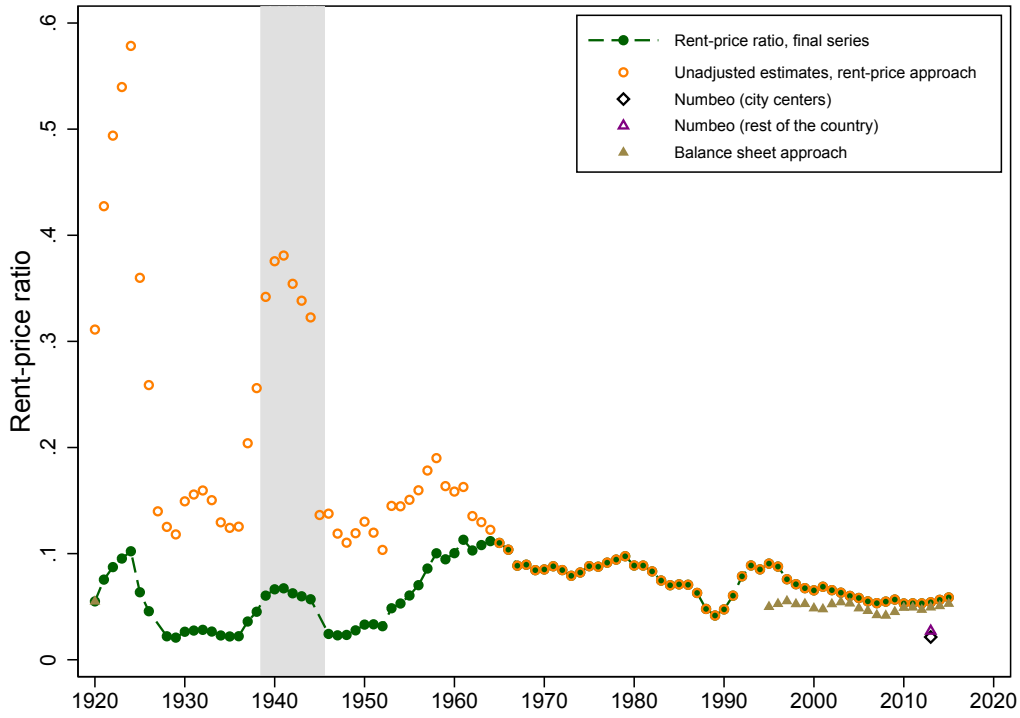
This gives us the final adjusted rent-price ratio series—the green-circled line in Figure A.7—used in this paper.

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, 2016b; 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-World War 1 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

Figure A.8: *Finland: plausibility of rent-price ratio*



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 A.8. 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 A.8—used in this paper.

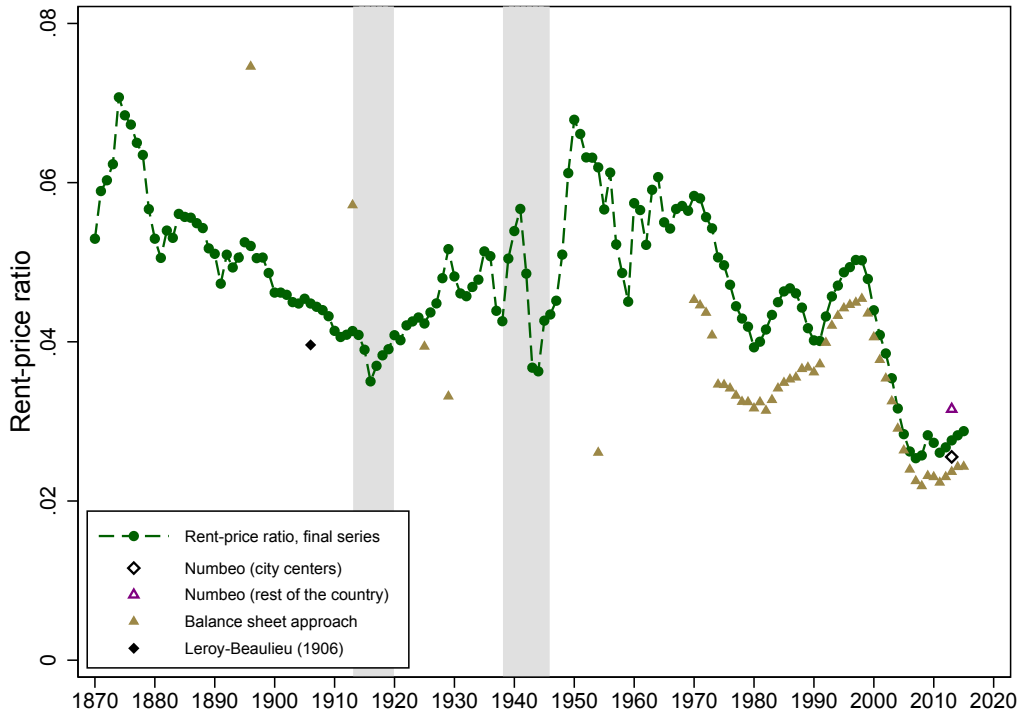
We obtain two alternative estimates of the net rent-price ratio for the modern period. First, we construct proxies of gross rental expenditure, running costs and depreciation, and total housing wealth back to 1995 using data from Statistics Finland and OECD. These are roughly the same as our benchmark 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 A.8 shows that this estimate is significantly below the long-run rent price ratio in 1920. Similarly to the case of Spain, 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 A.8 displays the resulting adjusted long-run rent-price ratio.

France

Figure A.9: *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 A.9, which are the estimates used in this paper.

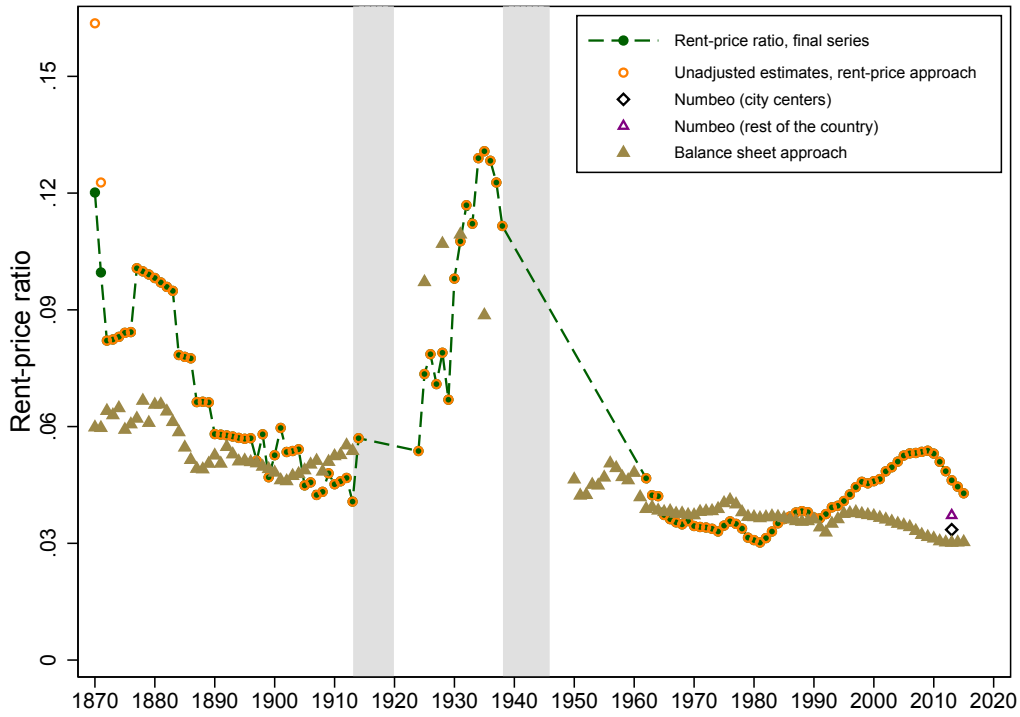
We obtain several scattered independent estimates of rent-price ratios in France since 1870. First, we calculate rent-price ratios using the balance-sheet approach, based on the data on total housing value (Piketty and Zucman, 2014) and total expenditure on rents (Statistics France, 2016b; Villa, 1994) 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 A.10: *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 A.10. 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 A.10—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.

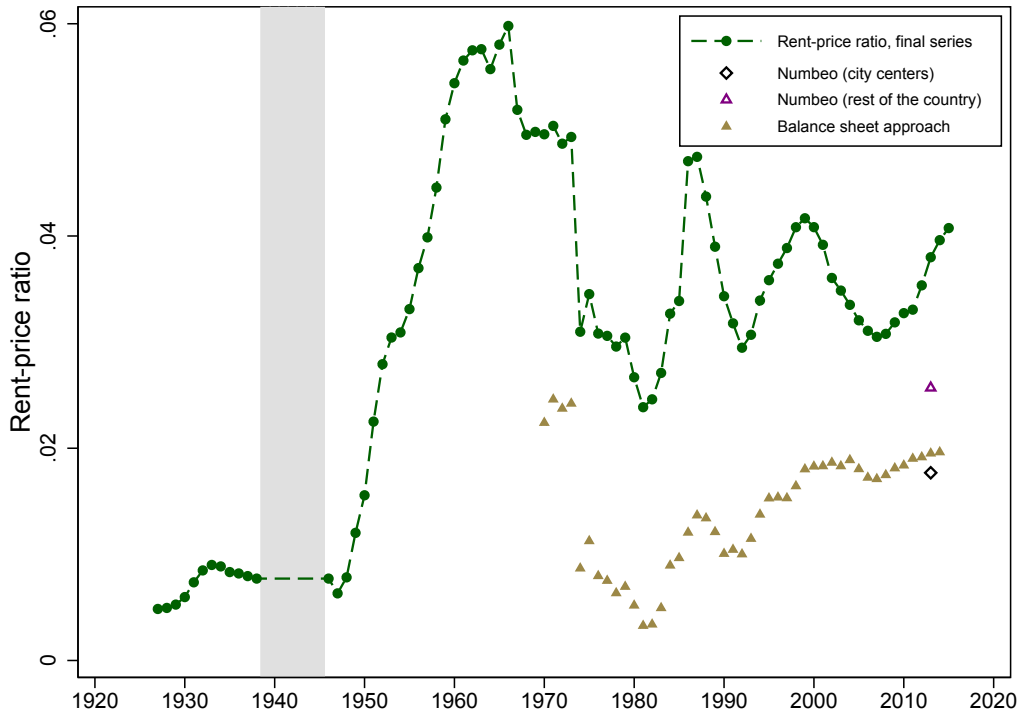
Second, we calculate the balance sheet approach estimates for benchmark years based on data on total housing value and total expenditure on rents. The housing wealth series combines the data in Piketty and Zucman (2014), and various issues of *Statistik der Einheitswerte*. For the pre-WW1 period, we 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 (2016b) 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 A.10 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 A.11: *Italy: plausibility of rent-price ratio*

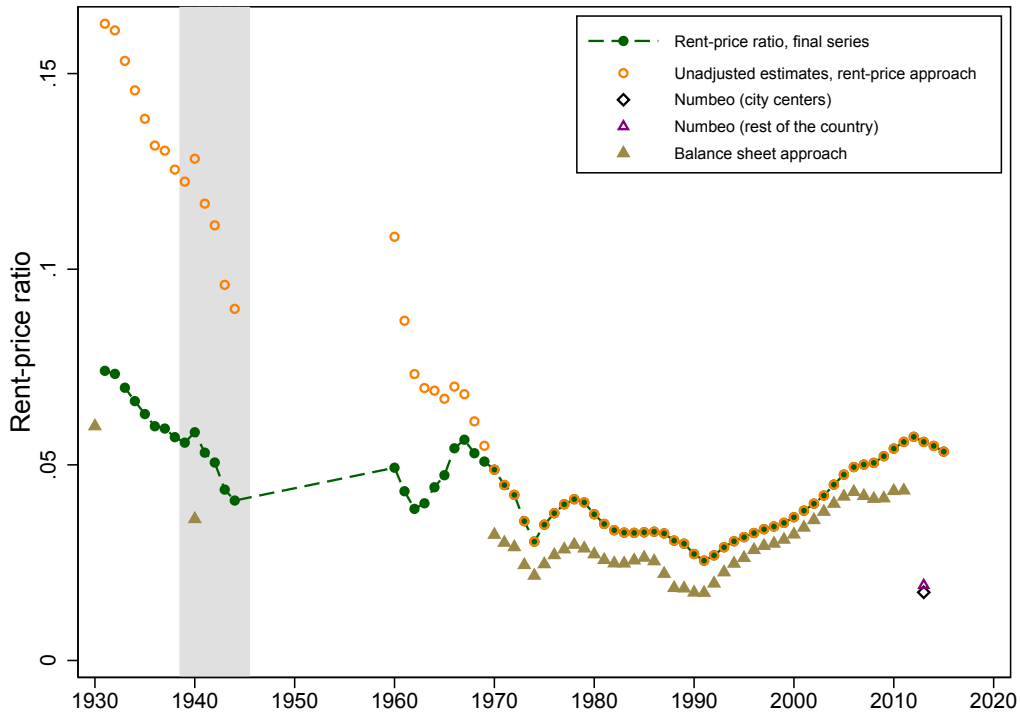


For 2013, the MSCI (2016) reports the rent-price ratio for Italian residential real estate of 0.038. Applying the rent-price approach to this benchmark gives us the long-run net rent-price ratio series depicted as green circles in in Figure A.11, which are the estimates used in this paper.

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 A.12: *Japan: plausibility of rent-price ratio*



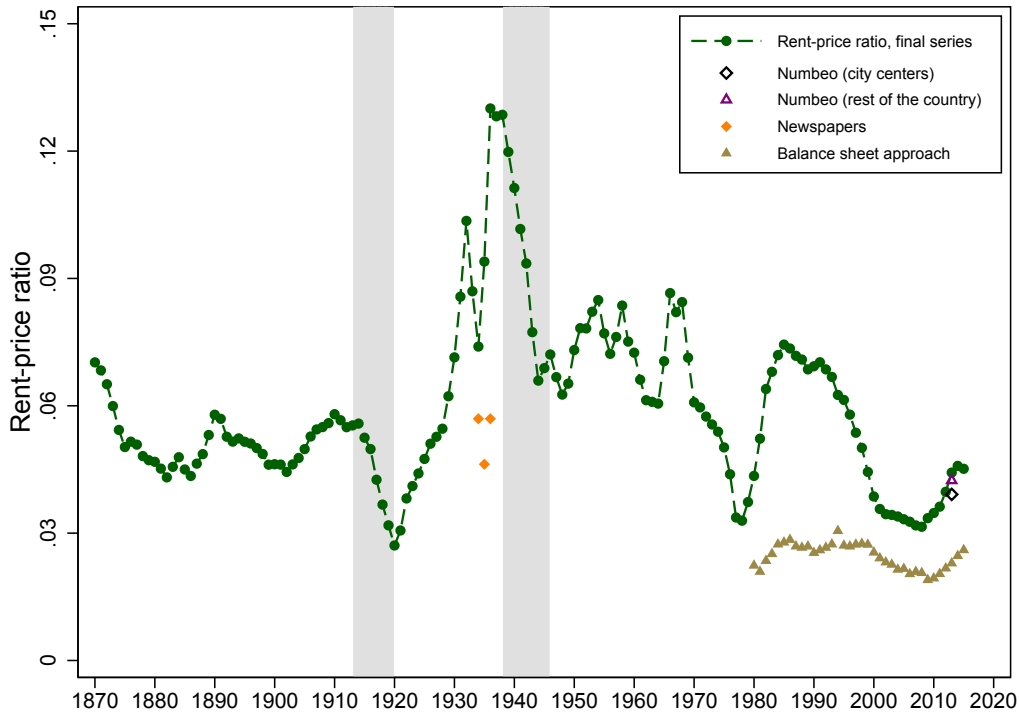
For 2013, the MSCI (2016) reports the rent-price ratio for Japanese residential real estate of 0.056. Applying the rent-price approach to this benchmark gives us the unadjusted long-run net rent-price ratio series depicted as orange circles in in Figure A.12. We make one adjustment to these series to 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 A.12—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 A.12). 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 A.13: *Netherlands: plausibility of rent-price ratio*



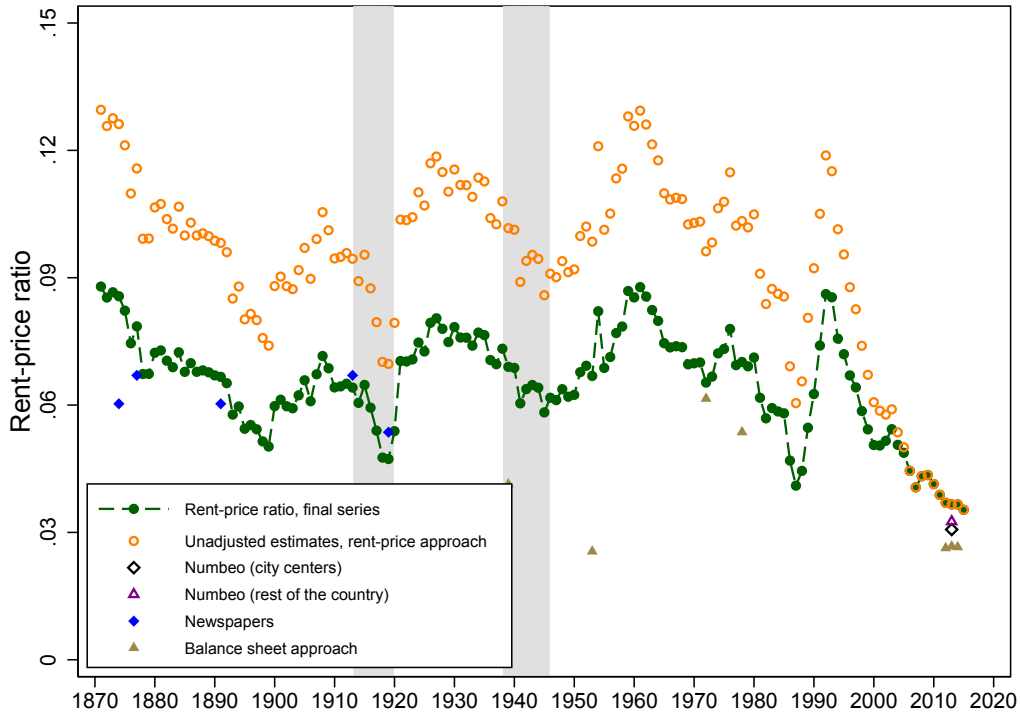
For 2013, the MSCI (2016) reports the rent-price ratio for Dutch residential real estate of 0.044. Applying the rent-price approach to this benchmark gives us the long-run net rent-price ratio series depicted as green circles in in Figure A.13, which are the estimates used in this paper.

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 (2016b), and housing wealth estimated from non-financial balance sheet data in OECD (2016c) and Groote, Albers, and De Jong (1996) (brown trianges in Figure A.13). 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 A.14: *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 A.14. 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 A.14—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, 2016c) and total expenditure on rents (OECD, 2016b; 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.

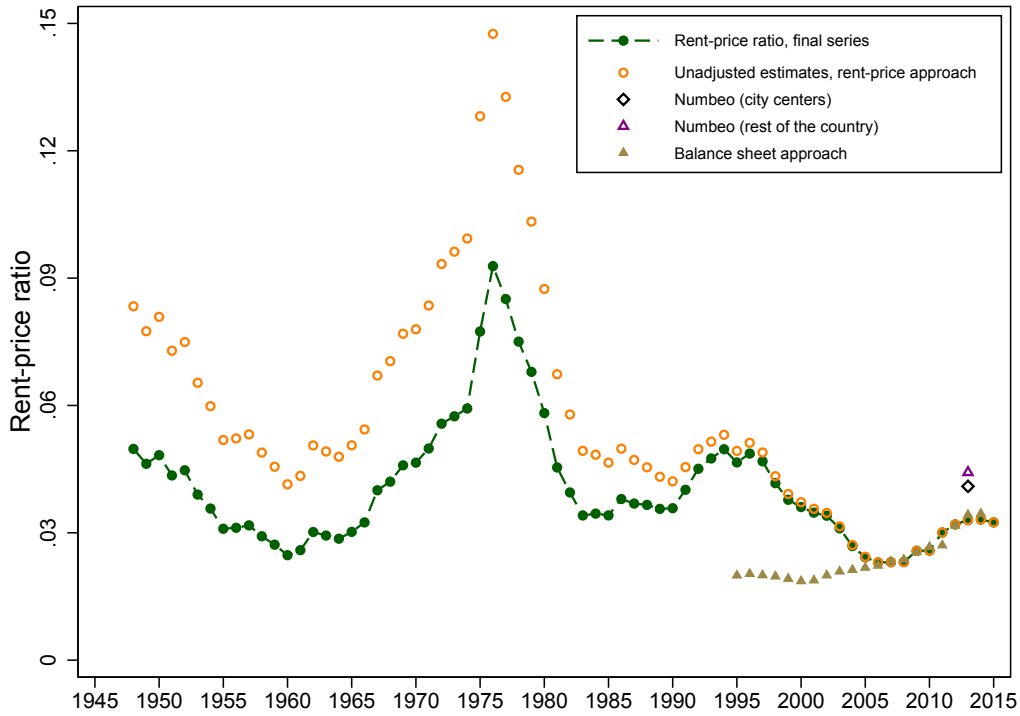
Both these sets of estimates confirm the general long-run trend in the rent-price ratio. The long-run rent-price ratio was essentially stable up until the early 2000s, with increases in early 20th century and late 1960s reversed by falls in World War 1 and the 1980s, and is currently at a historical 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 A.15: *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 A.15. 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 A.15—used in this paper.

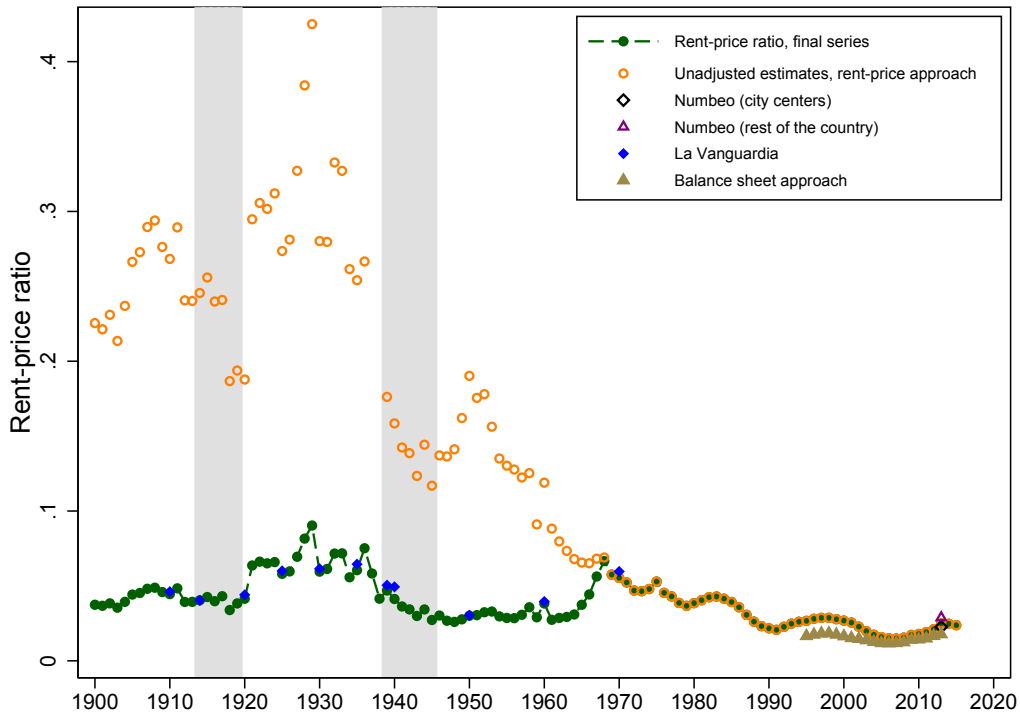
We obtain several scattered independent estimates of rent-price ratios in Portugal. First, estimates of the rent-price ratio based on data from www.Numbeo.com are slightly above, but broadly in line with our baseline IPD benchmark (MSCI, 2016). Second, we compute the rental yield using the balance-sheet approach, based on data on total rental expenditure (OECD, 2016b) 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 A.15). 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 A.15) 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

Figure A.16: *Spain: plausibility of rent-price ratio*



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

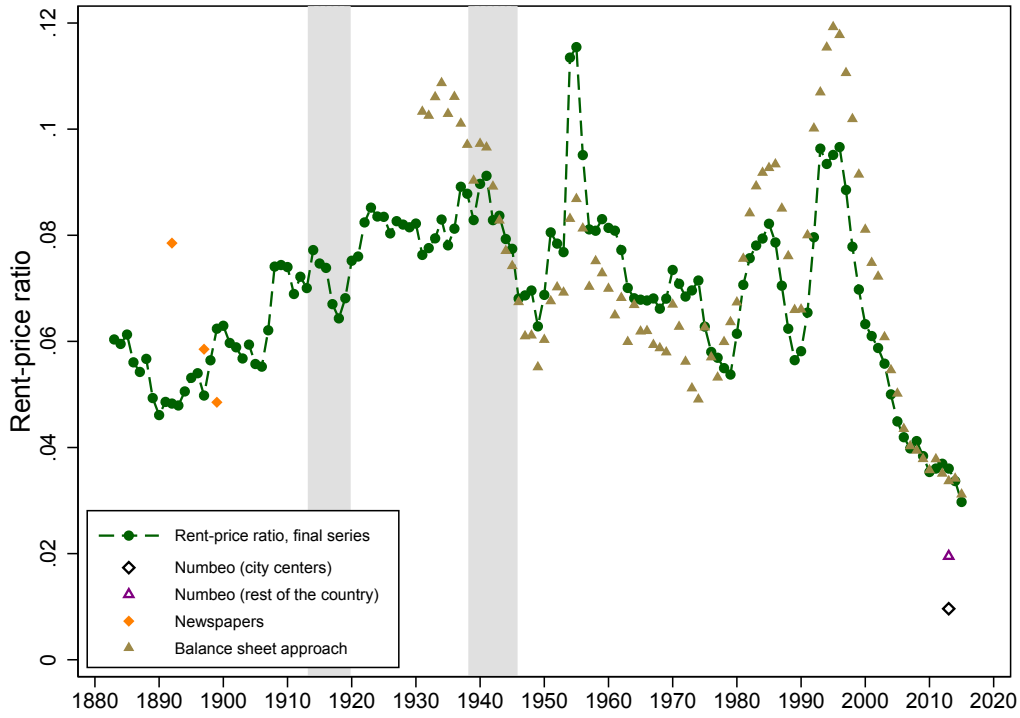
ratio series depicted as orange circles in in Figure A.16. We make one adjustment to these series to correct for possible mismeasurement of rental growth during the rent controls imposed in the early-to-mid 20th century (see below for details). This gives us the final adjusted rent-price ratio series—the green-circled line in Figure A.16—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, 2016b) 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 A.16 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 A.16 displays the resulting adjusted long-run rent-price ratio (green circles), which is the final series we use in this paper.

Sweden

Figure A.17: *Sweden: plausibility of rent-price ratio*



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 A.17, which are the estimates used in this paper.

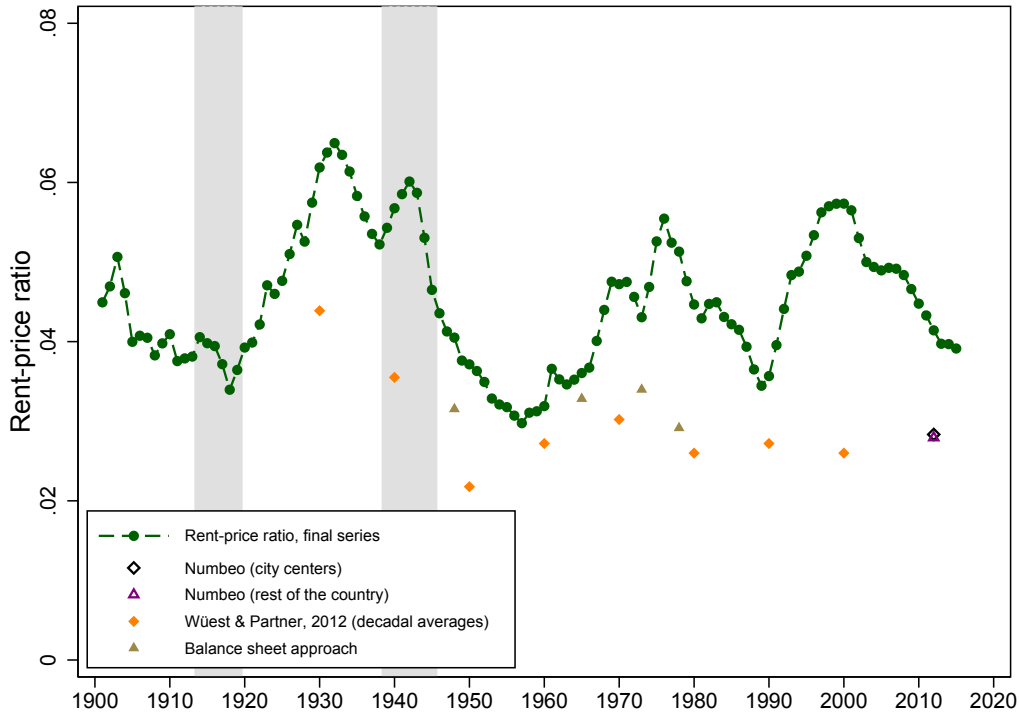
We obtain three independent estimates of rent-price ratios for Sweden. First, we compute net rental yields based on the balance-sheet approach as total rental expenditure less running costs and depreciation, as a share of housing wealth, drawing on a variety of sources. The modern-day rental expenditure data are obtained from OECD (2016b), 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, 2016b) 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 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 A.18: *Switzerland: plausibility of rent-price ratio*



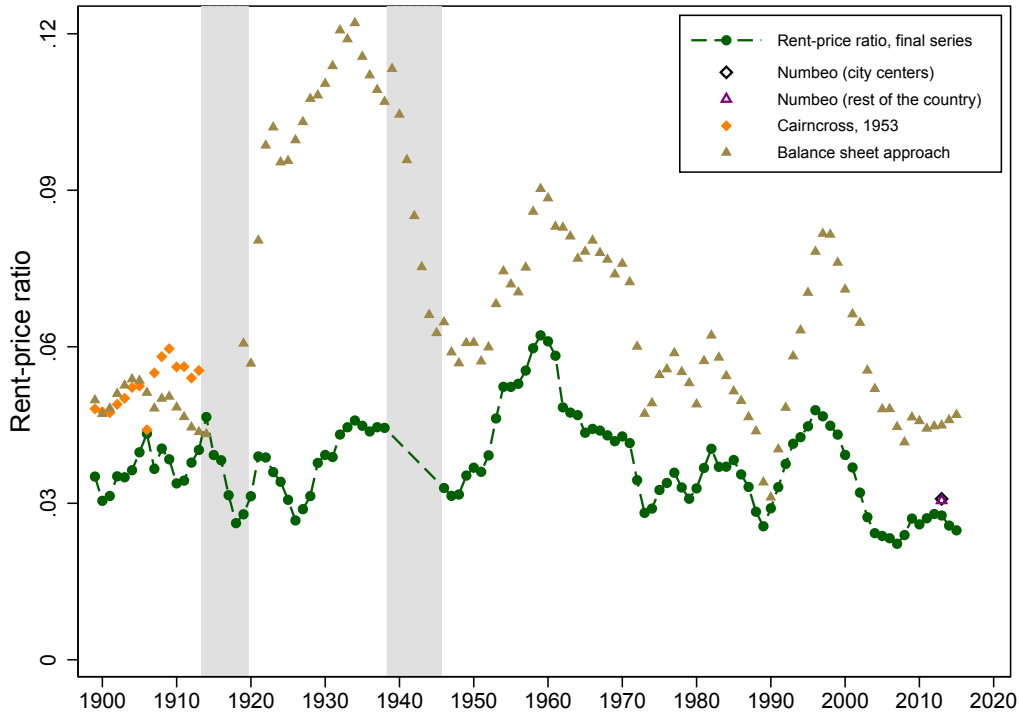
For 2013, the MSCI (2016) reports the rent-price ratio for Swiss residential real estate of 0.040. Applying the rent-price approach to this benchmark gives us the long-run net rent-price ratio series depicted as green circles in in Figure A.18, which are the estimates used in this paper.

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, West 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 A.18), taking into account the various estimation uncertainties. For the post-World War 2 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 A.18).

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 A.19: *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 A.19, 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.[26]

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

[26] 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.

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.

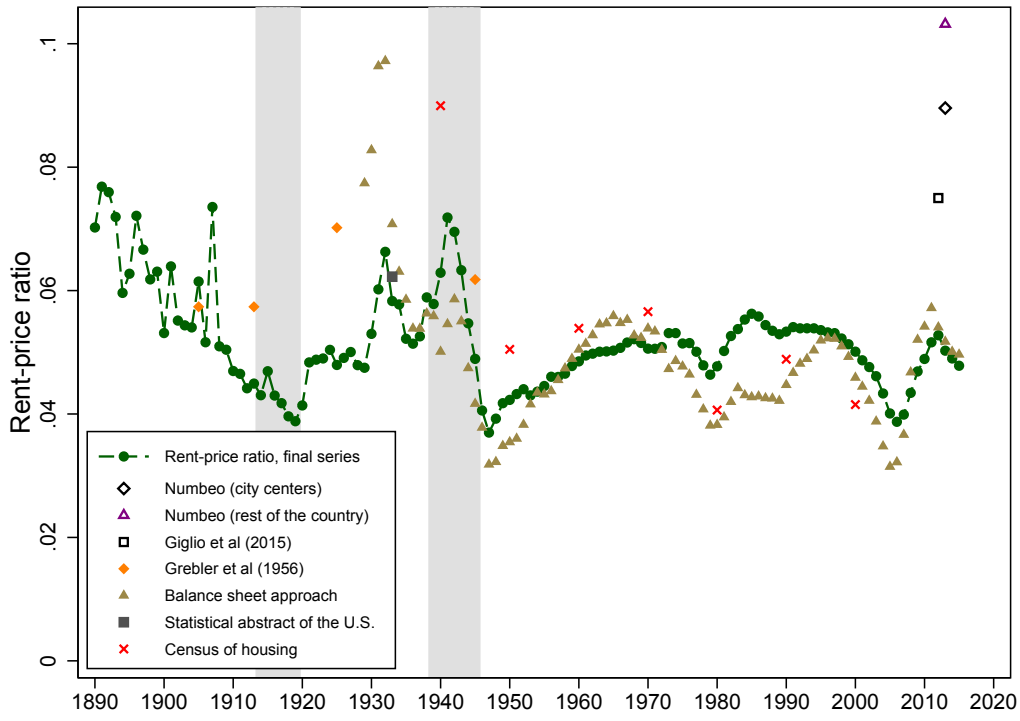
Some additional scattered data on rent-price ratios are available for the pre-WW2 period. For England, Cairncross (1975) reports an average gross rent-price ratio of 0.068 between 1895 and 1913, or around 0.05 in net terms. Offer (1981) estimates slightly higher rent-price ratios for selected years between 1892 and 1913 for occupied leasehold dwellings in London. As Figure A.19 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 A.20: *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 A.20, 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 A.20). 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.

L. Equity and bond returns

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

Australia

Table A.16: *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	MSCI total return index
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	Total return on benchmark 10-year Australian government bond, *Thomson Reuters Datastream*.

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

Belgium

Table A.17: *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.

Denmark

Table A.18: *Data sources: equity and bond returns, Denmark*

Year	Data source
Equity returns:	
1893–1922	Weighted average of returns on individual shares, computed from price and dividend data in various issues of the statistical yearbooks (Statistisk aarbog, years 1896–1927). Weighted by 1926 share capital of the company where data are available, or by median share capital of the respective sector. From 1914 onwards, we use the official stock price index in the Statistisk aarbog, combined with dividend yields on individual shares.
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 (2016), which is compiled from League of Nations, UN and IMF data.
2000–2015	Returns on the MSCI total return index, from *Thomson Reuters Datastream*.
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 A.19: *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	HMX 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	Total return on the 10-year benchmark local currency government bond, *Thomson Reuters Datastream*.

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

France

Table A.20: *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 A.21: *Data sources: equity and bond returns, Germany*

Year	Data source
Equity returns:	
1870–1913	All-share value-weighted performance index from Weigt (2005) and 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 A.22: *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	Returns on the MSCI total return index, from *Thomson Reuters Datastream*.
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	total return on Italian government bonds from a variety of *Thomson Reuters Datastream* indicies: *Merrill Lynch* Italian government, *Datastream* Italian government and 7-10 year Italian bond indices, and the *Datastream* Italy benchmark 10-year government bond index.

We are grateful to Stefano Battilossi for helpful advice about the historical series. 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 A.23: *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).
1952–2004	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).
2005–2015	Return on the MSCI total return index, from *Thomson Reuters Datastream*.
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 World War 2, 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.
1971–1983	Total return on long-term government bonds; 9-10 year maturity, from Hamao (1991).
1984–2015	Total return on the Japanese 10-year benchmark government bond total, calculated from the index by *Thomson Reuters Datastream*.

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 A.24: *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.
1996–2015	Return on the MSCI total return index, from *Thomson Reuters Datastream*.
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.
1988–2015	Total return on benchmark 10-year government bond, *Thomson Reuters Datastream*.

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

Norway

Table A.25: *Data sources: equity and bond returns, Norway*

Year	Data source
Equity returns:	
1881–1914	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.
1915–2000	Capital gain from Klovland (2004b). Dividend return from various issues of Norway's historical statistics and statistical yearbooks (*Historisk Statistikk*, *Statistisk årbok* before 1970, and constructed from MSCI indices on *Thomson Reuters Datastream* after 1970, with the two series spliced over 1970–74. We compute the MSCI dividend return as the difference between the accumulation gain on the total return and share price indices.
2001–2015	Return on the MSCI total return index, from *Thomson Reuters Datastream*.
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	Total return on benchmark 10-year government bond, *Thomson Reuters Datastream*.

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 A.26: *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	Return on the MSCI total return index, from *Thomson Reuters Datastream*.
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	Total return on benchmark 10-year government bond, *Thomson Reuters Datastream*.

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 A.27: *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).
1940–1969	Historical IGBM total return index for the Madrid stock exchange from López, Carreras, and Tafunell (2005), Chapter 10, "Empresa y Bolsa", Table 10.33. All shares, market capitalization weighted.
1970–1987	Return on the MSCI total return index, from *Thomson Reuters Datastream*.
1988 - 2015	Return on the IGBM index from *Thomson Reuters Datastream*.
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-term government bonds from various *Thomson Reuters Datastream* indices: medium-term government bonds, and benchmark 10-year government bond.

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 A.28: *Data sources: equity and bond returns, Sweden*

Year	Data source
Equity returns:	
1871–2012	Total return index from Waldenström (2014).
2013–2015	SIXGX total return index, capitalization-weighted.
Bond returns:	
1870–1874	Total return on 4% and 5% perpetuals, using individual bond data in the online appendix of Waldenström (2014).
1874–2014	Holding period return on long-term government bonds from Waldenström (2014), generally targeting 10-year maturity.
2015	Total return on benchmark 10-year government bond, *Thomson Reuters Datastream*.

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

Switzerland

Table A.29: *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.
1926–1969	Total return on Swiss equities from Pictet and Cie (1998).
1970–2015	Return on the MSCI total return index, from *Thomson Reuters Datastream*.
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).
1927–1984	Total return on Swiss bonds from Pictet and Cie (1998).
1985–2015	Total return on benchmark 10-year government bond, *Thomson Reuters Datastream*.

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 A.30: *Data sources: equity and bond returns, United Kingdom*

Year	Data source
Equity returns:	
1870–1928	Total return on all UK stocks listed on the London stock exchange, capitalization weighted, from Grossman (2002, 2015).
1929–1963	Blue-chip market capitalization weighted index based on the largest 30 stocks listed on the London stock exchange, from Barclays (2016).
1964–2015	FTSE all-share index, coving circa 98% of UK stocks' capitalization. Market capitalization weighted.
Bond returns:	
1870–1901	Total return on 3% and 2.75% consols from the *Statistical abstract for the UK*, various issues.
1902–1979	Total return on gilts (price change + lagged yield) from Barclays (2016).
1980–2015	Total return on benchmark 10-year government bond, *Thomson Reuters Datastream*.

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

United States

Table A.31: *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.

M. Taxes on real estate

Although the extent of real estate taxation varies widely across countries, real estate is taxed nearly everywhere in the developed world. International comparisons of housing taxation levels are, however, difficult since tax laws, tax rates, assessment rules vary over time and within countries. Typically, real estate is subject to four different kinds of taxes. First, in most countries, transfer taxes or stamp duties are levied when real estate is purchased. Second, in some cases capital gains from property sales are taxed. Often, the tax rates depend on the holding period. Third, income taxes typically also apply to rental income. Fourth, owners' of real estate may be subject to property taxes and/or wealth taxes where the tax is based upon the (assessed) value of the property.

This section briefly describes the current property tax regimes by country and provides estimates of the tax impact on real estate returns. With few exceptions, the tax impact on real estate returns can be considered to be less than 1 percentage point per annum.

Australia

Two kinds of property taxes exist. First, all but one Australian states/territories levy a land tax (no land tax is imposed in the Northern Territory). Typically, land tax is calculated by reference to the site value of the land (i.e. excluding buildings). Tax rates vary depending on the property value between 0.1% and 3.7%. Yet, the land tax is a narrow-based tax, i.e. many states apply substantial minimum thresholds and several land uses—such as owner-occupied housing—are exempt. Consequently, I will not consider any tax impact of land taxes on housing returns. Second, council rates are levied by local governments. Rates vary across localities rates and are set based on local budgetary requirements. Some councils base the tax on the assessed value of the land, others base it on the assessed value of the property as a whole (i.e. land and buildings) (Commonwealth of Australia, 2010). While all these specific make it difficult to determine an average or exemplary tax impact on returns, it can generally be considered to be well below 1%. Capital gains taxes apply only to investment properties, not to primary residences. Rates are higher the shorter the holding period. All Australian states levy stamp duties on property transfers. Rates vary across states and different types of property and may amount up to 6% of the property value (Commonwealth of Australia, 2010).

Belgium

Property taxes (*Onroerende voorheffing*) are levied on the cadastral value, i.e. the notional rental value, of the property. Rates range between 1.25% in Wallonia and Brussels and 2.5% in Flanders (Deloitte, 2016a). Using a tax rate 2.5% and a rent-price ratio of 0.045 (2012) the implied tax impact is $0.025 \times 0.045 \times 100 = 0.11\%$. Capital gains taxes of 16.5% are levied if the property has been owned for less than five years. Property transfer taxes amount to 12.5% of the property value in Wallonia and Brussels and 10% in Flanders (Deloitte, 2016a).

Denmark

Two kinds of property taxes exist. First, the national property tax (*Ejendomsvrdiskat*). The tax rate is 1% of the assessed property value if the property value is below DKK 3,040,000 and 3% above. The tax is not based on current assessed property values but on 2002 values. Second, a municipal land tax (*Grundskyld* or *Daekningsafgifter*) is levied on the land value. Rates vary across municipalities and range between 1.6% and 3.4% (Skatteministeriet, 2016). According to Pedersen and Isaksen (2015) the national property tax amounted to a little below 0.6% of property values in 2014 and municipal

land taxes to about 0.07% giving us a combined tax impact of about 1.35% (Pedersen and Isaksen, 2015). No capital gains tax is payable if the property was the owners' principal residence. Stamp duties are levied on property transfers and amount to 0.6% of the purchase prices plus DKK 1,660.

Finland

Property taxes (*Kiinteistövero*) are levied by municipalities. Tax rates for permanent residences range between 0.37% and 0.8% of the taxable value where the taxable value is about 70% of the property's market value (KTI, 2015). The implied tax impact is therefore $0.8 \times 0.7 = 0.56\%$. Capital gains from property sales are taxed at progressive rates, from 30% to 33%. There is a 4% property transfer tax for property. First-time homebuyers are exempt from transfer taxes (KTI, 2015).

France

Property taxes (*taxe foncière sur les propriétés bâties*) are levied by municipalities. The tax base is the cadastral income, equal to 50% of the notional rental value (Public Finances Directorate General, 2015). Tax rates in 2014 ranged between 0.84% and 3.34% (OECD, 2016a). Using the rent-price ratio of 0.045 in 2012 and assuming a tax rate of 3.34%, the implied tax impact therefore is $0.045 \times 0.5 \times 0.034 \times 100 = 0.08\%$. Capital gains from property sales are taxed at 19%. Property transfer taxes amount to about 5% of the property value (Deloitte, 2015a).

Germany

Property laxes (*Grundsteuer*) are levied by federal states. Tax rates vary between 0.26% and 0.1% of the assessed value (*Einheitswert*) of the property and are multiplied by a municipal factor (*Hebesatz*). Since assessed values are based on historic values, they are significantly below market values. In 2010, assessed values were about 5% of market values (Wissenschaftlicher Beirat beim Bundesministerium der Finanzen, 2010). Municipal factors in 2015 ranged between 260% and 855% (median value of 470%) (Deutscher Industrie- und Handelskammertag, 2016). Using a tax rate of 0.5%, the implied tax impact is $0.05 \times 0.005 \times 4.7 = 0.12\%$. Capital gains from property sales are taxed if the property has been owned for less than 10 years (*Abgeltungssteuer*). Property transfer taxes are levied on the state level and range between 3.5% and 6.5% of the property value.

Japan

Two kinds of property taxes exist. First, a fixed assets tax is levied at the municipal level with rates ranging from 1.4 to 2.1 of the assessed taxable property value. The taxable property value is 33% of the total assessed property value for residential properties and 16% if the land plot is smaller than 200 sqm. Second, the city planning tax amounts to 0.3% of the assessed taxable property value. The taxable property value is 66% of the total assessed property value for residential properties and 33% if the land plot is smaller than 200 sqm (Ministry of Land, Infrastructure, Transport, and Tourism, 2016b). The implied tax impact is therefore $0.33 \times 2.1 + 0.66 \times 0.3 = 0.89\%$. Capital gains from property sales are taxed at 20% if the property has been owned for more than five years and at 39% if the property has been owned for less than five years. Owner-occupiers are given a deduction of JPY 30 mio. There is a national stamp duty (*Registered Licence Tax*) of 1% of the assessed property value and a prefectural real estate acquisition tax of 3% of the property value (Ministry of Land, Infrastructure, Transport, and Tourism, 2016a).

Netherlands

Property taxes (*Onroerendezaakbelasting*) are levied at the municipal level. Tax rates range between 0.0453% and 0.2636% (average of 0.1259%) of the assessed property value (*Waardering Onroerende Zaak (WOZ) value*) (Centrum voor Onderzoek van de Economie van de Lagere Overheden, 2016; Deloitte, 2016c). The tax impact on returns therefore ranges between about 0.05% and 0.26%. No capital gains tax is payable if the property was the owners' principal residence. Property transfer taxes amount to 2% of the property value (Deloitte, 2016c).

Norway

Property taxes are levied at the municipal level. Tax rates range between 0.2% and 0.7% of the tax value of the property. Typically, the tax value of a dwelling is about 25% of its assessed market value if the dwelling is the primary residence. Higher values apply for secondary residences. In addition, wealth taxes are levied at a rate of 0.85% (tax-free threshold is NOK 1.2 mio) on the tax value of the property (Norwegian Tax Administration, 2016). The implied tax impact therefore is $0.25 \times 0.7 + 0.25 \times 0.85 = 0.39\%$. Capital gains from the sale of real estate property are taxed as ordinary income at 27%. A stamp duty of 2.5% applies to the transfer of real property (Deloitte, 2016b).

Sweden

Property taxes (*kommunal fastighetsavgift*) are levied at the municipal level. For residential properties, the tax rate is 0.75% of the taxable property value with taxable values amounting to about 75% of the property's market value. Fees are reduced for newly built dwellings (Swedish Tax Agency, 2012). The implied tax impact is therefore $0.75 \times 0.75 = 0.56\%$. Capital gains from sales of private dwellings are taxed at a rate of 22%. Stamp duties amount to 1.5% of the property value (Swedish Tax Agency, 2012).

Switzerland

Most Swiss municipalities and some cantons levy property taxes (*Liegenschaftssteuer*) with rates varying across cantons between 0.2% and 3% (property taxes are not levied in the cantons Zurich, Schwyz, Glarus, Zug, Solothurn, Basel-Landschaft, and Aargau). The tax is levied on the estimated market value of the property (Deloitte, 2015b). The tax impact on returns therefore ranges between 0.2% and 3%. Capital gains from property sales are taxed in all Swiss cantons (*Grundstückgewinnsteuer*). Tax rates depend on the holding period and range from 30% (if the property is sold within 1 year) and 1% (if the property has been owned for more than 25 years) of the property value. In addition, almost all cantons levy property transfer taxes (*Handänderungssteuer*). Tax rates vary between 10% and 33% (ch.ch, 2016; Eidgenössische Steuerverwaltung, 2013).

United Kingdom

Property taxes (*Council tax*) are levied by local authorities. Each property is allocated to one of eight valuation bands based on its assessed capital value (as of 1 April 1991 in England and Scotland, 1 April 2003 in Wales). Taxes on properties in Band D (properties valued between GBP 68,001 and GBP 88,000 in 1991) amounted to GBP 1484 in 2015 (Department for Communities and Local Government, 2016). Since 1991, nominal house prices have increased by a factor of about 2.5. The implied tax impact in 2015 for a property valued at GBP 68,001 in 1991 is $1484/(68,001 \times 2.5) \times 100 = 0.87\%$.

No capital gains tax is payable if the property was the owners' principal residence. Property transfer tax rates (*Stamp Duty Land Tax*) depend on the value of the property sold and range between 0% (less than GBP 125,000) and 12.5% (more than GBP 1.5 m.) (Deloitte, 2016d).

United States

Property taxes in the U.S. are levied at the state level with rates varying across states and are deductible from federal income taxes. Generally, tax rates are about 1% of real estate values. Since property taxes are deductible from : and, while there is variation across states. Giglio, Maggiori, and Stroebel (2015) assume that the deductibility reflects a marginal U.S. federal income tax rate of 33%. The tax impact is therefore $(1 - 0.33) \times 0.01 = 0.67\%$. Property transfer taxes are levied at the state level and range between 0.01% and 3% of the property value (Federation of Tax Administrators, 2006).

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