The Housing Affordability Revolution

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Abstract

This paper provides the first long-term overview of developments in urban housing affordability, quality and inequality, focusing on seven European cities from 1500 to the present. Based on the rental indices developed by EKL (2022), we create new indices of housing quality and inequality, and relate these to changes in wages and population. Before 1900, markets were unregulated and rent prices and wages mostly rose in tandem when cities grew while housing quality and inequality increased. We document a housing affordability revolution between the 1910s and the 1970s when housing affordability and quality improved dramatically while housing consumption inequality declined. We show that part of the short-term affordability improvement in this period was attributable to rent controls. Most of the surge in housing expenditure that did occur over time is due to increasing housing quality rather than rising rent.

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> *There is no city in Europe, I believe, in which house-rent is dearer than in London, and yet I know no capital in which a furnished apartment can be hired as cheap. Lodging is not only much cheaper in London than in Paris; it is much cheaper than in Edinburgh of the same degree of goodness.* Adam Smith (1776), The Wealth of Nations, Book 1, Chapter 10.

Urban housing is dear for many households and is perceived to have become too expensive in cities all over the world, as a barrage of existing and recently introduced affordability policies attests. At the same time, consistently measuring affordability problems remains a challenge. Housing affordability problems are not merely a matter of rising housing costs meeting insufficient income: they stem from the spatial interplay between house prices, housing rents, income levels, income distributions, and housing quality (Quigley and Raphael, 2005). Exemplified by the quote on top of this paper, different definitions of housing affordability can give rise to very different perceptions of affordability (e.g Glaeser and Gyourko, 2003; Stone, 2006; Ghent and Leather, 2021).

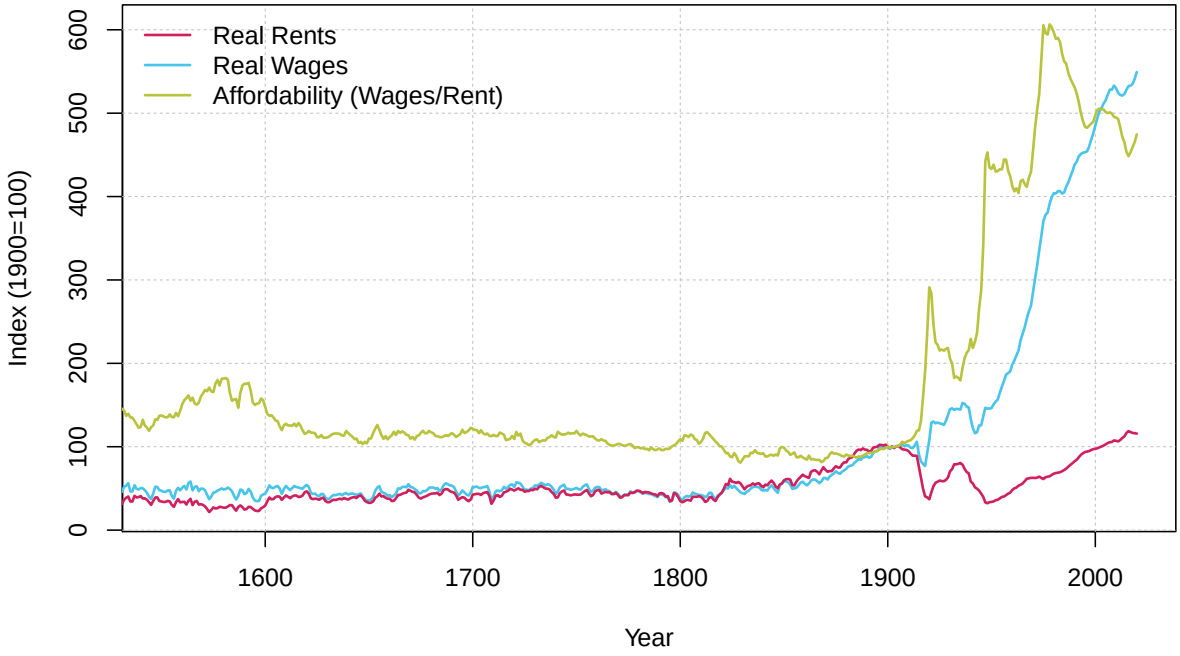
There remains very limited knowledge about the evolution of urban housing affordability over time. This is not merely reflecting the lack of a consistent definition: empirical challenges also play a significant role. First, it is difficult to separate to what extent changes in household rental expenditures are driven by changes in rental prices and to what extent by changes in housing quality or household sizes. Second, developments in rental prices and housing quality might differ substantially across geographies and income groups, implying that affordability developments might differ across the population (Aladangady et al., 2020; Ghent and Leather, 2021; Dustmann et al., 2022). Third, the wide array of housing policies observed across countries implies that households' net housing burdens often diverge from market prices in nontrivial ways.

The goal of this paper is to present the first truly long-term overview of urban rental housing quality, inequality, and affordability, going back more than 500 years. We cover seven European cities: Amsterdam, Antwerp, Bruges, Brussels, Ghent, London, and Paris from 1500 to the present. We extend the data and rent price indices developed in Eichholtz et al. (2022) with information on trends in housing standards and relative prices across properties since 1500. All in all, the purpose of the paper is to provide new stylized facts on the long-term evolution of key housing parameters and to interpret these stylized facts in light of existing theories and findings. We focus on rents rather than house prices, since renting has been, and still is, the dominant tenancy form in most

large cities. The seven cities in our sample offer rich data on housing markets in diverse economic conditions: each city has been an important commerce hub at different periods in time – or still is.

To motivate the main analysis in this paper, Figure 1 plots an equal weighted average of the affordability index, which we define as the quantity of housing consumption one can afford per unit of labor. Empirically, this equals the ratio of real wages (daily/hourly) to rent prices across the cities in our sample. This shows the key stylized fact of the paper: the absence of any improvement in the development of real wages relative to real rents until the early 20th century, the *housing affordability revolution* between the 1910s and the 1970s, and the mild reduction in affordability afterward.

Figure 1: The Housing Affordability Revolution



Notes: This plot shows the developments in the real rent index, the real wage index and the affordability index as a weighted average over the cities in our sample since 1500.

We divide the analysis of the paper into two different parts. In the first part of the paper, we focus on establishing stylized facts on the long-term evolution of housing affordability, quality and inequality both in the period before the housing affordability revolution, which covers the period from 1500 until the early 20th century, and afterward. In the period before the affordability revolution, government regulation in the housing market was limited to intervention in the planning process, with limited requirements on property quality and no regulation of rental prices. Afterward, government interference

was much more substantial.

We show three stylized facts regarding the long-term development of housing standards. First, we extend Figure 1 and show that the long-term dynamics in housing affordability did not differ much across cities. In each city, affordability was stagnant or decreasing until the early-20th century and improved much afterward. The reduction in affordability in the late 20th-century and early 21st century is also common across cities.

Second, we show that average urban housing quality improved substantially before 1900 and that most of that improvement happened already prior to the Industrial Revolution. In the literature, there has been substantial debate about growth in the standard of living before the Industrial Revolution. One view is that growth was negligible and that the world was effectively captured in a Malthusian trap (e.g. Clark, 2008), while the revisionist view argues there was significant economic growth already (e.g. De Vries, 2008), building upon evidence for growth in estimates of GDP per capita (Van Zanden and Van Leeuwen, 2012; Broadberry et al., 2015). Our evidence on housing quality lends support to the revisionist view, providing evidence based on measures of direct housing consumption rather than macroeconomic aggregates, and also providing specific evidence for cities rather than the existing measures for Holland or England. To document the evolution in housing standards of the average property, we compare the development in average prices relative to the development of quality-controlled rental prices. If homes gradually become larger or of better quality, we expect average prices to rise faster than quality-controlled prices. Given that the ratio of urban day wages relative to rents did not increase, this implies that wage dispersion, working hours or expenditure shares on housing must have increased. We also show these improvements were not offset by larger numbers of tenants occupying these improved homes: we observe the same patterns when studying housing quality per capita.

After 1900, data limitations and government interference in prices do not allow us to measure housing quality in the same way. Instead, we focus on showing the developments in some *observable* characteristics of housing quality. We show that housing space per capita increased drastically in the 20th century and, unsurprisingly, that housing also became more luxurious. In the early centuries covered in our study, the defining attribute of a typical dwelling was space, and little of that. Gradually, housing space per capita increased, and amenities like heating, running water, plumbing, access to sewers

or electricity became standard features of urban dwellings.

In line with these increases in housing consumption, we observe increasing shares of income being spent on housing over time. Combining this fact with our first stylized fact also implies that rising housing expenditures have been primarily the result of increased housing consumption and smaller household sizes, rather than worsening affordability.

Third, we focus on the trends in housing consumption inequality by measuring the Gini coefficient of the distribution of rental values for all properties in a city. We collect snapshots of rental values for all properties in a city for several Belgian cities and Amsterdam. We show levels of housing consumption inequality were persistently at very high levels pre-1900, with Gini coefficients on housing consumption on average around 0.5. In line with our evidence on the housing affordability revolution, housing consumption inequality started to drop dramatically in the first part of the 20th century, while increasing again recently. The latter pattern is also visible in the United States (Aladangady et al., 2020).

After establishing these long-term stylized facts, we focus on studying the dynamics in each of these quantities over medium-run horizons and the implications of these. We separate the pre-20th century period, when market forces were primarily driving our main outcomes of interest, and the more regulated 20th and 21st centuries.

Before the 20th century, we focus on understanding how periods of population growth in these cities affected the relative developments in rents, quality and affordability. Following a long literature in economics and economic history (Bairoch, 1988; De Vries, 2013; Jedwab and Vollrath, 2015), we view population growth here as a broader proxy for urban economic growth. Based on descriptive regression analysis using 25-year changes, we find that urban population growth coincided with a weakly significant and modest long-term worsening of housing affordability, with an elasticity of -0.20. Again, we define housing affordability as the evolution of quality-controlled prices relative to median wages. At the same time, we find that a 1% increase in population growth resulted in a 0.3% increase in housing quality. These effects are averages and hide any dispersion in such effects. In response to urban growth, we find that housing inequality increased, with housing quality improvements concentrated in the upper end of the housing distribution.

Finally, we find that the rent prices of below-median properties rose more in response to growth compared to properties of with (ex ante) above-median prices. A likely expla-

nation, in line with (Guerrieri et al., 2013) for modern housing booms, is that growth causes individuals with increased incomes to push up prices for below-median properties just outside of the more central areas. New migrants or incumbent tenants with lower incomes are then pushed towards the cheapest areas in cities or new construction at the fringe, where land is comparatively cheap.

Overall, it might seem surprising that housing quality improved while affordability worsened when cities grew. First, households might have been able to increase housing consumption by working more, in line with evidence from the United Kingdom (Humphries and Weisdorf, 2019), and as we also find for workers in Antwerp. Second, innovations in the finance, trade and the artisan sector might have resulted in improvements in urban productivity in this period that primarily benefited the earnings of skilled workers, such as merchants or bankers (e.g De Vries and Van der Woude, 1997; Acemoglu et al., 2005) whose wages likely had little relation to day wages of masons and carpenters. Relatedly, Soltow and Van Zanden (1998) and Ryckbosch (2016) show that inequality increased in city size in the Low Countries, and such a pattern also exists in modern US cities (Baum-Snow and Pavan, 2013; Eeckhout et al., 2014). In modern urban economics, there is also a long line of theory that stresses the link between urban growth, productivity growth, and growing dispersion in wages and skill accumulation (e.g. Black and Henderson, 1999; Behrens and Robert-Nicoud, 2014; Behrens et al., 2014; Roca and Puga, 2017; Aghion et al., 2019).

In short, improvements in housing standards related to urban growth were not widely shared among the population before 1900: while housing quality improved in response to growth, housing inequality increased while affordability for the median worker declined. The more interesting question is why we observe such a strong break in the developments in housing affordability and inequality at the turn of the 20th century. This break appears hard to rationalize with changes in income and urban population growth because these did not alter in this period, as both urban populations and urban wages had been growing steadily since the 19th century and suburbanization did not start until the mid-20th century.

In the final part of the paper, we highlight the role of government intervention in turning around some of these relationships in the 20th century, focusing particularly on the introduction of rent control and broad-based government support to improve housing

supply and quality standards. First, we suggest that rent control is one—but not the only–important factor contributing to the rapid improvements in affordability and housing consumption equality. Following both world wars, all countries in our sample imposed strict regulations of nominal rents. Exploiting variation in inflation rates across countries, we provide evidence that nominal price controls were a key driver of improvements in housing affordability over the short run.

A growing strand of literature documents the potential harm that rent controls can cause in the longer run, such as lower maintenance incentives (Downs, 1988), negative neighborhood effects (Sims, 2007; Autor et al., 2014), the misallocation of housing (Glaeser and Luttmer, 2003) and housing supply effects (Diamond et al., 2019). Our data does not allow for any strong inference to confirm any adverse long-term effects of rent controls. Quite the opposite, at least in correlations: While we observe that housing affordability gains from rent controls partially vanished when rent controls were eased, affordability metrics never dropped back to pre-rent control levels.

How can the long-term gains in affordability be explained, then? It is key to not look at individual policies, such as rent control, in isolation but to realize that governments experimented with various interventions simultaneously—and boldly. The world wars ended the laissez-faire regime in European urban markets. Growing urban populations expected more than rudimentary shelter from their cities. Changes in suffrage, incomes, education, or collective bargaining strengths shifted the power balance within cities and housing markets. In all cities we study, governments took a radically more active role in the housing market. The observed improvements are the results of all interventions jointly. Separating the long-term effects of individual policies on housing affordability in this period remains one empirical bridge too far.

While we cannot establish causal effects, it remains striking by how much housing conditions have improved from the 1910s to the 1970s. The housing affordability revolution made homes cheaper, better, and more equally distributed. We find it hard to view these improvements as completely independent from the public efforts aimed at accomplishing exactly that.

This paper proceeds as follows: The next section will briefly present the original data we have recovered for this paper. We will then discuss our measurement methods for housing affordability, inequality, and quality. The section after that will show our results,

and we will end the paper with a short summary and some conclusions.

1 Data

We track rent prices, housing quality and affordability for seven cities in four countries: Amsterdam, London, Paris, and the Belgian cities Antwerp, Bruges, Brussels, and Ghent, and we do that for the period from 1500 until 2020. To do so, we make use of the large database of primary rental price observations from Eichholtz et al. (2022) and the indices of rent prices, wages and consumer prices constructed in the same paper. Full details regarding the construction of this data are given in Eichholtz et al. (2022), we briefly highlight here the most important points.

The rental data consists of about 436,000 rental price observations, combining scattered snapshots of the complete distribution of house rental values in some of the cities with a long panel of rent data for the same properties over time. Until the mid-20th century, rent price indices are based on repeated rental contracts of properties owned by institutional investors. Afterwards, they are primarily based on secondary rent price constructed by statistical offices. Snapshots of rental prices are based on assessed tax rental values of properties available from the late-16th century until the early 20th century and only cover Amsterdam and the Belgian cities.

To estimate average housing rents and their distribution, we complement the rental data with rental value distributions from other sources and time periods. We discuss these sources in Appendix A.

2 Methodology

2.1 Housing Affordability

The literature offers no single definition of 'housing affordability' but explores a wide range of approaches. On one side of the spectrum, for example in Glaeser and Gyourko (2003), housing is considered unaffordable if housing costs exceed construction costs. On the other end, housing affordability is viewed as an income issue. For example, in the residual income approach, which is favored in the overview of Stone (2006), affordability issues arise if insufficient income is left after paying housing costs. The main problem

with such an approach is that it relies on housing and income standards, which vary over time.

In this paper, our main measure of affordability in city i at time t expresses affordability as the ratio of wages to rent prices.

$$Affordability_{it} = \frac{W_{it}}{R_{it}} \tag{1}$$

The affordability attempts to measure how many units of housing can be bought per unit of labor: the rent price index measures the cost of one unit of housing of constant quality, and the wage index measures the return to one unit of labor. In practice, this measure is primarily based on day wages until the 19$^{\text{th}}$ century, and hourly wages afterward. Such an approach is in line with earlier work of Gyourko and Linneman (1993) and Gyourko and Tracy (1999), who study developments in US housing affordability but look at owner-occupied housing rather than rental housing, and do not appropriately control for quality. The wage index we use is based generally of wages of construction sector workers or similar workers, implying we primarily capture affordability for typical workers. As indicated in Eichholtz et al. (2022), developments in incomes of higher-class urban workers, such as merchants, might have diverged from these estimates.

Because we have not collected construction cost data, we cannot identify exactly how rent prices evolved relative to the costs of new construction, as in Glaeser and Gyourko (2003).[1] They find that house prices primarily deviate from construction costs due to zoning constraints. Given that we study markets without such constraints over the very long-term, such deviations are most likely absent in our setting, at least before the 20$^{\text{th}}$ century. Instead, our interest is to determine how much long-term 'equilibrium' rent prices and affordability change as cities grow and decline.

2.2 Housing Quality

The basic repeated measures methodology from Bailey et al. (1963) starts with the observation that the log price on any asset, in this case the log rental price r_t on a particular

[1] We should note though that until the 19$^{\text{th}}$ most wage data is based on day wages for construction workers, so in this period our measure of affordability does at least partially account for changes in construction costs

home i, can be represented as the sum of three components:

$$r_{it} = \alpha_i + \beta_t + \epsilon_{it} \tag{2}$$

The first term, α_i reflects the underlying value, and therefore quality, of the home: the key assumption is that this does not change over time, at least at the level of an individual home. The second term, β_t is the value of the log rental price index, while ε_{it} reflects price noise and is assumed to be distributed as N(0,σ^2).

Since the repeat-rent index provides an estimate of the market price component, we can simply rewrite equation (2) to obtain an estimate of implied housing quality α_i. Rewriting (2):

$$r_{it} - \beta_t = \alpha_i + \epsilon_{it} \tag{3}$$

Taking averages over all properties i at each time period t:

$$\bar{\alpha}_t = \bar{R}_t - \beta_t \tag{4}$$

Exponentiating (4), we can use the indexed ratio of the mean rent index to the quality-controlled rent index as a measure of average quality. The quality index reflects the monetary value of quality improvements over time, which have two dimensions: improvements in the quantity of space consumed and changes in the quality of a given space due to construction improvements, such as plumbing, better insulation, higher ceilings or the installation of bathrooms or kitchens. Quality improvements external to the property are not taken into account: these are included in market prices.

As changes in the composition of the sample sometimes lead to significant noise in the developments of average rents in the short term, we only compute housing quality indices for periods of 25 years between 1500 and 1900. For London, not enough data is available to compute a quality index for any period. Instead, we report data from Clark (2002) who has estimated an implied quality index for England and Wales, based on a method very close to ours. Last, we compute a joint rent and quality index for the Belgian cities, based on a population-weighted average. We do not extend our quality indices to the 20$^{\text{th}}$ century, as from the 1910s no new homes are added to our samples. Also, the

introduction of social housing and rent control policies in the 20th century implies that the rent paid cannot be used anymore to infer housing quality. For this period, we will use census data to examine whether housing quality improved.

2.3 Housing Inequality

One issue with our aggregate measures of rental housing affordability and quality is that they do not take into account variation in rental price appreciation and dwelling quality across market segments. Affordability issues are particularly pressing for those with lower incomes, and prices of their properties might appreciate faster than those in other segments. For example, Glaeser et al. (2012) and Guerrieri et al. (2013) document that properties in cheaper neighborhoods appreciated faster during house prices booms than those in more expensive neighborhoods. This could reflect gentrification processes, as in Guerrieri et al. (2013), but also changes in credit availability (Landvoigt et al., 2015). Of course, only the former would apply to long-term rental prices.

To investigate this, we estimate rent price indices for above- and below median properties using the data that was collected by Eichholtz et al. (2022). For each rental observation, we determine whether it is above or below the median price in the sample in that particular year. Next, we determine whether a pair of repeat-rents is consistently above or below the median. We estimate an above- and below- median rent price index using pairs consistently above or below the median price, based on a standard repeat-sales index, following the methodology outlined in Eichholtz et al. (2022)

To further study the evolution of housing inequality over time, we compute the Gini coefficient for the distribution of housing quality values at various points in time. These inequalities reflect differences in both structure and location quality.

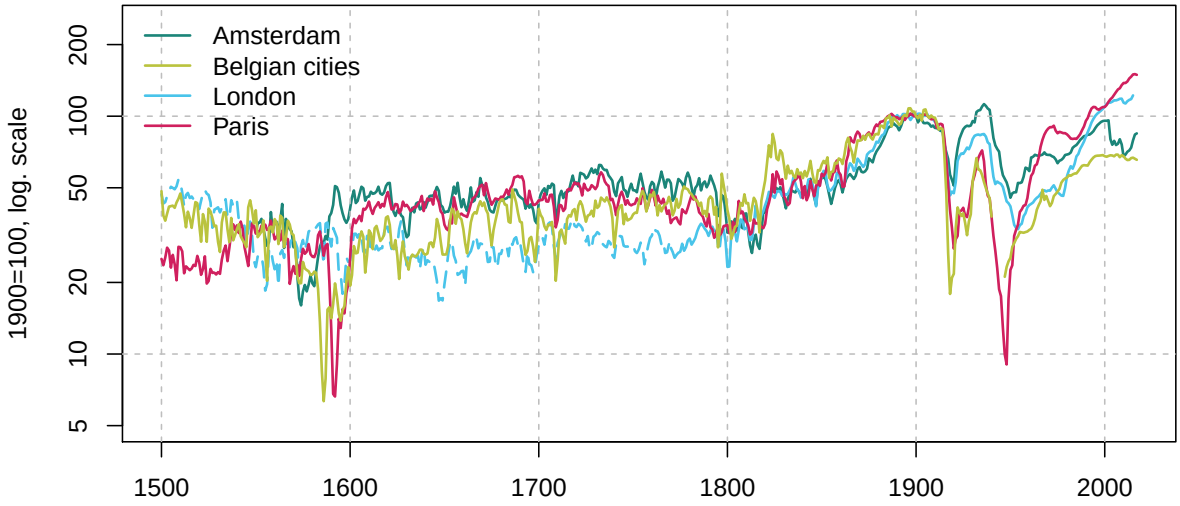
3 Urban Housing in the Long Run

3.1 Rental Housing Affordability

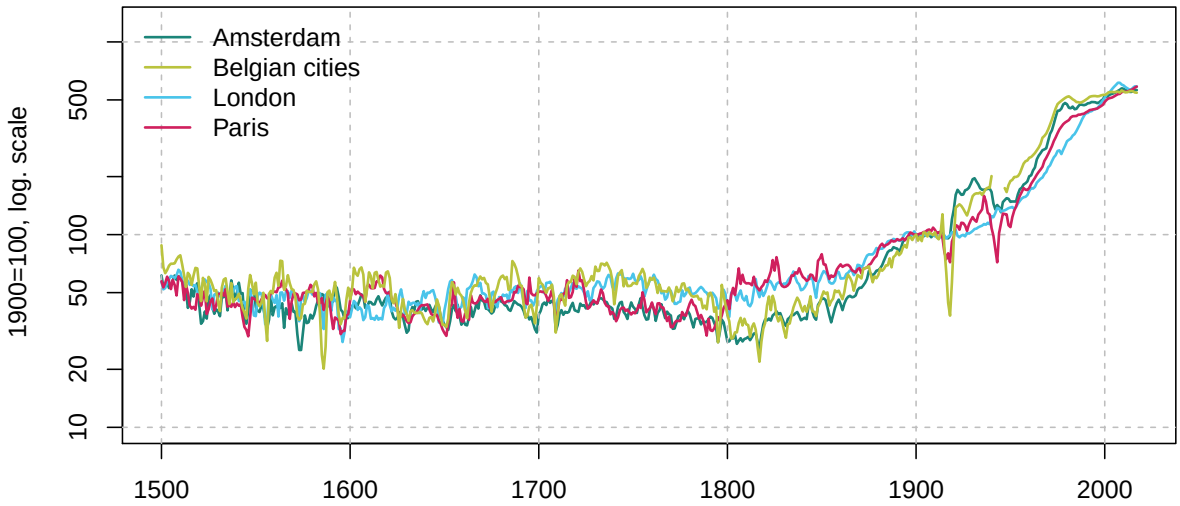
Figure 2 reports the rent indices for Amsterdam, Paris, London, and the Belgian cities, both in real terms, together with estimates of the real wage development. Given that most developments in aggregate rent prices have already been discussed in Eichholtz et al.

(2022), we focus our discussion on their development relative to wage levels.

Figure 2: Real Rent Prices and Real Wages



(a) Real Rent Indices, 1500–2018



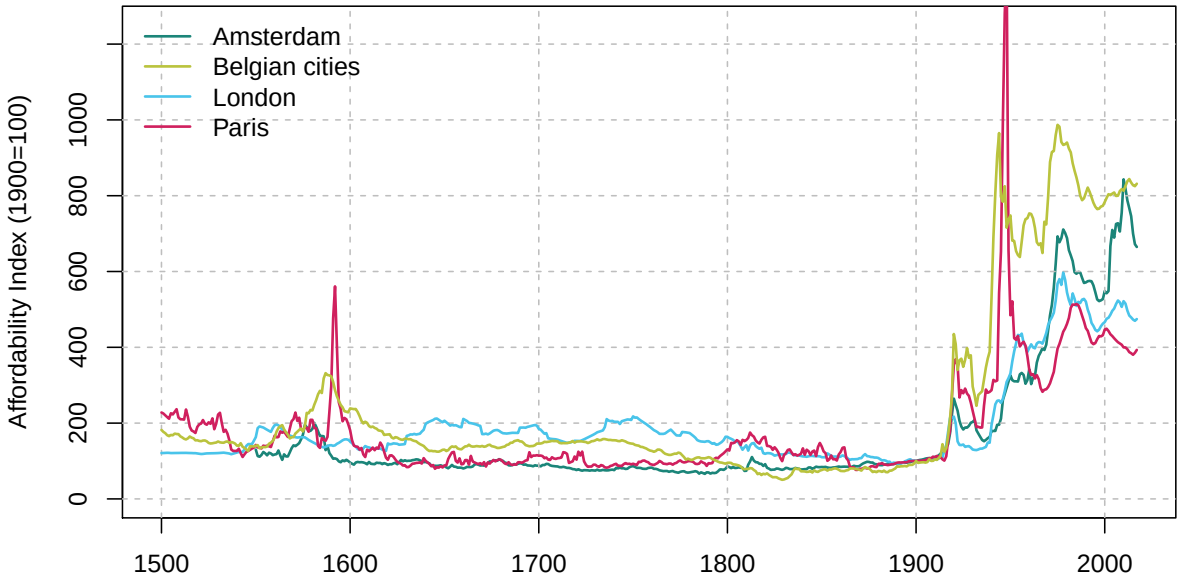
(b) Real Wage Indices, 1500–2018

Notes: The plots compare the developments in real rental prices (Figure 2a), using the indices from Eichholtz et al. (2022), to developments in real wages (Figure 2b). Rents and wages are deflated using the CPI. Data is aggregated for the Belgian cities by using a population-weighted average of the individual indices. From 1940, the Belgian index covers all urban areas.

The first and most striking conclusion from the figure is that rental prices have shown little real growth in the long run. Unsurprisingly, wage growth has been particularly significant in the 20th century. Both our real rent and real wage indices adjust for consumer prices. However, this is not necessary when we are only interested in their relative prices: our indices of housing affordability. Figure 3 plots the indices of housing affordability that we have constructed for each of the studied cities. The pattern emerging

from the figure is rather surprising: housing has never been as affordable as it has been over the past few decades and has improved tremendously in the period between World War I and 1980, albeit with stark fluctuations. Housing affordability did not improve at all before the 20th century: between 1500 and 1900, it even worsened significantly in Paris and the Belgian cities, while staying roughly constant in London and Amsterdam.

Figure 3: Housing Affordability Indices, 1500-2018



Notes: This plot shows the developments in the housing affordability index, which is defined as the indexed ratio between the wage index and the rental price index. High levels of the affordability index imply affordable housing.

Beyond these long-term developments, there are substantial differences in affordability both across cities and over shorter periods. Before 1800, most of these are due to differences in rents. Correspondingly, the Belgian cities and London were relatively more affordable compared to Amsterdam and Paris during the 17th and 18th century, in line with the remarks of Adam Smith at the start of this paper. At the end of the 18th century, this gradually changed, as rent growth outpaced growth in wages. In the 19th century, part of the increase in rents was compensated by increasing wages, which also had started rising gradually. However, it took until the early 20th century before wage growth outpaced rental price growth. This was not an even process. Due to strict rent controls, housing rents could not rise with inflation in the period around the World Wars. Rent controls were particularly stringent in Paris, which explains the large peak in affordability after World War II, when real rents had dropped dramatically.

The result of these unprecedented improvements in affordability in the 20th century

is that one unit of labor today buys approximately four to eight times as many units of rental housing as it could in 1900. To illustrate these affordability improvements more clearly, we collected data on the share of rental expenses in the household budget for all of our cities, both in the early 20th century and for very recent years. Subsequently, we use our affordability indices to estimate the budget share needed nowadays to buy the same bundle of housing services as the early-20th century household consumed while keeping the number of hours worked constant.

Table 1: Housing Budget Shares in the 20th and 21st Century

City	*Year*	*Budget Share*	*Implied Share in 2015*	*Coverage*
Amsterdam	1911	16.25%	2.59%	Renters
Amsterdam	2015	38.90%		Renters
Amsterdam	2015	36.70%		All
Belg. cities	1910	11.60%	1.46%	Renters
Brussels	2016	33.80%		All
Belgium	2016	30.40%		All
Paris	1900	18.10%	4.60%	Renters
Paris	2008	34.00%		Renters
Paris	2011	19.10%		All
London	1925	18.43%	5.41%	Renters
London	2015	39.17%		Renters
London	2015	28.86%		All

Notes: This table compares expenditure shares on housing at the start of the 20th century to more recent observations. Appendix B reports the sources for these household budget shares. In all cities, expenditure shares have increased over time.

Table 1, column 3, shows that the share of rental expenses in the household budget has increased substantially in all cities. This also holds when including the expenses of home-owners, who tend to be wealthier and spend a smaller part of their income on housing. However, when we calculate the budget share that would have been needed today to purchase the average early 20th century housing bundle, we see that it is substantially lower than in the early years of the 20th century. This is most striking in the Belgian cities and in Amsterdam, but it also holds true in London and Paris: only 1.5 to 5.4 percent of the 2015 household budget would have been needed to buy the housing bundle of a century earlier.

Evidently, the discrepancy between these budget shares implies that housing quality must have gone up substantially: households could only increase their budget shares on housing if they consumed more housing. However, we should be careful to use these

data to infer by how much housing quality has gone up: working hours and household sizes have changed substantially, our 20th century rent indices are based on less accurate spliced indices, and housing expenses are nowadays strongly influenced by housing policy. However, the magnitude of the changes we find suggests that the real question is not *whether* housing quality improved, but *when* and by *how much*.

3.2 Housing Quality

Table 2 reports the index of housing quality in the studied cities between 1500 and 1900, averaged over 25-year periods. For reference, we report the quality index of Clark (2002) for England and Wales. Housing quality has improved substantially in each city, although at varying rates: it increased most in Paris, and the least in Amsterdam and England. Part of this might be because no data is available for England and Amsterdam in the 16th century, when we already see marked improvement in the Belgian cities and in Paris. The timing of these quality upgrades is similar across cities: improvements in housing quality took place mostly prior to the Industrial Revolution. During the late 18th and most of the 19th century housing quality stagnated or even declined a bit, while increasing again at the end of the 19th century. Before 1800, the growth rate of estimated urban housing quality was around 0.2% per year in the (aggregated) Belgian cities and Amsterdam and 0.35% per year in Paris. The pattern is more dispersed in the 19th century, with quality improving in Paris but not in Amsterdam and only late in the 19th century in the Belgian cities.

The early cross-city improvement in housing quality may be surprising at first. One explanation may be an increase in the available housing space per capita. For Paris, where we report the largest improvements in housing quality, Hillairet (2004) estimates that the population density of the city reduced from 640 people per hectare in the late 14th century to just 180 people per hectare in 1789, suggesting that more housing space became available per capita. In a more qualitative account, Pardailhé-Galabrun (1991) describes how Parisian dwellings became much less crowded during the early-modern period. For Amsterdam, the expansion of the city during its Golden Age led to the construction of its famous circular canals and the large mansions along these.

Second, construction quality of homes gradually improved during the 16th and 17th century, as wooden and clay homes were gradually replaced by stone homes, and roofs

Table 2: Housing Quality Index (1750-1774 = 100)

Time period	*Belgian cities*	*Amsterdam*	*Paris*	*England (Clark, 2002)*
1500-1524	51		33	
1525-1549	62		35	
1550-1574	68	59	40	
1575-1599	76	55	43	
1600-1624	76	87	50	64
1625-1649	90	91	56	67
1650-1674	99	119	64	72
1675-1699	101	110	67	61
1700-1724	104	104	69	75
1725-1749	105	102	79	86
1750-1774	100	100	100	100
1775-1799	91	100	109	93
1800-1824	91	112	126	90
1825-1849	96	97	149	85
1850-1874	100	85	150	88
1875-1899	142	88		101

Notes: This table shows the developments in the housing quality index for each of the cities we study. The Belgian index is based on a population-weighted average of the quality index for the 4 Belgian cities. Bruges is excluded for the 19th century because its sample is insufficiently representative.

were constructed using tiles rather than thatch. Van Ryssel (1967) documented that during the 17th century an increasing number of homes had a more fire-resistant stone façade. The change from thatch to tiles already took place in the 15th and 16th century. Baer (2014) also reports significant improvements in the construction quality of homes in 17th century London, and concludes that housing quality improved consistently and for all income groups.[2] Beyond these changes on the outside of homes, De Vries (2008) describes a shift in the organization of the interior of homes, with functional spaces becoming much clearer defined: separate bed chambers appeared, as well as drawing- and dining rooms, even in middle-class homes.

A potential concern is that the quality indices discussed so far only measure the increases in housing quality *per home.* In case families became larger, or more people started sharing or sub-letting their homes, our quality indices are not an accurate measure of housing quality *per capita*, which is most relevant when discussing the evolution of the standard of living. Such concerns are relevant: Adam Smith explains the relative

[2]Note that the quality index of Clark does not report quality improvements in the 17th century but in the 18th century. This might be because this development was specific to London, or due to the low number of observations in Clark's sample in the 17th century.

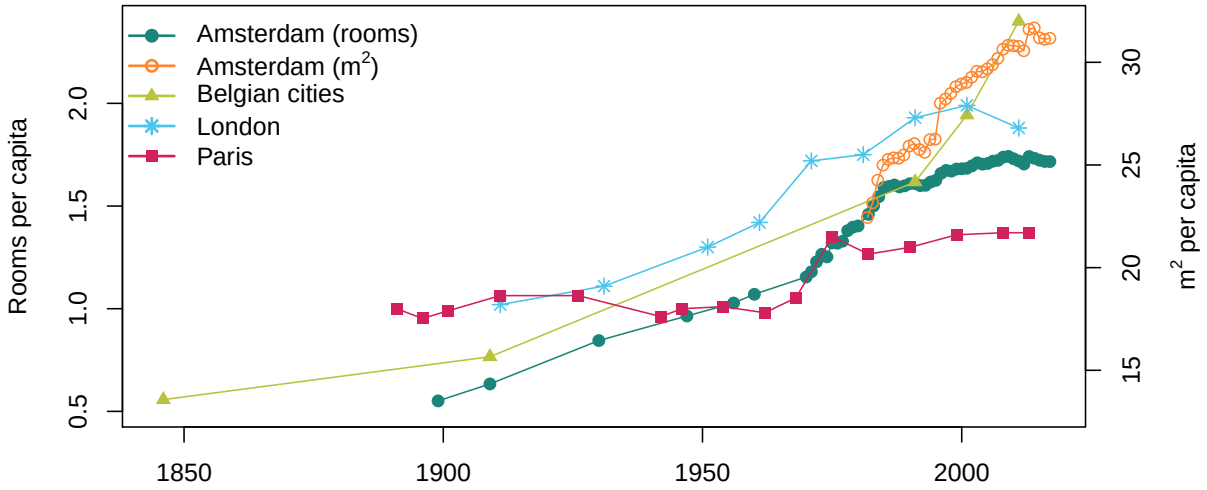
affordability of London housing as the result of mass-scale sub-letting of parts of dwelling homes (Smith, 1776). Smith's observation suggests that the number of people per house may have varied substantially across cities (and potentially over time). To address these concerns, we need to look at housing space per capita.

For a limited set of years, the rental database of Eichholtz et al. (2022) provides information on the entire cross-section of rental values in Amsterdam and the four Belgian cities. For Paris, statistics from Duon (1946) and Lyon-Caen (2018) provide information on the total rental value of all properties. If we scale the total rental value of all properties in a city by the number of inhabitants, we can estimate the mean rent per inhabitant. Next, we can compute the quality index on the basis of mean rents per capita, rather than mean rents per property. Appendix Table 7 reports the resulting quality index per capita, and its findings are in line with the estimates in Table 2.

We cannot extend our housing quality index into the 20th century, due to lack of primary data. To shed light on housing quality in the more recent era, however, we have collected census data for all cities in the sample. Given the societal importance of housing conditions, censuses have included variables on the number of persons per house, as well as the number of rooms per person. Although the definition of what constitutes a room varies across censuses, the number of rooms per capita should give us a reasonable idea of the development of housing space per capita – a key quality attribute. Figure 4 reports the level of rooms per capita in each of the studied cities, where we have used a population-weighted average of the Belgian cities. In all cities, the number of rooms per capita has increased. If the size of the average room increased as well, these data sources might even underestimate the change in housing space per capita. The only city for which we have the data to investigate this is Amsterdam, and we find that the growth in the number of square meters of housing space per capita, available since 1982, has been more than twice as high as the increase in in the number of rooms per capita.

However, even without controlling for room size, the increase in rooms per capita is notable. The growth is particularly large in Belgium. Relative to 1846, the average person has almost five times more rooms available nowadays. In Paris, the increase is smallest, but even there the number of rooms per capita has increased by approximately fifty percent. Paris has a relatively high number of rooms per capita in the 19th century, which also fits the observed improvement in housing quality in Table 2 during the 19th century

Figure 4: Space per Capita in the 19th–21st Century



Notes: This figure shows the development in space per capita for each city, again aggregating the Belgian cities. *Sources:* London: Mayor of London (2017), Paris: INSEE, Amsterdam: Statistics Netherlands (2021); Gemeente Amsterdam (2018), Belgian cities: Census data provided by StatBEL.

relative to the other cities, where housing quality does not improve (Amsterdam) or only late in the 19th century (Belgian cities). Correspondingly, around 1900 space per capita is lowest in Amsterdam. In the 20th century, the ranking of the improvements in rooms per capita across cities is consistent with the affordability improvements: affordability improved most in Belgium, followed by Amsterdam and London, with Paris reporting the smallest affordability improvements.

Beyond increases in the quantity of housing space, the quality of a given amount of space increased also significantly over the 20th century. The sources of census data used in Figure 4 also provide information on such quality improvements, although primarily for the second part of the 20th century. Nevertheless, large quality increases are visible even in this relatively short time period. For example, around fifty years ago proper sanitary facilities were still not the norm. In 1944, only 16 percent of Parisian households had a bathroom in their home, and about 46 percent had a proper toilet (at end of the 19th century, this was just 25 percent). By 1999, toilets and bathrooms were present in over 90 percent of homes. In the Netherlands, toilets were already found in 86 percent of homes in 1956, although private bathrooms were only available for a quarter of the population. By 2001, both figures had reached 100 percent. In the Belgian cities, practically all homes contained a toilet and bathroom in 2001, but toilets (60 percent) and bathrooms (50 percent) were not standard even as late as 1970, the first year in which the census

asked about these conditions.

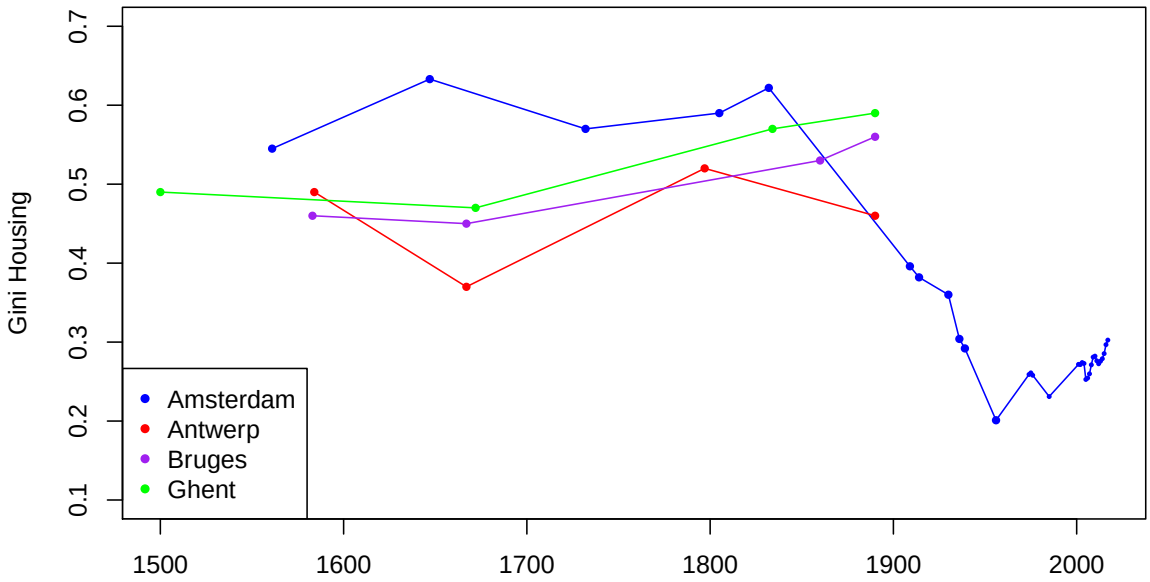
Similar improvements can be reported for the prevalence of central heating. At the end of World War I, central heating was only present in a quarter of Parisian homes, and this increased towards 50 percent around 1970. Similar values were recorded for urban homes in Belgium. The Netherlands lagged very much behind: by 1964, only 9 percent of homes were connected to a central heating system. Nowadays, that is over 90 percent. Beyond central heating, toilets and bathrooms, the 20th century also saw a rise in the number of homes with piped water and electricity, although these facilities had already reached a large number of homes in the 19th century: in 1891, 85 percent of Parisian households already had private access to water. More recently, better insulation of walls and windows has likely contributed to better housing quality by improving indoor climate and comfort. The improvements in space per capita and in amenities suggest housing quality has indeed continued to expand significantly during the 20th century, in line with improvements in affordability.

3.3 Housing Inequality

Housing has not only become more affordable and of higher quality, but the housing market has also become more equal over the last century. For Amsterdam, Antwerp, Bruges and Ghent, we can estimate Gini coefficients on housing inequality for the years for which the complete distribution of housing rental values is available – either based on actual rents or on rental value estimates of owner-occupied homes. For three Belgian cities, 4–5 full cross-sections shed light on the period from 1500 to 1890. The Amsterdam data extends to the present (see the appendix of Eichholtz et al. (2022) for a discussion of the sources used). Figure 5 reports the trend in estimated Gini coefficients.

Until the late 19th century housing provisions were very unequal - and persistently so. Before 1900, we find Gini coefficients between 0.4 and 0.65, which are in line with the higher levels in income and housing inequality found by Milanovic et al. (2010) and Ryckbosch (2016). Apparently, relatively few households benefited from the improvements in housing quality in this period. However, during the 20th century inequality reduced, at least in Amsterdam, to much lower levels. The great compression in housing inequality we document for post-1900 Amsterdam is in line with the findings of Piketty (2014) for the income distribution and the earlier found city-wide increases in housing quality and

Figure 5: Housing Inequality Estimates, 1500-2018



Notes: This figure reports the estimate Gini coefficients on housing inequality for Amsterdam, Antwerp, Bruges and Ghent. Data sources are provided in Appendix A.

affordability. Housing inequality has increased again since the 1980's, which coincides with the halt in affordability improvements.

In the next sections, we aim to provide a deeper dive into the facts presented here and make an attempt to explain some of the forces driving their changes. We make an explicit distinction between the period before World War I and the period afterward. As we shall see, government intervention in the housing market before 1913 was mostly limited to involvement in urban planning. From approximately World War I onwards, governments became very active in regulating rental prices and directing housing quality and housing construction. We thus use the pre-1913 as an opportunity to study long-term dynamics in affordability, quality and inequality in response to growth in a market without major government interventions. Similarly, we use the 20th-century to discuss how government intervention might have changed dynamics in these same parameters.

4 Housing Standards and Inequality Before WWI

On average, housing quality improved substantially before World War I, both in per capita terms and when measured per housing unit, despite the lack of improvements in measured housing affordability. In this section, we first provide better-identified empirical estimates on how these housing developments relate to urban growth. We then proceed

to discuss the underlying mechanisms that drove their evolution.

In our analysis, we start from the assumption that urban population growth generally reflects improving underlying economic fundamentals, in line with the strong empirical relation between urbanization and GDP per capita in history at the national level (Bairoch, 1988; Jedwab and Vollrath, 2015) and the wide use of urbanization as a proxy for growth in the economic literature. We need to do so by assumption because the lack of good data has made it very difficult to directly show a strong relationship between urban population growth and income growth; existing evidence from day wages of construction workers comes with significant limitations (e.g. Humphries and Weisdorf, 2019). In general, growing economic opportunities in cities might lead to improvements in housing standards but they might also make housing more expensive relative to earnings per unit of labor.

To test for such relationships, we start by estimating a set of panel regressions of the following form, for each city i at time t:

$$\Delta y_{it} = \beta_1 \Delta^+ pop_{it} + \beta_2 \Delta^- pop_{it} + \gamma_n x_{it} + \mu_i + \tau_t + \varepsilon_{it} \tag{5}$$

The changes in y_{it} correspond to the various dependent variables of interest for each regression: we start by studying changes in housing affordability and quality, and later move to investigate inequality in these developments. We link these to population growth, separating periods with positive population growth ($\Delta^+ pop_{it}$) from periods with negative population growth ($\Delta^- pop_{it}$), as these might have very different implications on rent development (Eichholtz et al., 2022), in line with the findings of (Glaeser and Gyourko, 2005). In our results, we will primarily focus on the case of urban growth. In some regressions, we add a vector x_{it} with controls, and μ_i is a city fixed-effect and τ_t a time-fixed effect. Our analysis thus exploits variation across cities over time.

We use relatively long time horizons, looking both at 25-year changes and 50-year changes. First, a low frequency of observations reduces noise and enables us to measure changes in population and housing quality sufficiently precisely. Second, adjustment of the housing supply to positive shock can be slow, and Eichholtz et al. (2022) show that such adjustment could take decades in the cities that we study. 25-year changes and particularly 50-year changes leave sufficient time for the housing stock to adjust to increased demand.

We estimate the models using overlapping differences. For the regressions, we use data from all periods before 1913, given the limited intervention of governments in the housing market before 1913. To account for the serial correlation introduced by the overlapping observations, and the potential spatial auto-correlation across cities, we use standard errors based on Driscoll and Kraay (1998). We exclude periods where data is thin or insufficiently representative, implying we exclude London (before 1800) as well as Bruges (after 1800).

Table 3 reports the outputs of the regressions that relate changes in affordability and quality to periods of urban growth and decline. Starting with the estimates on changes in housing affordability, reported in Columns 1–3, we find that housing affordability worsens somewhat in response to urban economic growth. On average, a one percent increase in population worsens affordability by about 0.2 percent. This coefficient changes little when adding time fixed effects (Column 2) and when using 50-year changes instead of 25-year changes (Column 3), although increasing in statistical significance. We find much larger effects of population decline: a one percent decrease in population improves housing affordability by 1.4 percent. This result is in line with the estimates reported in Eichholtz et al. (2022) and the predictions of Glaeser and Gyourko (2005): rents fall more rapidly in response to negative population shocks because the housing supply cannot adjust.

Columns 4–6 contain the estimates that relate population growth to changes in housing quality. On average, we find that a one percent increase in the population improves average housing quality by about 0.3 percent. This effect is similar when adding controls for changes in real rents and wages and time fixed-effects (Column 5), and when using 50-year changes instead of 25-year changes (Column 6). The fact that average housing quality grew in response to urban expansion suggests that increased urbanization in this period did go hand in hand with higher standards of living. Although the link between urbanization and GDP per capita growth is strong at the national level, it has been difficult so far to link urban growth to improvements in the urban standard of living.

In Column 4, we find that the effect is exactly the opposite in response to population decline: a one percent decrease in population improves average housing quality by 0.3 percent. The basic intuition is that while population growth leads to significant expansion of the housing stock that results in higher levels of housing quality, population decline does not lead to major reductions in housing space due to the durable nature of housing.

Table 3: Population Change, Housing Quality and Affordability

	Dependent variable:					
	$\Delta(w_t - r_t)$			Δq_t		
	Δ_{25}	Δ_{25}	Δ_{50}	Δ_{25}	Δ_{25}	Δ_{50}
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta^+ pop_t$	-0.207	-0.219^*	-0.200^{**}	0.297^{***}	0.280^{***}	0.276^{***}
	(0.186)	(0.128)	(0.100)	(0.054)	(0.070)	(0.066)
$\Delta^- pop_t$	-1.447^{***}	-1.436^{***}	-1.463^{***}	-0.311^{**}	-0.168	-0.144
	(0.189)	(0.210)	(0.255)	(0.131)	(0.165)	(0.291)
Δw_t^r					0.077	0.239^{**}
					(0.115)	(0.107)
Δr_t^r					-0.190^{***}	-0.222^{***}
					(0.058)	(0.077)
City FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	No	Yes	Yes	No	Yes	Yes
Observations	2,258	2,258	2,083	2,127	2,127	1,977
R^2	0.290	0.261	0.292	0.064	0.089	0.129
Adjusted R^2	0.288	0.104	0.138	0.061	-0.120	-0.073
F Statistic	459.664	329.182	352.448	72.475	42.130	59.295

Notes: This table reports regression estimates of Equation 5, where we regress different dependent variables on 25-year changes in population, separating growth ($\Delta^+ pop_t$) and decline periods ($\Delta^+ pop_t$). In Columns 1–3, we use changes in affordability as the dependent variable and Columns 4–6 changes in housing quality. Columns 1 and 4 show the baseline specification with city fixed effects only. Columns 2 and 5 add time fixed effects and, for the quality regression, controls for real wage and real rent changes. Finally, Columns 3 and 6 use 50-year changes whereas all other columns use 25-year changes. Standard errors are based on Driscoll and Kraay (1998), with a lag length of the time horizon plus five years (i.e. 30 and 55 years). *p<0.1; **p<0.05; ***p<0.01

As a result, the remaining housing stock is redistributed over fewer individuals resulting in higher levels of housing consumption. Columns 5 and 6 show that a large part of this effect is driven by increased housing consumption in response to lower prices: when controlling for changes in real rents, this effect decreases in economic magnitude and loses statistical significance. Unsurprisingly, real wage growth increases housing consumption whereas real rent growth reduces it.

We next study whether the impact of population growth on urban housing quality and rental prices differed across segments of the housing market. To investigate this, we look at two main outcomes. First, we look at inequality in rental prices, comparing the evolution of rental prices for properties above the median in the sample of each city and those below the median. Note that we cannot study affordability for different groups, because we only have income estimates based on day wages of construction workers and no measures of income for individuals higher in the income distribution. Second, we measure inequality in housing consumption, using the difference in housing quality for properties above and below the median. To construct this, we computed for each city changes in the log interquartile range of rent prices and subtracted the price difference between above- and below-median properties. The results are in Table 4

The first three columns look at rental price inequality. Column 1 shows that a one percent increase in population results in 0.2 percent less rent price growth in above-median properties compared to below-median properties. These estimates do not change much when adding time fixed effects and controls for real wages (Column 2) and when using 50-year changes instead of 25-year changes. (Column 3). We do not find consistent estimates for periods of urban population decline and standard errors are larger in this case. Note that these estimates do not imply that structural population growth causes house prices of cheap- and expensive properties to converge: the set of properties that are below-median or above-median changes over time, both due to new construction and because price changes can push a property above or below the cut-off.[3].

Columns 4–6 study changes in housing quality for above- and below-median properties, a crude measure of inequality in housing consumption. Although the magnitude and significance of this effect differ slightly across specifications, we find that a one percent increase in population leads housing quality for properties above the median to increase

[3]To estimate the index, we only include pairs of repeat rentals where both rent observations are below the median or above the median

Table 4: Population changes and housing inequality

	Dependent variable:					
	$\Delta(r_t^h - r_t^l)$			$\Delta(q_t^h - q_t^l)$		
	Δ_{25}	Δ_{25}	Δ_{50}	Δ_{25}	Δ_{25}	Δ_{50}
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta^+ pop_t$	-0.180^{***}	-0.241^{***}	-0.215^{***}	0.231^{*}	0.327^{*}	0.495^{***}
	(0.062)	(0.064)	(0.039)	(0.124)	(0.192)	(0.091)
$\Delta^- pop_t$	0.043	-0.106	-0.135^{*}	-0.009	0.396	-0.408
	(0.072)	(0.115)	(0.073)	(0.188)	(0.433)	(0.380)
Δw_t^r		-0.114^{**}	-0.093^{*}		0.051	0.029
		(0.046)	(0.056)		(0.177)	(0.155)
Δr_t^r					-0.044	0.022
					(0.107)	(0.088)
City FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	No	Yes	Yes	No	Yes	Yes
Observations	2,127	2,127	1,977	2,053	2,053	1,903
R^2	0.043	0.096	0.158	0.013	0.034	0.121
Adjusted R^2	0.040	-0.111	-0.036	0.010	-0.197	-0.093
F Statistic	47.310	61.235	100.759	13.510	14.723	52.509

Notes: This table reports regression estimates of Equation 5, where we regress different dependent variables on 25-year changes in population, separating growth ($\Delta^+ pop_t$) and decline periods ($\Delta^+ pop_t$). In Columns 1–3, we use changes in rent price inequality as dependent variable and Columns 4–6 changes in housing inequality. Columns 1 and 4 show the baseline specification with city fixed effects only. Columns 2 and 5 add time fixed effects and, for the quality regression, controls for real wage and real rent changes. Finally, Columns 3 and 6 use 50-year changes whereas all other columns use 25-year changes. Standard errors are based on Driscoll and Kraay (1998), with a lag length of the time horizon plus five years (i.e. 30 and 55 years). *p<0.1; **p<0.05; ***p<0.01

by around 0.2-0.5 percentage points relative to properties below the median. This result appears most strong over very long horizons when the housing supply is likely able to adjust fully. Again, we find no clear effects for periods of urban decline.

The basic message of Table 4 is that urban growth leads to increasing housing inequality, with higher price pressure on below-median properties and higher quality growth on above-median properties.

4.1 Mechanisms and Implications

Our long-term findings show that on average, housing quality improved in the cities we study while there was no improvement in housing affordability when measured by the evolution of market rents relative to day wages. Many of these dynamics link in the shorter term to the growth of these cities. In general, most of the cities in our sample grew in population and growth went hand in hand with increased housing quality and only weakly deteriorating affordability. However, quality growth concentrated among higher-end properties and cheaper existing properties generally appreciated more in price than more expensive properties. Growth thus also made the housing situation more unequal. We now move on to discuss which mechanisms could be driving these novel empirical facts about long-run housing developments in cities, and what this implies for the literature on urban economic history more broadly.

First, the growth in average housing quality that we observe, in particular before 1800, signals growth in the urban standard of living before the Industrial Revolution. There is substantial debate about the presence of such growth. One point of view is that economic growth before the Industrial Revolution was limited and that the world was effectively captured in a Malthusian trap (e.g. Clark, 2008). The revisionist view argues there was economic growth already before the Industrial Revolution (e.g. De Vries, 2008), building mostly upon evidence for growth in estimates of GDP per capita (Van Zanden and Van Leeuwen, 2012; Broadberry et al., 2015). Our evidence on housing quality provides important evidence for the revisionist view, providing evidence based on measures of direct housing consumption rather than macroeconomic aggregates, and also showing this for regions outside of The Netherlands and the United Kingdom, which had been studied so far. We also provide specific evidence for cities rather than country-wide measures.

Although the lack of data makes it difficult to provide precise evidence for the drivers

of this growth, we argue there are two plausible channels. First, households might have been able to increase housing consumption by working more. For the United Kingdom, Humphries and Weisdorf (2019) shows the number of days worked increased substantially between the 16th and 19th centuries. In Appendix C we show there is a similar trend in Antwerp when comparing the day wages of masons with annual wages of workers at the Plantin Press, which grew by around 50% between the 16th and 18th centuries while day wages were very much stagnant.

Second, certain developments might have led to improvements in urban productivity already before the Industrial Revolution. For example, De La Croix et al. (2018) point to the role of guilds and apprenticeships in disseminating knowledge and fostering innovation in the artisan sector. In the context of our cities, developments at the nexus of finance and trade also helped create flourishing merchant economies (e.g. De Vries and Van der Woude, 1997; Acemoglu et al., 2005). If productivity improvements concentrated in high-skilled workers such as artisans, bankers, or merchants, that might help to explain why improvements in housing standards were concentrated higher in the income distribution and why urban growth resulted in increased inequality. In the end, these individuals could not easily be replaced by rural migrants that lacked these skills. Overall, cities grew in this period exclusively due to migration, and Soltow and Van Zanden (1998) and Ryckbosch (2016) show that inequality increased in city size in the Low Countries in the pre-modern period.

In line with this, Eichholtz et al. (2022) show that households in booming cities and above-average incomes were particularly spending high fractions of their income on rent, indicating these were able to live in high-quality housing. More detailed evidence on the relationship between historical urban growth, wage inequality, and productivity is hard to come by, but this view is in line with much theory in modern urban economics. A long list of papers stresses the link between urban growth, productivity growth, and growing dispersion in wages and skill accumulation (e.g. Black and Henderson, 1999; Baum-Snow and Pavan, 2013; Behrens and Robert-Nicoud, 2014; Behrens et al., 2014; Roca and Puga, 2017; Aghion et al., 2019).

This explanation leaves open why rental prices in the bottom half of the rent distribution increased more in response to urban growth compared to properties in the top half. A first potential explanation is that there was segmentation or lack of supply

adjustment in the rental market so that the pressure from mostly poor migrants when cities were growing primarily increased the prices of cheap rental properties. There is not much evidence for structural segmentation of the rental market; if population pressure became high, the poor often resorted to building their housing outside the city walls (e.g. Descimon and Nagle, 1979; Soly, 1977). It also does not seem plausible that building restrictions within the city were tighter in poor than in rich areas; if anything, more expensive areas restricted increased densification (e.g. Abrahamse, 2010). A more likely explanation can be found in theories of gentrification, such as in (Guerrieri et al., 2013). The basic intuition is that if urban growth increased incomes for the incumbent middle- to upper-middle class, these individuals might have been bidding up prices for below-median properties just outside of the more central areas with above-median prices. New migrants or incumbent tenants with lower incomes are then pushed towards the cheapest existing areas in cities or towards cheap new construction at the edge of the city, where land is comparatively cheap. Both movements cause the prices of cheap properties to rise faster than those with above-median prices.

In short, quality growth and rising housing inequality in response to urban growth likely reflected growing economic opportunity, which led to income increases for individuals benefiting from this growth and potentially growing numbers of days worked for day wage workers. Improved urban economic opportunity led to rising equilibrium rents relative to day wages, which could explain the worsening of affordability we observe, in particular for the poor. Workers with limited skills thus could only improve housing consumption by working wore. Before the 20th century, the gains from urban economic growth thus were not shared widely. In the next section, we aim to discuss what led to the breakdown of this relationship.

5 Affordability in the 20th century

Until the 20th century, housing markets operated without much intervention from governments in price setting and construction, with governments mostly involved in urban planning and basic building codes. Towards the end of the 19th century the role that governments played in the housing market gradually started to change, fueled by increasing social concern about the housing conditions of the working class and numerous private

initiatives to improve these conditions.

Early on, governments sought to support private initiatives to develop low-cost housing with laws that gave designated cooperatives or associations access to credit at reduced interest rates or certain tax advantages. In Belgium, this was arranged through the Law of August 9, 1889 (Buyst, 1992), France introduced the "Siegfried Law" in 1894 (Shapiro, 1982), and the Netherlands followed with the 1901 Housing Law (Elsinga and Wassenberg, 2014). In the United Kingdom, the various Housing of the Working Classes Acts passed in the late 19th century allowed local governments to clear slums and build public housing (Malpass and Murie, 1999). Laws that allowed the government to demolish or prohibit the habitation of unhealthy houses also became prevalent in other countries.

These efforts notwithstanding, the impact of these policies on the housing situation remained small until World War I. Construction of working-class housing through these acts was only a small fraction of total construction and clearance or improvement of low-quality housing only proceeded very gradually. Far-reaching housing policies were only implemented after the turmoil of World War I, which led to large housing shortages in all cities we study. Across the board, governments implemented strict rent controls while at the same time making funds available for the construction of new housing and quality improvements on the existing stock. Although the far-reaching consequences of these policies and their wide implementation imply we cannot establish causal effects, these policies undoubtedly played a large role in changing the housing relationships we documented in the previous section for the period before World War I. For the first time in history, we observed large-scale improvements in housing quality, inequality, and affordability at the same time, despite continued urbanization.

5.1 Rent Controls

Rent controls were instated in all cities we study following World War I and corresponding housing shortages, and fixed rents relative to their levels at the start of the World War.[4] While rent controls remained tight in the early 1920s governments gradually decontrolled rents by increasingly permitting market rents in higher segments or by allowing higher

[4]Various studies provide a detailed overview of these laws, such as (Duon, 1946) for Paris, Malpass and Murie (1999) for London and Bettendorf and Buyst (1997) for the Belgian cities. For The Netherlands, we build on our own analysis. Kholodilin (2020) provides an overview of rent control across countries, showing rent controls were instated around the same time in most of the western world.

rent hikes on cheaper existing properties. Strict rent controls were reinstated again when World War II broke out, typically freezing rents on existing property to their levels at the start of the war. Again, rent controls remained tightly in place at the end of the war but were gradually loosened in the 1950s and 1960s. In some countries, most notably the Netherlands, a large fraction of the rental stock remains rent-controlled until today. The sizable growth of public housing after World War II plays an important role in this.

These historical patterns in rent controls also correlate closely with changes in affordability and real rents: Figure 3 shows affordability improved particularly quickly at times when rent controls were strict. To measure the effects of rent control on affordability more precisely, we exploit that changes in inflation rates across countries provide variation in the tightness of nominal rent controls that is plausibly exogenous to local housing markets. Most early rent controls were stated in nominal terms, either as outright rent freezes or as a fixed limit on the rate of rent price increases (Arnott, 1995). In case of substantial inflation, rent prices would be unable to adjust with inflation, while wages remained unrestricted. Given their far-reaching consequences, rent control adjustment was debated. Belgian evidence from Bettendorf and Buyst (1997) also indicates officers thought post-war inflation was temporary so immediate adjustment would not be necessary. In short, the higher inflation, the tighter the nominal rent control, and the larger its potential benefit on affordability.

The identification of such an effect relies on two crucial assumptions. First, inflation rates should only affect the tightness of the rent control and have no other effects on housing affordability, either directly or indirectly. This implies that inflation rates should not correlate with changes in affordability in the absence of rent controls. Second, our measure of rent controls should only capture periods of strict nominal controls, and not anything else. To identify these, we have studied rental regulations in each of the four countries, and constructed a dummy variable for the presence of strict nominal rent controls that applied to all rental contracts on existing housing. AppendixD provides more information on the construction of this variable. As a secondary measure, we use the regulation index of Kholodilin (2018), which contains a measure for the presence of nominal rent controls. This measure is broader than ours: it for example also covers periods when only subsets of properties are controlled.

In our baseline model, we estimate the following panel regression, for each city i at

time period t.

$$\Delta(w_{it} - r_{it}) = \mu_i + \beta_1 RentControl_{it} + \beta_2 RentControl_{it} \times \Delta p_{it} + \beta_3 \Delta p_{it} + \gamma_x x_{it} + \varepsilon_{it} \tag{6}$$

We estimate this regression for Amsterdam, London, Paris, and the combined Belgian cities, including city fixed effects. Δp_{it} refers to changes in inflation, and x_{it} are control variables. $RentControl_{it}$ is a dummy variable that captures the existence of nominal price controls. Standard errors are Driscoll-Kraay errors, with lag length selected by the Bayesian Information Criterion.

The results reported in Table 5 show that the existence of nominal rent controls itself is unrelated to improvements in affordability. However, the extent to which these controls are binding matters: We expect that higher inflation rates will render the nominal rent controls more binding, resulting in larger affordability gains. This is exactly what we find: inflation in the absence of rent control does not affect affordability, but when we look at the interaction term of inflation and the nominal rent control dummy, which measures inflation when nominal rent control is present, a one percent increase in inflation increases rental housing affordability by 0.6 percent. This finding is robust to the use of the measure of rent controls from Kholodilin (2018).

In Column 3, we restrict the sample to a shorter time frame around the periods, restricting it from the period of 1850 to 1980. In this period, we have annual population estimates for most cities, and they (or their urban areas) were mostly growing. We exclude the post-1980 period, when rent controls became more sophisticated (Arnott, 1995) and when home-ownership increased at the expense of public housing. We find this does not change results. In Column 4, we use the same specification but additionally include time fixed effects, thus exploiting variation across cities. This reduces the statistical significance of the effect although the effect size is comparable. Given the close correlation in rent control policy across countries over time as well as co-movement in inflation, it is not surprising to see this reduction. Finally, in Column 5 we also control for construction. For a small subset of data, we have also collected information on construction rates (see Appendix D.1). This variable follows the number of newly built properties relative to total population. We normalized this variable for each city, to account for differences in the definition of construction. After controlling for new construction, the interaction

Table 5: Nominal Rent Control and Affordability

	Dependent variable:				
	$\Delta(w_t - r_t)$				
	(1)	(2)	(3)	(4)	(5)
$RentControl_{it}$	−0.001	−0.009	−0.010	0.021	−0.015
	(0.014)	(0.007)	(0.016)	(0.030)	(0.014)
$\Delta p_{it} * RentControl_{it}$	0.609***	0.455***	0.525***	0.414*	0.845*
	(0.080)	(0.156)	(0.146)	(0.228)	(0.458)
Δp_{it}	0.033	0.041*	0.135	−0.047	−0.050
	(0.027)	(0.023)	(0.169)	(0.207)	(0.434)
Δpop_{it}			−0.493*	−0.337	−0.416
			(0.270)	(0.236)	(0.550)
$Constr_{it}$					−0.002
					(0.004)
City FE	Yes	Yes	Yes	Yes	Yes
Time FE	No	No	No	Yes	No
Observations	2,010	2,010	504	504	382
R^2	0.105	0.072	0.211	0.078	0.193
Adjusted R^2	0.102	0.069	0.200	−0.257	0.178
F Statistic	77.986	51.622	33.210	7.785	17.862

Notes: This table reports regression estimates of Equation 6, where we regress changes in rental housing affordability, measured by the indexed ratio between wages and rents, on a rent control index interacted by inflation. Columns 1, 3–5 use our measure of periods of strict nominal rent controls, Column 2 uses the measure of Kholodilin (2018) that also includes periods with second-generation rent controls. Column 3 additionally controls for population changes and adds time fixed effects. Column 4 restricts the sample size to 1850 to 1980. Column 5 also controls for housing construction. All regressions use city fixed effects, and standard errors are based on Driscoll and Kraay (1998). *p<0.1; **p<0.05; ***p<0.01.

term is less significant due to the large reduction in the number of observations, but the economic significance remains roughly the same.

In general, it is not surprising that the relationship is less than one-to-one because countries sometimes permitted increases in rent prices also in response to inflation. Because these increases were heterogeneous across property types it is difficult to quantify them for rental markets as a whole.

5.2 Housing supply

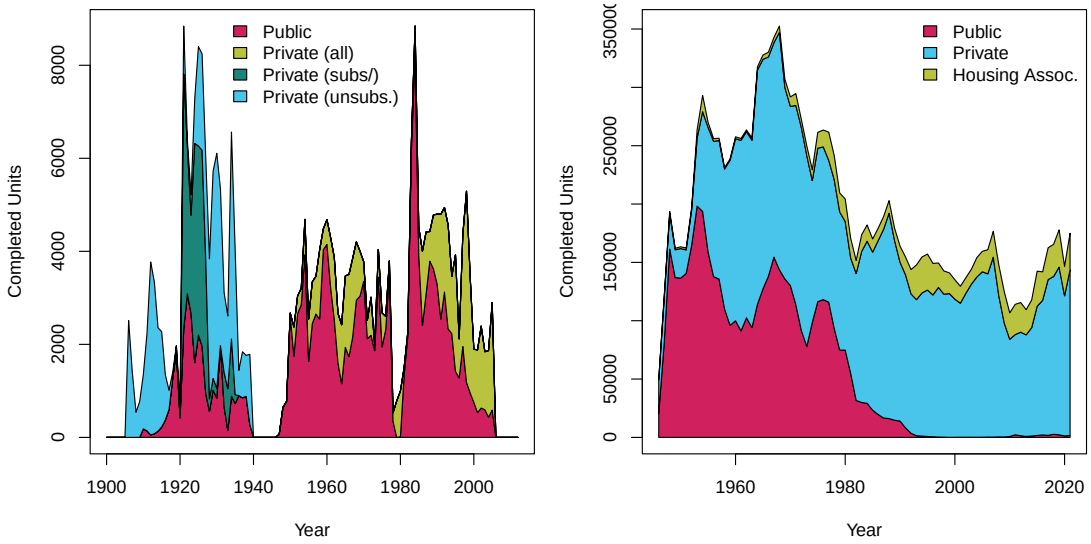
Undoubtedly, rent controls introduced during or after the World Wars led to large improvements in affordability. The knee-jerk counter-argument an economist might raise is that investments in housing must have become unattractive as real housing rents plummeted. How could housing quality and inequality improve so rapidly and permanently, then? Why did the gains not quickly erode again as markets returned to pre-war equilibria, in particular as urban populations continued to grow fast and home-ownership rates were low?[5] Over longer horizons, income growth could allow households to increase their housing standards, but housing supply and quality could only increase if homes were to be built or remodeled. The short answer is that governments stepped in and boldly stimulated the construction of many new units and improvements in housing quality. Such policies have been extensively discussed in the academic literature before, and the next section will thus just provide an overview of key policies and statistics.

For Amsterdam, we collect the evolution of public and private construction using statistics from the yearbooks of the municipality (see Fig. 6a). Before World War I, the statistics separate private construction built with or without subsidies, which mostly came in the form of cheap loans.

In Amsterdam, rent regulation after World War I restricted rents to their 1916 levels (or to the levels of the first tenancy for new construction). To keep building with artificially low rents and high construction costs, the government increased support measures for non-profit housing associations, which for several years became the dominant builders. However, this situation did not last long as some of their advantages were repealed in 1921 while subsidized loans also became available to private developers (Beekers, 2012). They

[5] By 1950, home-ownership in the countries we study averaged around 33% (Kohl, 2017). These rates were likely lower in the cities that we focus on here.

Figure 6: Public and Private Supply of Housing



(a) Amsterdam, 1904–2007 (b) England, 1946–2021

Notes: Panel (a) shows annual construction in Amsterdam based on the statistics provided in the yearbooks of the Amsterdam municipality (Gemeente Amsterdam, 2018). Public housing combines properties constructed by municipalities and housing associations (woningcorporaties). In England (Panel b), local councils (public) provided the vast majority of completed dwelling in the decade after World War II. Private enterprises re-emerged in the mid 1950s. Private enterprises did not expand supply after the Thatcher government ended the construction of new council homes. Total housing supply has not reached the volume enjoyed in the 1970s, since. Data for (b): Office for National Statistics (2022).

realized an unprecedented amount of housing in a short period and continued building when rent controls and subsidized loans were abolished in the mid-1920s.

After World War II, private housing development remained much more limited as state politics preferred public housing through associations and municipalities, which were built en-masse (see Figure 6a). Rents were again tightly restricted, with increases tied to their 1940 levels, and construction again mostly relied on public funds and subsidized loans. After World War II, there were various subsidies for private construction but we cannot distinguish in the data which construction was subsidized and which was not. The consensus view is that building shifted to a more market-based approach with less subsidization from the 1980s onwards (Van Kempen and Priemus, 2002). From the 1990s, there came increasing room for private rentals at unregulated rents, and building shifted from the housing association sector to construction of the owner-occupied property. In the rest of the Netherlands, this shift happened somewhat earlier.

London experienced a similar revolution of public housing supply. At the end of World War I, Prime Minister David Lloyd George promised returning troops half a million

"Homes fit for Heroes" (formalized in Housing, Town Planning, &c. Act, 1919), many of which to be built in London. Supplying housing at a massive scale has to be understood as a truly revolutionary policy change, given the pre-war free markets regime. This radical new approach to housing supply in Britain had been intensely debated already during the war and was by no means uncontroversial. Ultimately, the belief prevailed that "the war had permanently changed the relations between social classes and that a new 'social contract' was required" (Swenarton, 2005). Having witnessed the Bolshevik Revolution in Russia and less successful attempts in, e.g., Germany or other European countries, housing the working class better was not only gratitude to victorious soldiers but also a defensive move: Improving working-class living conditions lowered any revolutionary potential—or, as Lloyd George put it, *"the money we are going to spend on housing is an insurance against Bolshevism and Revolution"* (Lloyd George, 1919, as cited in Swenarton, 2005).

Less than half of the initially promised Homes for Heroes were ultimately delivered (Swenarton, 1981) but the policy established precedent: Government, again, played an active role in housing supply after World War II. Figure 6b presents a breakdown of new construction in England, by supplier type (Office for National Statistics, 2022). Local councils provided the vast majority of completed dwellings in the postwar decade before private enterprises re-emerged in the mid-1950s. Private enterprises did not expand supply when the Thatcher government ended the construction of new council homes in 1980. Total housing supply has not reached the volume enjoyed in the 1970s, since.

For Paris and the Belgian cities, it is more difficult to make a consistent series of subsidized and non-subsidized housing construction, as sources are more limited. Alike London and Amsterdam, the Belgian cities saw increased subsidization of housing construction when rents were tightly regulated after World War I (Bettendorf and Buyst, 1997). Although there were many different measures, the government primarily stimulated construction primarily through subsidized loans and the construction of semi-private rental housing at subsidized rates. Buyst (1992) estimates that in this period up to 40% of properties were constructed this way, with the fraction highest in the 1920s when rent controls were tightest. In the first half of the 20th century, the experience of Paris is a bit of an outlier in the sense that it implemented probably the most consequential set of rent controls between 1914 and 1948, while it lacked the government stimulus of private or

public construction observed in other cities (e.g. Duon, 1946; Ellickson and Le Bris, 2019; Bonneval, 2019; Eichholtz et al., 2021). In line with this, Paris is the only city where we see housing space per capita deteriorating between World War I and the mid-20th century (see Figure 4).

In France, the housing law of 1948 led to a complete overhaul of the rent control system (Loiseau and Bonvalet, 2005), and also paved the way for more a active role of the government in boosting the housing supply. Based on statistics of (Newsome, 2009), around 90% of properties constructed during the 1950s and 1960s received some form of state aid. Initially, the focus was primarily on public rental housing (*HLM*). Housing allowances and loans or subsidies on private construction gained more traction in the 1970s and 1980s (Schaefer, 1993). Construction stimulus reduced afterward. Based on statistics of the CGEDD, the share of new construction in France that received subsidies or subsidized loans reduced from almost 30% in the 1980s to around 10% in the 2000s. Contrary to the other cities in our sample, Belgian cities never build up a large public housing stock after World War II and had deregulated most rents by the early 1950s. While in the 1950s more than half of the housing was built with government support, this mostly consisted of subsidized loans and direct building subsidies supporting private construction, with only a fifth of new construction being social housing (Buyst, 1992). Private construction could also ramp up quickly due to the lack of significant urban planning, which led to a much stronger emergence of owner-occupied properties in 'ribbon' developments.

5.3 Implications

There are three two main conclusions from our analysis in the previous subsections. First, rent control played a big role in the development of urban housing affordability in the 20th century. Second, large-scale government intervention in the housing market and construction supported housing quality improvements and reductions in inequality in housing standards. Although countries differed significantly in their implementation of these policies, affordability, housing quality, and housing equality improved all across the board. The gradual removal of these policies and corresponding expenditures later in the 20th century also correlates with a worsening of affordability. The question is what this evidence implies for modern debates about rent controls and government interference in

housing markets.

Before doing so, we want to highlight that our findings are descriptive and that we abstain from causal statements. In the 20th century, government intervention became a defining feature of housing markets across developed countries, so we do not observe the counterfactual world where such inference was limited. And because governments used such a wide mix of different policies, it is also hard to theoretically evaluate the general equilibrium consequences of them. Although the time-series correlation is stark, with few improvements until the 'affordability revolution' of the early 20th century, it ultimately is impossible to make precise causal statements on what exactly drove the enormous improvement in housing parameters until the mid-20th century. Nevertheless, a lack of causal identification should not stop us from thinking about the largest improvements in housing conditions in history.

A first implication is that the assessment of rent controls might depend on whether we evaluate them in isolation or jointly. Most of the economic literature on rent controls has highlighted the potentially harmful effects of rent controls over the long run. Many of these concerns are also echoed in the historical evidence. With that in mind, it seems surprising that we find large improvements in housing standards under periods of severe rent control. Our descriptive evidence suggests this might be because governments paired strict rent controls with supply-side measures that counteracted the negative side effects of rent controls, most notably by subsidizing mortgage loans, construction, and/or property maintenance. It is hard to view these policies separately, in particular, because they were part of the same political agenda. In short, the presence of such supporting policies might alter the overall welfare effects of rent controls.

A second implication is that irrespective of the extent to which these housing policies contributed to improvements in (ine)quality and affordability, they left a lasting market on the housing situation today. Until the end of the 19th century, the structure and dynamics in housing markets are very similar across cities, with large and mostly unregulated private rental markets. Later, housing arrangements become central to the political debate, with differences appearing both in the cross-section and over time. For example, Belgium mostly boosted private development leading to a relatively early growth of home ownership, while neighboring The Netherlands developed one of the largest social housing systems in the world after World War II, and only later transitioned to a system with more

room for private development. This has resulted in a large difference in the composition of the housing stock and its allocation to households today.

6 Conclusion

This paper traces the trajectories of urban rental housing affordability, housing quality, and inequality in seven European cities from 1500 to the present. For the first 300 years, real rents did not grow significantly in most cities. However, the average quality of housing units gradually improved in time. This increase in quality was not uniformly distributed across all housing segments, and housing inequality increased when cities expanded. During the 19$^{\text{th}}$ century, real rents started to increase significantly, however not exceeding the growth rates of real wages. Initially, these increases in housing costs seemed to hamper further increases in housing quality, but from the late 19$^{\text{th}}$ century onward housing quality started improving again.

Importantly, governments did not interfere in rental markets for the first four centuries studied here. The interplay of market forces stabilized long-term real rent levels relative to wages: real rents increased when cities were growing, but improvements in wages appear to have largely compensated for these. Instead, the main negative consequence of urban growth over the long term is an increase in housing inequality. Part of this increase is attributable to differences in rent price increases across cheaper and more expensive segments. More research is needed to also investigate the spatial implications of this.

When wages started to outpace growth in rents during the first 75 years of the 20$^{\text{th}}$ century, possibly with the support of intervening governments, households could expand their housing consumption (and expenditure shares on housing) even further to the high levels currently observed, while housing inequality fell. Rent control does seem to have played a role in short-run affordability improvements. More empirical work is still needed on the long-run effects, though, although it is likely that broad-based government policies to support housing construction and quality played a role. More recently, such policies have become less intense and housing affordability seems to have worsened slightly, particularly in London and Paris. Nevertheless, in all cities we study rental housing has been much more affordable during the past few decades than it has been at any time before.

This paper shows that in order to estimate housing affordability it is essential to look

at income, quality-controlled market rent indices and measures of housing quality and inequality simultaneously. Excluding any of these components can result in an incomplete picture of housing affordability. However, even in the modern era quality-controlled rent indices are barely available (Ambrose et al., 2015), and data on developments in housing quality and inequality are even harder to find. We hope our findings will stimulate researchers or statistical offices to also produce such estimates for the 21st century.

The relevance of this study goes beyond housing affordability. For economic historians, we provide important new evidence on the way the household budget was spent on housing, and our rent indices and estimates of housing quality shine new light on the historical standards of living: housing quality seems to have improved very significantly prior to the 19th century.

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A Inequality Data

To estimate the level of housing inequality within a city requires data on the distribution of housing rental values at the household level. The distribution of these values reflects both differences in the value of the actual quality of the house, as well as differences in its location. Such distributions also exist for the early parts of our sample because property taxes were the most common form of taxation. To estimate taxes, cities computed the rental value of properties based on actual rent prices or an estimation of rental value when a home was owner-occupied. Existing studies have used these measures as a proxy for income inequality (e.g Soltow and Van Zanden, 1998; Milanovic et al., 2010; Ryckbosch, 2016).

Until the 19th century, we use the Gini-coefficient of housing inequality for Bruges, Ghent and Antwerp from Ryckbosch (2016). For Amsterdam, we combine Gini-coefficients from Soltow and Van Zanden (1998) with Ginis computed from our own database of rental data. However, for 1647 and 1832 these measures are only available at the home level rather than the household level. Because there often lived multiple households in the same home, we have to transform these measures. To do so, we make the assumption that the ratio of home to household inequality was constant between 1647 and 1732. In that manner, we can use the 1732 ratio, based on Van Zanden (2018) and our archival data, to estimate the level in 1647. We apply the same procedure to estimate inequality in 1832. In this year, we use the ratio based on data from 1805.

In the 20th and 21st century, we only compute housing inequality data for Amsterdam, since this was the only city for which we are able to find data that would enable us to extend our measure of inequality consistently until the 21st century. For the period between 1909-1940, we use data on the rental prices or values of all properties in Amsterdam, available from Laloli (2018). Contrary to the older tax registers, all these measures are at the household level. One limitation is that owner-occupied housing has not been valued in all periods, which likely was of higher rental value than the average rental property. However, the impact of this on the rent distribution is small, because owner-occupancy rates were only 3-4% in the first part of the 20th century.

For the second part of the 20th century, we use data on rent prices or rental values from various publications of the Amsterdam Statistical Office, which we retrieved from

the Amsterdam City Archives.[6] Such rental censuses were taken in 1956, 1974-1976 and 1985. One limitation is that the presence of housing policies made rental prices and rental values an imperfect measure of housing quality. Thus, these measures are primarily a measure of housing expense inequality, which might differ slightly from actual housing inequality. We believe this limitation applies particularly to the distribution of rents in 1956. Amsterdam was still under strict rent controls in these periods, that likely had a compressing effect on the distribution of rental prices.

In the 21th century, we use the Gini coefficient on the taxed value of all properties in Amsterdam (*WOZ-waarde*), which was directly provided to us by Statistics Amsterdam, due to the confidentiality of the underlying microdata. For tax purposes, every residential property in The Netherlands has been valued. The advantage of this measure is that it is computed in exactly the same way for owner-occupied housing, rental housing and social housing, despite the different (implied) rentals for these properties. Although such property taxes existed already in the 20th century, their valuation has changed significantly over time. For this reason, Statistics Amsterdam only provided data between 2000-2018, when there were few changes in the tax valuation of properties. One limitation of these measures is that they do not include rentals or sub-rentals of rooms. However, less than 5% of households rent a room, and Statistics Amsterdam estimated that they would have only a very small impact on inequality.

B Income Shares on Housing

To reconstruct expenditure shares on housing we searched both for historical data for the early 20th as well as modern expenditure shares for the 21st century. For Amsterdam, we used a study of Claeys (1921) on 23 households in Amsterdam that were surveyed just after World War I. Contemporary data was retrieved from Statistics Netherlands (2021). Surprisingly, we found the most reliable estimates of expenditure shares in urban Belgium in a publication of the Great Britain Board of Trade (1910), which reported shares for middle-income households in industrial towns. Contemporary data on expenditure shares, both for owner-occupiers and renters, was retrieved from the housing survey of Statistics Belgium (2021). For Paris, we used historical estimates from Duon (1946),

[6] ACA 30525, Collectie Kenniscentrum Amsterdam, nos. 2036, 2391 and 3733

while contemporary data on Parisian rent shares was taken from ADIL (2009) and from INSEE (2021) for both owner-occupiers and renters. For London, the earliest estimates of expenditure shares we could find were published in Jones (1928), for a sample of 50 London families. Today, the Mayor of London (2017) publishes expenditure shares. For all modern data, household budget shares accounted for potential rent benefits.

C Day Wages versus Annual Income

In order to provide more quantitative evidence on the developments of annual wages relative to day wages in urban Western Europe, the scope of this study, we have digitized 1,584 records of annual wages from 117 compositors of the Plantin Press in Antwerp, published in Verlinden (1972). The Plantin Press was, particularly in the 16$^{\text{th}}$ century, one of the most important printing houses in Europe and employed a substantial number of compositors and pressmen. For each of these compositors, we know the number of weeks they worked as well as their annual earnings.[7] However, likely as a result of fluctuating demand, some workers only worked a few weeks per year. To avoid that these fluctuations affect our estimates of annual income, we only classify a worker as 'full time' if he is employed for at least 40 weeks, which reduces the number of observations by 25 percent. In addition, given the small number of observations per year, we take decadal averages.

Table 6 reports the results, and compares these to decadal trends in day wages. Between 1590-1599 and 1760-1769, the first and last decades for which we have data, the annual income of Plantin Press compositors grew by about 60 percent, while the corresponding day wage index increased only by 5 percent. However, possibly due to the uncertainty in the Plantin Press operations, its wage index is more volatile than the day wage index. Nevertheless, from the 1630s onwards annual incomes at the Plantin Press are substantially higher than income estimates based on day wages. Thus, if we assume, as in Clark and Van Der Werf (1998) and Humphries and Weisdorf (2019), that the long-term differences in annual and daily wages are entirely driven by changes in the number of hours worked, then day wages underestimate income significantly. The figures from the Plantin Press suggest an average difference of about 30-40% between annual

[7]Data is also available for the pressmen, but their salary contains in most cases also the salary of the apprentice that worked with them, without specifying the exact division.

wages and day wages. About a quarter of this difference can be attributed to changes in the number of weeks worked. The remainder is likely due to changes in the length of the working week, or changes in the salaries of compositors relative to other employments.

Table 6: Indexed daily, weekly and annual wages in Antwerp

Years	Annual wages	Weekly wages	Day wages
1590-1599	100	100	100
1600-1609	108	104	105
1610-1619	124	123	105
1620-1629	146	143	105
1630-1639	136	132	105
1640-1649	157	149	105
1650-1659	168	160	105
1660-1669	150	142	105
1670-1679	148	143	105
1680-1689	138	130	105
1690-1699	144	137	105
1700-1709	118	110	105
1710-1719	132	121	105
1720-1729	145	133	105
1730-1739	150	138	105
1740-1749	118	108	105
1750-1759	139	127	105
1760-1769	160	147	105

Annual and weekly wages are based on the compositors of the Plantin Press, day wages are for construction workers.

D Rent Control Index

We use two different measures of rent controls for our analysis in the main part of the paper. First, we use the measure of nominal rent controls from Kholodilin (2018), which is one of the inputs in his total rent regulation index. This dummy takes the value of 1 if any form of nominal rent control is present in a given year. If rent regulation is only introduced or changed through the year, it uses the share of time the rent control was present. One disadvantage of the index of Kholodilin (2018) is that it does not allow to distinguish between first generation rent controls and more modern ones that are

more flexible (e.g Arnott, 1995). A second disadvantage is that it is a national measure. For example, in The Netherlands rents were regulated at the local level rather than at national level. Only recently this system has been nationalized. We therefore also create a secondary rent control index that restricts the index of Kholodilin (2018) to the most stringent nominal rent controls, and also accounts for differences in rent controls across localities or housing classes. We motivate our index here.

For The Netherlands, we use information from a report of the Dutch Rental Committee (Huurcommissie, 2017). Rent controls were introduced in 1917, and these freezed the level of rents on smaller homes at the level of 1916. In 1918, rents on more expensive properties were frozen as well. At the same time, municipalities could introduce rental committees that would judge whether landlords were allowed to raise the rent if maintenance costs for example increased. Rent controls were gradually relaxed from 1922 until they were fully liberalized on January 19, 1927. To account for this, our rent control index linearly decreases from 1 to 0 in this period.

Rents were frozen again on December 27, 1940 following the outbreak of World War II in 1940. Because rent laws were set at the national level, but differed across municipalities, we use information from rent regulation published in the Dutch *Staatsblad*, which published all applicable laws. Until January 1951, no changes on rents were allowed. Between 1951 and 1967, rent increases were strictly set by the government, and had to be adhered to. Rent increases were announced on average every two years. In this period, our rent control index takes the value of 2/3. In some municipalities, rents were already liberalized by the 1960s, as rents had caught back up to their market level. Between 1968 and 1981, rent increases in Amsterdam were capped, but could be set freely below that cap. In this period, the rent control index takes the value of 1/3.

In Belgium, interwar rent control laws are discussed in Bettendorf and Buyst (1997). They were introduced in 1919 following the housing shortages that had built up during World War I. Homes were frozen relative to the level of 1914. Rents were gradually decontrolled across housing classes between 1927 and 1929, so we linearly reduce the rent control dummy. After 1929, only properties with very low rentals were controlled by the market. To account for this, we keep the value of the rent control dummy at 0.1 until 1938, when also these properties were de-controlled. Rent control was reinstated in 1940 following the outbreak of World War II. Rent controls were abolished in 1957 except for

subsidized housing (which is not in our sample), when we change the rent control index back to zero (Brown, 1970). There was some reimposition of rent controls in the 1960s and 1970s, but we do not incorporate these as rental information is missing from Belgium between 1961–1977.

In France, the rent control regime was most severe (see Bonneval, 2011). Rent controls were initially only applied in 1914 for those drafted for war, but applied to all properties from 1919. Rents were fixed by applying a coefficient relative to the rent level of 1914. The exact regulations varied across properties and rent levels, but the law remained firmly in place until 1948, when a new law was passed that ended this regime. It replaced the old system of rent controls, and only applied to certain dwellings. It deregulated rents on new dwellings, but also gave tenants the right to stay in old dwellings for low regulated rents. The share of dwellings covered by this law gradually declined from the 1948s onwards, although nowadays a very small set of properties is still under the 1948 law. However, because the 1948 ended strict rent controls on new contracts, we set our rent regulation index to zero after 1948.

In the United Kingdom, rent controls were introduced on December 23, 1915 to combat housing shortages caused by World War II. Rents were frozen relative to the level of 1914. The law was extended in 1920, and rents remained in full control until 1923. Between 1923 and 1933, the UK government gradually lifted rent controls, and our rent index therefore gradually and linearly declines in this period (Willis, 1950). Rent controls remained in place for cheap properties if the tenant did not change, but since our index only covers new contracts, rarely below this limit, we put the rent control index after 1933 at zero. Rents were frozen again in 1939, and strict nominal controls remained in place until 1957, when more valuable properties were decontrolled. Correspondingly, we set our index at 0.5. From 1965, strict controls were completely removed and replaced by regulated tenancies. The idea of rent regulation rather than rent controls was that rents would be set by the market, but that landlords and tenants could appeal to the government in case of disagreement about the 'fair' rental price (Wilson, 2017).

D.1 Construction Estimates

To control for the effect of construction, we compiled data on construction levels for our cities for the period of time where such controls played a likely important role.

One difficulty in creating such measures is that there exist few consistent measures of construction both over time and across cities. To create a consistent measure across cities and over time, we therefore normalized values per city. If the definition of construction changed within a city, we normalize per construction measure using standard z-scores.

For Amsterdam, statistical yearbooks provide annual estimates on the number of completed residential buildings from 1870-2018 (Gemeente Amsterdam, 2018). To measure the rate of construction, we scale this number by the level of population in the city.

For the Belgian cities, we use data on the number of complete buildings (at the national level) from the annual yearbook of Belgian Statistics (Statistics Belgium, 2018) from 1940 until 1961. We do not extend this measure after 1961, because our rent index is interpolated between 1961 and 1977. From 1920 to 1940, we use the number of constructed buildings published in Buyst (1992). Again, we normalize both measures after scaling them with the total level of Belgian population.

For Paris, we use data from Duon (1946) on the number of newly constructed housing units between 1870 and 1944. To estimate the number of housing units, we multiplied the number of homes constructed by the number of households per home. Between 1944 and 1967 we use data on completed construction from Mairie de Paris (1967) for the Seine department, which contains the Greater Paris area. We scale both measures by population, and normalize them.

For London, we use data from Mayor of London (2017) that compiles annual data on completed construction between 1871 and 2017f. We scale this by population, and normalize.

Table 7: Housing Quality per Capita

Year	*Amsterdam*	*Bruges*	*Ghent*	*Antwerp*	*Brussels*	*Paris*
1527						26
1561	66					
1571			45			
1584		33		45		
1632	50					
1667		57		73		45
1695						61
1700						76
1713						56
1733	63					
1755						62
1796				82		
1787						69
1790						84
1805	79					
1815	73					
1819						107
1832	65					
1834			67			
1851						84
1865		63	84	70	61	
1878						80
1889						89
1890		100	100	100	100	
1900						94
1909	100					
1911						100

Notes: This table shows the indexed developments in housing quality per capita, for years for which it can be computed. For the Belgian cities, the index is normalized at 1890=100, for Amsterdam we use 1909=100. For all cities, the developments in housing quality per capita are in line with those reported in Table 2 in the main paper. The main outlier in the table is Amsterdam in 1561, but it is likely that this number is biased upward, due to a significant underestimate of the total Amsterdam population. This estimate is based on Van Dillen (1929) estimated population by multiplying the number of homes by five, but in all 17th century fiscal records, the estimated number of persons per home is well above 10, suggesting the 1561 quality per capita figure should be halved.