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Authors: Thies Lindenthal[a], Matthijs Korevaar[b] and Piet Eichholtz[c]

Affiliation: University of Cambridge[a,] Maastricht University[b&c]

Contact corresponding author: Thies Lindenthal, htl24@cam.ac.uk

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500 Years of Urban Rents, Housing Quality and Affordability

Piet Eichholtz, Matthijs Korevaar and Thies Lindenthal*

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Abstract

We study urban housing rents and quality from 1500 to 2017 for Amsterdam, Antwerp, Bruges, Brussels, Ghent, London, and Paris. Based on a dataset of 436,000 rent observations, we relate rent developments to wages and consumer prices. Real rents have developed similarly in the long term, but reflect shorter-run differences in local economic and political conditions. Long-run growth in real rents has been limited. The ratio of wages to market rents was stationary before 1900, but grew considerably after that. Most of the increase in housing expenditure that did occur is attributable to increasing housing quality rather than rising rent.

*Eichholtz: Maastricht University, p.eichholtz@maastrichtuniversity.nl. Korevaar: Maastricht University, m.korevaar@maastrichtuniversity.nl. Lindenthal: University of Cambridge, htl24@cam.ac.uk. *Acknowledgements:* We thank David le Bris, Gregory Clark, Heidi Deneweth, Steven Devaney, Marc Francke, Jacques Friggit, Philip Hoffman, Katharina Knoll, Patrick Lusyne, John Quigley, Arthur van Riel, Carolin Schmidt, Yves Segers, Sven Vrielinck, and participants at the AREUEA International Conference, European Macrohistory Workshop, RCA Research Seminar, UPenn-Wharton China Conference, Vrije Universiteit Brussel, and the World Congress of Cliometrics for their helpful comments and/or for generously providing their data. We are also thankful to the staff of the various archives we visited for smoothly dealing with our requests for archival materials. We thank Jeanine van den Bosch and Sjoke Merk for their research assistance to collect different parts of the dataset. We particularly want to thank Ronan Tallec for his efforts to locate and retrieve the Parisian archival sources. Korevaar has been financed by the Netherlands Organisation for Scientific Research under the Research Talent scheme (no. 406.16.552). Part of the data collection for this paper was funded by a Cambridge Humanities Research Grant and an Exploratory Travel & Data Grant from the Economic History Association.

> *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.

Affordable homes, according to the Cambridge Dictionary (2018) are "able to be bought or rented by people who do not earn a lot of money". As appealing as this sympathetically straight-forward definition might sound at first, it turns out to be not very helpful when analyzing affordability in detail. Housing affordability problems are not merely a matter of rising housing costs meeting insufficient income: they stem from the interplay between house prices, housing rents, income levels, income distributions and housing quality (Quigley and Raphael, 2004).

Definitional quibbles aside, housing is dear for many households and is perceived to have become too expensive in many cities, as a barrage of existing and recently introduced affordability policies attests. For example, London's mayor promised to start building 116,000 "truly affordable" homes by 2022 (Mayor of London, 2018), while Paris and many German cities experimented with new rent control policies since 2015 (The Economist, 2018). In New York, over one million housing units are subject to rent regulations and similar policies are being discussed or have been implemented in various cities across the US, most notably in the San Francisco Bay Area (Diamond, McQuade and Qian, 2018).

The intensity of the debate in the general public shows the urgency of the issue, while the lack of best-practice housing market interventions reveals the difficulty in measuring housing affordability and assessing the success of any interventions. Despite the long history of housing market interventions, with many countries already introducing rent control and supply side measures after World War I, we do not know how rent prices, housing affordability and housing standards have evolved in the long run.

This paper aims to fill that gap: we present the first long-term overview of developments in urban rents, housing quality and affordability, going back more than 500 years. First, we construct continuous annual rent price indices from

1500 to the present for seven European cities: Amsterdam, Antwerp, Bruges, Brussels, Ghent, London and Paris. Second, we combine these new rent indices with indices of wages and consumer prices – both existing and newly constructed – to investigate developments in housing affordability. Last, we complement our rental information with additional data to construct indices of housing quality that trace trends in housing standards since 1500.

We focus on urban rents, because in most European cities renting has traditionally been the dominant tenancy form. The seven cities in our sample offer rich data on housing markets in diverse economic conditions: each city has been an influential commerce hub at different periods in time – or still is. Some grew quickly initially and slowed down later, such as Ghent, Bruges, Antwerp and Amsterdam, while others, notably London and Paris, have continued expanding and retained their leading status in the 21st century. Such shifts possibly had an impact on fundamental equilibria of housing costs, affordability and quality, which are most visible over the long run.

By taking a half-millennium perspective, we believe this paper offers three contributions that jointly provide a different outlook on the current housing affordability debate. First, most urban rental markets in Europe have been under some form of government regulation since the early 20th century, often due to concerns over affordability (Arnott, 1995). However, we still have very little information on how affordability and housing quality evolved before, during and after these interventions. Our long-term study gives a perspective on housing rents and affordability for the 400-year before direct rent regulation and other market interventions were introduced, as well as for the past century when such housing policies were in place. This comparison leads to a very different perspective on developments in affordability: we show that housing affordability, in terms of the ratio of quality-controlled rents to wages, showed no long-term improvement before the 20th century. However, affordability improved drastically from World War I onward until the second part of the 20th century, and most of these improvements seem to have taken place during periods of strict rent controls.[1] Although

[1] This does not imply a causal link between rent controls and improvements in affordability as

affordability has recently started worsening in some of the cities we study, rental housing remains far more affordable than in the centuries before.

Second, we show that urban rental housing quality and housing consumption per capita have both risen considerably. A house provides a collection of housing services, and for the housing stock as a whole, the variety and quantity of the attributes generating the services increases gradually over time. 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 and plumbing, and access to sewers and electricity became standard features of urban dwellings. The timing of these updates is remarkable: housing quality already rose considerably from the 16$^{\text{th}}$ to the 18$^{\text{th}}$ century, suggesting that living standards already improved prior to the Industrial Revolution. This is both visible per capita and per home. During the Industrial Revolution, housing quality stagnated or sometimes even declined. Housing quality started rising again from the late 19$^{\text{th}}$ century and continued to increase in the 20$^{\text{th}}$ century, helped by improvements in rental affordability. This seems to be at odds with households' expenditure shares on housing reaching new heights, but implies that most increases in housing expenses stem from improvements in housing quality and quantity rather than increasing prices of a given set of housing attributes. Evidence on observable characteristics of housing quality obtained from census data further supports these claims.

The third contribution, and arguably the most important one, lies in the creation of the new rent indices themselves: these are annual frequency indices, based on primary data, estimated using a state-of-the-art methodology that accounts for quality differences, and that is consistently applied across cities. We collected more than 436,000 individual rent observations from archival sources and from earlier studies. These indices – which are the longest in the literature – give important insights in the long-term developments of the housing market rental price. Our results underscore the importance of quality controls when constructing indices of

post-war rent control polices went hand-in-hand with efforts to increase housing supply through construction and reconstruction (Arnott, 1995).

housing rents: had we not controlled for quality improvements, our indices would have overstated rental growth manifold. Beyond cost of living, housing rents also are a crucial – but not widely available – component of any total return calculation to housing investments. Since data on actual cap rates is barely available, typically housing returns are computed by relating a house price index to a rent price index Jordà et al. (2017). However, if these indices do not adequately account for housing quality – and very few do – this will lead to problematic return estimates.[2]

Our annual rent indices reveal that long-term growth in real housing rents has been modest, at most. The annualized geometric growth rate of real housing rents between 1500 and the present is around 0.2 percent for the Belgian cities and Amsterdam, and around 0.3 percent for Paris and London. In addition, from the 17^{th} century onward, rents have followed very similar trajectories over the long run, suggesting that the long-term benefits from regional diversification across housing markets might be less significant than previously thought.

Our paper relates to three different strands of literature: the economic history literature on developments in the cost and standard of living, the large literature in real estate finance and economic history on developments in long-run house prices and rents, and the economic literature on housing affordability and the policy interventions to support it.

To start with the latter, it is important to re-iterate that the literature does not offer a single consensus definition of 'housing affordability' but a wide spectrum. On one extreme, housing affordability is considered 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 is tied to housing or income standards, which vary over time. On the other end, affordability issues are consid-

[2] Since the rent and house price series in Jordà et al. (2017) are based on indices that sometimes do and often do not control for quality, this likely is a major reason why their standard rent-price ratios often produce implausibly high values, particularly early in the sample. Jordà et al. (2017) correct their series using scattered estimates of cap rates from a variety of secondary sources, implicitly assuming that the error results from the rent price index and not the house price index.

ered to arise if house or rent prices exceed their fundamental values, independent of income. Constraints on housing supply, for example through zoning regulations, have been found to be a major driver of expensive housing (Glaeser and Gyourko, 2003; Quigley and Raphael, 2005; Hilber and Vermeulen, 2016)

Most approaches combine measures of house costs – prices or rents – with estimates of income. This is also the approach taken in this paper. However, we need to be careful in defining 'housing costs'. For example, simple cost-to-income ratios are still widely used to assess housing affordability, while they do not control for the quality of housing nor take account of differing consumption of housing amenities (Linneman and Megbolugbe, 1992). We compare rent and wage developments, in line with 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. Quigley and Raphael (2004) apply various measures to trace affordability in the United States from 1960 until the early 2000s, including rental housing. They find that affordability has worsened over time, in particular for low-income renters, and that this may be due to improvements in housing quality. As far as we can see, no studies look at developments in housing affordability over longer periods of time.

In addition, a wide body of literature discusses the effects of policy measures targeted at improving housing affordability, most notably rent control. The earliest paper warning that such measures can have negative consequences is Friedman and Stigler (1946), and since then, different authors have pointed at lower maintenance incentives (Downs, 1988), negative neighborhood effects (Sims, 2007; Autor, Palmer and Pathak, 2014), and the misallocation of housing Glaeser and Luttmer (2003). However, due to lack of detailed data and the endogeneity of housing policies, it is still unknown to what extent these measures influence rents and the long-run development in the housing supply. This is crucial, however: if rent ceilings weaken the incentive for landlords to construct homes, so lowering the growth of the housing supply, their log-run effect may be higher rents, even if these ceilings had lowered rents in the short run. Interestingly, a recent paper of Diamond,

McQuade and Qian (2018) exploits quasi-experimental variation in rent controls in San Francisco, and finds that city-wide rents increase and housing supply decreases in response to rent control. Although we find that housing affordability improved most during periods of rent control in the early 20th century, our set-up does not provide causal evidence on the effect of such policies. For example, large expansions in subsidized housing supply in these periods might have played an important role in housing rents. Instead, our main focus is to track developments in the main policy outcome variables: rents, housing quality, and affordability.

While a long-term, cross-city perspective on rental housing affordability has not been achieved before, studies aiming to trace the historical cost of housing are becoming more and more frequent. Beyond a large number of studies for various cities in Western Europe, which are almost all compiled in this paper (see appendix A), studies have appeared for other regions too, starting with the early work of Margo (1996) for 19th century New York City. In light of our study, the papers of Carmona, Lampe and Rosés (2017) and Clark (2002) are particularly relevant. The former studies housing rents and prices in early 20th century Spain and, as we do, attempts to relate this to measures of housing affordability. The study of Clark (2002), whose primary data are also used in our study, focuses on England and also estimates implied changes in housing quality. Except for the smaller sample, the main difference between his study and our approach is the fact that we focus on urban rents only, and apply an index estimation method that is more suitable for smaller sample sizes.

Studies of historical rent prices have uncovered excellent primary rental data on particular cities and eras, yet a consistent overview and comparison across cities and centuries, updated to current times, is lacking. However, various existing studies have made attempts to compare rent or house prices across countries. Hoffman et al. (2002), as part of a broader study on real inequality, compile rent prices indices for England, Holland and Paris from the 16th to 19th century. For house prices, Knoll, Schularick and Steger (2017) splice together existing indices to obtain annual house price indices, covering 14 different advanced economies

from 1870 to 2012. In Jordà et al. (2017), these series are combined with rent price indices, which have been compiled in a similar fashion. Contrary to this paper, these three studies combine existing indices on both urban and rural rents, and are constructed with various methods that do and do not control for housing quality. However, at least for the cities and time periods we study, consistently controlling for quality is critical: had we not done so, we would have arrived at a completely different conclusion regarding the long-run evolution of rent prices.

So far, few cost-of-living studies have been able to include housing rents, and even fewer have been able to use quality-controlled indices, despite the importance of housing for living standards. Typically, housing costs are assumed to have been a constant five to ten percent of total housing expenditures, and were neglected if no data was available (see e.g. Allen, 2001). Our findings suggest that expenditure shares on housing were not constant over time, both due to changing rental prices and gradual improvements in housing quality. The substantial improvements in housing standards that we document suggest that living standards already improved prior to the Industrial Revolution.[3]

1 Data

Tracking rent prices, housing quality and affordability for seven cities and for more than 500 years at annual frequency, creates some data collection challenges. We compile rental cash flow and contract data from dozens of existing historical and contemporary studies, combined with hand-collected primary data from archives. This effort resulted in the collection of about 300,000 observations of housing rents, most of which originate from the archives of social institutions, such as churches, monasteries, orphanages or hospitals. Beyond these sources, we collected addi-

[3] Such improvements are subject to significant debate in the literature in economic history. One branch of economic history literature, in which Clark (2008) has been most notable, has argued that no standard of living improvements took place. A second view, among others presented in De Vries (2008), and in Broadberry et al. (2015) for the United Kingdom, is that standards of living already improved prior to the Industrial Revolution. Since the cities we study are at the heart of the region that experienced the 'Industrious Revolution' that is at the core of this debate, our study also sheds new light on this issue.

tional primary and secondary data on estimated rents from tax registers in order to assess the representativeness of the institutional data. Including these, our database of primary rental data contains over 436,000 observations, about 30 percent of which we hand-collected from archival sources. An overview and detailed discussion of all sources, both primary and secondary, can be found in appendices A and B. We converted rents for each country into a single local currency (Dutch guilder, French franc, Belgian franc, British pound), and removed duplicate or non-representative observations from the sample.

Rather surprisingly, it was more difficult to obtain primary data on housing rents for the 20th and 21st century than for preceding centuries. We therefore had to rely on secondary sources from the mid-20th century onward, while still only selecting sources that (attempt to) control for housing quality.[4] In most cases, these series are based on the rent component of the CPI, often at the urban level but sometimes using national figures. Although these indices do adjust for quality, there has been some debate whether they accurately represent market developments. For the United States, Gordon and VanGoethem (2005) argue that the rent component in the CPI from the early 20th century until the 1980s is biased downward, given that hedonic improvements in housing quality cannot make up for the increase in mean housing rents relative to the quality-controlled CPI figure. One potential reason for this bias is that renters are less likely to be included in the rental survey when they move place, even though rent increases typically occur after signing a new contract. Ambrose, Coulson and Yoshida (2015) make a comparable point but find a bias in a different direction for the 2000s: their repeat-rent index, based only on newly-signed contracts, increases much less than the rent component of the CPI. To investigate whether these issues might also affect our findings for the late-20th and 21st century, we will look both at implied improvements in housing quality as well as observable improvements in quality in this period.

Beyond housing data, we also compiled primary and secondary data on consumer prices and wages, in order to assess real rents and rental housing afford-

[4] The only exception is Paris, where we rely on a secondary rent index already from 1867.

ability. For the Belgian cities, we create a new consumer price and wage index (1500-1830), while we rely on existing series for the other cities. The data sources and methodology for our wage and consumer price indices are discussed in appendix C and D. As much as possible, we have selected wage data that closely reflect the marginal product of labor. This is important, because our affordability estimate is targeted to measure the number of units of housing that can be purchased per unit of work. Until the 19$^{\text{th}}$ century, most of our series are based on day wages, while for the remainder we have used estimates of hourly wages whenever possible.

Last, we searched existing sources for population estimates of all cities except London, and interpolated population numbers using cubic splines. We employ these population numbers to create population-weighted indices for the Belgian cities and to compare developments in housing quality per home and per capita. The data sources are discussed in appendix E.

How representative are institutional rents?

With the exception of Paris (1809-1860) and London (1909-1959), virtually all of our primary sources originate from the archives of social institutions. Such institutions were very prevalent in most European cities, and often had considerable housing portfolios, mostly resulting from bequests or donations over time. They used the rental cash flows of these homes to finance their activities. These institutions were the precursors of the modern-day institutional investors (Gelderblom and Jonker, 2009), and kept extensive archival records of their accounts, of which many have survived the test of time. Although renting from private landlords was more common than renting from such institutions, small-scale landlords did not keep archives, such that institutional data sources offer the best perspective on urban housing rents. This limitation implies that we have to address two important issues: did these institutions own a portfolio of housing that was representative of the housing stock of the city, and were these homes leased at market rates?

There is compelling evidence showing that the homes owned by these institutions were indeed rented at market rates. First, many institutions relied heav-

ily, and some even exclusively, on rental streams to finance their core activities and could therefore not afford to ask below-market rents (Le Roy Ladurie and Couperie, 1970). Correspondingly, they cared significantly about the returns they made on these properties (Gelderblom and Jonker, 2009). For rural properties around Paris, owned by the Cathedral of the Notre-Dame de Paris, Hoffman (2000) provides anecdotal evidence that clearly points towards these charitable organizations trying to make profits from their property portfolios. Second, these institutions did not use their real estate portfolios to provide low-cost housing to the poor, and in each city there was considerable variety in the homes being leased, varying from sober tenements to urban mansions. Only in a handful of cases there was evidence that homes were rented at low or no cost (e.g. to widows), but such cases were typically clearly indicated and excluded from our sample.

To investigate the representativeness of the institutional housing portfolio for the housing stock in each city, we compared the mean level of rent in our sample to the mean level of rent obtained from historical fiscal sources or private rents. For the period before World War I, we could obtain such an estimate in 49 cases, spread over various cities and centuries. On average, institutional rents are only 2 percent higher than those obtained from other sources, indicating they are not systematically different from each other. However, in some periods, most notably Amsterdam and Bruges in the 19$^{\text{th}}$ and early 20$^{\text{th}}$ century, mean rent levels do not seem representative for the entire city. These differences are typically due to small-sample issues, since they coincide with periods with both a lower number of observations and different institutions in the sample. Although observations in these periods can still be used to estimate market rent prices, we should be more careful in using them to infer housing quality. For a more detailed discussion of this comparison and the sources used we refer to Appendix B.

We could not formally assess the representativeness of the London sample. For the early 19$^{\text{th}}$ century, Clark (2002) used estimates of rents from tax records, and found those to be closely correlated with the average level of rents in his sample for England and Wales. However, our London sample is likely the least representative

due to the low number of observations. This is particularly the case before 1770, when our sample contains only 2.5 observations per year.

2 Estimating Rent Price Indices

The literature on the estimation of rent indices has relied on hedonic models and repeated-measures models, also used in this paper. The basic repeated measures methodology from Bailey, Muth and Nourse (1963) starts with observation that the log price on any asset, in this case the log rental price r_t on a particular home i, can be represented as the sum of three components:

$$r_{it} = \alpha_i + \beta_t + \epsilon_{it} \tag{1}$$

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). Taking differences for any time periods t_1 and t_0, the change in log rental price on any home i can be written as follows:

$$r_{it_1} - r_{it_0} = \sum_{t=1}^{T} \beta_t D_{t,i} + \tilde{\epsilon}_{it} \tag{2}$$

D refers to a set of dummy variables that take on the value of 1 if t=t_1 and -1 if t=t_0, and $\tilde{\epsilon}_{it}$ equals the difference in the two error terms. Equation (2) can be estimated using OLS, and subsequently converted to an index by exponentiation.

To satisfy the assumption of constant quality between rent reviews, homes in our sample were treated as new observations if there was any indication that the home had been rebuilt, renovated or significantly affected in some other way. Still, it is unlikely that house quality does not change at all. First of all, we cannot account for the effect of aging on the properties as we do not know the years in which they were built. Second, minor quality improvements to the property might

not have been registered. However, we believe the potential errors are small, as homes were well maintained for, in many cases, hundreds of years.[5]

Since rental contracts were typically signed for several years, we only included a rental observation in the index estimation in the year a new contract had been signed. For the Belgian cities, and for most observations from Amsterdam, rent data did not specify new contracts. For these observations, we only included observations where the rent changed, as that implies a new contract has been signed. The main disadvantage of this approach is that it misses observations where the new contract is signed at the same price. In Paris, this was the case in about 30 percent of contracts. Additionally, as in Clark (2002), we excluded contracts lasting more than 21 years as they likely represent ground leases rather than rents.

The use of repeated contracts implies that in some cities, in particular London and Bruges, the remaining number of observations is low. In such cases noise in the rent prices can have a large impact on the resulting index. The literature has proposed several adaptations of the original model to improve the signal-to-noise ratio. Probably the most notable of these are the studies by Goetzmann (1992), proposing a Bayesian ridge estimator, and Francke (2010), who develops a generalization of Goetzmann's method that allows for general model specifications that can be compared using likelihood criteria. We follow the model of Francke (2010), and specify the betas in equation (2) not as fixed unknown parameters to be estimated using OLS, but by using a local level model:

$$\beta_{t+1} = \beta_t + \zeta_t, \qquad \zeta_t \sim N(0, q_\zeta \sigma^2) \tag{3}$$

The dependence between the betas is based on the signal-to-noise ratio q_ζ. If this ratio is low, the variance of the error terms of the index is low and the dependence between the betas will be strong, resulting in a smoothening of the index compared to the standard case. Francke (2010) proposes an empirical Bayes procedure to

[5] Some archival records also specify property related expenses. For example, the Burgerweeshuis, the biggest institutional owner in Amsterdam, spent about 26 percent of its rental revenue on maintenance between 1682 and 1806 (ACA 367.A, no. 141).

estimate the index. Conditional on the variance parameters q_ζ and σ^2, estimates of the annual coefficients can be obtained using generalized least squares. The variance parameters are subsequently estimated by maximum likelihood. Summary statistics of this index estimation procedure, as well as further robustness checks, are reported in Appendix F for each city. For more detail regarding the estimation method, see Francke (2010).

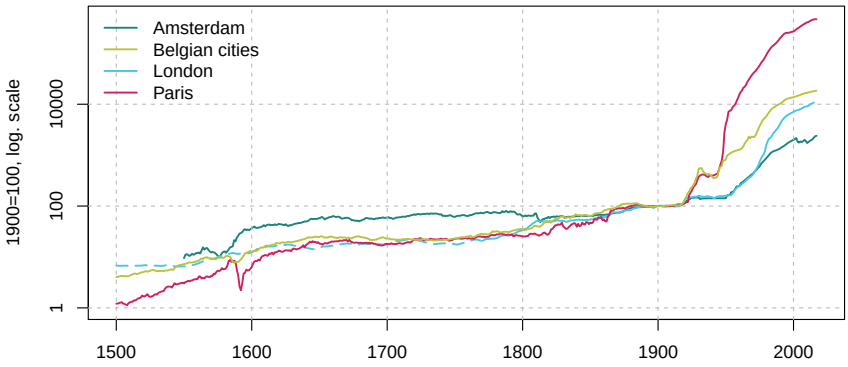
3 Rents in the Long Run

Figure 1 reports the rent indices for Amsterdam, Paris, London and the Belgian cities, in both nominal and real terms, together with estimates of real wage developments. Real rents are deflated based on consumer price indices. Although real rents can be compared across cities, they are very volatile due the large short-term fluctuations in the consumer prices indices, in particular before the 20$^{\text{th}}$ century. As can be seen from Figure 1a, volatility in nominal rent developments is much lower.

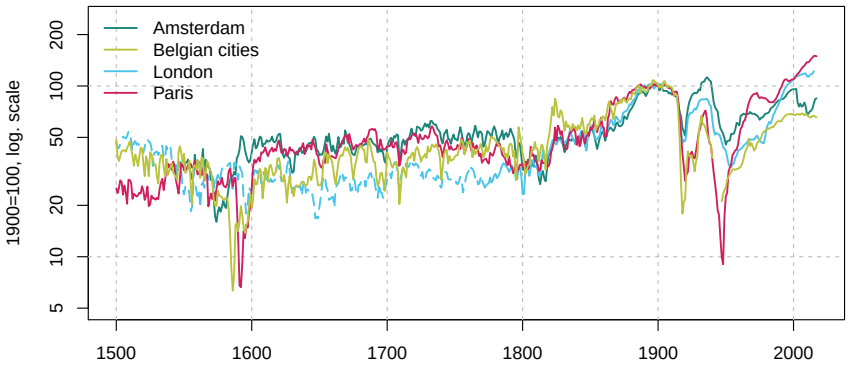
The first and most striking conclusion from the figure is that rental prices have shown little growth in the long run. For Paris the implied annual (geometric) growth rate of real rents is around 0.35 percent, while in London and Amsterdam real rents have increased at a rate of 0.2 percent per year. For the Belgian cities, real rent growth has been even less at 0.06 percent per year. This result confirms existing evidence for urban house prices. Eichholtz (1997) finds little long-term price appreciation for the homes on the Herengracht, Amsterdam's most expensive canal. The same holds for Shiller's (2000) price index for US homes since 1890. While house prices differ from rental prices in the short to medium run, Ambrose, Eichholtz and Lindenthal (2013) show, based on data form Amsterdam, that the long-run developments in house prices and rents have been similar. The long-run stability of rental prices also shines new light on existing studies. Hoffman et al. (2002) note that rising housing rents contributed to rising real inequality prior to 1800, most notably in pre-revolutionary Paris, as the poor had to rent their homes. However, this rise in housing rents seems to be the result of rising housing

Figure 1: Rent and Wage Indices, 1500-2015

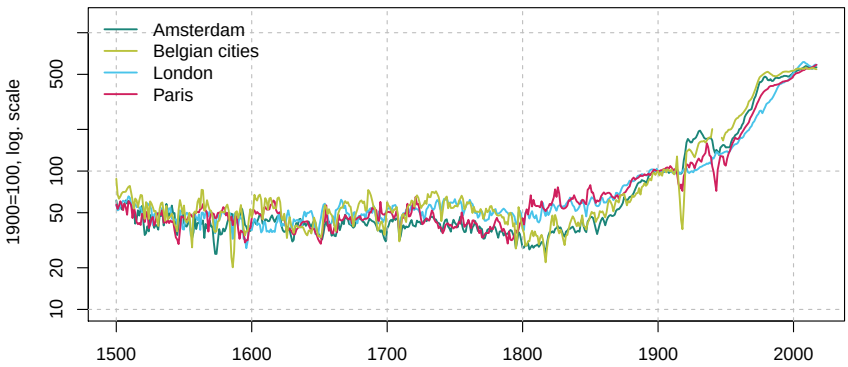
(a) Nominal Rent Indices



(b) Real Rent Indices



(c) Real Wage Indices



quality, since it mostly disappears after controlling for quality. This suggests that housing costs were not a major force driving up real inequality.

The second important conclusion is that over the long run, in particular since the 17$^{\text{th}}$ century, developments across these rental markets exhibit strong similarities. Since 1600, the correlation in 50-year growth rates across cities varies between 0.9 and 0.95. This suggests that these cities have had close economic connections

in the last 400 years, and it would imply that benefits from geographic diversification, for example for very long-term rental housing investors like sovereign wealth or pension funds, might be smaller than previously thought, at least within Europe (Jordà et al., 2017).

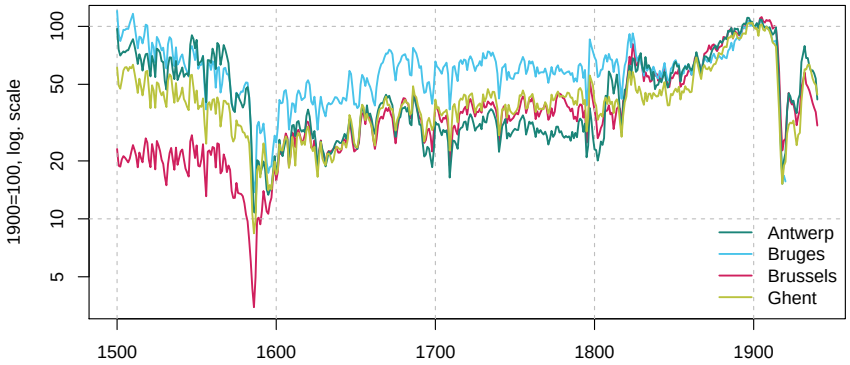
Beyond the general long-term conclusions, the short- to medium-term developments of the indices also offer interesting perspectives on the economic history of these cities and their housing markets. Discussing 500 years of economic history for seven cities in detail is of course beyond the scope of this study, but we would like to point out some of the most interesting trends over time and give a few examples of how housing rents often closely reflect a city's fortunes. We believe this is particularly interesting because real rents show much more variation in the short-term than real wages, as can be seen from Figure 1. This suggest that from a historical point of view, time series of the housing market might provide a more direct perspective on the sometimes turbulent history of the cities in our sample.

Of the more than five centuries that our indices cover, the 16$^{\text{th}}$ century was probably one of the most turbulent in terms of rent development. In the first part of the century, spectacular movements in rent levels were still absent: real rents were steadily increasing in Paris, but gradually declining in London and the Belgian cities, where the decline in real rents coincided with a declining level of real wages. In the second part of the 16$^{\text{th}}$ century, real rents started declining more quickly in both the Belgian cities and The Netherlands, following the start of the Eighty Year's War in which the provinces of the Low Countries fought against the Spanish. Although the Eighty Years' War was full of twists and turns, it induced an economic shift of the Southern Netherlands, containing Brussels, Antwerp, Ghent and Bruges, to the Northern Netherlands, most notably Amsterdam. Antwerp, the economic powerhouse in the region for most of the 16$^{\text{th}}$ century, was captured by the Spanish in 1585, ensuring Spanish control of the Southern Netherlands as Brussels, Bruges and Ghent had surrendered already. Many merchants left the Belgian cities and moved to Amsterdam. As also visible in the level of rents, Amsterdam entered its Golden Age, while the Belgian cities

were left in state of despair.

As can be seen from Figure 2, which reports developments in real rents for each of the Belgian cities, Brussels was the only city to emerge relatively unscathed from the wars. It didn't experience such a large loss of population as Antwerp and the two Flemish cities, and could sustain its economic status as the capital of the Southern Netherlands. For the other cities, most notably Antwerp, this had been made more difficult as the Dutch had started a naval blockade of the Scheldt, limiting the access of Antwerp, Ghent and Bruges to the sea. For Antwerp, this situation lasted until the end of the 18$^{\text{th}}$ century-early 19$^{\text{th}}$ century, when the Scheldt was gradually reopened. In that period, Antwerp's housing rents recovered fast, as the city developed once again into one of Europe's main port cities. That did not happen in 19$^{\text{th}}$ century Bruges. It did not industrialize like Ghent, Brussels and Antwerp, and became one of the poorest cities in Belgium. This is reflected in the much lower growth in its housing rents.

Figure 2: Real rent indices for Belgian cities, 1500-1940



Note: Indices deflated with combined consumer price index for four cities

Paris experienced trouble similar to the Belgian cities at the end of the 16$^{\text{th}}$ century. During the Wars of Religion, the Catholic and Protestant side of the conflict fought over possession of Paris, culminating in the 1590 Siege of Paris. Around the Siege, nominal housing rents declined by as much as 75 percent, following the starvation and migration of a large part of the Parisian population, and it took almost 20 years for housing rents to recover fully. The situation was so exceptional that the *Parlement de Paris*, its most important court, twice ruled that

tenants only needed to pay a fraction of their contractual rent amount (Félibien, 1725). These Parisian laws are among the very first recorded instances of explicit public interference in rental markets.

After the turbulent 16th century, rents were at relatively stable levels throughout the 17th and 18th century. However, by the end of the 18th century, real housing rents started to decline substantially in most cities. This decline was most severe in Amsterdam, where it lasted well into the 19th century. Amsterdam had remained one of the most important European cities for most of the 18th century, but ended in a very deep economic crisis following the start of the French period in the late 18th century. The only city that did not experience a fall in real rents was London. This should not be very surprising. First of all, London's rent levels were at relatively low levels compared to the other cities for most of the 17th and 18th century. Correspondingly, it is also at this point in time that Adam Smith makes his point about London's low lodging costs (Smith, 1776). Second of all, England initiated the Industrial Revolution in the second half of the 18th century, and subsequently dominated the European economy in the 19th century. The Industrial Revolution did not only lead to the first sustained increases in real wages, it also led to unprecedented urbanization and the first sustained upswing in real housing rents across cities. During the 19th century, real rent growth reaches unprecedented levels: rents roughly triple in each of the cities we study.[6] Although real rent prices also rose enormously throughout the second part of the 20th century, particularly in Paris, total growth in this century was close to zero, or even negative for the Belgian cities.

Just like the rent swings at the end of the 16th century, 20th century rent developments cannot be seen separately from the wars that ravaged Europe at that time. At the start of the century, urban rent levels were already at high levels and rose even further due to World War I housing shortages. To address affordability concerns, all countries in the sample gradually started to adopt rent controls during the war. It is remarkable how similar the governments in the

[6] As noted before, Bruges was the main exception to this pattern, where rents have grown at much lower rates.

four countries studied here have acted during this turbulent period. First of all, most rent regulation focused on the nominal level of rents, rather than aiming to stabilize rents in real terms. With nominal rents fixed, hyperinflation and deflation after World War I created unprecedented volatility in real rents. Second, it seems that governments realized approximately at the same time that the combination of frozen rents and high inflation left little incentives for landlords to invest, harming the supply of rental housing. Thus, in each country rents were slowly deregulated from the 1920s onward (Willis, 1950). Nevertheless, the higher inflation had been, the more difficult it was to restore equilibrium in the rental market. Exactly the same process happened again during and after World War II: real rents initially declined significantly due to nominal rent controls, but could catch up as soon as rent controls were abolished or gradually weakened. After this turbulent period, most countries started to introduce more sophisticated rent control policies (see Arnott, 1995), which has likely had a dampening effect on real rent volatility.

Urban rental costs have started rising again in the last part of the 20$^{\text{th}}$ century and the 21$^{\text{st}}$ century. Although rent growth was limited in the Belgian cities, where real rents are still much below their level from the 19$^{\text{th}}$ century, Paris and London are characterized by large increases in housing rents.[7] As we have seen, like in the late 19$^{\text{th}}$ and early 20$^{\text{th}}$ century, this has led to increasing concerns about housing standards and affordability.

4 Housing Affordability

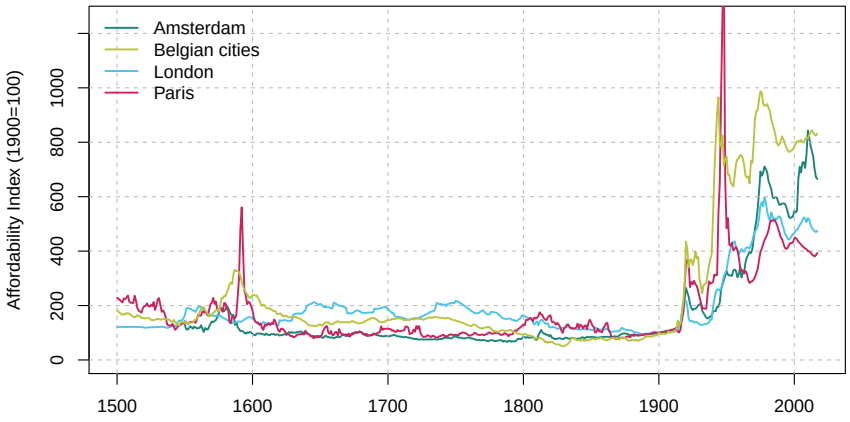
The discussion about housing affordability is as much a discussion about income as it is a discussion about the evolution of rental prices over the longer run: if rents for a given house rise faster than the income of the household, the share of housing expenses in the household budget will increase. To measure affordability, we therefore use an approach that is similar to Gyourko and Linneman (1993) and Gyourko and Tracy (1999), and express affordability as the indexed ratio of the

[7]Note that our Paris (1988-2017) and Amsterdam (2000-2017) indices are based on rent per square meter for part of this period. As a result, these rent indices might overestimate rent growth: rent per square meter only controls for size, and not for other aspects of housing quality.

wage index to the rent index.

Figure 3 plots the resulting indices of housing affordability 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. Equally striking is the fact that 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, 1500-2015



Wage indices switch to national indices from the early 19th century (Amsterdam, Belgian cities) or early 20th century

Beyond these long-term developments, there are substantial differences in affordability both across cities as well as over shorter periods of time. In the 16th century, most short-term variation in affordability was due to the changes in housing rents following the events sketched in the previous section, while declining real wages lead to a more gradual worsening of affordability. There were still significant differences in the relative affordability of the cities: the Belgian cities and London were relatively more affordable compared to Amsterdam and Paris during the 17th and 18th century, again 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 both London and the Belgian cities. This continued

in the 19th century, as housing rents continued to rise following industrialization.

The most striking developments in affordability took place in the early 20th century: housing affordability started improving dramatically and structurally. Although we can only provide correlational evidence, it is reasonable to assume that government interference in the rental market played a major role in the improvements of housing affordability. The first sudden wave of affordability improvements occurs from the last years of World War I until 1920-1921. This period coincides in each city exactly with the introduction of strict rent controls. The second cross-city jump in affordability took place right after World War II, and again coincided with introductions of strict rent controls. The fact that these sudden improvements in affordability were highest in the countries which experienced high levels of inflation suggests that the rent control measures – stated in nominal terms – were among the causes of these affordability jumps. Nevertheless, it remains difficult to identify to what extent rent control affected the systematic improvements in affordability in the 20th century: affordability often worsened when rent controls were released again, in particular after World War I, and increasing wages and expanding housing supply are likely to have played an important role as well. From the 1980s onward housing affordability did not improve anymore and even worsened a bit, in particular in London and Paris. Hence, from a short-term perspective the recent public-policy worries about housing affordability are understandable. But the long-term indices developed in this paper given a radically different perspective on developments in housing affordability: urban rental housing has become increasingly affordable, and still is more affordable that it has been in most of the last 500 years.

To be more specific, our indices imply that one unit of labor today buys four to eight times as much units of housing as one unit of labor 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 – so before the public-policy interventions in rent levels – 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, column 2, shows that the share of rental expenses in the household budget has increased substantially in all cities. Even including the expenses of home owners, who tend to be wealthier and spend a lower part of their income on housing, we still see increases in budget shares in the last 100 years. But 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 20th century itself. This is most striking in the Belgian cities and in Amsterdam, but it also holds true in London and Paris.

Table 1: Household budget shares on housing in the 20th and 21st century

City	*Year*	*%*	*2015 prices/wages*	*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

Sources: See Appendix A.3

Evidently, the discrepancy between these budget shares implies that housing quality must have gone up significantly: households could only increase their budget shares on housing if they would consume more housing. Hence, the main challenge is not to identify *whether* housing quality improved, but *when* and by *how much*.

5 Developments in Housing Quality

Equation (1) decomposed log rental prices into a quality component, a market price component and an error term. Thus, we can now use our index of rent prices together with an index of mean rent prices to get an estimate of the average level of housing quality over time: the indexed ratio of the mean rent index to the quality-controlled rent index. As changes in the composition of the sample sometimes lead to significant noise in the developments of mean rents in the short-term (see also Appendix B), we only compute housing quality indices for periods of 25 years between 1500 and 1900. We do not extend our quality indices to the 20^{th} century, as from the 1910s no new homes are added to our samples. For this period, we will use census data to examine whether housing quality improved.

Table 2 reports the index of housing quality in the studied areas between 1500 and 1900. As insufficient observations were available to compute a quality index for London, we also added averaged numbers from Clark (2002) on housing quality in England, which he constructed using a method very similar to ours. The housing quality index reflects the monetary value of quality improvements over time. These quality improvements have two dimensions: improvements in the quantity of space consumed over time 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, such as changes in pollution or local infrastructure, are not taken into account: these are implicitly included in the market prices. Note again that as the repeated-rent index is unlikely to control fully for changes in dwelling quality, our housing quality index might still misestimate the true increase in housing quality. Nevertheless, in the long run we believe the indices should give a reasonable estimate of quality changes.

In each city housing quality has improved substantially, although at varying rates. Housing quality increased most in Paris, and the least in Amsterdam and England. However, part of this might be due to the fact that no data is available for England and Amsterdam in the 16^{th} century. The timing of these quality

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

The Belgian cities are based on a population-weighted average of the quality index for all cities. Bruges is excluded for the 19th century

upgrades is remarkable and very similar across cities: in all 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, while increasing again at the end of the 19th century.

At first sight, this early cross-city improvement in housing quality seems to be rather surprising, so the question is what caused it. The first explanation may be an increase in the available housing space per capita. For Paris, where we report the largest improvements in housing quality, Hillairet (1963) 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. It is likely that this created more housing space per capita. In a more qualitative account, Pardailhé-Galabrun (1991) describes how Parisian dwellings became much less crowded during the early-modern period. Although not as dramatic, comparable reasons might explain the strong quality improvements in Amsterdam. After the disastrous events in the Belgian cities in the 1580s, many of their inhabitants left, and a significant

share of migrants moved to Amsterdam. Amsterdam responded to the increased population through a large coordinated expansion of the city: the 'Uitleg'. This took place from the late 16th until the mid-17th century, and led to the construction of Amsterdam's famous circular canals. Despite large increases in population, supply constraints do not seem to have affected the housing market after the 17th century, as building plots remained available until well into the 18th century.

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 were constructed using tiles rather than thatch. Van Ryssel (1967) attempted to quantify the magnitude of these changes for Ghent. Prior to 1612, stone homes were only for the wealthiest citizens, but after 1612 citizens could receive a government subsidy to construct a more fire-resistant stone façade. As a result, the large majority of homes were built from stone at the end of the 17th century. The change from thatch to tiles likely took place earlier, as the government required that all homes be constructed using tile roofing already in the 15th century. However, this process likely took until the late 16th century to complete, as city fires continued to occur frequently (Van Ryssel, 1967). 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.[8] 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-renting 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

[8] Note that the quality index of Clark does not report quality improvements in the 17th century but in the 18th century. This might because this development was specific to London, or due to the low number of observations in Clark's sample in the 16th century.

Smith explains the relative affordability of London housing as the result of mass-scale sub-renting of parts of dwelling homes (Smith, 1776). Smith's anecdotal evidence suggests that the number of persons per house may have varied substantially across cities (and potentially over time). To address these concerns, we have used fiscal sources and population data to compute the mean rent or rental value per capita, and the corresponding level of housing quality per capita. Although we could only do so in 36 cases, developments in housing quality per capita are in line with the developments sketched earlier.[9]

In summary, we believe our findings on urban rental housing quality provide robust evidence of significant improvements during the early modern era, and subsequently in the latter part of the 19$^{\text{th}}$ century. These findings have important implications. First, given that affordability did not improve significantly before 1900, expenditure shares on housing likely increased in this period. Although few historical cost-of-living studies have been able to include rents, its expenditure share was typically considered fixed and amounted to less than 10 percent (see e.g. Allen, 2001). Second, the improvements in housing quality in the pre-industrial era might be indicative of an improvement in the general standard-of-living, supporting the views of De Vries (2008) and Broadberry et al. (2015). Of course, absent increases in affordability and real wages, these improvements could only occur if the working year expanded. However, such an expansion is debated, and Appendix F provides a discussion of this issue, as well as the result of a new analysis for Antwerp between 1590 and 1769. The consensus is that changes in day wages may underestimate developments in annual pre-industrial income, such that pre-industrial wage earners might have had gradually more money available to spend on housing.

For the modern era, changes in the length of the working year might also help to explain changes in expenditure shares on housing and corresponding changes in housing consumption. Huberman and Minns (2007) show that in the countries we study, working hours reduced between 30 and 50 percent from the late 19$^{\text{th}}$ century until 2000. Nevertheless, even after accounting for this reduction, the figures in

[9] For numbers, sources and details, see Appendix B.

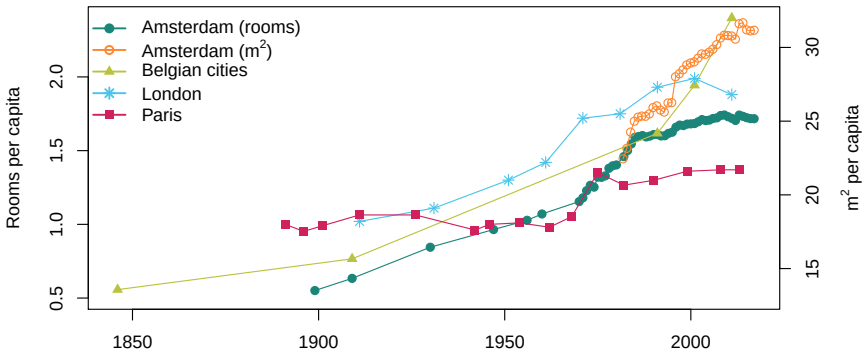
Table 1 suggest substantial improvements in housing quality. However, we should be careful in interpreting these. From 1900 onward, we do not have sufficient primary data to conduct an analysis as we have done for the period before 1900, and as our secondary sources do not consistently use the same data sources and methodology, they are likely prone to error. Second, decreasing average household size makes it increasingly important to compute housing consumption at the per capita level rather than at the household level. Third, due to the introduction of various housing policies, housing expenses deflated by rent prices or rental values become a problematic estimate of housing quality. For example, tenants of social housing, which has considerable market share in the studied cities, are likely to experience a much higher level of housing quality than would be expected on the basis of their rent. Similarly, the trend towards higher owner-occupation, stimulated by fiscal policies, also implies that renters typically no longer are a representative draw from society. Such issues are much less of a concern before 1900, due to the absence of such policies.

To shed more light on housing quality in the more recent era, 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, suggesting housing space per capita has increased significantly. If the size of the average room increased as well, these data sources might still 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 growth in the number of square meters of housing space per capita, available since 1982, has been more than twice as high as growth in the number

of rooms per capita.

Figure 4: Space per capita in the 20th and 21st century



Sources Paris: INSEE (1957, 2018). London: Mayor of London (2017), Amsterdam: Statistics Netherlands (2018), Gemeente Amsterdam (2018), Belgian cities: Census data provided by Statistics Belgium.

However, even without controlling for room size, the increase in rooms per capita is notable. The increases are particularly large in Belgium. Relative to 1846, the average person has almost five times more rooms available nowadays. In Paris, the increase is smallest, as the number of rooms per capita has increased by less than fifty percent. The relative ranking of the improvements in rooms per capita across cities is consistent with the affordability indices: 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 significantly as well. Although for most cities this type of quality data has only been included in censuses since the second part of the 20$^{\text{th}}$ century, large quality increases are visible even in this 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 house, and about 46 percent had a proper toilet (at end of the 19$^{\text{th}}$ 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 in urban Belgian homes. 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 20$^{\text{th}}$ 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 19$^{\text{th}}$ 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 expanded significantly during the 20$^{\text{th}}$ century, in line with improvements in affordability. More recently, these improvements have halted, with affordability and space per capita even worsening in London. However, we should not forget to embrace what we have: both housing affordability and quality are at levels that far surpass anything seen in history.

6 Conclusion

This paper, for the first time, traces the trajectories of rents in various European cities from 1500 to the present on a continuous annual basis. The combination of the wage, rent and quality indices tells a compelling story. Until about 1800, growth in real urban market rents was close to zero or even negative. However, housing quality gradually expanded, as tenants were able to spend more of their income on housing. From the 19$^{\text{th}}$ century onward, real rents started to increase in most cities, while keeping up with the pace of real wages. Initially, these increases in housing costs seemed to hamper further increases in housing quality, but from

the late 19th century onward housing quality started improving again.

Importantly, direct government interference in rent levels did not exist in the first four centuries we study, and the interplay of market forces seems to have done its work in stabilizing long-term real rent levels relative to wages: there were no substantial changes in housing affordability before the 20th century. When wages started to outpace growth in rents during the first 75 years of the 20th century, possibly with the support of intervening governments, households could expand their housing consumption (and expenditure shares on housing) even further to the levels currently observed. More recently, housing affordability seems to have worsened slightly, particularly in London and Paris. Nevertheless, in all cities we study rental housing has been most affordable during the past few decades.

The main contribution of this paper is show that in order to estimate housing affordability it is essential to look at income, quality-controlled market rent indices and measures of housing quality simultaneously. Excluding any of these components can result in biased estimates. Unfortunately, contemporary quality-controlled rent indices are barely available in the literature (Ambrose, Coulson and Yoshida, 2015), and our study is one of the first to produce long-run estimates of the developments in housing quality.

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.

Last, the dataset presented in this study is the largest historical real estate dataset constructed to date, and by providing the data and resulting indices to all interested researchers, we hope to have created a solid basis for future research on the long-term history of the housing market.

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A Discussion of rental sources

This section provides an overview of all rental sources, organized per city. A summary of all sources can be found in Table 1.

A.1 Belgian cities

Most Belgian historical rental studies follow a tradition that has been set up in the early 1960s, most notably with the work of Etienne Scholliers on Antwerp rents, also published in Verlinden (1972). The early works, done by Mason for Bruges (Verlinden, 1972), Van Ryssel (1967) for Ghent, Avondts (1971) for Brussels, and Scholliers (Verlinden, 1972) for Antwerp, focused on collecting housing rents for the largest possible number of representative homes. In each of these studies, representativeness was assessed in terms of location, ownership and fluctuations in rents. In each city, rental observations stem from homes spread all over the city. Due to data availability, practically all rents stem from institutional accounts, as explained in the main body of our paper. The main exception to this case is the study of Van Ryssel (1967) for Ghent, where 25 percent of homes stem from private investors and another 12.5 percent from city records. Homes that showed abnormal changes in the level of rents were excluded. In each study homes were only included in the database if rental observations were available for at least 7 years. If observations were available for less than 7 years, but the rent was revised within this period, the home was included as well.

Most rents in these studies were paid annually: monthly, quarterly or half-yearly payments were exceptional and seemed to occur only during very turbulent periods, such as the start of the Spanish occupation. Although the starting dates of the contracts are unknown, annual rents were mostly paid on various religious holidays, such as Christmas, Candlemas or Maria Ascension, which were spread evenly throughout the year. In the index estimation, it is therefore assumed that contracts start mid-year.

Works for the period after the Ancien Regime, from Avondts and Scholliers (1977), Van den Eeckhout and Scholliers (1979), Henau (1991, unpublished) and

Table 1: Overview of rental data sources

Source	*City*	*Type*	*I*	*Years*	*Obs.*
Primary sources, rents:					
Henau (1991)	Belgian cities	Rent prices	Y	1910-1940	11,711
Segers (1999)	Belgian cities	Rent prices	Y	1800-1920	33,088
Verlinden (1972)	Antwerp	Rent prices	Y	1500-1876	27,643
Verlinden (1972)	Bruges	Rent prices	Y	1500-1800	22,157
Avondts (1971)	Brussels	Rent prices	Y	1500-1800	19,150
Van den Eeckhout and Scholliers (1979)	Brussels	Rent prices	Y	1800-1940	14,977
Van Ryssel (1967)	Ghent	Rent prices	Y	1500-1796	41,492
Avondts and Scholliers (1977)	Ghent	Rent prices	Y	1796-1932	13,585
Lesger (1986)	Amsterdam	Rent prices	Y	1500-1869	48,860
ACA 367.A, no. 141-150	Amsterdam	Contracts	Y	1671-1805	7,537
ACA 367.C , no. 100, 1794, 1804-1805	Amsterdam	Contracts	Y	1833-1936	11,701
ACA 367.C, no 938, 947, 1498, 1798	Amsterdam	Rent prices	Y	1934-1940	348
ACA 201, no. 1973, 3596	Amsterdam	Contracts	Y	1849-1928	65
ACA 404, no. 156	Amsterdam	Contracts	Y	1843-1942	100
ACA 1120, no. 2087-2089, 2130	Amsterdam	Rent prices	Y	1845-1942	1,397
ACA 191, no. 979, 987, 991-992	Amsterdam	Contracts	Y	1840-1941	295
ACA 612, no. 432	Amsterdam	Contracts	Y	1853-1884	20
Clark (2002)	London / UK	Contracts	Y	1225-1914	19,246
LMA, CLC/B/216/MS144	London	Contracts	N	1909-1959	15,274
Archives Nationales, 66 AJ 2029-2035	Paris	Contracts	Y	1400-1792	9,221
Archives de l'APHP, 782 FOSS 1	Paris	Contracts	Y	1733-1820	1,047
Monin and Lazard (1920)	Paris	Contracts	Y	1766-1819	2,012
Archives de Paris, DQ18	Paris	Contracts	N	1803-1870	861
Primary sources, rental values:					
ACA 5044, no. 254, 273, 281, 284	Amsterdam	Rental value	N	1647-1650	14,549
ACA 5044, no. 402-405	Amsterdam	Rental value	N	1733	25,328
ACA 5045, no. 269-323	Amsterdam	Rent prices	N	1805	33,210
ACA 5045, no. 269-323	Amsterdam	Rental value	N	1805	17,777
ACA 5210, no. 69	Amsterdam	Rental value	N	1815	1,619
Fryske Akademy (2018)	Amsterdam	Rental value	N	1832	30,047
Felixarchief Antwerp, inv. 782 no 1-14	Antwerp	Rental value	N	1584	11,852
Secondary sources, rent indices:					
Henau (unpublished)	Belgian cities	Urban	N	1941-1961	
Banque Nationale de Belgique (1980)	Belgian cities	National	N	1975-1977	
Statistics Belgium (2018)	Belgian cities	National	N	1977-2017	
Gemeente Amsterdam (2018)	Amsterdam	City	N	1940-1994	
Statistics Netherlands (2018)	Amsterdam	National	N	1994-2000	
Dröes et al. (2017)	Amsterdam	City	N	2000-2017	
Samy (2015)	London	City	N	1903-1909	
ONS / National Archives RG 77/3	London	National	N	1959-1987	
Office for National Statistics (2018)	London	National	N	1987-2005	
Office for National Statistics (2018)	London	City	N	2005-2017	
Marnata (1961)	Paris	City	N	1867-1957	
Friggit, by courtesy	Paris	City	N	1957-2017	

ACA = Amsterdam City Archives, LMA = London Metropolitan Archives. Column *I* indicates with Yes / No whether the primary data were based on institutional data.

Segers (1999), vary slightly in methodology but rely on the same set of sources: social institutions. De 'Burelen van Weldadigheid' (offices of kindness) and 'Burgerlijke Godshuizen' (civil alms-houses), were founded after the French revolution and operated like the institutions in place during the Ancien Regime. These institutions were merged in 1925 into a single organization that still exists nowadays in each Belgian municipality in the form of a Public Centre for Social Welfare (OCMW). Their archives formed the source for each of these studies. The work of Henau (1991) covers the period after the start of the World War I until 1940, whereas the others span from 1796 to the first half of the 20$^{\text{th}}$ century. Overlapping observations have been removed, as in some cases observations on the same address for the same year appeared in multiple studies. For the study of Henau (1991) and Segers (1999), we also digitized data from the cities of Leuven and Liège, but we did not include indices for these cities in this paper as no data was available before 1800. Chain indices for these cities are presented in the corresponding papers; results for our repeat-rent indices are available upon request. The main methodological differences in these later studies are that they are able to exactly estimate rents per calendar year, since the starting dates of the contracts are known. If a contract for example changed mid-year, the annual rent would be based on both the first six months of the old contract and the last six months of the new contract.

It is important to realize that the rental market was severely impacted by rent regulations introduced during World War I. In August 1914, a law was passed that gave the Belgian state the power to adapt contracts during wartime, including rental contracts. In 1919 and 1921 legislation was passed such that large groups of renters did not have to pay rent arrears built up during World War I. In some cases, actual market rents demanded might have therefore been higher than reported in our data, as we only observe the actual rent paid.

Rents were frequently re-capped relative to the rent level on January 1, 1914, with rent ceilings slowly increasing. There was significant variation in the imposition and revision of rent ceilings across municipalities, with the general trend

being a relaxation of the regulations throughout the twenties and thirties. Following World War II, rent restrictions were re-imposed until the early fifties to deal with the housing shortages caused by the war.

We unfortunately do not possess underlying data for the unpublished study of Henau, which we have used from 1940 to 1961. Methodologically, this study is similar to Henau (1991), and covers the largest cities in Belgium. Between 1961 and 1975, no rental indices are available at the city level or national level. In order to splice our indices, we have used developments in house prices to proxy for rental prices from Knoll, Schularick and Steger (2017). From 1975, we rely on the rent component of the CPI. The first three years, we use a statistic published in Banque Nationale de Belgique (1980), while from 1977 we rely on the nation-wide CPI published by Statistics Belgium (2018). The rent component of the Belgian CPI is based on the average rent reported in a monthly survey of 1800 properties in the private sector. Properties remain in the sample for extended periods of time. Changes occur either when tenants do not want to participate in the survey anymore or when old homes are being replaced by newer dwellings to keep the sample representative.

A.2 Amsterdam

The work of Lesger (1986), our source for Amsterdam from 1550-1854, follows in the tradition of the Belgian rent studies, albeit with one significant difference: the selection of homes based on quality. Whereas the homes in the samples of the Belgian cities were well spread throughout the cities, there might have been a bias towards homes of a particular quality bracket in particular years. Lesger therefore categorized on the quality of the observed home, ensuring that in every year homes from each of the four defined quality categories (from low to high) were in the sample. Each category was defined based on a set of reference homes, for which quality characteristics were available such that a categorization could be made. Homes were subsequently classified based on their rental price relative to the rental prices of the reference homes.

Homes were only included in the sample if more than five years of rental data was available. If data was missing for less than two years, most likely because the home was not rented, the missing data would be filled with the rent that was paid after the gap. This strategy is somewhat unfortunate for our repeat-sales index, since rent revisions might occur one or two years earlier than they have occurred in reality. It was not possible to trace these observations, but fortunately these gaps were relatively rare.

We complement the data of Lesger with our own archival data collection, using data from various institutional archives kept in the Amsterdam City Archives. Our main source is the archive of the Burgerweeshuis, the Amsterdam orphanage, which has been discussed extensively in the work of McCants (1997). In addition we have collected data from the archive of the Roman-Catholic boys' orphanage, the Brants-Rus Almshouse and various churches: the Walloon Reformed Church, the Remonstrants and Mennonites. For the majority of data, we have attempted to collect data on rental contracts, but for some cases it was only possible to rely on rent payments. For the Burgerweeshuis, we collected but eventually excluded a significant set of contract data prior to the 19$^{\text{th}}$ century: the homes in the Noordsche Bosch, an area in Amsterdam. The homes in this neighborhood were initially rented out at below-market rates because they were used to attract textile workers. Correspondingly rent prices of these homes increased much faster than anywhere else in the city.

From 1940 onwards, we do not have sufficient primary sources to allow for the computation of a market rent index. However, this is not problematic since it coincides with a period of strict rent freezes. The first rent controls had been introduced in the Netherlands during World War I (despite Dutch neutrality in the war), following housing shortages and a broader set of government policies to control prices for basic needs during periods of large uncertainty. Initially, rents were fixed by the 'Huurcommisiewet' of 1917, but later rents could increase with the rate of inflation. In the early 1920s governments grip on rents had reduced already, but only in 1927 this was confirmed by law. The rent freeze after the

start of World War II remained until 1950, when gradually more sophisticated rent policy was introduced. The idea of the rent policy was to slowly bring the prices of pre-war homes and expensive, but still subsidized, post-war housing back to market level, while keeping rents affordable. While in many municipalities rents were already liberated in the late 1960s, Amsterdam, and most other big cities, remained under rent controls until the late 1970s.

For rent prices in this period until 1994, we rely on a rent price index of the Amsterdam Statistical Office, which we retrieved from its annual yearbook. The methodology used for this statistic followed standards of the Dutch Central Bureau of Statistics. From 1994 until 2000, we rely on the rent component of the Dutch consumer price index. Although the methodology has been updated multiple times, the core of this study is formed by a rental survey currently sent out yearly to about 15,000 Dutch households, whose rent changes are used to estimate the index. To control for unobserved quality changes, the survey does ask whether renovations happened in the past year. If that is the case, only price changes after the renovation are accounted for. A small share of homes is added to and deleted from the sample every year to keep the sample of homes representative. A drawback of this index is that households living in private and social housing are surveyed. From 2000 onwards, we make use of an index on average rent per square meter reported in Dröes et al. (2017). Note that this measure only partially controls for quality, as it only takes account of changing space over time, and not of the quality of a given space.

A.3 London

The main historical study used in our work on the English market is Clark (2002). Clark (2002) assembled a large dataset of rents, consisting of 19,246 observations spanning from 1225 until 1907.[1] As in the other cases, most rental observations stem from investigations into the activities of charities. Clark's sample consists of data from both Wales and England, but about a quarter of observations originate

[1] Note that the number of observations does not match the number of observations reported in the paper, since Clark added observations to the dataset after publication.

from London. Not all transactions in the sample of Clark correspond to actual rents. First of all, in about 10 percent of cases tenants had to pay fines or payment for repairs of the building. Since these are generally considered to be part of rental expenses, Clark (2002) annualized these fines and used these to adjust the rental values of the observations. Second, in another 10 percent of cases Clark estimated the rental values of homes from house prices, since no rental payments were mentioned.

Our index is only based on repeated observations on London, both within and outside the City, with rent contracts of 21 years or less. There are 1,624 observations left for the estimation of the index. Before 1770, there are very few observations and a significant number of years have no observations at all. As a result, the signal-to-noise ratio is very low, and hence the model smooths the index significantly.

From 1903 to 1909 we rely on the recent study of Samy (2015), who developed a house and rent price index for London for the period from 1895 until 1939, based on data from the London Auction Mart (1895-1922) and the mortgage registers of the Co-operative Permanent Building Societies (1920-1939). Absent repeat sales, Samy (2015) used the hedonic method to estimate the indices. Unfortunately, no structural characteristics are available for the London Auction Mart data, and only very basic ones (number of rooms, frontage size and property size) for the CPBS data. Hence, his index likely overstates rental price growth. However, since we only use six years of his data (with almost constant prices), this effect does not alter the London index significantly.

From 1909 until 1959, we have collected data on more than 30,000 rent observations from the archives of Trafalgar House Developments Ltd. We have collected data from seal books of two of its subsidiaries: Consolidated London Properties and City & West End Properties. These companies managed several apartment buildings, shops and offices spread out through London, and their seal books contain data on newly registered leases and renewals on existing ones, listing date, new price and old price. To identify repeat-sales, we first cleaned data on the unit

identifiers per building. The unit numbers for each lease were not written down in a consistent way in the seal books, such that it was not always clear which unit exactly was let. After cleaning the unit numbers, we only matched rents as repeats in case the old rent matched the new rent on the previous observation on that unit. In total fifty percent of data could be matched. For the index, we only used residential rent observations. Devaney (2010) has used the same sources to estimate an office rent index for the City of London.

From 1959 until 1987 we use the nation-wide rent component of the CPI, as produced by the Office of National Statistics. The methodology behind this index has changed multiple times; from the early 1960s onwards the rent component also included the implied cost for owner-occupied housing. After 1987 we rely again on the rent component of the CPI, which is based on a representative sample of homes whose rents are tracked over time. If no rental prices are available for a particular home, it is substituted by a home of comparable quality. As homes in both the private sector and the social sector (local authority rents) are in the sample, the index is not a pure measure of changes in constant-quality market rents. After 2005 we use ONS's experimental index on private housing rents in London, which relies on the same sources as the rent component of the CPI, but only includes homes rented in the private sector.

A.4 Paris

The landmark study on the history of the Paris rental market is Le Roy Ladurie and Couperie (1970). In their paper, Le Roy Ladurie & Couperie publish a triennial index from 1400 to 1789 based on about 11,000 leases. Rental data does mostly come from actual lease contracts, stored in the archival records of 26 different social institutions; either religious institutions or hospitals. Only in a minority of cases data originate from accounting books for which the contract date is unknown. Since contracts were most commonly signed for nine years, rent payments from accounting books are not always representative of market rents. We therefore excluded these in the estimation of the index. For the period 1400-1485, which

we have not reported in the main body of the paper, insufficient observations on rental contracts were available, such that the index for this period (available on request) is built on both contractual and non-contractual observations.

Le Roy Ladurie and Couperie (1970) made an impressive effort to construct a sample representative for Paris. As mentioned previously, they collected an additional 12,000 leases from private contracts for 23 benchmark years to underline the representativity of the charity rents: no differences in average rental prices were found in the private and charity samples. Additionally, they separated isolated and repeated observations and ensured renovated homes were treated as new observations. Last, properties are well spread around Paris: while each institutions typically only owned real estate close the location of the institution, the large number of institutions covered ensures a sufficient locational spread.

Unfortunately, the authors of the study did not preserve the punch card lists which contained the rents for every home. However, the authors organized transcriptions of the contracts and records, which are stored in the French National Archives. We collected and typed for each of these contracts the identifier and approximate location of the home, the contract date, the date of the accounting year and the rental price. All prices were converted to livre tournois.

Following the French Revolution and the dramatic state of the French public finances, all possessions of the institutions were nationalized in 1792, and only privatized again in 1811. Archival data is scarce for this period, and in order to continue our series we have combined several archival and non-archival sources. First, the French government registered the rent on each property and the contract date when all homes were nationalized, and these lists are published in the Sommier des Biens Nationaux de Paris Monin and Lazard (1920). Second, when the properties were returned in 1811, references were made to the underlying notary contracts, which in many cases could still be found in the Archives of the Assistance-Publique des Hopitaux de Paris, the Paris hospital system. It is the latter archive from which we have collected additional archival data in order to combine data from before and after the Revolution.

From 1809 until 1870, we add data from the first register of the Parisian 'sommier foncier'. The sommier foncier is one of the registers that was part of the famous French *Enregistrement*, and contains data on contracts relating to all Parisian homes, such as inheritances, sales contracts, rental values or auctions. For the taxation of wealth, it was important to keep track of the owners of homes, as well as the value and revenue they generated with their real estate. In the first register, which lasted from 1809 to the 1860s, rent contract data was included as well. We have collected a small sample of this rent data for various streets in central Paris, and since observations are organized per house it allows for the identification of repeat rents.

From 1867 until 1957 we rely on a rent index from Marnata (1961). Marnata collected 11,800 different rents from lease management books from residential neighborhoods in Paris and subsequently used these observations to compute a chained index. Although his index is not a pure repeat sales index but rather a chain index, it controls for quality as it follows the same residential units over long periods of time. The main disadvantage of his study is that most of the residential units in the sample are of relatively high quality, meant for the upper class of society. Since rental developments might have differed in lower class rental units, the index cannot be considered completely representative for the city of Paris.

From 1960 onwards, we make use of various rent indices compiled in data kindly provided by Jacques Friggit. Between 1960 and 1988, this index is based on the rent component of the CPI for the Paris region. From 1989 to 2015, it is based on the median rent per square meter in Paris from the Observatoire des Loyers de l'Agglomeration Parisienne. The latter method likely overstates growth in quality controlled rents, since it only controls for quality improvements due to increased space, but does not take into the account that the quality of a given space has improved as well (e.g. due to better insulation).

A.5 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 (2018). 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 (2018). For Paris, we used historical estimates from Duon (1946), while contemporary data on Parisian rent shares was taken from ADIL (2009) and from INSEE (2018) 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.

B Representativeness of Institutional Sample

The quality indices developed in this paper rely strongly on the assumption that the mean rent derived from our sample of institutional rents is representative for the general housing stock in the city. In this appendix, we assess these claims in more detail by comparing the rent estimates from our sample with other estimates of rent prices in the city. We also pair these sources to population data to make estimates of housing quality per capita.

For Amsterdam and the Belgian cities, our main sources for these secondary estimates derive from property tax records. Prior to the 20th century, property taxation was the most common form of taxation and many cities, in particular in the Low Countries, had a developed system of property taxation already from the late medieval period onwards. Taxes were typically levied on the estimated capital

or rental value of homes, sketching a fairly representative picture of the value of the housing stock in a city. Correspondingly, historians have already used these registers to make assessments of income inequality (e.g. Soltow and Van Zanden, 1998; Ryckbosch, 2016). From the early 19th century onwards, these systems were replaced by taxes on cadastral income.

These tax records also have several drawbacks. First of all, although the rental or cadastral value is typically aimed to proxy for actual rents, it is difficult to assess how precise these estimates are, particularly since they were rarely updated. If possible, we therefore only collected data in years when such an update took place. If that was not possible, we corrected the rental value for rent price changes that took place since the last correction, often employing the market rent indices estimated in this paper. Second, in various records it was not possible to separate non-residential property (most notably basements and warehouses) from residential property. However, the resulting error is likely small. For example, in 1805 non-residential property only constituted about 11 percent of total rental value in Amsterdam.

In total, we obtained data from 22 tax registers. For most of these, we were able to also collect data on the number of homes in the register, either by collecting all rents in the archival registers or through existing statistics.

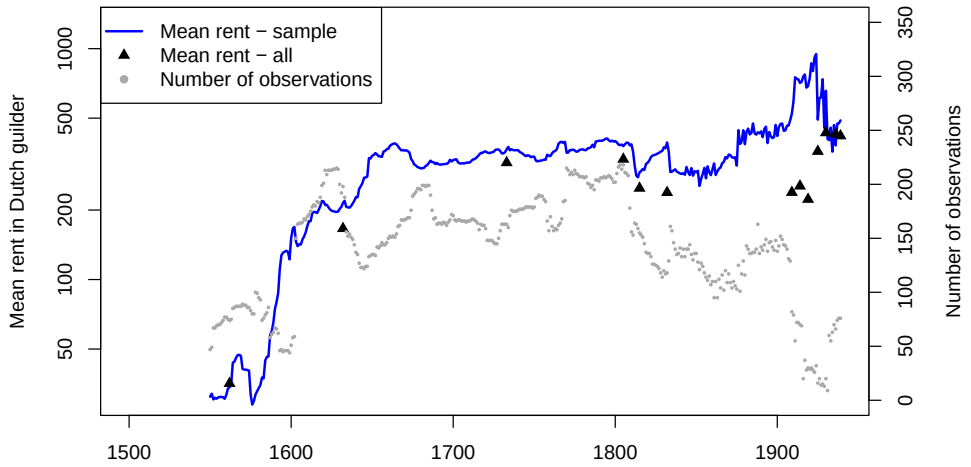
Beyond these tax-based rents, data on the level of actual private rents was also available for Paris, Amsterdam and Brussels. For Amsterdam, we computed the average level of rents for seven years between 1909 and 1939 based on census data. For Paris, Le Roy Ladurie and Couperie (1970) collected data on 12,000 (private) rent contracts from the Paris notarial archives, covering 24 years between 1500 and 1788. For Brussels, we computed the average level of private rents in 1865 based on data from the Lokstat-PoppKad database. Overall, we obtained 53 points in time to compare levels of institutional rents to private rents.

In the figures below, we plot for each city these points relative to developments in mean rents in our sample. For reference, we also plotted the number of observations. In each city, the level of mean housing rents is close to the level

of housing rents obtained from our sample. Major differences mainly appear in Amsterdam in the early 20th century and Bruges in the 19th century; these parts are not included in our quality indices.

In the shorter term, substantial revisions in the sample typically lead to significant volatility in the sample. This is particularly visible in Bruges around 1800, and to lesser extent in Antwerp and Brussels. In each of these cases, the sample changes almost entirely. For London and Paris, developments in annual mean rent levels are substantially more volatile, since these samples are entirely based on rent contracts rather than rent payments. Due to the low number of observations, this issue is particularly severe for London. Correspondingly, no quality index has been constructed for London.

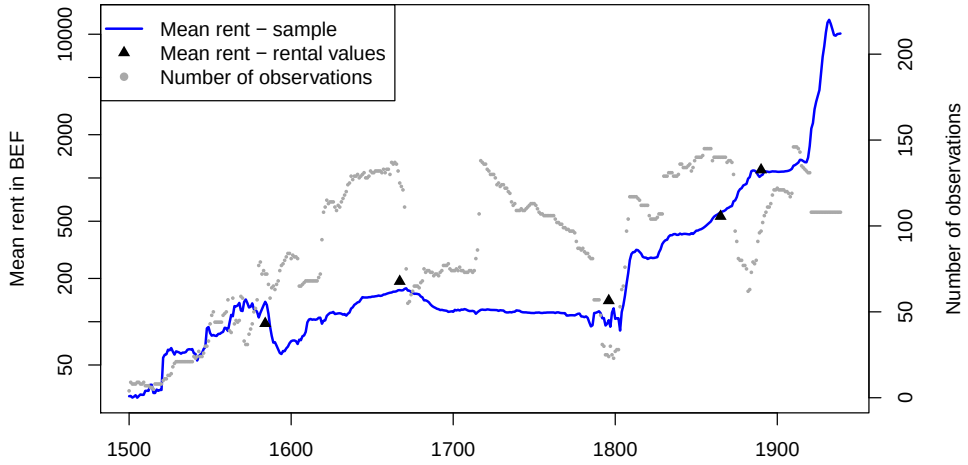
Figure 1: Amsterdam Mean Rents



Sources: Rental values: Soltow and Van Zanden (1998); ACA 5044 no. 254, 273, 281 284, 402-405; ACA 5045 no. 269-323; ACA 5210 no. 69; Fryske Akademy (2018); Laloli (2018).
Notes: The points for the 20th century reflect actual rents rather than rental values. To splice rental values and rents, we used data from the 1805 rent register listing both rental values and actual rents.

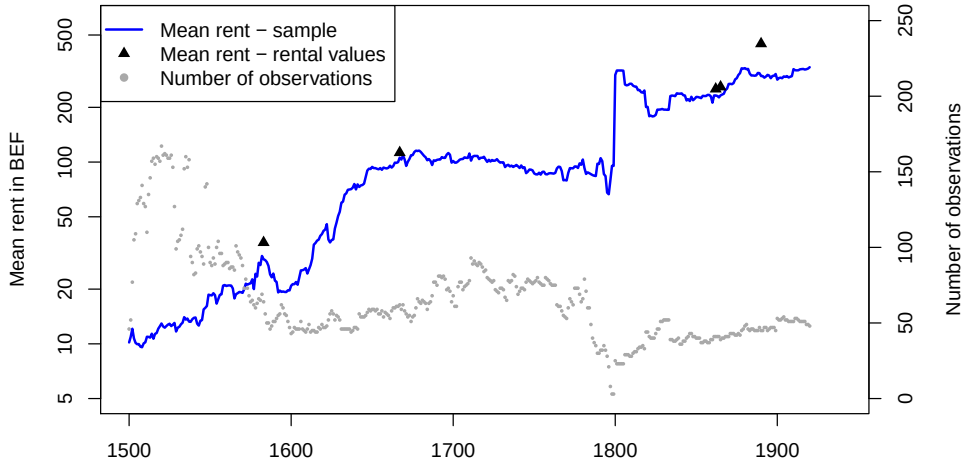
Although the previous figures indicate that mean rent developments in our sample are representative for the housing stock in the city, it is possible that changes in household size and the prevalence of sub-renting lead to different trends in housing quality per *home* and housing quality per *capita*. To assess this, we have used the fiscal sources which were complete to make estimates of total rental value per city. Note that an additional benefit of doing so is that our trends

Figure 2: Antwerp Mean Rents



Sources: Rental values: Felixarchief Antwerp 782 no. 1-14, Baetens (1976), De Belder (1977), LOKSTAT-POPPKAD.

Figure 3: Bruges Mean Rents

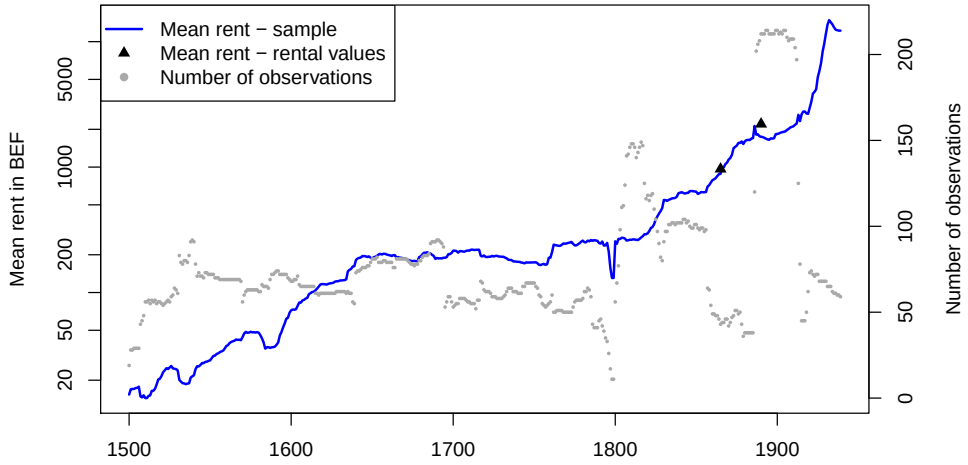


Sources: Rental values: Database Heidi Deneweth, LOKSTAT-POPPKAD, Quetelet Center.

in housing quality cannot be distorted by changing trends in owner-occupation, since both owner-occupied and rented homes were taxed. Subsequently, we used population estimates (see Appendix E) to transform this into a measure of rental value per capita. We used data on average housing rents or rental values and the number of homes from Duon (1946) and Lyon-Caen (2018) to make similar estimates for Paris.

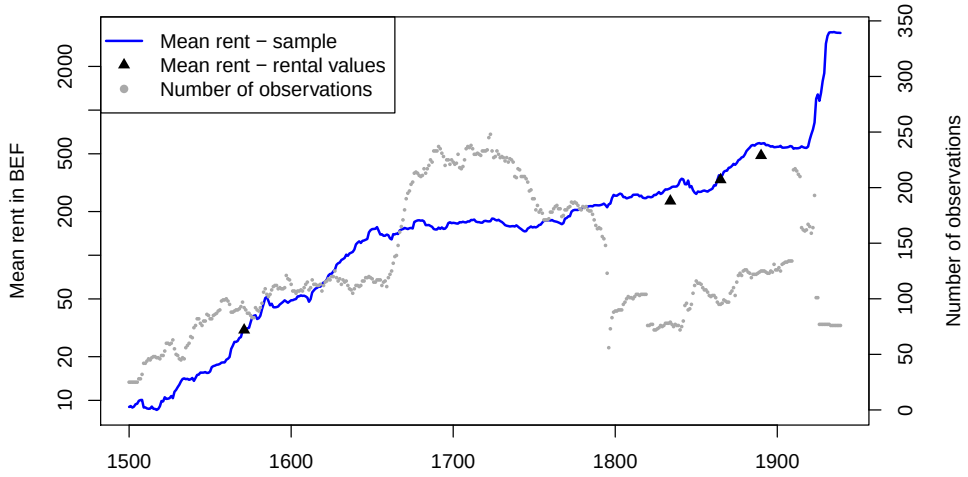
Table 2 reports the results. As can be seen, for all cities the developments in housing quality per capita are in line with those reported in Table 2 in the main

Figure 4: Brussels Mean Rents



Sources: Rental values: LOKSTAT-POPPKAD database, data kindly provided by Sven Vrielinck.
Notes: Data from Vrielinck indicated the average ratio of cadastral income to average actual rents in 1865. We used this ratio to transform average cadastral income to actual rents for all other Belgian cities in 1865 and 1890.

Figure 5: Ghent Mean Rents



Sources: Rental values: Dambruyne (2001), Vanhaute and Hannes (2007), LOKSTAT-POPPKAD.
Notes: The rental value for 1834 is an estimate based on rents from a decade earlier and, most likely, underestimated rents. We therefore correct the value by 25 percent.

paper. Housing quality per capita improves substantially before the Industrial Revolution, stagnates or even declines in the late 18$^{\text{th}}$ – early 19$^{\text{th}}$ century, before increasing again towards the end of the 19$^{\text{th}}$ century. The main outlier in the figure is the level of housing quality per capita in Amsterdam in 1561. Based on this

Figure 6: London Mean Rents (1500-1903

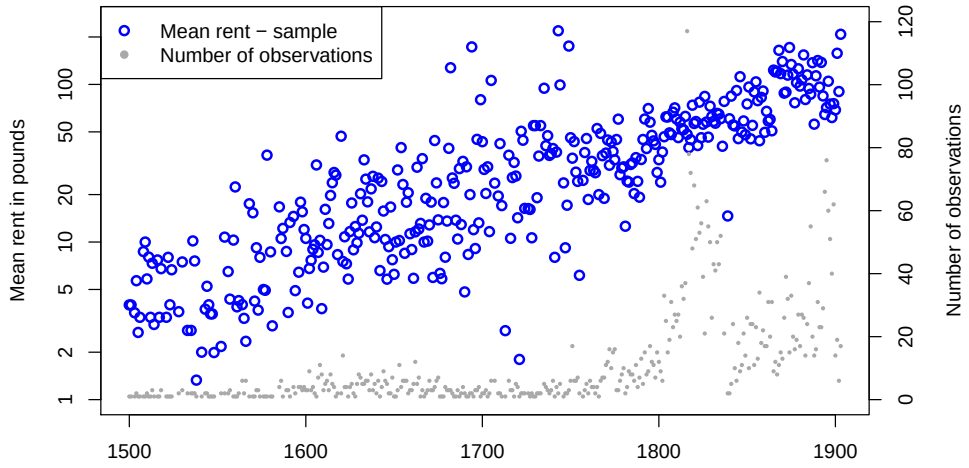
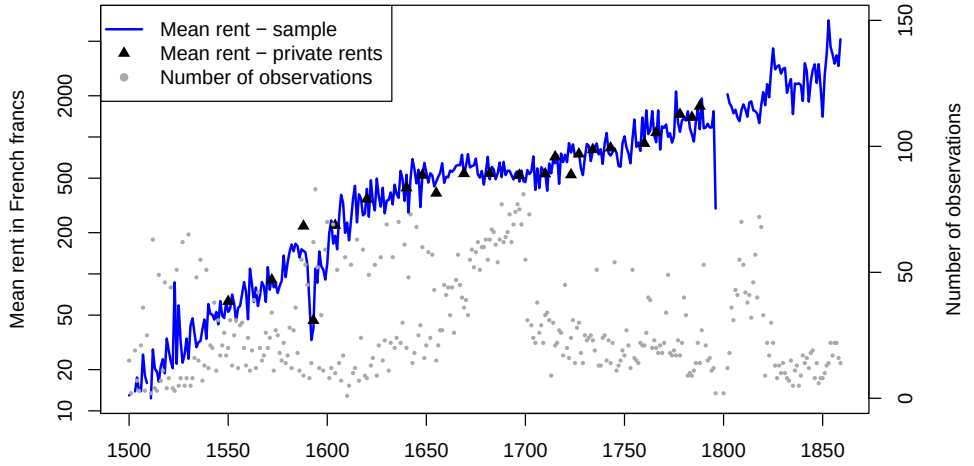


Figure 7: Paris Mean Rents



Sources: Average private rents: Le Roy Ladurie and Couperie (1970).

number, housing quality worsened significantly between 1561 and 1632, while it substantially increased according to our general quality index. However, it is very likely that the current figure overstates housing quality per capita. This estimate is based on Van Dillen (1929), who used the same fiscal records that we use here to estimate mean housing rents. He estimated population by multiplying the number of home by five. It is very well possible that this significantly understates population: in all subsequent fiscal records, the implied number of persons per home is well above 10, suggesting the 1561 quality per capita figure might as well be halved.

Table 2: 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

1890=100 for the Belgian cities, 1909=100 for Amsterdam.

C Consumer prices

C.1 Data sources

Our sources for consumer price data are reported in table 3. For most periods, we rely on existing consumer price indices. For Belgium, from 1500-1830, we rely on indices constructed from primary price data; the construction method is discussed in section C2. Primary price data on individual consumption goods are either based on actual purchase prices recorded by these social institutions, or on fixed prices set for tax or exchange purposes. Governments levied small taxes on goods, which were either based on actual market prices paid for the goods or on so-called 'spijker prices', fixed prices set by counties based on prevailing market conditions. Institutions without tax-levying authority used similar practices to set prices for monetary contracts that were settled in kind, providing an additional source of price information. These fixed prices were not always accurate representations of average annual market prices. Prices of goods could fluctuate considerably within a calendar year, as harvests could significantly be affected by bad weather or political instability.

For Antwerp, consumer price data is complemented with data from Van der Wee (1963). Prices are based on the consumer price index constructed by Michotte (1937) from 1830 until the World War I. For the period of World War I, we use an index for Brussels from Scholliers (1978). After World War I, a continuous consumer price index (1921-2017) is available from Statistics Belgium (2018), which uses 1914 as base year and is therefore spliced to the index of Michotte (1937).

Amsterdam consumption prices are from Van Zanden (2018), who computes a price index based on a representative basket of goods for Western Holland between 1500 and 1800. From 1800 to 1910, we use the price index constructed by van Riel (2018), which we deflate for rental expenses. Consumer prices after 1900 are based on the Dutch national consumer price index from Statistics Netherlands (2018).

For consumer prices in Paris we employ the index developed by Ridolfi (2017) for the period from 1500 to 1840. Annual figures for this index were kindly pro-

Table 3: Overview consumer price sources

City/Country	*Study*	*Years*	*Coverage*	*Type*
Belgium	Michotte (1937)	1830-1913	National	Index
	Scholliers (1978)	1914-1920	Urban	Index
	Statistics Belgium (2018)	1913-2017	National	Index
Bruges	Verlinden (1972)	1500-1800	Urban	Raw prices
Ghent	Verlinden (1972)	1500-1800	Urban	Raw prices
Antwerpen	Van der Wee (1963)	1500-1600	Urban	Raw prices
	Verlinden (1972)	1500-1830	Urban	Raw prices
Brussels	Verlinden (1972)	1500-1800	Urban	Raw prices
Amsterdam	Van Zanden (2018)	1500-1800	Regional	Index
	van Riel (2018)	1800-1900	National	Index
	Statistics Netherlands (2018)	1900-2017	National	Index
Paris	Ridolfi (2017)	1500-1840	City	Index
	Singer-Kérel (1961)	1840-1958	City	Index
	CGEDD (2018)	1958-1990	National	Index
	INSEE (2018)	1990-2017	National	Index
London	Allen (2001)	1500-1913	City	Index
	Thomas and Dimsdale (2017)	1913-1988	National	Index
	Office for National Statistics (2018)	1988-2017	National	Index

vided by Leonardo Rudolfi This index is built on a wide array of primary and secondary sources, improving existing estimates of Allen (2001). For the period from 1840 to 1950, we use the price index for workers from Singer-Kérel (1961). After 1950, we rely on consumer price indices reported in CGEDD (2018) and INSEE (2018). Indices for consumer prices in London covering the 1500-1913 period are from Allen (2001). For the 20th century, we use data from the the Bank of England dataset "a millennium of macroeconomic data" (Thomas and Dimsdale, 2017), from which we used their preferred headline CPI measure. To extend to 2017, we use the standard CPI index of Office for National Statistics (2018).

C.2 Index Construction

We estimate a new Belgian consumer price index from 1500 to 1830, based on 128 different price series collected from the Verlinden volumes and Van der Wee (1963).[2] Even though Flanders and Brabant were separate states until 1795,

[2] Allen (2001) has already estimated an annual consumer price index for Antwerp / Brabant from 1366-1913, but his index does not rely on a representative adjustable basket of goods and is likely to understate the true annual volatility in prices due to the strong reliance on interpolated

with each having their own currency, we do not estimate a separate index for these regions. We have found no evidence that aggregate consumer prices within Flanders or Brabant were more strongly tied together. This pattern was confirmed when looking at the individual price series.

We have also attempted to construct price indices for each city, as in the short run prices for particular goods could vary across cities, but this turned out to be infeasible. First, the number of series available per city is limited, in particular for Ghent and Brussels, causing their price indices to be unrealistically volatile relative to other cities. Second, the available sources are of varying quality, ranging from monthly averages of market prices to a single price fixed on the day before Christmas. Quality considerations seem more important than differences across cities: high-quality series on the same good across cities tend to be more correlated than high- and low-quality series on the same good within a city.

Due to the lack of continuous price series, we have developed a pragmatic method to estimate the consumer price indices, making use of the available data as much as possible. Note that due to the data-driven index estimation strategy, the index developed in this section cannot be classified in standard price index categories; such as the well-known Laspeyres, Paasche or Fischer price indices. The method to construct our indices consists of three steps.

In the first step, the 128 collected price series were stacked into 14 different groups: wheat, rye, barley, peas, butter, egg, cheese, potatoes, buckwheat, beef, chicken, fish, energy, and oils. The first nine groups contain only a single good, whereas the last five groups contain multiple goods representative of the group under consideration. To avoid sensitivity to size discounts or quality differences across cities, as each city had its own measures, we index the individual price series. Base years are chosen to be all years in which individual price series for a group overlap, which avoids strong base-year sensitivity. In case a series has no overlap, it is indexed relative to one or more high-quality series for the same good.

data. As the majority of prices is missing, interpolation results in unrealistically smooth indices, in particular during the 18^{th} century. This will make it much more difficult to identify to what extent nominal rents move with the general price level.

Aggregate indices are constructed for each product group by taking averages of the most-representative series. Representativeness is assessed based on the nature of the prices (fixed versus market prices) and the frequency and timing of the observations within a year, with preference given to high-frequency market prices matching the calendar year.

Table 4: Expenditure patterns in an Antwerp orphanage (Scholliers, 1960)

Year			*Expenditure as % of total*						
	Price	*Total exp.*	*Food*				*Nonfood*		
	Grains	*Local curr.*	*Grains*	*Dairy*	*Meat*	*Rest*	*Energy*	*Clothes*	*Repairs*
1585			40%	9%	10%	15%	3%	18%	4%
1586	31.1	18,737	59%	13%	3%	12%	3%	7%	3%
1587	32.7	14,184	59%	6%	4%	21%	2%	6%	2%
1588	9.78	6,627	34%	16%	10%	5%	7%	15%	14%
1589	5.87	8,852							
1590	10.2	10,389	25%	17%		24%	4%	21%	9%
1591	10.25	10,559	21%	20%	7%	24%	4%	22%	2%
1592	8.28	10,208	21%	16%	7%	22%	5%	18%	10%
1593	7.86	11,515	11%	20%	7%	26%	6%	23%	7%
1594	10.9	12,302	16%	18%	9%	24%	5%	21%	7%
1595	20.9	13,853	29%	18%	7%	20%	4%	17%	6%
1596	16.8	13,167	27%	17%	6%	20%	4%	16%	10%
1597	15.8	12,044	28%	18%	7%	21%	5%	13%	9%
1598	14.3	11,240	24%	19%	7%	24%	6%	13%	7%
1599	10.9	10,253	19%	17%	6%	21%	5%	19%	13%
1600	10.1	9,442	18%	15%	9%	18%	7%	24%	9%
Average			29%	16%	7%	20%	5%	17%	7%

In the second step the base weights of each good in the overall price index were determined. Weights are based on scarce information on expenditure patterns of Ghent households and Antwerp orphanages for a handful of years in the late 16$^{\text{th}}$ and 19$^{\text{th}}$ century, published in Scholliers (1960) and Avondts and Scholliers (1977) (1977) and reported in Table 4, for 1600 and 1840. Weights are fixed before 1600, and from 1600 to 1830 interpolated. Potatoes and buckwheat are only included after 1800 due to data availability. It is important to realize that expenditure patterns vary significantly over time and across sources. This becomes evident when looking at the expenditures of the 'Maagdenhuis' in Antwerp relative to the price of grains from 1585 to 1600, reported in Table 4. The price of grain, which was the most important component of the household budget until the early 19$^{\text{th}}$

century, increased significantly in 1586 due to the uncertainty caused by the Fall of Antwerp to the Spanish in late 1585. Since cereals were, even at very high prices, the cheapest source of calories, inhabitants did not shift their consumption to other goods, but were forced to spend their money on cereals to avoid starvation.

The main problem with the selected base weights is that for some product groups no continuous price observations are available, in particular after 1800. In order to make use of the available data as much as possible, without engaging in excessive smoothing, we vary the weights across years depending on data availability (see Table 5).[3] In case prices for a product group are not available or of insufficient quality, its weight is redistributed to a group (or groups) that is (are) most correlated with the price index of the missing group. In the last step, the prices for each good are converted to index prices and multiplied with the weights to produce the consumer price index.

Table 5: Base weights price index, key years

Year	Wheat	Rye	Butter	Cheese	Beef	Chicken	Egg
1600	4.0%	40.0%	16.0%	7.0%	5.0%	5.0%	0.5%
1799	11.5%	23.4%	14.3%	6.2%	9.1%	8.3%	1.7%
1800	13.0%	19.0%	15.0%	-	16.0%	-	-
1835	15.1%	15.5%	15.0%	-	16.0%	-	-
Year	Fish	Peas	Barley	Energy	Oils	Potatoes	Buckwheat
1600	3.0%	2.0%	6.5%	9.0%	2.0%	-	-
1799	3.0%	3.7%	5.3%	11.5%	2.0%	-	-
1800	-	-	5.0%	14.0%	2.0%	12.0%	4.0%
1835	-	-	5.0%	14.0%	2.0%	13.4%	4.0%

D Wages

D.1 Data sources

Until the 19th century, most of our wage indices are based upon day wages of workers in the construction sector, that often originate from institutional archives.

[3] The weighting schemes for each city are available upon request.

An advantage of using these wages is that most of these jobs are still existent nowadays, such that it is possible to make long-run comparisons. A drawback is that wages in the construction sector varied significantly with season, level of skill, the amount of beer money and the riskiness of the job at hand. This is not always identified exactly in the records and, especially if data is scarce, is likely to cause noise in our index compared to the 'true' wage level. For later periods, our indices are based on national or local indices of wages. As much as possible, we tried to select sources that reflect the marginal return to working, with the ideal measure being a hourly wage index. Note that in the 20$^{\text{th}}$ century, the introduction of taxes and employer contributions makes it more difficult to have wage indices that consistently reflect the marginal return to working, since only a very small fraction of such taxes or costs directly benefit the worker proportional to the amount of his labor. An overview of sources is presented in table 6.

Table 6: Overview wage sources

City/country	*Study*	*Years*	*Coverage*	*Type*
Belgium	Peeters (1939)	1831-1913	National	Index
	Scholliers (1978)	1914-1919	City	Index
	Cassiers and Solar (1990)	1913-1959	National	Index
	FOD-WASO (2018)	1959-2017	National	Index
Bruges	Verlinden (1972)	1500-1628	City	Raw wages
Ghent	Verlinden (1972)	1500-1800	City	Raw wages
Antwerp	Van der Wee (1963)	1500-1605	City	Raw wages
	Verlinden (1972)	1606-1834	City	Raw wages
Amsterdam	De Vries and Van der Woude (1997)	1500-1815	Regional	Index
	Horlings and Smits (1996)	1816-1913	National	Index
	Schrage, Nijhof and Wielsma (1989)	1913-1939	National	Index
	Statistics Netherlands (2018)	1939-2017	National	Index
Paris	Ridolfi (2017)	1500-1870	City	Index
	Singer-Kérel (1961)	1870-1946	City	Index
	Bayet (1997)	1913-1951	National	Index
	INSEE (2018)	1951-2017	National	Index
London	Allen (2001)	1500-1913	City	Index
	Thomas and Dimsdale (2017)	1914-2016	National	Index
	Office for National Statistics (2018)	2016-2017	National	Index

Observations on daily wages of masons, carpenters, slaters and their helpers are obtained for Bruges (1500-1628), Ghent (1500-1799) and Antwerpen (1500-

1840) from the Verlinden (1972) series. These are converted to a total index based on the methodology discussed in section D2. The study of Peeters (1939) provides us with an aggregate index of hourly wages in various Belgian industries from 1831-1913. For later periods we rely on a multitude of publications on industrial wages. Scholliers (1978) provides estimates for Brussels wages during World War I. Cassiers and Solar (1990) produce an index of gross hourly wages for the 1913-1959 period. From 1960 onward, we use the average hourly wage increases for all employees (the Belgian government makes a division between 'laborers' and 'service workers') from the official estimates of FOD-WASO (2018), the Belgian ministry of labor.

For Amsterdam, we use day wages in the construction sector from 1500 to 1815, which we have from De Vries and Van der Woude (1997). Wages from 1815 to 1913 are based on nominal day wages reported in the study of Horlings and Smits (1996). Wage data for the period from 1913-1939 from Schrage, Nijhof and Wielsma (1989), and refer to average day wages across sectors. From 1939 onward, we rely on the average wage increases from collective labour agreements, which cover most of the Dutch labor force. Given that this figure has not yet been updated to 2017, we use the Statistics Netherlands (2018) index on hourly cost of labour to extend to the present.

The wage index for Paris for the period 1500-1860 is based upon average day wages of laborers and craftsmen, from the indices reported in Ridolfi (2017). Annual figures for this index were kindly provided by Leonardo Ridolfi. Between 1860 and 1920, we use the weekly wage index for Parisian workers from Singer-Kérel (1961). To correct for changes in the length of the working week, which were particularly prevalent in the early 20$^{\text{th}}$ century, we used national figures on nominal hourly wages reported in Bayet (1997) from 1914 to 1951. To fill the gaps in the war years, we still made use of the index of Singer-Kérel (1961). From 1950, we use INSEE (2018) indices on hourly pre-tax wage rates. Since these are not available for 2016-2017, we employ an INSEE index on hourly cost of labor in the construction for the period 2015-2017.

For London between 1500 and 1913, we use the standard day wage index from Allen (2001). From 1913 until 2016, we use a national index of weekly earnings derived from Thomas and Dimsdale (2017) and Office for National Statistics (2018). Since this does not control for changes in the number of hours worked per week, which likely declined, London wages probably slightly underestimate wage growth. This is confirmed by the fact that the London index increases the least of all cities during the 20$^{\text{th}}$ century.

D.2 Index construction

Wage indices for the Belgian cities are created based on thousands of day wage observations from construction sector workers (1500-1830). No wage index is constructed for Brussels, given the lack of wage data. The wage index for Bruges only spans the period from 1500 to 1628; after 1628 Ghent wages are used for Bruges. An aggregate wage index for Belgium is constructed as well, based on wage data from all cities. Note that for Antwerp, our index is almost entirely the same as Allen (2001), who used the same sources to construct his index.

Wage data come from wage lists published in the Verlinden series; one for every job in every institution, containing the years in which workers were employed, the various salaries that were paid and the number of days a certain salary was paid. In most cases, wages of 'masters' are separated from the wages of 'helpers'. We have excluded observations that make note of special circumstances, such as risky jobs, the provision of beer money or the aggregation of helpers' and masters' salaries. Other large outliers have been removed as well, since these are likely the result of special provisions not identified in the records.

Annual averages of wages are computed based on the remaining observations. Contrary to the consumer price indices, we have interpolated average wages for years where data is missing. This can be justified since the level of wages is extremely stable: contracts show that sometimes workers were paid the same wages for as much as 60 years. Persistent increases in nominal wages occur in every city only in the second half of the 16$^{\text{th}}$ century. After interpolating, wages

are indexed for each job and subsequently averaged across all jobs to construct the total wage index.

E Population Estimates

To construct estimates of population for our cities, which we use to make estimates of housing quality per capita, we combined population estimates found in historical studies, and interpolated these using cubic splines. It should be noted that the quality of these estimates varies, in particular for the 16$^{\text{th}}$ century. In some cases, estimates could differ by as much as 50 percent. For many early estimates, it was not always clear how they were constructed, such that it was difficult to judge the accuracy of the numbers. For each city, we used the following sources, which we deemed most accurate:

Antwerp: Quetelet (1846); Verbeemen (1956); Deprez (1957); Marnef (1996).
Bruges: Sentrie (2007); Deneweth (2010).
Ghent: Dambruyne (2001); Van Werveke (1948); Deprez (1957); Vermeulen (2002).
Brussels: Cosemans (1966), Avondts (1971). From 1820 onwards, we used for all cities census estimates of population reported in Segers (1999).
Amsterdam: Nusteling (1985), who also summarizes estimates from earlier studies; Van Leeuwen and Oeppen (1993); Gemeente Amsterdam (1923, 2018).
Paris: Biraben and Blanchet (1998) and Mairie de Paris (1967).

F Rent Index Estimates

Table 7 contains the output of the estimations of the repeat-rent index based on the methodology of Francke (2010). Tabulated indices are presented in Table **??** and **??**. Note that for Amsterdam, data was not available for the early part of the 16$^{\text{th}}$ century, such that our index only starts in 1550. For Paris, we estimated the index including observations from 1485 onward, since this significantly increased the number of observations available to estimate the growth of the index in the

first part of the 16th century. For London, we estimated the indices separately for the periods 1500-1903 and 1909-1959, due to the absence of data between 1903 and 1909, and the difference in data densities between the two samples. To compute a total Belgian city index, we used population-weighted averages. Consistent with the observations made earlier in the paper and in Appendix B, the signal-noise ratio for London, and to a lesser extent Bruges, is significantly lower compared to the other cities. This indicates these indices have been smoothed significantly.

Table 7: Estimates of variance parameters and signal-to-noise ratio

City	*Years*	*Obs.*	*Prop.*	σ	q_ζ	*Log likelihood*
A'dam	1550-1940	19,299	1,228	0.06	0.72	18,475.73
Antwerp	1500-1940	6,133	473	0.15	0.54	430.16
Bruges	1500-1920	3,115	592	0.20	0.25	-449.50
Brussels	1500-1940	4,304	894	0.17	0.40	-142.62
Ghent	1500-1940	6,495	1,278	0.21	0.34	-1,167.45
London	1500-1903	1,624	660	0.25	0.20	-400.32
London	1903-1959	3,165	1,141	0.08	0.56	1,469.50
Paris	1485-1870	8,712	2,364	0.15	0.53	416.00

q_ζ measures the signal-noise ratio, and σ measures the standard deviation of the price movements of the index.

F.1 Robustness checks

In this section, we perform two robustness checks to assess to what extent our repeat-rent indices might be influenced by potential depreciation or unobserved quality improvements.

First, if we assume that homes are new when they enter our sample, either due to new construction or significant renovation, we can test the assumption of constant quality based on the framework of Harding, Rosenthal and Sirmans (2007). To estimate net-of-maintenance depreciation, they suggest including the log difference in house age in the standard repeat-sales regression introduced in the methodology section. The non-linearity of the age effect avoids perfect collinearity with the length of the leases and corresponding dummy variables. Using this

technique, Harding, Rosenthal and Sirmans (2007) estimate that US housing depreciates at an average rate of 2 percent per year.

Of course, the strength of this test is weakened when homes are not new when they enter the sample. Although it is difficult to verify the extent to which this is the case, there is strong evidence from Amsterdam that many of the homes were new or significantly renovated when they enter our sample. First, we found construction or renovation plans for many of these homes in the archives we consulted. Second, analysis of data from Korevaar (2018) on housing transactions in Amsterdam between 1563-1811, reveals that institutions were very inactive in purchasing property. For example, the Burgerweeshuis, the most important real estate owner, was only involved in 41 real estate purchases, while it was involved in 244 sales. However, some homes were certainly not new when they were leased for the first time: we could link some of these purchases to homes in our sample.

Taking note of this limitation, Table 8 contains the estimate of the ageing coefficient for each city, using the standard repeated-measures model. For both Paris and London, we estimated the regression separately for the institutional sample and the non-institutional sample, given that the upkeep of these properties might have been different. The aging coefficient is highly insignificant in all but one case: London from 1909 to 1959. However, in this case it is positive, implying net appreciation over time rather than depreciation, although the effect is small in magnitude. Hence, if anything, our index might underestimate growth in this period. It is possible that part of this effect is driven by rent controls that correlated with house age, as some rent control measures in this period were directly determined by house age.

A second way to assess the robustness of the assumption of constant-quality is by comparing local housing rents to local land rents. Depreciation and quality improvements are aspects of the structures built on land, while the land itself does not depreciate. Hence, if quality is adjusted for properly, land rents should evolve similarly to housing rents over the longer run. Hoffman (2000) created such a land rent index for the Paris Basin, making use of land leases from the Cathedral

Table 8: Estimate of log-difference in house age coefficients

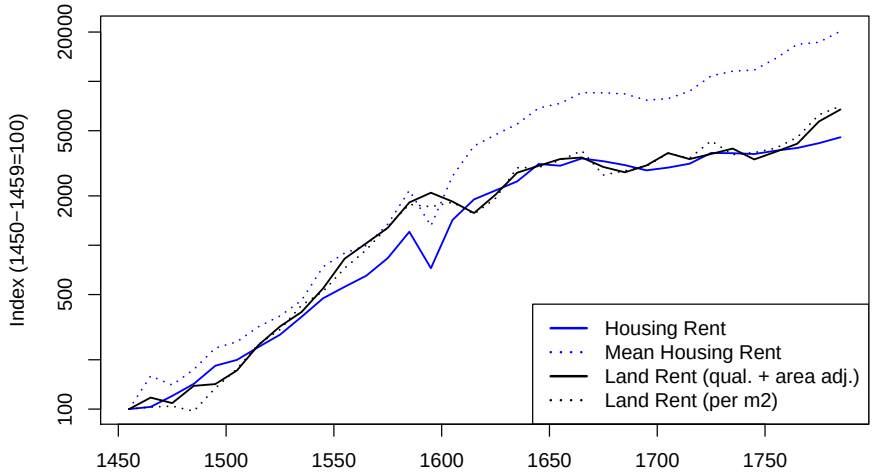
City	*Years*	*Coefficient*	*P-value*
Amsterdam	1550-1940	-0.00023	0.89
Antwerp	1500-1940	0.00421	0.49
Bruges	1500-1920	-0.00665	0.86
Brussels	1500-1940	-0.0014	0.86
Ghent	1500-1940	0.00306	0.61
London	1500-1903	0.0185	0.12
London	1909-1959	0.046	0.00
Paris	1400-1800	0.0011	0.77
Paris	1800-1870	0.0168	0.20

of the Notre-Dame in Paris, an institution very similar to the other institutions in our Paris sample. He computed both a mean rent index per hectare, as well as hedonic index that corrected for quality of the land (soil type, land use) and location.

Figure 8 compares his decennial indices to our (decennial) rent and mean rent index. As can be seen, the various land rent indices closely track the repeat-rent index for Paris, while the mean rent index diverges from each of the indices as housing quality gradually improves. There are some periods where the repeat-rent index also diverges from the land rent index, most notably in the late 18^{th} century, but this does not seem to result in misestimating quality, as the difference between the mean rent and repeat-rent index (the quality index) is not widening systematically in these periods. A second reassuring notion is that quality-improvements seem to matter much less for farm rents. Although leased lands could still contain significant capital, for example in the form of land preparation, buildings or the plants and trees on the land, the hedonic indices suggest these did not affect farmland rents as much as housing rents.

We should note that these farmland rents are not perfectly comparable to housing rents, as urban-rural rent differences might have changed over time, even though most properties were very close to Paris. To complicate matters, land leases also contained the right to levy the tithe, which effectively reduced the rent (Hoffman (2000) adjusted for this). However, imperfections aside, both robustness

Figure 8: Housing Rents and Land Rents, Paris area



checks supports our belief that the developments in the mean rent and repeat-rent index are accurate over the longer run.

G Day Wages versus Annual Income

Clark and Werf (1998) estimate work effort from piece rates and day wages, and compare income of rural workers on annual contracts and day wages. They argue that there was little evidence that the length of the working year expanded already prior to the Industrial Revolution. Recently, Humphries and Weisdorf. (2017) employ more extensive data on annual wages to contest these findings, suggesting a substantial increase in the length of the working year, supporting the notion of a corresponding industrious revolution. These two studies both focus on English rural workers, while our interest lies in the level of urban wages across Western Europe. For Londoners, Voth (2000) estimates that the number of hours worked increased by 40 percent between 1750 and 1830. For 16$^{\text{th}}$ century Holland, De Vries (2008) explains how the abolishment of holy days due to the Reformation suddenly lengthened the working year from about 250 days to a maximum of 307 days, and later also induced gradual increases in the working year in places that remained loyal to Rome.

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 16th 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.[4] 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 9 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 Werf (1998) and Humphries and Weisdorf. (2017), 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 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.

[4] 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.

Table 9: 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.

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