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Reaching for yield and the housing market: Evidence from 18th-century Amsterdam

Matthijs Korevaar

Erasmus University Rotterdam, Burgemeester Oudlaan 50, Rotterdam, 3062 PA, the Netherlands

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ABSTRACT

Do investors reach for yield when interest rates are low and does this behavior affect the housing market? Using the unique setting and data of 18th-century Amsterdam, I show that reach-for-yield behavior of wealthy investors resulted in a large boom and bust in house prices and major changes in rental yields. Exploiting changes in the supply of bonds, I show that investors living off capital income shifted their portfolios towards real estate and other higher-yielding assets when bond yields were low and decreasing. This behavior exacerbated house price volatility and increased housing wealth inequality.

1. Introduction

Over the past few decades, real interest rates have declined to very low levels. The conventional view in finance is that these reductions should not impact investors' preferences for risky assets. However, recent research on stock and bond markets has challenged this assertion, suggesting that some investors reach for yield (e.g. Lian et al., 2019; Jiang and Sun, 2020; Campbell and Sigalov, 2022; Daniel et al., 2021). These investors increase their exposure to higher-yielding assets when interest rates decline, particularly when rates are low and income yields are used to fund consumption or other expenses.

The goal of this paper is to study reaching for yield in the housing market and its implications for house prices and the distribution of housing wealth. Reaching for yield could have particularly important effects on housing markets. Firstly, rental income is the main determinant of long-term housing returns, and most private landlords view rent as a contribution to their income or pension.[1] When interest rates are low, investors might be more inclined to invest in housing over bonds to obtain satisfactory levels of capital income. Secondly, rental investors directly compete with owner-occupying households, implying that their behavior could impact home-ownership and wealth accumulation for ordinary households. Recently, there has been a notable increase in the share of private investors in the residential housing market (Mills et al., 2019; Bracke, 2021), concurrent with a surge in

[1] For instance, in the 2021 Private Landlord Survey from the British government, the two most common responses to the question, "how do you view your role as a landlord?" were "as a long-term investment to contribute to my pension" (54%) and "as an investment for rental income" (48%).

E-mail address: korevaar@ese.eur.nl

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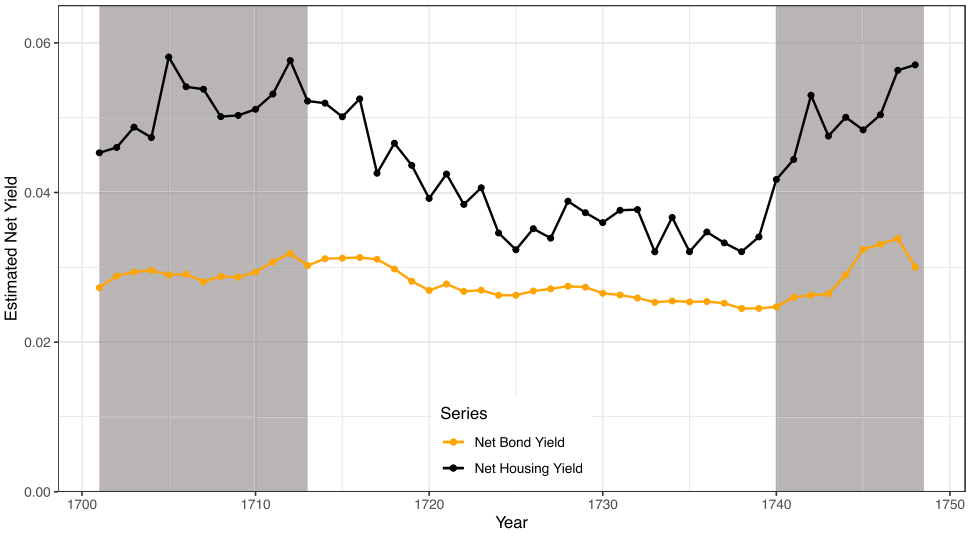


Fig. 1. Housing yields and bond yields, 1701–1748. Fig. 1 plots the estimated net yield on housing in Amsterdam relative to the net yield on Holland government bonds, both based on gross yields corrected for average taxes (and costs for housing). Housing yields are normalized based on the yield of the median property on the median street. The sources are in section E of the Internet Appendix.

house prices. Some worry that low rates and monetary policy stimulus have left the housing market susceptible to investors reaching for yield, leading to exuberance in house prices and an increase in wealth inequality.[2]

This paper investigates a historical episode particularly suited for examining the role of reaching for yield in the housing market: a housing boom and bust in 18th-century Amsterdam. Using newly-digitized archival data on property transactions, investment portfolios, and housing yields, I reveal novel stylized facts on investment and housing market activity. I examine the extent to which these facts can be explained by conventional asset pricing factors or, alternatively, if they resulted from investors reaching for yield. My main findings support the latter view. In Amsterdam, many wealthy investors were rentiers who lived off capital income. As bond yields and their capital income decreased, these investors actively shifted larger portions of their wealth to higher-yielding real estate. This behavior exacerbated volatility in house prices and rental yields. Because investors outpriced regular home-buyers during the boom and retained their properties during the bust, housing wealth inequality persistently increased.

Fig. 1 provides the primary motivation for examining this historical episode, presenting estimates of the net yield on long-term Holland bonds and Amsterdam housing from 1701 to 1748. The spread between the two will be referred to as the yield premium. As there was no structural growth in consumer prices, this spread is comparable in both nominal and real terms; however, nominal terms will be used throughout the paper. During the first decade of the 18th century, the yield premium grew gradually, with both bond and housing yields increasing. From 1714 to 1740, a significant boom in house prices occurred, leading to a considerable decline in housing yields and yield premia. Both of these reverted after 1740. Bond yields, although moving in the same direction as housing yields, remained more stable, fluctuating between 2.4% and 3.2%. On average, a one basis point reduction in the bond yield correlated with a 1.6 basis point reduction in the yield premium.

Recent empirical and theoretical evidence suggests that reach-for-yield behavior intensifies when rates are low (Lian et al., 2019; Daniel et al., 2021; Campbell and Sigalov, 2022).[3] Intuitively, a one-point decrease in interest rates has a more significant impact on the income of living-off-income investors when rates are already low. However, sustained periods of low interest rates are historically exceptional. For instance, Dutch long-term bond yields only fell below their 18th-century levels within the last decade. This fact underscores the relevance of studying this historical period.

Another reason for examining this period is that the shocks driving shifts in yields and investment were likely exogenous to the demand of Amsterdam investors for higher-yielding real estate assets. Changes in house prices and yields coincided with shifts in public finances, driven by international warfare periods (shaded in grey in Fig. 1). War expenditures increased bond yields and public debt during wartime, while yields and debt service decreased during peacetime. The amount of debt Holland could issue and its effect on yields depended on both its fiscal capacity and investors' demand for these securities. The paper therefore primarily exploits differences in the timing of wars. These wars were triggered by the deaths of foreign

[2] For example: "Monetary policy and inequality" ECB Speech Isabel Schnabel, November 9, 2021.

[3] A minor distinction exists between reaching for income and reaching for yield. Investors reaching for income purchase assets with high current income yields, which may still have low expected returns. In the context of this paper, no such distinction is present due to the absence of structural growth in cash flows, and the immediate payout of cash flows.

rulers, and the Dutch participated as part of their alliance with the English and Austrians. With waning Dutch influence relative to the English, their impact on the outcome and timing of peace negotiations was limited. This makes it unlikely that the duration of these wars was influenced by relative prices and investment in the Amsterdam housing market.

After introducing the data, the paper's main body presents several stylized facts about the housing market's boom and bust, and their relation to the bond market and warfare, adding further context to the trends depicted in Fig. 1. I demonstrate that yield changes coincided with shifts in investment portfolios and that reductions in bond yields also led to decreased interest income for investors. Subsequently, I explore the factors that could account for these stylized facts.

I begin by investigating whether changes in yield premia can be attributed to conventional asset pricing factors, such as changes in expected future cash flows or changes in the risk associated with housing relative to government bonds. These explanations seem improbable, as the data does not support increased optimism about future rents or reduced risk. The Amsterdam economy was stagnant during this period, displaying no significant changes in rents, wages, or population, in both war and peace times. Portfolio and property-level risk measures also do not suggest a decrease in rental cash flow risk during peace periods compared to war periods. This observation aligns with evidence from contemporaries and historians who emphasize the fiscal consequences of war rather than direct economic impacts (e.g. De Vries and Van der Woude, 1997). Wars may have had limited direct influence as they were fought abroad, often with private armies.

I then consider the main alternative hypothesis: that the compression in yield premia resulted from investors reaching for yield. The basic intuition is that downward pressure on yields during peace periods prompted investors to acquire higher-yielding real estate assets. In equilibrium, this would cause housing yields to decrease more rapidly than bond yields when rates declined, and revert when rates increased. In this scenario, the compression in yield premia corresponds to a compression in risk premia.

To test this hypothesis, I employ two different analyses. First, I investigate whether the dispersion in yields across properties decreased during peace periods and increased during war periods. Generally, low-grade properties had much higher yields than top-grade properties, whose yields were close to those on government bonds, even during wartime. If investors were reaching for yield, we would expect their demand to concentrate in properties with relatively high yields. The precise change in bond yields during war and peace periods may have depended on the investment demand for higher-yielding real estate. I leverage the more plausible assumption that the duration of war and peace periods was exogenous to the relative yields of properties within Amsterdam. I find that the decline in yields during peacetime, visible in Fig. 1, was concentrated in low-grade properties.

Second, I study how incentives to reach for yield varied by wealth and portfolio composition and link this to realized transaction activity. Most very wealthy individuals had inherited their wealth or accumulated it through business profits. They lived entirely or partially from capital income and generally did not draw down on wealth. Falling yields implied greater difficulty in living off income, potentially motivating them to invest more in higher-yielding assets, consistent with modern evidence (e.g. Daniel et al., 2021). This particularly applied to investors living off capital income from bonds, the main rentier asset, as their interest income declined on average by 20 percent when yields decreased. Individuals with limited wealth likely had few reasons to reach for yield, as they mostly relied on labor income and primarily invested in owner-occupied housing. Consistent with this, a one percentage point reduction in bond yields correlated with a 20 percentage point increase in the portfolio share of real estate for individuals in the top quartile of the estate tax records but almost a 10 percentage point decrease for those in the bottom quartile.

To formally investigate this, I identify individuals with unique names and link their wealth portfolios at death to the housing purchases made during their lifetimes. I again differentiate between war and peace periods, which affected bond yields but were plausibly exogenous to the relative demand of various investor types for Amsterdam real estate. Using a difference-in-difference strategy, I demonstrate that during peace periods, investors with substantial government bond investments became much more likely to buy real estate compared to those with fewer or no bond investments, controlling for wealth. This finding supports the notion that price increases and yield reductions were driven by a group of investors with strong incentives to reach for yield.

If yield reductions and reach-for-yield purchases increased house prices, these effects might have been reinforced if they led to an increased credit supply or if the price increases endogenously attracted short-term speculators. There is limited evidence for such confounding effects: mortgage credit was negligible in this period, and short-term purchase activity was limited. I provide suggestive evidence that the changes in yields led to changes in housing supply, primarily through a reconfiguration of the existing housing stock towards properties that experienced larger yield declines during the boom.

In the last part of the analysis, I examine implications for the distribution of wealth. As a result of reach-for-yield purchase activity, the fraction of housing wealth owned by the top 1% of society (or the top 5% in the estate tax records) increased from less than 20% to over 30% of wealth. This trend did not reverse when the boom went bust, given that most of these purchases were buy-and-hold investments. The impacts on aggregate wealth inequality are less pronounced although wealth inequality was growing over time, in line with reach-for-yield purchases increasing the expected returns for the very wealthy relative to the less wealthy.

In the final part of the paper, I discuss whether my findings can be reconciled with modern theories about reaching for yield in the stock and bond market and

whether similar mechanisms could still play a role in the housing market today.

The findings of this paper are generally consistent with the existence of a group of investors who invest by 'living off income', consuming income returns but leaving total capital unattached. This behavior fits the observed investment activity of wealthy investors in this paper and the related historical literature on the rentier class in Amsterdam (e.g. De Vries and Van der Woude, 1997). This behavior also appears specific to private investors: anecdotal evidence from institutional investors shows they increased their allocation towards bonds when the yield premium on housing reduced. When living off income investors hold a large chunk of wealth, portfolio rebalancing in response to low rates could have sizable implications for asset prices (e.g. Koijen and Yogo, 2019).

Importantly, the presence of living-off-income investors is not merely a historical phenomenon: many private investors invest like a living-off-income investor (Campbell and Mankiw, 1989), and Daniel et al. (2021) show that this behavior can lead to reaching for yield in the equity market. However, this behavior could have larger implications in housing markets, where private rental investors play a more substantial role. Recent literature also suggests that the growth in private rental investment might be linked to low interest rates (Gargano and Giacoletti, 2022; Boddin et al., 2023). The experience of historical Amsterdam demonstrates that such investment could affect house prices significantly.

There is generally less consensus on why investors decide to live off income. For endowments, this is natural as they are often not allowed to run down on wealth, and Campbell and Sigalov (2022) show that this could result in reaching for yield. Individual investors might do so as a commitment to future generations and to manage longevity risk, as living off capital income ensures both themselves and subsequent generations access to the income stream from their wealth (e.g. De Nardi et al., 2016). Both reasons could help explain why this behavior is particularly prevalent among older investors with sizable wealth.

Why do these living-off-income investors reach for yield? Jiang and Sun (2020) and Daniel et al. (2021) suggest reaching for yield is caused by behavioral frictions that lead investors living off income to prefer high current dividend yields over future returns. Although the trade-off between yields and capital gains is evident in equity markets, it is less apparent at the level of individual housing investments. An alternative view is that interest rate reductions reduce interest income and therefore force investors committed to live off income to reduce consumption. Such behavior could be rationalized particularly if there is reference-dependence and loss aversion relative to past capital income (Kahneman and Tversky, 1979). In an experimental setup, Lian et al. (2019) suggest investors could reach for yield if they use past interest rates as a reference point.

Although it is not possible to measure the extent to which each of these mechanisms drives reach-for-yield behavior, the presence of living-off-income investors purchasing higher-yielding assets when rates decline appears as a feature of the data both in modern and historical periods with low rates. It might also be particularly attractive to reach for yield in real estate. Most investors only own a few properties, implying their portfolios are subject to significant idiosyncratic risk. Purchasing additional real estate might thus lead to comparatively smaller increases in overall portfolio risk, making it relatively attractive.

Beyond the financial literature on reaching for yield, this paper contributes to a broader literature on the drivers of housing booms and busts. After the US housing cycle in the 2000s, much housing literature has investigated whether booms and busts in house prices can be explained by changes in credit constraints (Mian and Sufi, 2009; 2011; Favara and Imbs, 2015; Favilukis et al., 2017; Justiniano et al., 2019), reductions in interest rates (Himmelberg et al., 2005; Kiyotaki et al., 2011; Sommer et al., 2013), or other factors such as expectations and beliefs (Burnside et al., 2016; Kaplan et al., 2020; Mian and Sufi, 2022). This paper introduces reaching for yield as another plausible driver of housing booms and busts. Given the absence of large-scale mortgage borrowing and the very long nature of the boom (25 years), it seems less likely that credit or belief-based changes in expectations can explain the boom and bust in Amsterdam.

In the papers of Himmelberg et al. (2005), Kiyotaki et al. (2011), and Sommer et al. (2013), house prices move with interest rates, but there is no explicit role for changes in risk premia, which I consider in this paper. Such changes are explicitly considered in the theoretical work of Favilukis et al. (2017). In their paper, reductions in housing risk premia are driven by the loosening of financial constraints. Declining interest rates do not cause large booms because they crowd out domestic savers in the housing market, who need to be compensated for that through a higher risk premium. The insight in this paper is that reach-for-yield behavior can result in exactly the opposite effect, reducing risk premia on housing when rates decline. The absence of large-scale mortgage financing implies this finding cannot be attributed to credit conditions.

This paper also contributes to the growing literature on the role of investors in the housing market. Various papers have noted the increased activity of institutional and private investors in the housing market (Allen et al., 2018; Mills et al., 2019; Nijskens et al., 2019; Bracke, 2021). Garriga et al. (2021) report that these new entrants are more likely to be buy-and-hold investors, consistent with such investors reaching for yield. Several studies have investigated the role of investors in driving house price increases. Haughwout et al. (2011), Chinco and Mayer (2015), and Garcia (2022) show that speculative demand from second-home buyers contributed to the dynamics in the US housing bubble in the 2000s. Demand from foreign investors has also been linked to house price increases (Sá, 2016; Favilukis et al., 2017; Badarinza and Ramadorai, 2018; Cvijanović and Spaenjers, 2021). These studies support the view that increasing investor demand contributes to house price growth but do not study whether this is related to reaching for yield.

Next, this paper relates to the literature on the evolution of household portfolios and the role of housing

therein (e.g. Cocco, 2005; Chetty et al., 2017; Kuhn et al., 2020; Martínez-Toledano, 2020). The focus of these papers is to understand how the existence of housing and its price evolution influence household portfolios. For Spain, Martínez-Toledano (2020) shows that wealth inequality reduces during housing booms but increases during busts. This paper finds the opposite relation, with inequality increasing during the boom and not reducing afterward. The difference between these findings can be explained by the fact that the boom in Amsterdam was driven by buy-and-hold investors, whereas the boom in Spain was driven by households with mortgage credit.

Apart from housing, this paper is also connected to the emerging literature on the pricing of government debt and fiscal capacity (see Jiang et al., 2023). As I will discuss, Holland's ability to issue additional debt during wartime and repay it during peacetime was largely contingent on its fiscal capacity. On the one hand, Holland was able to finance a massive debt amounting to 200% of its GDP at low interest rates, thanks to high demand of savers and limited alternative investment opportunities (Gelderblom and Jonker, 2011), as well as its reputation as a reliable provider of safe assets, akin to the experiences of the UK in the 19th century and the US in more recent times (Chen et al., 2022). On the other hand, this paper demonstrates that these low rates also rendered private investors' propensity to invest in bonds, as opposed to other assets, highly susceptible to shocks. Moreover, when bond yields were at their lowest level, risk premia actually reached their lowest level as well.

2. Data

Three main datasets form the basis for most of the analysis in this paper: registrations of real estate transactions, records of estate taxes, and auction records with rent and sales prices for the same property. Most of these have been newly digitized from hand-written archival records and will be briefly introduced here. Next to these main sources, I collected additional primary and secondary data to support the empirical analysis. In the Internet Appendix, section A presents additional historical background and details on the data collection procedure, and section E provides a complete overview of all sources.

2.1. Estate taxes

To reconstitute investment portfolios, I use archival registrations of estate taxes, the *Collaterale Successie*. These were mandatory taxes on inheritances outside of the direct line: to heirs that were not children or grandchildren. About a quarter of the population that died with any wealth shows up in the records. Due to high mortality rates, many individuals died without having any (surviving) children.[4] These taxes were only levied on individuals that died while owning any real estate or registered financial assets (bonds and equities), which probably was around 20% of the population (Hart, 1973).

Together with research assistants, I hand-collected and transcribed data on all registrations between 1688 and 1780, totaling 25,675 individual observations. Per individual, the transcribed data contain the name of the individual, the year of registration, and the aggregated total value invested in each asset class. Most individuals paid estate taxes shortly after the actual inheritance, but in some cases, this could take several years. A full description of these asset classes and an example estate tax record and transcription is provided in section A.2 of the Internet Appendix. Although the focus of the paper is on the period between 1701 and 1748, I will use the broader sample to link individuals to their housing transactions: Individuals that died in 1780 might have bought real estate already in 1748.

The newly collected estate tax records provide the first comprehensive look into the wealth and portfolio composition of Amsterdam individuals in the 18th century. Various historical studies have drawn small samples from these tax records for smaller cities, arguing they draw a representative picture of investment portfolios (De Jong, 1985; Kooijmans, 1985; Prak, 1985).[5] The main conclusion is that estate tax records sketch a representative picture of wealth at death. There are two potential limitations of the data. First, deceased individuals are generally older than the population and might have different portfolios than the young. This concern is partly mitigated by the fact that in this period many people still died at young ages. Second, cash holdings, movable assets, and private business assets were not registered and thus not taxed. In the early part of the sample, international investments were also not always consistently recorded. This implies that estate tax records understate total wealth, but it is unlikely that this understatement influences the relative investment between bonds and real estate, which is key for the analysis in this paper.

2.2. Housing transactions

This paper uses data from registrations of individual real estate transactions to measure activity in the housing market, spanning the period from the late 16th century to 1810. These mandatory registrations were maintained by the municipal law court (*schepenbank*) and most have been preserved in the Amsterdam City Archives. In recent years, the archive and its volunteers have transcribed data on all 164,702 real estate transactions in the registers, involving more than 450,000 individuals. This study is the first to utilize this newly-digitized data.[6] Although a few registers did not withstand the test of time, the database is fully complete after 1700.

[4] I derived this number by comparing the number of estate tax records with rough estimates of wealth at death for the entire population based on burial taxes, reported in Hart (1973).

[5] I discuss this assumption in more detail in section A.2. of the Internet Appendix.

[6] I gratefully acknowledge the support of the Amsterdam City Archives. Note that the registrations have been indexed and can be found online at https://archief.amsterdam/indexen. Data on house prices, occupations, and various other variables are only available from the full database.

For each transaction, the data record the type of transaction, registration date, transaction price, and the names of the buyer(s) and seller(s). The data also register if a property was sold by a widow or by the heirs of the original owner. Each transaction includes information on the street name and a brief description of the property (e.g., 'home', 'land', 'warehouse'). Most sales are regular sales, with about 10% being foreclosure sales. Section A.1 of the Internet Appendix provides a transcription of one such act, for a property purchased by the painter Rembrandt.

2.3. Data matching

For the main analysis in this paper, I match individual housing transactions to previous transactions of the same property and the household portfolios of individuals at death. Since the data do not provide exact addresses or personal identifiers, matching can only be done based on the names of buyers and sellers. However, there may be misspellings in both the original data and its transcriptions, and many names appear multiple times. To properly match transactions and individuals, I combine algorithmic matching with manual data classification. The full details on the matching method are provided in Section C of the Internet Appendix. The techniques I use are similar to the fully automated matching approach Abramitzky et al. (2021) suggested for US census data.

To match household portfolios to housing transactions during their lifetime, I use the universe of Amsterdam marriage and death records to identify individuals with clearly distinct names, allowing for some misspellings. For individuals with unique names present in the estate tax records, I can link their wealth portfolios to their housing purchases. In total, the matched sample contains 2655 individuals. The limited number of linked individuals is primarily due to most individuals in the records not having sufficiently unique names, and my exclusion of individuals who only bought real estate before 1701 or after 1748.

Individuals in the matched sample tend to be wealthier than all individuals in the estate tax records. This is unsurprising: conditional on owning any real estate at death, individuals who actively added real estate to their portfolios were likely wealthier than those who did not. Finally, note that it was not possible to precisely match individuals to their sales. Many sales occur after the death of an owner (by heirs) and sales typically list several sellers, while purchases are generally made by a single person.

To match housing transactions, I identify unique names of buyers and sellers at the street level. The basic intuition is that if, on a given street, the name of a person appears exactly once as a buyer (before) and once as a seller (afterward), it is likely the same property being sold. Matching parameters were chosen to strike a balance between the number of matches and their accuracy. In total, this procedure resulted in 35,467 transaction pairs (1625–1810), sufficient to estimate a precise price index.

2.4. Yield data

A significant fraction of investment properties were sold voluntarily in public auctions. These auctions have been organized since at least the early 17th century and continue to take place today. The Amsterdam authorities kept records of these auctions and the assets that were sold, predominantly rental housing. This registration was separate from the registration of the property transfer. In addition to real estate, financial assets such as government bonds were also sold regularly (Van Bochove et al., 2017).

For many of these auction sales, the aldermen recorded both the sales price and the current rental contracts on the property or its most recent rental price. This makes it possible to estimate the gross yield at purchase. For the period between 1688 and 1748, I transcribed data for about 30 registrations per year that recorded both the rent price and sales prices (1749 yields in total). Data recorded include the total rental revenue of the property, the sales price, the street name, and the property type. Total rent was not recorded if rental prices for part of the unit were missing. If a housing unit was entirely vacant or owner-occupied at the time of sale, typically no rent would be registered.

3. Stylized facts

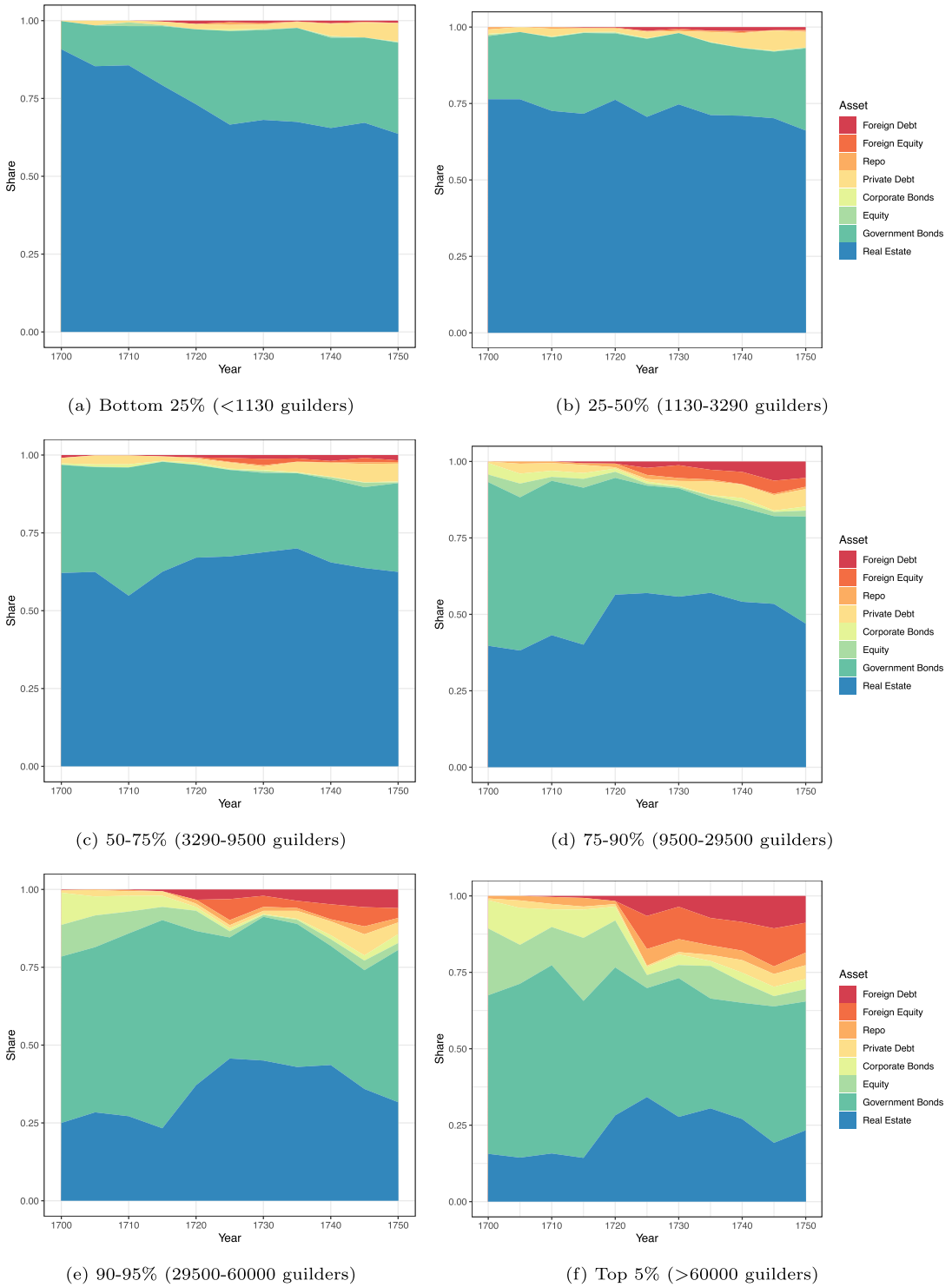
This section uses the obtained data to provide a set of stylized facts that motivate the main claims of this paper. These stylized facts also help to understand the historical context of the Amsterdam economy in the first half of the 18th century.

Stylized fact 1: *Real estate was the primary middle-class asset, while holdings of bonds and equities were concentrated among the wealthy. The wealthy allocated a growing share of wealth to real estate and other higher-yielding assets between the 1710s and 1730s.*

Fig. 2 uses the estate tax records and shows the evolution of the composition of wealth portfolios both over time (per 5 years) and across different groups of wealthy people. About 80% of individuals died without wealth, although these individuals might have had cash holdings that do not show up in the records. In the bottom half of portfolios, real estate is the most important asset, which primarily corresponds to owner-occupied properties.[7] These individuals had sufficient wealth to own a house but owned few other assets. For the bottom wealth group, the asset share of real estate declines substantially over time, while bond investments increase. This change is particularly significant in the 1710s and 1720s.

For wealthier individuals, most wealth was invested in domestic government bonds, primarily consisting of bonds of the Province of Holland. The asset share of real estate in the top three wealth groups (top 25%) increases significantly in the 1710s and 1720s. From the 1720s, and for the first time in history, international investments in debt and particularly equities become a common component of the portfolios of the very wealthy, with most of this investment going into the United Kingdom. Securities issued abroad were only taxed from May 1, 1723, and are thus under-reported before 1723. However, Dutch investment in

[7] The data do not allow me to identify exactly whether a property was owner-occupied. However, most individuals in the records only own a single house and no other assets, making it unlikely this was rental property.



(a) Bottom 25% (<1130 guilders)

(b) 25-50% (1130-3290 guilders)

(c) 50-75% (3290-9500 guilders)

(d) 75-90% (9500-29500 guilders)

(e) 90-95% (29500-60000 guilders)

(f) Top 5% (>60000 guilders)

Fig. 2. Investment portfolios, 1700–1750. Fig. 2 plots the evolution of the composition of portfolios for six different wealth groups between 1700 and 1750. Data are based on average portfolio shares (unweighted) and aggregated per five years, so the observation in 1700 for example covers the period from 1698–1702. For a detailed list of assets, see section A.2.1 of the Internet Appendix.

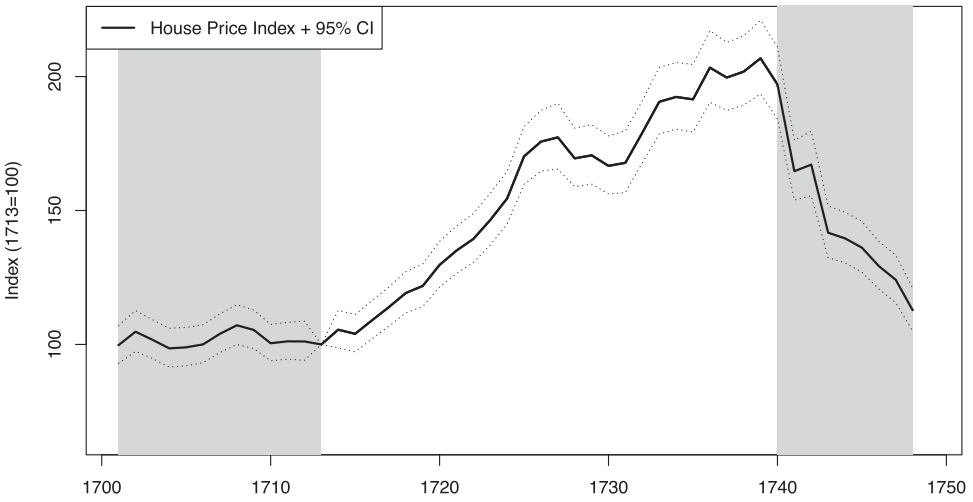


Fig. 3. House price index, 1701–1748. Fig. 3 plots the evolution of nominal house prices in Amsterdam between 1701–1748. Periods of major warfare involving the Dutch are shaded in grey. 95% confidence intervals for the house price index are relative to the price level in the base-year 1713.

British assets only began growing rapidly after 1720 and was very limited before that (Van Bochove, 2008).

In general, the period from the mid-1710s to the 1730s is marked by a shift from low-yielding domestic bonds to higher-yielding assets among the very wealthy. For example, the share of wealth invested in real estate and equities in the top 5% of estate tax records increases from just under 30% in the early 1710s to almost 50% in the 1720s and 1730s. It decreases again to about 40% in the 1740s.

Most wealth was concentrated in the top group. The top 5% in the estate tax records (Fig. 2f), approximately the top 1% of society, on average owned about 56% of total wealth. This is comparable to what Piketty et al. (2006) report for 19th-century Paris. Similar to France, many very wealthy individuals were rentiers who had accumulated or inherited vast sums of wealth and lived off the income returns it provided. The creation of this rentier class is usually attributed to the decline in profitable business opportunities and the stagnation of the Dutch economy in the late 17th century, when wealthy merchants gradually turned into rentiers (De Vries and Van der Woude, 1997).

Stylized fact 2: *After a period of price stability, there is a large boom in house prices between 1714 and 1740, followed by a bust. This cycle is characterized by increased volatility of capital gains but only limited changes in rental income.*

Fig. 3 illustrates the evolution of house prices between 1701 and 1748, the main period of analysis in this paper, estimated based on standard repeat-sales methods (Bailey et al., 1963; Case and Shiller, 1987). At the beginning of the index in 1700, house prices are stable. It should be noted that house prices had been stable since the mid-1680s after they had fallen substantially in the 1670s.[8] Prices start rising substantially from 1714 onward with a small hiatus in the late 1720s. After 1740, prices fall quickly back to their 1710 levels. The inflection points in the development of house prices closely coincide with the two main wars that were fought in Europe during this period: the boom starts at the end of the Spanish Succession War (shaded in grey, 1701–1713) and the collapse follows the Austrian Succession War, which began in late 1740 and ended in 1748.

Table 1 presents statistics on capital gains and total returns (capital gains + rental yields) during various periods. Rental returns are based on actual gross yields net of current taxes and a fixed cost assumption of 25% of rental income for housing.[9] Bond yields are used to compute Sharpe ratios. For reference, I also include the average fraction of wealth invested in real estate (% R.E.) and real estate and equities (% Risky) using data from the estate tax records, confirming the shifts in Fig. 2.

The housing boom was entirely driven by an increase in capital gains but not by a decrease in total return volatility, both when compared to the short pre-boom 1701–1713 period and the longer 1688–1713 period, which is included for reference. During the bust, house prices fell rapidly. Large fluctuations in house prices during the cycle pushed down yields during the boom while increasing them during the bust (Fig. 1). Overall, total returns were similar in the pre-boom period compared to the entire cycle given the stability of rents. Sharpe ratios were lower during the boom-bust cycle due to the heightened volatility of house prices.

Stylized fact 3: *There are large changes in the development of public expenditures and total public debt due to periods of warfare, which coincide with small changes in the yields on government bonds. Debt service moved in line with yields.*

[8] Fig. F.1 of the Internet Appendix plots the index for the entire 1625–1810 period.

[9] Tax rates computed based on (Fritschy, 2017) and the actual tax registers in the Amsterdam City Archive. The assumption on costs follows Eichholtz et al. (2021), who compute returns from auction yields in 20th-century Amsterdam.

Table 1
Geometric returns and risk on housing, by time period.

	Capital gains		Total returns				
Period	μ	σ	μ	σ	Sharpe R.	% R.E.	% Risky
Pre-boom: 1688–1713	0.1%	3.0%	3.9%	3.1%	0.43	35.0%	44.7%
Boom-bust: 1714–1748	0.3%	6.0%	4.0%	5.9%	0.20	35.0%	48.0%
Pre-boom (war): 1701–1713	0.0%	2.9%	3.9%	3.1%	0.47	29.7%	40.6%
Boom (peace): 1714–1739	2.8%	3.4%	6.2%	3.4%	1.13	36.0%	49.0%
Bust (war): 1740–1748	−5.8%	6.9%	−1.8%	6.9%	−0.61	32.5%	45.1%

Table 1 displays descriptive statistics of annualized log housing returns for various periods, including the mean and standard deviation for both capital gains and total returns. The Sharpe ratio is computed using these data and the bond yield. For reference, I report the fraction of wealth invested in real estate and real estate + equities in these periods, combining data from all estate tax records.

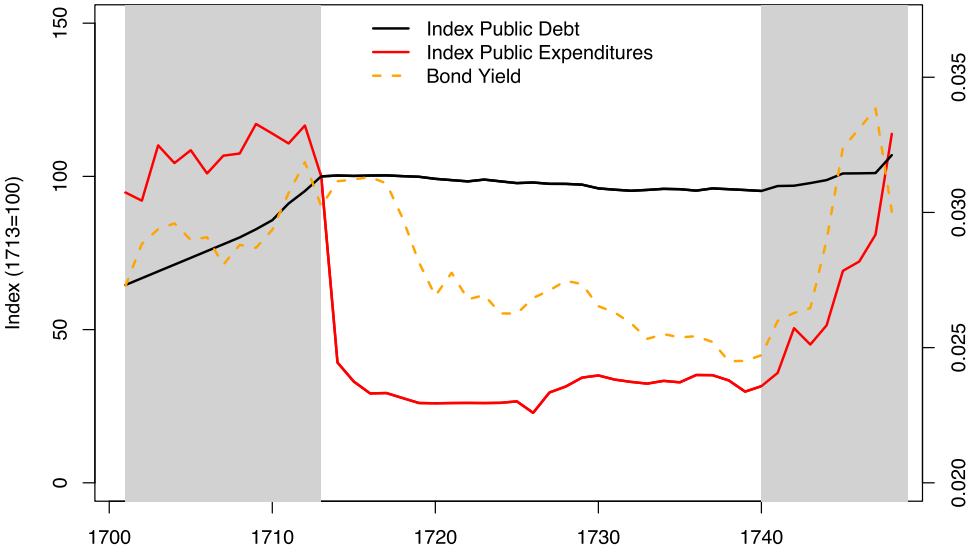


Fig. 4. Bond yields and public finance, 1701–1748. Fig. 4 plots the evolution of total provincial debt for Holland and its total public expenditures (excluding debt service and redemption). The values are indexed to the base-year 1713. The right-hand side of the plot shows the development in the yield on Holland annuities. This is based on the gross yield in the secondary market minus the average tax of 1.5%. Periods of major warfare involving the Dutch are shaded in grey.

Dutch involvement in the Austrian Succession War and, in particular, the Spanish Succession War, led the government to incur enormous expenses to fund its war activities. The cause of these wars was the contested succession of a deceased ruler, respectively the king of Spain and the archduke of Austria, and the corresponding control over their lands. The Dutch Republic joined these wars as part of their alliance with the Austrians and English who supported a successor from the House of Habsburg, fighting the French and their allies who viewed this as an opportunity to challenge the balance of power. For the Dutch and English, this challenge posed a potential threat to their political and trade interests, implying they were willing to engage in a costly war.

Fig. 4 plots an index of the stock of public debt and total expenditures excluding debt service and redemption for the Province of Holland (left-hand side), and the evolution of the yield on Holland *losrenten*, a bond similar to a UK consol (right-hand side). The Dutch Republic was a federal state, and every province contributed to federal expenditures, which were predominantly expenditures for warfare and the navy. Holland paid around 60% of these expenditures, which equaled 24 million guilders in the base year 1713. The index of total debt represents the provincial debt, which stood at 310 million guilders in the base year 1713, around 200% of annual GDP. On top of this, there was a small federal debt of 60 million guilders.

During this period, most public debt consisted of *obligaties*. These bearer bonds had a stated maturity of up to one year but were rolled over automatically at the same rate unless the government decided to redeem them, effectively making them long-term debt similar to UK consols.[10] The plot's yields originate from redeemable annuities (*los-*

[10] Historical literature has referred to *obligaties* as bills based on the stated maturity in the contract and the supposed ability of bearers to redeem their bonds after maturity at par (Gelderblom and Jonker, 2011; Van Bochove, 2013). To avoid confusion, I avoid this terminology: *obligaties* were effectively long-term debt, and the contracts and registers in the bond offices of Haarlem and Leiden do not indicate that bearers were allowed to redeem the debt at par. This would also create arbitrage opportunities, as bonds often traded below par in the secondary market (Archief van de Finantie van Holland (3.01.29), Nationaal Archief, 233–234 and 256–257).

renten), similar to *obligaties* but mostly issued in the 17th century and requiring a formal transfer of title at a notary, enabling the construction of price series. Both *losrenten* and *obligaties* had a fixed interest rate of 4%, with a 1.5% bond tax directly deducted, resulting in a 2.5% coupon. The tax varied slightly around the Spanish Succession War; the graph's yields assume expected taxes equaled 1.5%.

Expenditures surged in 1701 as Holland prepared to join the Spanish Succession War, which it formally entered in April 1702. War expenditures stayed elevated until the Peace of Utrecht in 1713. These war expenditures were mainly funded through newly issued public debt, except for a temporary increase in the bond and real estate tax that raised tax revenue (Fritschy, 2017). After the war, Holland had a massive public debt, with most of its tax revenue allocated to debt service.

Bond yield trends co-move with changes in public finances, increasing during periods of significant war expenditures and debt growth and decreasing during peaceful times. Holland could fund such substantial debt at very low rates due to the high demand for bonds: a lack of private business growth opportunities and the corresponding economic stagnation meant that merchants and other businessmen saved their profits and accumulated wealth in financial assets (De Vries and Van der Woude, 1997; Gelderblom and Jonker, 2011). Holland's debt was perceived as extremely safe, allowing it to issue more debt than warranted by future primary surpluses, consistent with the UK's experience in the 19th century and the US in modern times (Chen et al., 2022).

During the Spanish Succession War, war expenditures were so high that there was insufficient demand to fund all war expenditures by issuing regular taxed 4% bonds and bond yields in the secondary market increased. To attract investors to new issues, Holland exempted newly issued bonds from the bond tax for four years after issuance, extending the exemption periods for bonds issued in the latter part of the war. In the war's final stages, Holland began issuing bonds with higher yields in combination with tax-free bonds, such as lottery bonds and a taxed 20-year loan.

In the peace period, public debt stabilized, but sustained investment demand led to a gradual reduction in bond yields in the secondary market. Although net redemption of public debt remained limited due to the lack of fiscal capacity, Holland managed to reduce its debt service in line with yields. After the war, Holland paid around 9 million guilders in interest on provincial debt and over one million guilders on federal debt. As yields fell during the peace period, the government could gradually lift tax exemptions on war bonds and convert older, higher-yielding loans into lower-yielding ones. By 1740, debt service on provincial debt was 7.4 million and on federal debt 0.8 million, a reduction of about 20%, consistent with the drop in bond yields.

Although this practice seems unconventional by modern refinancing standards, it was legal and accepted in both the Dutch and English bond markets during this period (see Chamley, 2011; Gelderblom and Jonker, 2011; Fritschy, 2017; Ellison and Scott, 2020). Tax changes and conversions were likely more efficient ways to affect rates than redeeming the debt and providing bondholders with new securities, as long as bondholders accepted these changes over redemption. It is important to note that many investors were buy-and-hold rentiers who disliked redemptions (Van Bochove, 2013).

During the Austrian Succession War, Holland had more difficulty raising funds, and yields quickly returned to the levels reached at the end of the Spanish Succession War. By this time, Holland's capacity to issue additional debt had significantly declined. Debt levels remained very high following the Spanish Succession War, implying limited fiscal capacity to fund additional debt. Additionally, investors' willingness to finance Dutch debt at even lower yields likely decreased as newly-developed international capital markets allowed Dutch investors to invest in England, which also issued additional debt but at higher yields, potentially absorbing most Dutch saving demands. To fund higher war expenditures, the government relied more heavily on taxes on general wealth and personal income. However, these were controversial, and over time, the Holland government became less willing to join further war activities.

Stylized fact 4: *The yield premium on housing falls substantially during the housing boom and period of peace between 1714 and 1739 while reaching high levels in war periods.*

The fourth and final stylized fact establishes that there is a significant reduction in the rental yield on housing relative to the bond yield during the boom, confirming the trend in Fig. 1. To estimate the yield premium, I rely on property-level data on gross housing yields from the auction records, adjusted for costs (c), from which I subtract the bond yield: $\pi_{i,j,t} = (1-c) \times HousingYield_{i,j,t} - BondYield_t$. I assume costs equal 25%, which equals the actual expenses on maintenance in the housing portfolio of the Amsterdam orphanage in this period, probably the largest real estate investor in Amsterdam (Eichholtz et al., 2022). In the main analysis, I ignore changes in yields due to property and bond taxes to avoid having to make assumptions on investors' expectations of future taxes, which fluctuated a bit in war periods but were similar for real estate and bonds. Importantly, the yield premium on bonds relative to real estate was known to market participants, as both real estate and government bonds were sold in these auctions.[11]

To provide a point estimate of the mean housing yield in the sample, I take all individual yield observations deflated for costs and the bond yield, and estimate the following equation:

$$\pi_{i,j,t} = \beta_t + \gamma \ log(RentVal)i + \mu_j + \epsilon i, j, t \qquad (1)$$

β_t includes the main parameters of interest: bi-annual time fixed effects tracking the yield premium, with 1712–1713 used as the base year. There are too few observations to estimate the premium precisely annually. I additionally include street fixed effects (μ_j) and control for the log rel-

[11] Based on a small sample of cross-checks, the yields on *obligaties* in the Amsterdam auction market were virtually the same as the series of yields of *losrenten* from Gelderblom and Jonker (2011) in Gouda used here.

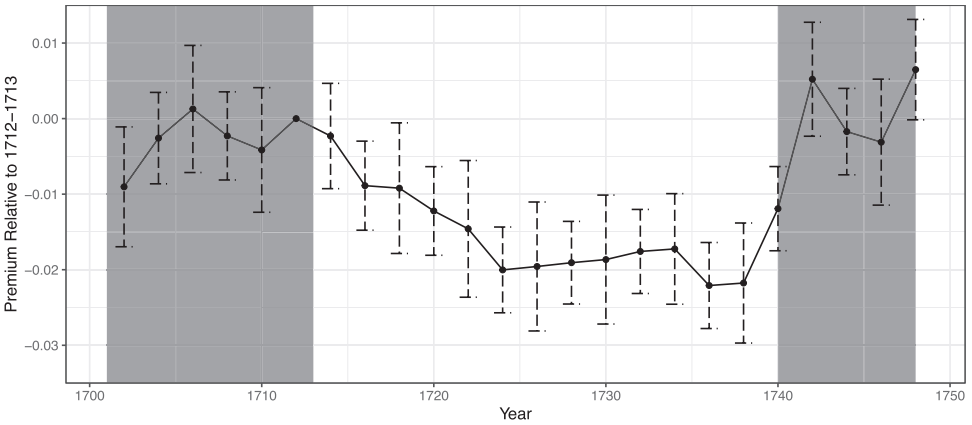


Fig. 5. Housing yield premia, 1701–1748. Fig. 5 plots bi-annual estimates of the difference between housing yields and bond yields for the period between 1701–1748 relative to the base-year 1712–1713 (e.g. the point plotted in the year 1740 refers to 1740–1741). Estimates control for rental value and include street fixed effects. The difference is computed excluding current taxes, which were similar for bonds and real estate but fluctuated over time.

ative rental value of each property (adjusted for market price changes), which aim to capture that larger or more luxurious homes and properties with high location value might have different levels of maintenance costs and risk. Fig. 5 shows the results.

There is a small increase in the yield premium during the Spanish Succession War of about one percent, which predominantly occurs in the early phase of the war. After the war, yield premia decline by about 2% until 1725 and remain at these low levels until 1740. In the Austrian Succession War, yields increase rapidly once again. Yield premia thus decline gradually during the peace period but increase and then stabilize during war periods. The magnitude of these changes is about three times larger than the drop in the bond yield itself, which fell by around 0.7% during the peace period. Note that these trends are not driven by changes in taxes or non-linear differences between yields on different properties: in Figures F.2 and F.3 of the Internet Appendix, I show that the results do not change when using the difference in log yields or the current net-of-tax yields as the dependent variable.

4. Analysis

The main purpose of this section is to analyze the mechanisms that could explain the four stylized facts introduced in the previous section: a boom-bust cycle in house prices that coincides with a compression and decompression in yields, and changes in the share of wealth the rich invested in real estate.

I begin this section by examining whether these facts can be explained by standard asset pricing models. In a discounted cash flow model, current rental yields and bond yields compress if investors expect higher housing returns going forward (higher growth rate of dividends) or if the relative risk of housing investments reduces (lower discount rate). Such changes operate independently of movements in safe interest rates.

Next, I study the main alternative hypothesis: that changes in relative yields were driven by investors reaching for yield, increasingly buying higher-yielding real estate relative to lower-yielding bonds during the peace period, while reversing this behavior when rates increased again. I conclude with a brief discussion of alternative explanations for housing booms and busts that have been raised in the literature and could confound the mechanism identified in this paper.

4.1. Changes in expected returns and risk

A first potential explanation for several of the stylized facts is that alternating periods of war and peace had a direct effect on economic conditions. War might have led to pessimism about the state of the economy, which could have negatively affected expectations about the housing market. If large-scale debt issuance was crowding out private investment during war periods, this could further depress economic conditions. If peace resulted in economic growth and home-buyers translated this into optimistic expectations of future rent growth, house prices could boom during peace periods. Such changes could also result in shifts in the holdings of real estate; for example, if wealthier investors were more informed or if rising prices due to improving fundamentals made homeownership less attainable for individuals with limited savings.

Given the size and length of the boom, with house prices doubling and yield premia relative to bonds declining by two percentage points, this would require sizable and long-lasting improvements in expectations during the peace period. For instance, assuming a housing risk premium of 2% over bonds, a standard Gordon growth model would require an increase in expected rental growth of 1.5 percent per year to explain the observed compression in yields during the boom period.

Although it is not possible to measure the expectations of 18th-century investors, we can assess whether realized data provide any justification for such optimism. First, structural rent growth of 1.5 percent would significantly exceed the actual rent price growth investors had experienced before the boom: structural rent price growth had been absent since the mid-17th century, and shorter-term fluctuations were relatively limited. Second, despite

Table 2
Descriptive statistics, war and non-war periods, 1701–1748.

	Peace			War			
Statistic	N	Mean	St. Dev.	N	Mean	St. Dev.	P-value
Δ log(CPI)	26	−0.002	0.041	22	0.0003	0.086	0.918
Δ log(GDP)	26	−0.011	0.053	22	0.022	0.111	0.213
Δ log(Wages)	26	0.001	0.004	22	−0.0001	0.002	0.518
Δ log(Population)	26	−0.001	0.006	22	0.001	0.004	0.332
Δ log(Rents)	26	0.004	0.018	22	−0.002	0.027	0.392
Δ log(ConstrCPI)	26	0.001	0.083	22	0.003	0.103	0.914
Δ log(HPI, Amsterdam)	26	0.028	0.033	22	−0.029	0.057	0.000
Δ log(HPI, Den Bosch)	26	−0.006	0.174	22	−0.009	0.284	0.965
Δ log(PublicDebt)	26	−0.002	0.004	22	0.027	0.018	0.000
Δ log(Yield)	26	−0.008	0.023	22	0.018	0.049	0.032
% Bond Tax	26	0.015	0	22	0.018	0.003	0.001
% Property Tax	26	0.143	0.016	22	0.221	0.040	0.000
% Wealth Tax	26	0	0	22	0.002	0.007	0.144

Table 2 shows descriptive statistics for various annual time series used in the empirical analysis, both for periods of peace (left) and periods of war (right). The column on the far right reports the p-value for a t-test of equality of means. Most variables are based on data from Amsterdam but data on GDP and the bond market is for the Province of Holland.

the peacetime boom lasting a quarter of a century, realized data on economic fundamentals during the boom provide limited evidence for economic improvements that could underpin more optimistic expectations.

In fact, one important motivation for studying this particular period is that it has generally been described as a period of economic stagnation. Both contemporaries and economic historians have argued that the wars primarily affected Holland through their large impact on public finances instead of their economic effects (de Montesquieu, 1729; De Vries and Van der Woude, 1997). To illustrate this point, Table 2 presents descriptive statistics on log changes in various economic variables related to the state of the economy of Holland and Amsterdam for periods of war and periods of peace. The last column reports p-values of standard difference-in-means tests. Periods of war include the Spanish Succession War and the Austrian Succession War. The first group of variables contains the main economic variables for which data is available. There are no statistically significant differences between periods of war and peace for key housing demand variables such as rents, wages, and population. Generally, differences are also negligible in economic terms. GDP growth shows the starkest economic difference, growing faster in periods of war than in peace. However, this difference is entirely driven by direct war expenditures and growth in international trading in wartime (Van Zanden and Van Leeuwen, 2012).

The relatively limited impact on economic fundamentals contrasts with the large and significant differences in house price growth and fiscal variables during periods of war and peace. House price growth differs by 5.6% per year in periods of war and peace and is precisely estimated. Similarly, both public debt and bond yields increase substantially in periods of war relative to periods of peace. There were also changes in taxation, but they generally affected holders of existing bonds and housing supply equally and cannot explain why house prices rose for a very long period during the peace period when taxes were unchanged.

It might seem surprising that wars had limited direct economic effects on Amsterdam despite the sizable expenditures the Republic made. First, most battles in these wars took place outside the Dutch Republic, with only minimal fighting at the border, far from Amsterdam. War was highly privatized, and a significant portion of troops were hired abroad (Brandon, 2015), implying less spending was local. Second, the wars resulted in negligible Dutch territorial changes and no structural changes in trading opportunities, despite short-term fluctuations in trade.[12] The fact that the Dutch gained very little from the wars likely related to their waning economic influence relative to their English allies, which meant they had limited impact on the timing and outcome of peace negotiations. When the Spanish Succession War ended with a peace agreement in the Dutch city of Utrecht, French diplomat Polignac famously said "*nous traiterons chez vous - de vous - et sans vous*" ("We negotiate in your place - about you - and without you", Van Bunge, 2018).

To further corroborate this point, I compared house prices in Amsterdam to those in Den Bosch, a city at the southern border of the Dutch Republic. Its location implied that its housing market was more exposed to the direct acts of war but less to changes in the bond market. Both real estate and bond investments were highly local (see Van Bochove, 2013), and Den Bosch did not have an office issuing government bonds. It fell under federal control rather than being part of a province, which issued most bonds, and lacked the large pool of wealthy savers found in other major cities. If the economic effects of alternating war and peace periods were driving the cycle, we would also expect a large boom and bust in Den Bosch. However, house prices show no trend, even at lower frequen-

[12] After the Spanish Succession War, the main 'gain' of the Dutch was its ability to station troops outside of the Dutch Republic in 'barrier cities' in the Southern Netherlands (current Belgium). These were supposed to provide extra protection against the French but turned out to be useless in the War of the Austrian Succession.

cies when Den Bosch capital gains can be estimated more precisely. A more extensive comparison is provided in section D of the Internet Appendix.

In short, even though the war affected some parts of the economy, its negligible effect both on aggregate fundamentals in Amsterdam and on house prices in more exposed Den Bosch indicate that the direct economic impacts of alternating periods of war and peace cannot plausibly explain the large changes in yield premia.

4.1.1. Changes in risk

Even if realized growth rates moved very little, it is still possible that peace brought economic stability that might have reduced the riskiness of rental cash flows and the corresponding discount rates of these cash flows.

At the aggregate level, the evidence in Table 1 shows there was no apparent reduction in the volatility of total housing returns in the boom period relative to the period preceding it. However, most total return volatility was driven by changes in capital gains, which were likely less relevant for buy-and-hold investors who populated the upper part of the wealth distribution and owned most rental housing. At the portfolio level, changes in rental cash flows and costs can contribute significantly to the volatility of income returns (Chambers et al., 2021), which are not measured in Table 1. If the volatility of income returns reduced significantly, investors might have increasingly preferred net rental cash flows over the interest return on bonds.

Limited data availability generally makes it difficult to study rental cash flow and cost risk over longer horizons. Fortunately, the *Burgerweeshuis* (an orphanage), a major institutional investor in 18th-century Amsterdam, maintained excellent records of its portfolio of approximately 70 middle-class properties. These records survived in the archives, and several books report total annual rent income and costs directly.[13] Relative to the average net-of-maintenance rental income between 1701–1748, the annual volatility of net rental cash flows was 20%. Splitting the war and peace periods, the volatilities were 11% and 25% respectively. Excluding the cost for a major renovation in 1725, the volatility in the peace period reduces to 12%. For this portfolio, there are no indications of reduced cash flow volatility during the housing boom in the peace period.

For most real estate investors, cash flow volatility was higher given their smaller portfolios. In the 1701–1748 period, the average value of the Burgerweeshuis portfolio was around 158,000 guilders relative to an average housing portfolio of 6640 guilders among real estate owners in the estate tax records. Only four investors in the estate tax records (0.05%) owned a housing portfolio with a larger value than that of the Burgerweeshuis. It is not possible to track the volatility of net-of-cost rental cash flows for smaller investors. Excluding costs, there is no evidence that property-level rental revenue became less volatile during the peace period. Lesger (1986) collected annually paid rent prices for individual properties owned by nine different institutional investors, including the *Burgerweeshuis*. The property-level volatility of annual rental price changes was 3.6% in the peace period and 3.4% in the war period, suggesting no difference in cash flow risk.

In conclusion, there is no concrete evidence that changes in the riskiness of housing investments were driving the boom and bust. One alternative hypothesis is that the risk of bond investments was changing, given the dire state of Dutch public finances in this period. Two observations are at odds with this view. First, bond yields move very little even when public debt grew rapidly. Second, the yield difference between housing and bonds reaches its highest level at the end of the two wars, when the financial situation is direst, while it reaches its lowest level in the second part of the peace period when public debt is stable and expenses for debt service have declined.

4.2. Reaching for yield

The absence of substantial changes in realized economic fundamentals and risk implies that it is challenging to explain the reduction in the yield premium on housing during the boom and its subsequent reversal with shifts in expected returns and risk. The primary alternative hypothesis explored in this paper is that the boom was driven by reach-for-yield behavior: as bond yields and interest income declined, investors increasingly preferred investing in higher-yielding assets, resulting in significant changes in house prices and housing yields, and dampening the volatility in bond yields. My analysis of this hypothesis consists of two distinct parts. The first part examines yield differences across real estate assets. If the boom was driven by reach-for-yield behavior, we would expect yield reductions to be concentrated in assets with relatively higher yields compared to bonds. The second part of the analysis identifies which investors had the strongest incentives to reach for yield and then tests to what extent they were buying higher-yielding assets, primarily distinguishing rentier (or rentier-like) investors living off capital income and owner-occupying homeowners.

4.2.1. Yield dispersion across risky assets

One stylized fact of modern real estate markets is that there are substantial differences in property-level yields within cities, with sub-prime properties having higher yields (Eichholtz et al., 2021; Colonnello et al., 2021; Demers and Eisfeldt, 2022). This also applied to historical Amsterdam. For example, the gross yield on properties with a rent price below 100 guilders averaged 9.4%, while it was 5.5% for rentals above 1000 guilders. Yields were even lower at top locations: on the Herengracht and Keizersgracht, Amsterdam's most famous canals, the average gross yield for rentals above 1000 guilders equaled 4.2%. After taxes and maintenance costs, these properties had net income yields similar to Holland government bonds.

If the reduction in aggregate housing yields was driven by general optimism about the housing market, we would expect proportional declines in the yields of all housing assets. If the boom was instead driven by investors reaching for yield, we would expect the yield reduction to be larger for assets with comparatively higher yields, as investors would gain little by investing in core properties with yields

[13] Source: ACA 367.A, inv. no. 141.

similar to bonds. To test whether low-yielding real estate evolves differently than high-yielding real estate, I estimate the following regression:

$$\begin{aligned} log(Yield)_{i,j,t} = \alpha + \beta_t + \gamma_0\ log(RentVal)_i \\ + \gamma_1\ log(RentVal)_i \times YearsPeace_t \\ + \gamma_2\ log(RentVal)_i \times YearsWar_t \\ + \gamma_3\ log(RentVal)_i \times War + \mu_j + \epsilon_{i,j,t} \end{aligned} \quad (2)$$

I use log gross housing yields in the baseline estimate, as this reduces sensitivity to differences in costs. β_t represent time fixed effects that control for any aggregate trends in yields. μ_j represents location (j) fixed effects. $log(RentVal)$ represents the relative rental value of individual property i, corrected for index developments.

I interact this term with three terms. First, I interact with the number of years that have passed since the end of the Spanish Succession War: *YearsPeace*. Similarly, I use *YearsWar* to indicate the number of years since the outbreak of war, counting the Spanish Succession War and Austrian Succession War separately. *War* is a dummy variable for war periods. Periods of war and peace drove the dynamics in public finances and bond yields, with yields increasing in war periods and gradually falling over time in the peace period. If investors were reaching for yield, we would expect gradual yield compression in the peace period and decompression in war periods. The interaction terms test for such trends.

The key identification assumption is that the start and end points of the war and peace periods are exogenous to yield differences between housing assets in Amsterdam. Given the earlier-discussed nature of these wars, this assumption is plausible. Note that I refrain from using debt levels and yields directly as independent variables: how much debt Holland could issue or redeem and how much interest they paid were also dependent on investor demand for Holland bonds relative to other assets, which could be linked to the difference in yields. This relationship is also not one-to-one due to changes in taxation and the rise of investment in British debt. Table 3 reports the results.

Column 1 includes the most basic specification that excludes street fixed effects. As expected, properties with higher rental values have lower yields, likely due to lower risk and/or lower maintenance costs. However, this effect varies substantially over time. For example, at the start of a peace period, a one standard deviation increase in rental value reduces gross yields by about 12.5%. Since the median yield in the sample in this period is around 8.5 percent, that implies a reduction from 8.5% to 7.5%. However, the impact reduces substantially over time during peace periods. At the end of the housing boom (after 25 years of peace), a one standard deviation increase in rental value reduces yields by only 5%. In this period, the median gross yield in the sample is around 5.5 percent, so this implies only a small reduction from 5.5% to 5.2%. Thus, yields on different property types compressed substantially during the boom. As expected, the results for war periods are the opposite, but they are statistically insignificant with much larger standard errors.

Just controlling for rental value does not perfectly capture differences between high- and low-yielding properties. For example, a large building with many different rental units in a poor area might have the same total rental value as a luxurious house in an expensive location, but the latter likely experiences much lower costs and rental risks and thus should have a lower gross and net yield. To account for this, Column 2 compares the impact of rental value during war and peace periods, controlling for street and year fixed effects. As expected, the street fixed effects soak up part of the impact of general rental value. Moreover, the interaction term increases in significance because it now captures the difference between high- and low-yielding properties more precisely. Again, the results are insignificant for war periods.

In Column 3, I replicate the same result using yields in levels rather than logs as the dependent variable. For ease of interpretation, yields are multiplied by one hundred. Thus, for every year of peace, the yields on properties with one standard deviation higher rental value increase by five basis points relative to average properties. Columns 4 and 5 repeat the specification in Columns 2 and 3, but instead of using a continuous measure of rental value, they use a dummy that takes the value of 1 if a property's rental value is below the median. For every year of peace, the yield on cheap below-median properties relative to expensive above-median properties declines by 0.8% (log(Yield), Column 4) or in absolute terms by seven basis points (Yield, Column 5). Results are of similar magnitude but exactly opposite for war periods, but these are not or only weakly significant.

The conclusion is that yields of low- and high-yielding properties gradually compressed in the peace period and decompressed in the war period. This is consistent with a reach-for-yield explanation of the boom and subsequent bust, with investors pushing up the prices of assets with relatively higher yields. If such motives were important for the boom in housing, they should have led to similar trends in other higher-yielding assets.

The most important higher-yielding assets were equities in the Dutch East India Company (*VOC*) and investments abroad. The dividend yields of the *VOC* exhibited a similar compression and decompression of yield premiums relative to bonds (see Figure F.4 in the Internet Appendix). The period of declining domestic yields also coincided with the surge in Dutch investment in higher-yielding foreign assets, and Dutch money has been associated with the decline in yields on foreign assets during this period (e.g. Sussman and Yafeh, 2006). However, establishing a causal link is more challenging and beyond the scope of this paper: international investments were not consistently recorded before 1723, and trade was one of the sectors most vulnerable to warfare.

4.2.2. Rentiers vs. regular homeowners

An important distinction between real estate investments and investments in equities or other higher-yielding assets lies in the concentration of ownership. In both the present and the past, owner-occupied homes have been the main asset for those with more limited wealth,

Table 3
Determinants of property-level yields.

	Dependent variable:				
	log(Yield)		Yield	log(Yield)	Yield
	(1)	(2)	(3)	(4)	(5)
log(RentVal)	−0.178***	−0.066**	−0.491*		
	(0.028)	(0.032)	(0.281)		
log(RentVal) × YearsPeace	0.004**	0.006***	0.051***		
	(0.002)	(0.002)	(0.017)		
log(RentVal) × YearsWar	−0.006	−0.001	−0.043		
	(0.005)	(0.005)	(0.046)		
log(RentVal) × War	0.043	0.007	0.082		
	(0.040)	(0.041)	(0.365)		
BelowMedian				0.071	0.646
				(0.045)	(0.399)
BelowMedian × YearsPeace				−0.008***	−0.073***
				(0.003)	(0.024)
BelowMedian × YearsWar				0.006	0.104*
				(0.007)	(0.060)
BelowMedian × War				−0.046	−0.510
				(0.060)	(0.526)
Constant	- 1.798***	- 2.425***	8.977***	- 2.770***	6.662***
	(0.160)	(0.186)	(1.640)	(0.065)	(0.577)
Year FE	Yes	Yes	Yes	Yes	Yes
Street FE	No	Yes	Yes	Yes	Yes
Observations	1377	1377	1377	1377	1377
R^2	0.378	0.669	0.653	0.669	0.653
Adjusted R^2	0.354	0.526	0.503	0.525	0.502
Residual Std. Error	0.276	0.237	0.021	0.237	2.806
F Statistic	15.773	4.658	4.335	4.648	4.331

Table 3 shows the results of estimations of Eq. (2). Columns 1, 2 and 4 use the log gross yield as dependent variable, and Columns 3 and 5 the yield in levels. The interaction terms with (years since) war and peace periods are either using the log rental value or a dummy whether the property is below the median. $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

while equities and other investments are concentrated among the very wealthy (Fig. 2). As a result, most estates with limited wealth contain only a single property.[14] The distinction between 'regular homeowners' with limited wealth in other assets and wealthier individuals earning significant capital income is crucial because their incentives to reach for yield likely differed substantially.

Less wealthy individuals primarily earned their income from regular labor, which did not change significantly during war and peace periods. These individuals already invested most of their wealth in housing or were saving to become homeowners. For them, the primary value of housing investments was the consumption benefit of living in their own house rather than having to pay potentially volatile rent. It is less clear why changes in public finances and yields would significantly alter their willingness to pay for owner-occupied housing relative to bonds.

This contrasts with the group of very wealthy individuals. Economic historians have described how the decline in private investment opportunities and the growth of public debt at the end of the 17th century facilitated the development of a large rentier class that lived off interest income from government bonds (De Vries and Van der Woude, 1997; Gelderblom and Jonker, 2011; Fritschy, 2017). These bonds also dominate the portfolios of the wealthy in estate tax records. In a 1742 register of income taxes levied on higher-earning households, "rentier" is the most commonly stated profession. Their share reaches 20% among top-income earners (Oldewelt, 1945), although most rentiers had moderate incomes. Matching the rentiers in these records to the estate tax records indicates they had wealth levels of 10,000 guilders or more, placing them in the top 25% of the estate tax records.[15] From these levels of wealth, income returns from capital were generally sufficient to live from.

For the traditional rentier, who lived entirely off bond income and owned real estate solely for owner-occupation, reductions in yields and interest payments had significant implications. During the peace period, yields and interest payments, on average, declined by about 20%. Income losses for rentiers could vary at the individual level due to debt conversions and tax changes. If rentiers did not want to accept lower levels of consumption in response to declining debt service, they could potentially compensate for their losses by seeking higher yields in higher-yielding assets. Historical evidence suggests that rentiers preferred to hold onto their wealth: most passed their wealth to the next generation and disliked redemptions.

The distinction between extremely wealthy 'rentiers' and less-wealthy 'regular homeowners' was not abso-

[14] It is not possible to directly identify whether a property is an investment property or owner-occupied, and thus determine homeownership rates in this period. Homeownership was 41% in 1562 (Van Tussenbroek, 2019) but decreased to around 13% by 1805.

[15] The tax records only include individuals with over 600 guilders of income. Some rentiers might have owned less wealth, but this would only allow them to consume a limited consumption bundle.

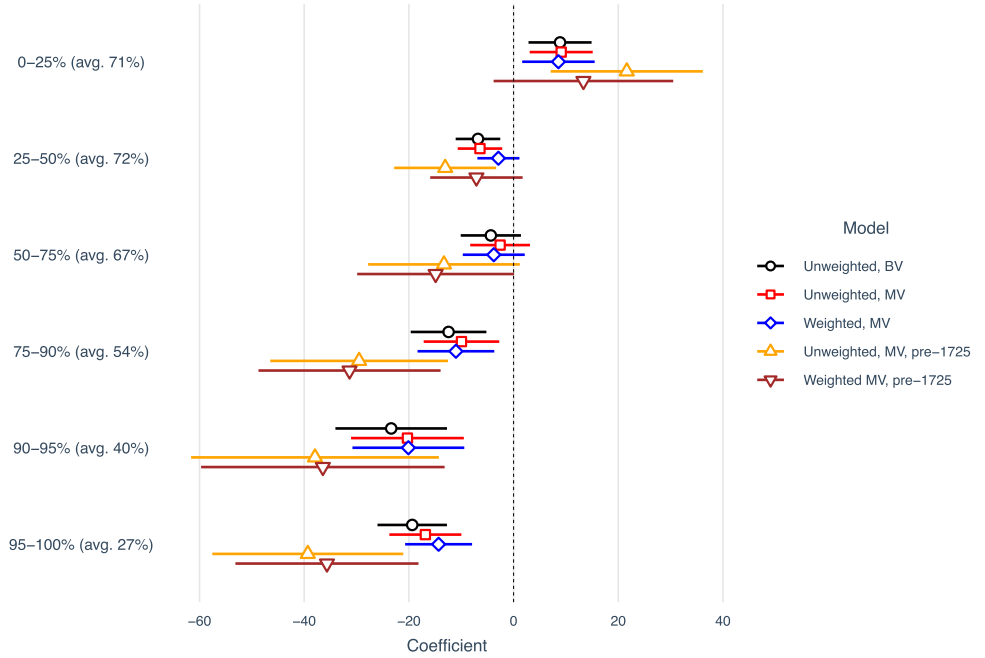


Fig. 6. Bond yields and portfolio composition. Fig. 6 plots the coefficients for all six wealth classes from a regression of the real estate share on bond yields. 95% confidence intervals are based on heteroskedasticity-adjusted standard errors. The coefficient measures the effect of a 1% change in bond yields on the share of wealth invested in real estate. The average share of wealth that each group invests in real estate is reported in parentheses. In the top model, I use the unadjusted investment in domestic bonds. In the bottom four models, I adjust the value of domestic bonds using market prices. In the third and fifth models, I also weigh each observation by portfolio size. Models four and five exclude the period after 1725.

lute. Some rentiers had inherited their wealth, but others earned their fortunes through their businesses and only became rentiers after accumulating enough capital to live off income and retire. Many non-rentiers also earned substantial capital income but combined this with regular jobs or their trades. For individuals still accumulating wealth, low interest rates implied they needed to accumulate more capital to live off income, which might have affected their preference for investing in housing relative to bonds. However, it is less likely that reductions in rates had a large downward impact on their income.

In summary, pure rentiers likely had the strongest motives to seek higher yields as rates decreased, whereas regular homeowners with more limited wealth in other assets had the least. Non-rentiers earning sizable capital returns could be considered an intermediate case.

These observations align with correlational evidence. Fig. 6 provides a point estimate of the relationship between the (de-meaned) bond yield and the share of wealth invested in real estate for different wealth groups. The wealth groups correspond to those in Fig. 2, and the average share of wealth they invest in real estate is reported in parentheses. There are five estimates for the six groups: I estimate this relationship with and without weighting for portfolio size, and both using the registered value of domestic bonds (the capital value) and the market value of these bonds.[16] I estimate the equation for the entire 1701–1748 period and the period until 1725 when international investment opportunities were limited and when reductions in yield premia were strongest. All these measures are conditional on owning any registered assets at death.

Starting with the results based on the entire sample period, individuals who die with limited wealth have a higher fraction of their wealth invested in real estate when interest rates are high. As we move to wealthier groups, this pattern reverses. For the two groups around the median, a one percentage point decrease in interest rates correlates with an increase in the real estate share of around 5 to 10 percentage points relative to an average investment share of around 70%. For individuals in the top quartile of the estate tax records, where many rentiers are present, the effect is largest and statistically most significant. For the top 5%, a one percent decrease in interest rates correlates with an increase in the real estate wealth share of 15 to 20 percentage points, despite having the lowest average shares. These effects become even more substantial when focusing on the period before 1725 when international investment is still limited and yield premia decline significantly.

It is important to emphasize that this is a correlational measure because changing yield premia on housing imply that the value of real estate relative to bonds will change also for individuals who do not actively adjust their portfolios. The degree to which it does also depends on the aggregate propensity of investors to seek higher yields.

[16] Contrary to other assets, domestic bonds were valued at par in the estate tax records as long as the loan had not been in default or partially repaid. I convert their value to market prices based on current bond prices and yields from Gelderblom and Jonker (2011).

4.2.3. Housing purchases and investor portfolios

The main conclusion from the previous section is that the incentives to reach for yield and corresponding shifts in portfolio allocations depended on investor types. To examine whether these motivations translated into actual purchases, I estimate a difference-in-difference model that compares whether an individual buys property in a year ($Purchase_{i,t}$) for individuals with different levels of wealth or bond wealth over time. I focus on property purchases, as sales are often executed by multiple persons and frequently occur after death, making it more challenging to link them to portfolios.

For all 2655 matched individuals in the dataset who ever purchased real estate, I compute whether they buy property in each year until their death.[17] Since it is difficult to match death dates to birth dates, I include all years before the year of death, with a limit of 60 years before death.

Following the identification strategy in the previous section, I again compare periods of war with periods of peace. The intuition is that periods of war and peace affected the relative propensity of different types of investors to buy real estate. Periods of war and debt impacted bond supply and the corresponding bond yields, but the implications of these shocks differed across investors. The assumption is that the timing of periods of war and peace was exogenous to the relative propensity of different types of investors to buy real estate. Because the dependent variable is the flow of investments rather than the level of yields, I use dummies for war and periods instead of the duration of war and peace used in Table 3. With observations for each investor i alive at time t, I estimate the following regression:

$$Purchase_{i,t} = \alpha_0 + \alpha_1 War_t + \gamma\, Wealth_i + \beta\, Wealth_i \times Peace_t + \mu_{i,t} + \tau_{i,t} + \varepsilon_{i,t} \quad (3)$$

The main parameter of interest in this regression is β. I estimate this model with three different measures of wealth. First, I use the log of total wealth, as indicated in Eq. (3). Second, I use the classification into six wealth groups used earlier in the paper. Third, and most importantly, I use the six wealth groups and add a dummy variable that indicates whether an individual belongs to the top 10% investors in Holland government bonds based on the estate tax records. Holland government bonds were the main rentier asset, and individuals with holdings in the top 10% earned an interest income of at least 300 guilders per year, which was generally sufficient to live on (the average income was around 450 guilders per year).

Finally, I included fixed effects for the number of years until death ($\mu_{i,t}$), computed for each investor but estimated jointly. This fixed effect accounts for the fact that I cannot observe the birth year of investors. In many cases, the data will contain periods before investors were alive or financially mature. Adding the fixed effect thus reduces downward bias due to some investors being considered potential buyers even though they were not yet alive or able to buy housing. I also add a fixed effect for the year of death ($\tau_{i,t}$) to account for potential different valuation practices of appraisers in the data, as well as for the gender and marital status of the person. I estimate the model for both the period from 1701–1748 and the period from 1701–1725 when higher-yielding international investments were less prevalent.

Table 4 reports the results of these regressions. The first three columns use data covering the entire period from the start of the Spanish Succession War until the end of the Austrian Succession War. The final three columns only include data up to 1725. In Columns 1 and 4, I report the impact of wealth on purchase activity in both periods of peace and periods of war. As expected, transaction activity increases with wealth. A one standard deviation increase in wealth results in approximately one-twentieth of a standard deviation increase in the likelihood of buying real estate in a given year.[18] However, in peace periods, this effect becomes approximately a third larger, particularly when focusing on the shorter sample.

To distill in more detail which investors were buying properties, Columns 2 and 5 show results when splitting purchase activity into the wealth groups reported in Fig. 6. The baseline is individuals in the bottom 25% of the estate tax records. As expected, the base rate of purchase activity increases with wealth, with the wealthiest individuals about a quarter of a standard deviation more likely to purchase real estate in a given year relative to the bottom quartile (Column 6, in the pre-1725 period). Although not included in the analysis, properties purchased by the top 5% are also more expensive, with an average value of 10,000 guilders compared to 2500 guilders for properties below the median. Purchase rates change substantially in peace periods, with the group between the 75th and 90th percentile in the estate tax records being particularly more likely to purchase real estate relative to the baseline. This difference is more significant in the period before 1725. Thus, wealthier individuals become more likely to purchase real estate in peace periods relative to individuals in the bottom quartile. However, this effect is weaker or even insignificant for individuals in the top 10% of the wealth distribution. One plausible explanation for why the effect is largest for the group between the 75th and 90th percentile is that this group contains many rentiers with relatively low incomes, who might have been more prone to reach for yield if their capital income declined.

This increase in transaction activity in this wealth bracket might be due to reach-for-yield behavior, but it could also partially reflect that it was simply harder for households with less wealth to purchase real estate when house prices were high. If reach-for-yield motives played a role in the boom, we would expect that shifts in pur-

[17] The number of properties bought is not always consistently identified in the records; sometimes, multiple properties are pooled in a single transaction, and sometimes this is done separately. For this reason, the dependent variable measures if a property gets bought in a year. Individuals who sell less than half of a property are counted as half a transaction.

[18] Note that it is difficult to translate this into actual investment activity. The base rate underestimates the actual number of purchases per year because I cannot observe when individuals were born, and when they were legally able to buy real estate.

Table 4
Results: Real estate purchase activity per individual per year.

	$Purchase_{i,t}$ (1701–1748)			$Purchase_{i,t}$ (1701–1725)		
	(1)	(2)	(3)	(4)	(5)	(6)
Peace	−0.002	0.002	0.002	−0.008	−0.001	−0.001
	(0.007)	(0.003)	(0.003)	(0.009)	(0.004)	(0.004)
log(Wealth)	0.007***			0.008***		
	(0.001)			(0.001)		
Top10%BH			−0.019***			−0.023***
			(0.004)			(0.005)
25–50%		−0.001	−0.001		0.007**	0.007**
		(0.003)	(0.003)		(0.003)	(0.003)
50–75%		0.002	0.002		0.010***	0.010***
		(0.003)	(0.003)		(0.003)	(0.003)
75–90%		0.016***	0.017***		0.023***	0.025***
		(0.003)	(0.003)		(0.003)	(0.003)
90–95%		0.015***	0.020***		0.024***	0.030***
		(0.004)	(0.004)		(0.004)	(0.005)
95–100%		0.038***	0.049***		0.048***	0.062***
		(0.004)	(0.005)		(0.004)	(0.006)
log(Wealth) × Peace	0.002***			0.003**		
	(0.001)			(0.001)		
Top10%BH × Peace			0.063***			0.085***
			(0.006)			(0.009)
25–50% × Peace		0.013***	0.013***		0.009*	0.009*
		(0.004)	(0.004)		(0.005)	(0.005)
50–75% × Peace		0.018***	0.018***		0.012***	0.012***
		(0.004)	(0.004)		(0.005)	(0.005)
75–90% × Peace		0.032***	0.028***		0.040***	0.034***
		(0.004)	(0.004)		(0.005)	(0.005)
90–95% × Peace		0.016***	−0.003		0.009	−0.016**
		(0.006)	(0.006)		(0.007)	(0.007)
95–100% × Peace		0.005	−0.034***		−0.001	−0.054***
		(0.005)	(0.007)		(0.007)	(0.009)
Years-to-Death FE	Yes	Yes	Yes	Yes	Yes	Yes
Year-of-Death FE	Yes	Yes	Yes	Yes	Yes	Yes
Widow + Gender FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	100,271	100,271	100,271	61,123	61,123	61,123
R^2	0.025	0.026	0.028	0.041	0.044	0.047

Table 4 shows the results of estimations of Equation 3, using different classifications and wealth (log wealth: Columns 1 and 3, six wealth groups: Columns 2 and 4, and six wealth groups + top bondholders: Columns 3 and 6. Columns 1–3 use the full sample, Columns 4–6 the pre-1725 sample. Standard errors control for heteroskedasticity. $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

chase activity are not driven by wealth alone but also by the size of the bond portfolio of these investors. In general, rentier investors highly invested in bonds experienced the most salient changes in capital returns due to changes in yields and debt service. In Columns 3 and 6, I test whether large bond investors were more likely to purchase real estate in peace periods after controlling for their wealth. I find that the increase in purchase activity is much larger for holders of Holland government bonds. In the period before 1725, individuals with the 10% largest bond holdings are about 40% of a standard deviation more likely to purchase a house relative to the baseline. Interestingly, the effect of peace periods on purchase activity even turns negative for the most wealthy individuals, which suggests that wealthy individuals not invested in domestic government bonds deemed real estate a less attractive investment in this period.

To provide insight into the dynamic timing of these effects and check for unobserved time trends, I re-estimate the regression reported in Column 3 of Table 4 for 4-year periods, instead of only distinguishing periods of war and peace. The key parameter of interest here is the impact of large bond holdings on purchase activity, controlling for aggregate levels of wealth. If the boom in house prices and the corresponding reduction in yields after the war is driven by reach-for-yield behavior, we would expect that large bondholders only start buying more real estate when the war ends. Fig. 7 plots the estimated coefficient for each period that measures the effect of large bond holdings on the number of purchases per year. As a baseline, I take the period between 1710 and 1713. Bondholders became increasingly more likely to purchase real estate only when the war ended. This effect diminished over time and becomes insignificant by the 1730s. This is consistent with the increase in alternative investment opportunities, most importantly British securities, and the stability in yield premia in this period.

It is not possible to determine to what extent these investors were selling their bond holdings to purchase real estate assets. There were no records of government bond transactions, and most of these were bearer bonds. In addition to the auction market, notaries also facilitated the sale of government bonds, but their archives

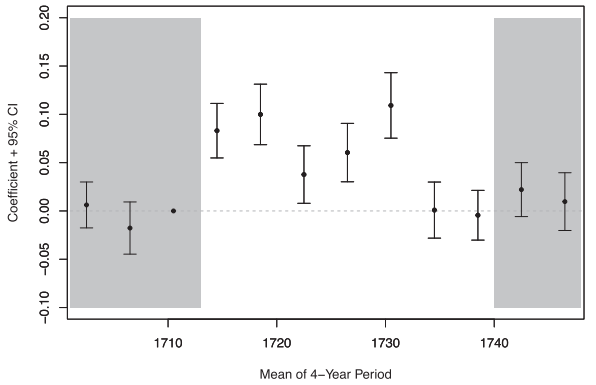


Fig. 7. Difference-in-difference estimates, per 4-years. Fig. 7 plots the difference-in-differences coefficients that compare the number of annual purchases of large bondholders to those of investors with no or limited bond investments for each four-year period, similar to the specification in Column 3 of Table 4. The standard deviation of purchase activity is 0.21.

are so vast that reconstructing this market is currently unfeasible. Gelderblom and Jonker (2011) and Van Bochove (2013) have studied samples of notary sales in other cities near Amsterdam. Their findings suggest there was a strong increase in the number of government bond transactions during the peace period.

4.3. Confounding mechanisms

The analysis in the previous section suggests that the reach-for-yield behavior of wealthy investors was a key driver of the boom and bust in the housing market and the corresponding compression and decompression of yields. In this section, I examine the extent to which these key findings could be confounded by other factors recognized in the literature as contributors to housing booms and busts. I examine the role of credit, speculation, and construction.

4.3.1. Credit

Expansions and contractions in credit supply are arguably the most prominent alternative explanation for booms and busts in house prices. This explanation could also confound reach-for-yield behavior if low rates increased investor demand for mortgages, whose issuance could have reinforced house price growth.

In Amsterdam, mortgages used to purchase real estate were interest-only and had no fixed maturity date, similar to government bonds. They were peer-to-peer loans registered with the local government. These registrations survived in the archives, and I counted the annual number of mortgage and non-mortgage loans. In the 17th century, the number of mortgage contracts had been almost a third of the volume of housing transactions. However, the number of new contracts dried up almost entirely in the late 17th century, potentially because many loans defaulted during the crisis in the 1670s. Only a handful of contracts were signed each year in the 18th century. This implies that mortgage credit was not a contributing factor in the housing boom and bust. Section B of the Internet Appendix provides more detail on the mortgage market in this period.

Interestingly, non-mortgage private lending correlated very significantly with the boom and bust in house prices (see Figure F.5 in the Internet Appendix). However, total investment in these loans was negligible compared to real estate investment and thus not a major factor (see Fig. 2). The increase and decline in private lending could be consistent with reach-for-yield behavior because private loans generally paid a rate of 4%, above the yields on bonds.

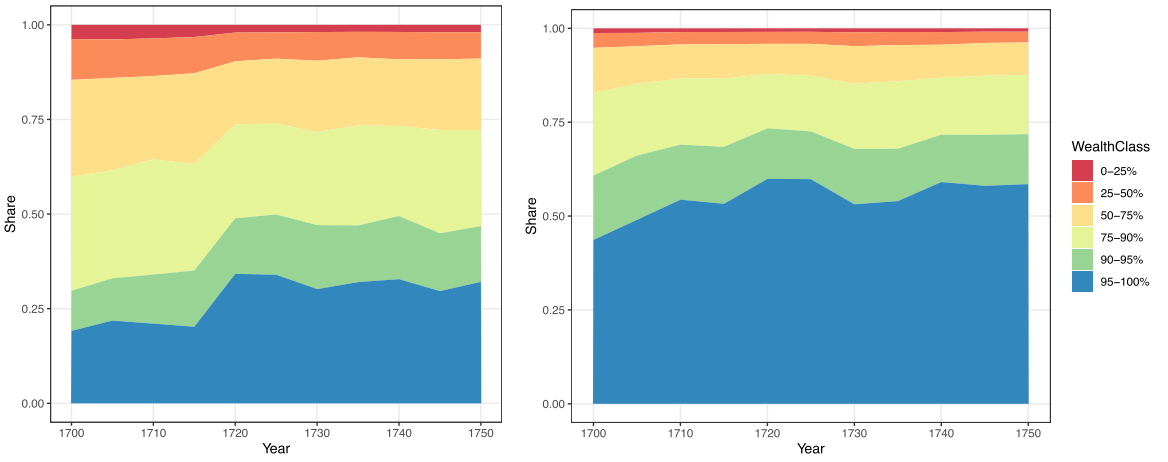
4.3.2. Speculation

Various recent papers have argued that the US housing boom in the 2000s coincided with increased speculation, and that such behavior could amplify housing booms and busts (e.g. Bayer et al., 2020; Gao et al., 2020; Mian and Sufi, 2022; DeFusco et al., 2022). The basic intuition is that house price growth, for example, due to an increase in credit supply, attracts investors expecting that past price growth will result in future price growth. If reach-for-yield behavior of long-term investors led to growth in house prices, speculative activity by short-term investors extrapolating price growth could have further amplified this effect. Following Bayer et al. (2020), I estimate the fraction of properties in the repeat-sales sample that was resold within 2 years, a measure of speculation. I limit the sample to properties sold within 50 years of purchase. In wartime, the average share of properties sold within two years of purchase equaled 6.1%, while the share equaled 8.0% in peace periods. The difference between the two is primarily driven by a decrease in quick resales during the bust (4.4%). The share of quick resales in the peace period (8.0%) and during the Spanish Succession War (7.5%) is comparable. Overall, the share of short-term sales and its increase during the boom appears small compared to the literature on the US housing boom. This suggests the cycle in Amsterdam was primarily driven by long-term investors, and that speculative investment played only a limited role.

This does not rule out that reach-for-yield behavior coincided with increased speculative activity, but if that happened, it was likely more prevalent in other assets. Frehen et al. (2013) document that during the South Sea bubble of 1720, there was a large bubble in the prices of newly formed public companies in Holland. In the 1760s, there was a large boom in plantation loans, securitized mortgages to plantations in the Caribbean that promised yields of 5–6%, which dramatically went bust in the 1770s (de Jong et al., 2022). Both episodes took place in periods of low and declining bond yields.

4.3.3. Supply responses

During the housing boom, house prices rose while housing yields declined, particularly for low-grade properties with relatively high yields. High house prices might have fueled new construction, especially in segments where yields declined the most, which in turn would have helped limit house price growth. Note that it is unclear how construction would affect yields because rents will also fall when the housing supply increases (holding demand for housing consumption constant).



(a) Housing Wealth Inequality (b) Wealth Inequality

Fig. 8. Evolution of (housing) wealth inequality, 1700–1750. Fig. 8 plots for each five-year period the cumulative distribution of real estate wealth and total wealth in the sample of estate records, conditional on owning any wealth and distinguishing six different groups of wealth. Observations are centered at their mean, so the observation in 1720 uses data from the period between 1718 and 1722. Bond data is adjusted to reflect market values.

Realized estimates of new construction, provided in Internet Appendix Figure F.6, show that Amsterdam built barely any additional properties in this period. This is not surprising: the city government generally did not permit the building of additional low-grade housing on existing lots, and to accommodate its population, the city had already expanded sufficiently in the 17th century (Abrahamse, 2010).

The composition of the housing stock could still change through the reconstruction of existing property. Based on the modern Dutch address register (*BAG*), 23% of current Amsterdam addresses located in a property built before 1800 were constructed between 1714 and 1739. Most of these properties were built after 1725 when prices were relatively high. Few addresses are located in properties built during the Spanish Succession War or the second part of the Austrian Succession War. There are also remarkable differences in size. Addresses in properties built in war periods average 115 square meters, whereas addresses in peace-time properties average 103 square meters.[19] These estimates are suggestive, given that small homes are more likely to have been enlarged or demolished due to improvements in housing standards, which would bias down the relative difference in size. However, the direction of the effect is in line with an active reconfiguration of the housing stock towards smaller properties, which typically had lower rental values and experienced larger declines in yields during the peace period.

4.4. Long-term consequences

One key concern about the modern rise of investors in the housing market is that it might reduce homeownership and exacerbate wealth inequality, forcing households to rent instead of earning positive capital returns. I now investigate whether the reach-for-yield boom in Amsterdam coincided with increasing (housing) wealth inequality.

If low interest rates increased the housing valuations and purchase activity of very wealthy investors relative to regular homeowners, then the share of housing wealth owned by the very wealthy must have gradually increased over time. Existing homeowners (or their heirs) might have sold their homes to these investors, whereas new cohorts might have found it increasingly difficult to buy a home at these increased prices. Because the shift into housing and other higher-yielding assets concentrated among the wealthy, it also implied an increase in the expected returns on wealth for the wealthy relative to the non-wealthy, in line with the pattern in Fig. 2. In the modern context, Bach et al. (2020) have shown that this might affect wealth inequality dynamics.

To examine the evidence for these effects, I use the larger sample of estate tax records to estimate the evolution of inequality and housing wealth inequality for every five-year period between 1700 and 1750. Before moving to the results, note there are three natural limitations to this data. First, I only observe individuals who died with any wealth, thus naturally excluding any individuals who sold their real estate or were unable to buy it. Second, valuations are based on assessments at the time of registration, which might have differed from the current market valuation of assets among the entire population. They also do not include holdings of cash. Third, because wealth was so highly concentrated, the estates of extremely wealthy individuals can introduce some noise in the individual point estimates.

Fig. 8 plots the developments in both housing wealth inequality and aggregate wealth inequality, again distinguishing between the six different wealth groups in the estate tax records. In line with earlier observations, housing wealth was distributed much less unequally than aggregate wealth inequality.

[19] Estimates exclude addresses larger than 1000 square meters and the year 1740.

In general, we observe an increasing concentration of housing wealth in the top wealth categories in the 1710s and the 1720s. During the peace period, the share of housing wealth owned by the top 10% in the estate tax records (top 2% of society) increases from approximately a third to about 50 percent. This implies that the top investors purchased annually an additional 0.7% of the housing stock during the peace period, with the increase particularly rapid around 1720. Given that about 2.5% of the housing stock was bought and sold every year in this period, these net purchases comprised a substantial fraction of total transactions. Importantly, housing wealth inequality did not reduce after 1740, suggesting that many buy-to-let investors held onto their properties.

There is also some evidence that the reach-for-yield boom reinforced the concentration of aggregate wealth, although this pattern is less clear-cut because wealth inequality was already increasing in the 1700s (see Fig. 8). Note that the effect on aggregate wealth inequality is also more ambiguous as reaching for yield primarily redistributed ownership of higher yielding assets so that the implications for overall wealth are less clear-cut. The wealth share of the top 5% in the estate tax records, approximately the top 1% of society, increased from 43% at the start of the sample to around 60% by the mid-1720s, after which it stabilizes. The short dip around 1730 is likely caused by the fact that there were no large inheritances in this period.

Although the estate tax records do not allow for very precise effects, the trends in inequality indicate that the reach-for-yield purchases of wealthy investors reduced homeownership and concentrated housing wealth among the very wealthy. In modern societies, where homeownership is considered key for building wealth (Sodini et al., 2016), such effects might not be socially desirable.

5. Discussion

The main finding of the analysis is that reach-for-yield behavior of rentier investors living off capital income played a crucial role in the boom and bust in the housing market and the compression of yield premia in the period of study. In this section, I discuss which type of investors might be susceptible to reach for yield, whether such investors are still prevalent today, and what mechanism could explain why these investors reach for yield.

The first key observation is that the reaching-for-yield behavior documented in this paper primarily pertains to individual investors with sufficient wealth to live off capital income and likely a low share of labor income. There are no such effects for individuals with limited wealth, who were mostly reliant on labor income. It also does not appear that institutional investors were reaching for yield: the Burgerweeshuis, one of the largest institutional investors in Amsterdam, tripled its bond portfolio during the peace-time housing boom by purchasing securities in the secondary market (Gelderblom and Jonker, 2009). Gelderblom and Jonker (2009) provide anecdotal evidence along similar lines for other institutional investors. For the Burgerweeshuis, the share of its income from fixed income increased from 16% to 37% during the peace period, while the share of income from real estate reduced from 52% to 39%. McCants (1997) argues that the asset managers of the Burgerweeshuis found the return premium on housing too low in this period. Although institutional investors only held a few percent of total assets, the different propensities of private and institutional investors to live off income and reach for yield could explain why demand elasticities differ between households and institutional investors. Such differences in asset demand might have important pricing implications (e.g. Koijen and Yogo, 2019).

The question is whether reach-for-yield behavior by private investors living off income is sufficient to generate significant shifts in asset prices. In Amsterdam, changes were sizable: aggregate allocation to risky assets increased by 10% during the boom, and the small reduction in bond yields of 0.7% was accompanied by a much larger reduction in housing risk premia of 2%.[20] If investors were actively shifting their assets towards real estate when rates declined, the utility of increased income must have offset the reduction in utility due to increased portfolio risk. But that does not explain why they did so and whether such behavior could also play a role in modern contexts.

To start with the latter point, Campbell and Mankiw (1989) argue that about half of investors in the United States follow the 'living-off-income' rule of thumb, consuming dividends and not capital, similar to the Amsterdam rentiers. More recently, Daniel et al. (2021) show this behavior remains widespread among private investors in the 21st century. They show living-off-income behavior causes investors to reach for yield in high-dividend stocks when rates are low, structuring their portfolio such that it provides enough dividend income to achieve desired levels of consumption. The presence of living-off-income investors is sufficient for shocks in interest rates to influence portfolio allocations and risk premia on equities, in line with the findings of this paper for real estate. In the traditional model, investors respond to decreases in interest rates by selling some of their assets, which allows them to increase consumption today and leaves risk premia unchanged.

There is also recent evidence that living-off-income investors have increasingly turned their attention to real estate. In the Australian context, Gargano and Giacoletti (2022) find a strong increase in the number of landlords in response to the reduction in interest rates after 2008, which they show is largely driven by wealthier older individuals living off income. Daniel et al. (2021) find a similar demographic profile for equity markets. In short, while wealth inequality and rentierism might not be as pervasive in modern markets as in 18th-century Amsterdam, living-off-income investors are still an important factor today and appear to behave very similarly to the rentiers in this paper. Given the presence of a large and growing population of wealthy seniors, living-off-income investors might also play an increasingly important role in asset markets.

[20] Note the observed shifts only partially offset the fall in expected returns. Given realized yields, a price-taking investor investing all of its wealth in bonds in 1714 should have invested approximately 75% in real estate to earn the same expected return in 1740.

Why do so many private investors, both today and in historical Amsterdam, appear unwilling to draw down on wealth and instead only consume income returns? Existing literature provides various micro-foundations for such behavior. A first view is that the rule 'consuming dividends but not capital', which living-off-income investors follow, is a tool for self-control avoiding excessive consumption out of wealth (e.g. Shefrin and Statman, 1984; Baker et al., 2007; Daniel et al., 2021). From this point of view, purchasing real estate could be particularly attractive because it is generally a more lumpy investment with significant transaction costs, which raises the barrier to selling. It does not seem plausible, though, that living-off-income investors have a strong tendency to over-consume. In modern data, Bräuer et al. (2022) find that investors who consume dividends appear very prudent and also specifically plan to do so. In line with Daniel et al. (2021), middle-aged and older wealthier investors are particularly prone to invest in assets with higher yields and to consume their dividends. This description also matches the historical depiction of Amsterdam rentiers.

Nonetheless, there might be important reasons why living-off-income investors commit not to draw down on wealth. Campbell and Sigalov (2022) build a formal model in which reaching for yield arises because long-lived investors face a sustainable spending constraint, which only allows them to consume expected returns and does not allow them to reduce wealth. If rates fall, investors instead increase consumption by investing in assets with higher expected returns. While such a binding constraint is plausible for an endowment fund, it is less reasonable for private investors.

However, many private investors might feel constrained to draw down on wealth for other reasons. Individuals might be unwilling to decumulate wealth because they have strong bequest motives (e.g. Hurd, 1987; Kopczuk and Lupton, 2007) or because they face significant uncertainty about longevity risk (e.g. Davies, 1981), which was particularly sizable historically. Following a living-off-income strategy can be viewed as a commitment to manage such risks and to provide subsequent generations with income after one's own death. Given that living off income is so prevalent among older and wealthier individuals, it is perhaps not so much a tool for self-control to prevent consuming too much too early during one's own lifetime, but rather to preserve it not just for one's own life but also for that of future generations.

If these individuals are committed to living off income, why do they ultimately reach for yield? The literature on equities has studied mechanisms causing investors to prefer current yields over future capital gains. In the model in Daniel et al. (2021), 'living-off-income' investors suffer from money illusion, preferring investments providing current income and disregarding that these have lower capital gains. Although the broader framing of their study is in line with the findings of this paper, this particular mechanism is less plausible for housing investments because there is no clear trade-off between current housing yields and future capital gains: rents are always paid out to the homeowner and capital gains are limited in the long term. In the particular setting of this paper, long-term capital gains were even zero.

Another mechanism that could explain why living-off-income investors shift to riskier assets is reference-dependence (Kahneman and Tversky, 1979). Lian et al. (2019) conduct a lab experiment and show that participants allocate more wealth to risky assets when rates decline and suggest they do so because returns appear too low relative to past values that form a reference point. For living-off-income investors, past capital income could be a reasonable reference point. If rates are reduced, the interest income of living-off-income investors would fall below the reference point, which under prospect theory would lead to significant disutility. In that case, it could become attractive to allocate more wealth to higher-yielding assets, despite the loss in utility due to a riskier portfolio. This could also explain why shifts to real estate concentrated among large bondholders. This mechanism also increases in importance at lower rates: a one percentage point reduction in interest rates reduces income more when rates are already low.

Both the unwillingness of living-off-income investors to draw down on wealth combined with aversion to reducing consumption in the wake of interest income shocks could be plausible reasons why investors reach for yield. Although it is not possible to formally quantify the importance of each of these channels, there are two reasons why this behavior could be particularly pronounced in the housing market and in this particular context.

First, there was a limited supply of alternative assets beyond real estate and domestic bonds in the early 18th century, which makes shifts in real estate portfolios particularly likely. For this paper, the lack of alternative investments and a mortgage market made it possible to precisely pin down the impact of reaching for yield. However, it does not appear that this behavior was limited to real estate: equity yields display the same trends (Figure F.4 in the Internet Appendix), and investment in higher-yielding international assets developed exactly when yields were low. Possibly, reach-for-yield behavior might thus have played a role in the development of international financial markets. The lack of a mortgage market in this period might imply that effects on housing wealth inequality could be smaller today: if private investors reaching for yield nowadays also buy higher-yielding mortgage securities, it might effectively increase credit to home-buyers.

Second, both today and in the historical context, it was likely more attractive to reach for yield in real estate compared to other assets, independent of the mechanism. Most private real estate investors only hold small portfolios of a few properties, implying their returns are subject to significant idiosyncratic risk (e.g. Giacoletti, 2021; Sagi, 2021; Eichholtz et al., 2021). If investors purchase additional properties, they can diversify part of this risk away. Larger portfolios could also allow for economies of scale in property management. This implies that for many living-off-income investors, increasing real estate holdings might have comparatively smaller effects on portfolio risk relative to investing more in other higher-yielding assets. In line with this, many countries have seen a sizable increase in

private buy-to-let investment (Bracke, 2021; Gargano and Giacoletti, 2022).

6. Conclusion

This paper shows that reach-for-yield can be a key driver of booms and busts in housing markets. In a low-interest-rate environment, small changes in bond yields cause large volatility in house prices and rental yields. When interest rates were low and decreasing, investors living off capital income shifted their wealth towards higher-yielding real estate investments. In this process, investors were bidding up home prices and crowding out regular home-buyers. This resulted in a persistent increase in housing wealth inequality.

In Amsterdam, these shocks had very large effects because there was a large group of rentier investors and there were relatively few outside investment opportunities. However, modern evidence suggests living-off-income investors still play a sizable role in equity markets today (Jiang and Sun, 2020; Daniel et al., 2021), and they likely play a sizable role in housing markets too. Many housing markets have experienced increasing demand from investors, and the recent surge in urban prices has been linked to such investor purchases. While various factors might have contributed to increased investor demand for housing today, historical Amsterdam shows that reach-for-yield purchases of investors could be a very potent factor in driving up house prices and investor purchases when rates are low, with significant implications for long-term homeownership rates.

Data availability

Replication data is available here: https://data.mendeley.com/datasets/db9nz3yhdr/1.

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Supplementary material

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