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Abstract

Real and private-value assets—defined here as the sum of real estate, infrastructure, collectibles, and noncorporate business equity—compose an investment class worth an estimated $84 trillion in the U.S. alone. Furthermore, private values can affect pricing in many other financial markets, such as that for sustainable investments. This paper introduces the research on real assets and private values that can be found in this special issue. It also reviews recent advances and highlights new research directions on a number of topics in the real assets space that we believe to be particularly important and exciting.

JEL Classification: G11, G12, G41, R31, R33, Z11

Keywords: real estate, Art, infrastructure, private business wealth

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Real and Private-Value Assets*

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Abstract

Real and private-value assets—defined here as the sum of real estate, infrastructure, collectibles, and noncorporate business equity—compose an investment class worth an estimated $84 trillion in the U.S. alone. Furthermore, private values can affect pricing in many other financial markets, such as that for sustainable investments. This paper introduces the research on real assets and private values that can be found in this special issue. It also reviews recent advances and highlights new research directions on a number of topics in the real assets space that we believe to be particularly important and exciting. (*JEL* G11, G12, G41, R31, R33, Z11)

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Financial assets are contractual claims to benefits that flow from ownership or promises from income-producing entities. By contrast, the owner of a *real* asset has the right to possess and personally enjoy a particular piece of durable physical property that is typically unique (or at least in limited supply and subject to heterogeneity in quality). Ownership also gives the right to contract over the use of this property. The most well-known real asset type is of course real estate, be it residential, commercial, or agricultural. Other important real asset categories are physical infrastructure and collectibles.[1]

When can durable physical objects be considered *assets*? Commercial real estate and infrastructure projects yield cash flows, and acquirers' intention is clearly to earn a return commensurate with the risks they are taking. By contrast, one might treat a cabin in the woods or an oil painting as simply a consumption good for which one pays a price and then enjoys a service flow. However, when a residential structure or a collectible is purchased with an expectation of a (possible) future resale—when there is an anticipated dimension of time with attendant concern for the object's financial risk and return—then it becomes an asset.

The price formation and trading process of real assets is unlike that for publicly traded equities. Real assets are characterized by infrequent trading in search and auction markets, market values that are difficult to pin down exactly, and investment returns that can only be estimated with noise. Moreover, for assets such as owner-occupied housing and works of art, the use value derived from ownership is nonmonetary and nontradable, and is *private* in the sense that it depends on the identity of the owner. For private-value assets, any two potential buyers will be willing to pay different amounts—reflecting differences in preferences and relative wealth—even when they have identical resale strategies and agree on future monetary cash flows. Because of the illiquidity of the markets in which these assets are traded, variation in private values can translate into systematic differences in transaction prices and thus financial returns between market participants. Heterogeneity in

[1]Commodities are a well-established asset category on their own, and fall outside of the scope of our analysis. Many commodity markets are relatively liquid; trading often happens through financial contracts, such as futures; and the notions of uniqueness and heterogeneity are not as relevant as for the assets discussed in this paper. We also do not cover research on secondary markets for durable consumer goods (e.g., cars) or capital equipment (e.g., aircraft); see Gavazza and Lizzeri (2021) for a recent review of the literature.

beliefs about the future dynamics of private preferences—driving potential resale revenues and thus the *common*-value component of an asset—can further amplify the price uncertainty at any point in time.

Real assets are not the only type of investments with private-value components. In particular, the nonpecuniary private benefits from running one's own business may be an important part of the utility flow from entrepreneurship. Noncorporate businesses also share the aspect of illiquidity with the real assets mentioned before.

We here thus define "real and private-value assets" (RPVA) as the sum of real estate, infrastructure, collectibles, and noncorporate business equity. Such assets not only are pervasive but also represent a significant fraction of the economy. Both institutional and household portfolios have substantial sums of money invested in RPVA. In Section 1 of this paper, we attempt a rough quantification for the United States, which arrives at an aggregate asset class value of $84 trillion.

Private values also can be of importance for the pricing of more traditional financial assets. We can think, for example, of distributions of idiosyncratic preferences around the ESG or impact features of businesses and how these increasingly affect investment decisions and valuations.

The existing body of published research arguably does not measure up to the importance of RPVA and of the role of private values in asset pricing more generally, even if much progress is currently being made. The *Review of Financial Studies* therefore decided to sponsor a conference and special issue on the topic. The idea was to simultaneously showcase the current work in the area and to stimulate new research, as explained in more detail in Section 2.

The current article, authored by the sponsoring *RFS* Editor and the two organizers of the conference, serves as the introduction to the special issue. In Section 3, we present the eleven original research articles in this issue. We organize our discussion around three research themes: the measurement of risk, return, and liquidity of real assets; drivers of variation in valuations and investment behavior; and private values in other asset markets. In Section 4, we identify a number of research topics that we believe to be particularly promising areas for future work.

1 Size of the Real and Private-Value Asset Class

It is fiendishly difficult to arrive at a precise and internally consistent assessment of the total size of the RPVA class. All methods agree, however, that the asset class is large and growing. Table 1 compiles our—admittedly rough—estimate of its size in the United States, based on the latest available data. The bottom line is that RPVA is a $84 trillion asset class. The appendix lists the data sources and the details of the calculations. Here is a summary of how we arrived at our headline numbers:

Residential real estate. Residential real estate is relatively straightforward to value. According to the Financial Accounts of the United States, it was worth $31.2 trillion in 2020.Q3.

Commercial real estate. The aggregate value of commercial real estate (CRE) assets, including multifamily rental housing, is much more difficult to measure. We use Financial Accounts data on real estate values held by the nonfinancial corporate, nonfinancial noncorporate, nonprofit, and equity real estate investment trust (REIT) sectors. This delivers an aggregate U.S. CRE market value of $32.8 trillion.

Table 1 also provides a breakdown into the various subsectors of CRE. We use private (i.e., non-government-owned) fixed asset data from the Bureau of Economic Analysis (BEA) to decompose the CRE value derived from the Financial Accounts into its subsectors. Industrial real estate includes warehouses and manufacturing structures. Many manufacturing structures are owned by end users and rarely trade. Health care includes hospitals, many of which may not trade much either, and which are sometimes classified as social infrastructure instead.

Our estimate exceeds numbers provided by the CRE industry, which tend to be based on "investable" assets. The third column of Table 1 reports one such estimate based on Koijen and Van Nieuwerburgh (2021) for the four main CRE sectors, using data from Real Capital Analytics (RCA). They construct price indexes based on all CRE transactions from 2001 until 2020 over $10 million, and then value the stock of all CRE assets that ever traded over this 20-year period as of the end of 2019. The RCA assets add to $4.7 trillion, an estimate that excludes many assets that never trade, such as office and manufacturing properties owned and used by the corporate sector.

Agricultural real estate. Agricultural real estate (land and structures) is worth an estimated $2.6 trillion in 2020, according to the U.S. Department of Agriculture. Farmland, like other commercial property, is income producing. However, like for housing, some fraction of its value may have private-value components associated with patrimony, intergenerational ownership, and status.

Infrastructure. The next category of real assets is infrastructure. The World Economic Forum (2014) defines infrastructure as "the physical structures—roads, bridges, airports, electrical grids, schools, hospitals—that are essential for a society to function and an economy to operate." Many infrastructure assets are owned by governments (around 75% according to a report by RARE (2013)). We focus on privately held assets in the United States and use BEA data to arrive at an estimated value of $6.9 trillion for 2019. Table 1 provides a breakdown into various subcategories. Our measure of social infrastructure covers educational, vocational, and religious structures, but excludes hospitals, which we classify as commercial real estate.

Collectibles. For collectibles, we rely on Vorsatz (2020), who estimates the total float of different collectible types based on wealth distribution data and high net worth individuals' reported collectibles ownership. We get to an aggregate value of jewelry, fine art, and antique furniture owned by U.S. households of $4.6 trillion.[2] Table 1 reports the estimates for the different components. Goetzmann and Whitaker (2021) use U.S. estate tax records from 2013 to arrive at a year 2020 value for fine art between $1.5 trillion and $2.0 trillion, which is similar to the $1.8 trillion estimate reported here.

Noncorporate business equity. Finally, we include private business wealth. According to the Financial Accounts, household-owned equity in nonfinancial noncorporate businesses (such as sole proprietorships and partnerships) is worth $12.7 trillion as of 2020.Q3. However, a substantial

[2]This is a conservative estimate as we exclude classic cars, coins, stamps, wine, and other types of collectibles.

Asset type	Aggregate	Subtype	RCA data	Period
Residential real estate	31,232			2020.Q3
Commercial real estate	32,793			2020.Q3
Multifamily		7,027	1,453	
Office		6,305	1,519	
Retail		7,015	916	
Industrial		5,167	811	
Hospitality		3,466		
Health care		3,522		
Student housing		291		
Agricultural real estate	2,569			2020
Infrastructure	6,901			2019
Power		2,433		
Electrical transmission equipment		564		
Communication		702		
Transportation		515		
Water, sewage, and waste treatment		185		
Petroleum and gas		1,350		
Mining		148		
Social infrastructure		1,004		
Collectibles	4,638			2017
Precious jewelry		2,156		
Fine art		1,798		
Antique furniture		684		
Noncorporate business equity (excl. CRE)	6,055			2020.Q3
Total	84,189			

Table 1: Aggregate value of RPVA in the United States (in billions of US$)

portion of this estimate represents a claim to real estate assets that are already included in our commercial real estate measure. To avoid double-counting, we subtract the $6.6 trillion in real estate equity owned by the nonfinancial noncorporate business sector to arrive at a value of $6.1 trillion.[3]

Another way to emphasize the importance of RPVA is to compute their share in household portfolios. If we consider real estate, consumer durable goods, and noncorporate business equity as RPVA for this exercise, then the asset class is worth $50 trillion of household wealth in 2020.Q3, up from $30 trillion in 2012. This represents 38% of overall household assets, a share that has remained fairly constant over the past decade.[4]

[3] To compute the sector's real estate equity, we subtract its total loans from its real estate assets.

[4] We include durables in this calculation as a proxy for collectibles. We include all $12.7 trillion of noncorporate business equity since the double-counting issue does not arise here. Data come from the Financial Accounts of the United States, table B.101.h for the household sector, for 2020.Q3. This share understates the fraction of RPVA in household portfolios since some of their corporate equity, mutual fund, and pension fund holdings reflect real estate and

Gomes, Haliassos, and Ramadorai (2021) review the available evidence on household balance sheets around the world. They report that shares of real assets are even higher in developing economies than in developed markets, a finding that points to an "asset tangibility preference" potentially related to the use of real assets as collateral or as a way to ease intergenerational transfers. Similarly, a survey of Barclays (2012) shows that financial motivations for holding art and other collectibles are more important in emerging economies. More research on the drivers of RPVA holdings in global household portfolios is warranted.

2 The Yale-*RFS* Conference and Special Issue

To stimulate new research and showcase important work in the area, the *Review of Financial Studies* decided to sponsor a conference and special issue on the topic of "Real and Private-Value Assets." The conference was held on January 31, 2020, at the Yale School of Management, and cosponsored by the International Center for Finance. The program committee was cochaired by the authors of this article.

To allow authors sufficient time to develop new work, a first announcement for the conference went out in January 2019. The final submission deadline was October 15, 2019. We received exactly 100 submissions. Of these, 73 papers were submitted under the dual submission rules of the *RFS*. About 75 papers were sent out for review by a committee of 14 experts. Each paper received two reviews. Based on the review scores and thematic fit with the conference, the program cochairs chose eight papers for inclusion on the conference program.

Six of the eight papers at the conference were dually submitted to the *RFS*. In addition, the sponsoring *RFS* Editor independently selected six more papers that were dually submitted to proceed to formal submission to the *RFS*. All 12 of these papers went through the regular *RFS* paper review process, independent from the conference evaluation. Paper acceptance decisions were made solely by the *RFS* Editor, based on the recommendations of two referees. Six of the papers in this issue originate from this dual submission process.

infrastructure investments.

In addition, the *RFS* received several more papers that were not submitted to the conference but were thematically a good fit for the special issue. Some of these manuscripts were already under review prior to the conference. Five of the papers in this issue are such regular *RFS* submissions, including a paper coauthored by one of the conference organizers (Chambers, Spaenjers, and Steiner 2021).

3 Research in This Special Issue

In this section, we briefly present the papers included in this special issue, highlighting their contributions along three dimensions: the measurement of risk, return, and liquidity in real asset markets; drivers of variation in valuations and investment behavior; and private values in other asset markets.

3.1 Measurement of risk, return, and liquidity in real asset markets

Historically, the evaluation of the investment characteristics of real assets has typically taken place through the construction of market-wide price and total return indexes. One challenge that the literature on real estate faces is to control for time-series variation in the quality of the underlying properties. Prior research has also struggled to estimate the average net income yields realized by real estate investors, as data on actual cashflows are hard to obtain. Two papers in this issue, namely, Eichholtz et al. (2021) and Chambers, Spaenjers, and Steiner (2021), aggregate from detailed asset-level archival data on property prices and income to asset-class return estimates. Using different empirical settings, both papers come to the conclusion that the return estimates for housing in Jordà et al. (2019), which are based on aggregate market statistics, may be biased upward. Eichholtz et al. (2021) find geometric average annual real total returns of 2.8% for Paris (1871–1943) and 4.8% for Amsterdam (1900–1979), respectively 1.4% and 2.3% below the estimates of Jordà et al. (2019) for the same locations and time periods. Using data from Oxford and Cambridge University college portfolios over the period 1901–1983, Chambers, Spaenjers, and Steiner (2021) report an annualized real total return for U.K. housing of 2.3%, a difference of 2.4% with Jordà et al. (2019).

Driven by a growing awareness that most household investors in real assets do not hold diversified portfolios, and that indexes are not investible (Chambers, Dimson, and Spaenjers 2020), researchers are placing increasing attention on asset-level rather than on index-level risk measures. Two papers in this issue discuss the idiosyncratic risk associated with real estate investments: Giacoletti (2021) for housing and Sagi (2021) for commercial real estate. Both papers start from the idea that the combination of an illiquid asset market and variation in subjective valuations must lead to substantial transaction-specific risk. Hence, property values do not follow a random walk, and the variance of property-level capital gains does not scale with the holding period. Sagi (2021) builds a search model formalizing this idea and shows that it fits patterns in commercial real estate transaction data well. Giacoletti (2021) documents evidence in favor of a causal effect of illiquidity on transaction price dispersion. He also shows that idiosyncratic risk accounts for two thirds of total property-level capital gain risk for 2-year holding periods, but only 45% for 15-year holds. The mean Sharpe ratio on individual houses is just 0.44 for a 2-year holding period, although this increases to 0.57 after 15 years. This compares to a Sharpe ratio estimate of 0.79 when ignoring idiosyncratic risk. Disregarding asset-level capital gains risk thus leads to a biased view on real estate's risk-return trade-off.

Giacoletti (2021) and Sagi (2021) study real estate, but transaction-specific risk is likely to be important in other real asset markets as well. For example, Lovo and Spaenjers (2018) construct an auction model for artworks in which variation in bidder types is a source of idiosyncratic risk that does not disappear even as the holding period converges to zero. The search model of Sagi (2021), like the auction model of Lovo and Spaenjers (2018), implies that asset owners are more likely to have a short holding period if an agent with a higher valuation comes along quickly. This highlights the crucial role played by arbitrageurs in real asset markets. It also suggests a selection bias in observed returns in real asset markets, where resale decisions and reserve prices are endogenous, at least over short horizons. As such, these theoretical contributions relate to an econometric literature that aims to correct repeat-sales estimators of art and housing returns for selection bias (Goetzmann and Peng 2006; Korteweg, Kräussl, and Verwijmeren 2016; Korteweg and Sorensen 2016), and can hopefully inform future work in this area.

Another, related insight following from these papers is that there is never a single, unambiguous market value for an artwork or a house, but that one should think of a menu of possible combinations of (expected) prices and speed of execution ("time on the market"). Recognizing the transactional frictions in real asset markets should thus help in developing measures of liquidity (see, e.g., Kotova and Zhang (2020)).

While Giacoletti (2021) and Sagi (2021) focus on idiosyncratic price dispersion, Eichholtz et al. (2021) perform an asset-level decomposition of the variance of *total* real estate returns including income yields. They find that, while in the short term, total return risk is mostly driven by idiosyncratic capital gains, income yield risk becomes an increasingly important component of property-level risk for longer investment horizons. Overall, a better understanding of time-series and cross-sectional variation in the components of property-level returns and risk should also help in studying and modeling, first, how income yields and capital gains correlate with each other and with local housing market characteristics (e.g., Eisfeldt and Demers 2015), and, second, to what extent different types of risk are priced (e.g., Han 2013; Peng and Thibodeau 2017; Eiling et al. 2020).

A related interesting question is whether returns compensate investors for bearing the risk that is present in nearby cash flows or in cash flows that will materialize in the distant future. This is the central focus of the paper by Giglio et al. (2021). Using data on freeholds and (very) long-term leaseholds for the United Kingdom and Singapore, the authors deduce that the expected return for cash flows more than 100 years in the future is only 2.6%. This long-run return estimate is substantially below the average return on housing of about 6% that they compute based on various data sources for recent decades for a number of different locations. Hence, they conclude that the term structure of housing returns must be downward sloping. This confirms the evidence for the equity market (van Binsbergen, Brandt, and Koijen 2012).

Finally, we want to emphasize that several papers in this issue study the investment characteristics of property types other than housing. For commercial real estate, there of course exists a long literature studying the properties of REIT returns (for a recent example, see Van Nieuwerburgh

(2019)). This literature mostly focuses on aggregate indexes. Also, the fact that equity REITs are (modestly) levered and trade in public stock markets affects their liquidity and risk-return characteristics. Ghent, Torous, and Valkanov (2019) recently reviewed the properties of both public and private U.S. commercial real estate indexes going back to the 1970s. In this issue, Chambers, Spaenjers, and Steiner (2021) find that both commercial and agricultural real estate outperformed housing over the first eight decades of the twentieth century in the United Kingdom, with agricultural (commercial) real estate exhibiting relatively high capital gains (income yields). Sagi (2021) focuses on *asset-level* risk and return in the commercial real estate market, using transactions data from the NCREIF. Andonov, Kräussl, and Rauh (2021), also in this issue, study the investment performance of commingled closed-end infrastructure funds, and report relatively low risk-adjusted returns. This is consistent with Gupta and Van Nieuwerburgh (2021), who find similarly poor risk-adjusted performance for both infrastructure and real estate private equity funds. Andonov, Kräussl, and Rauh (2021) also find that these funds on average fail to match the long-term stable income yields of the underlying infrastructure assets, do not add much diversification to investor portfolios, and have a risk profile more similar to that of other private equity investments. We return to their question of how to best structure investments in infrastructure, and any other real assets for that matter, for long-term institutional investors later in this article.

3.2 Drivers of variation in valuations and investment behavior

As highlighted in the previous subsection, the combination of market illiquidity on the one hand and heterogeneity in subjective valuations between market participants on the other hand can lead to dispersion in acquisition prices. One reason for variation in the willingness-to-pay by investors can be heterogeneity in private preferences or "tastes." Adams et al. (2021), speaks directly to this issue by documenting international, culture-driven differences in preferences for male rather than female art. In their large sample of historic auction prices, art produced by women sold at a discount at auction, controlling for a variety of other factors. This discrepancy was larger in countries with higher levels of gender inequality metrics. Their evidence is not merely historical.

Experiments reported by the authors provide additional evidence that hypothetical works of art are valued less when they are identified as being made by women. The paper ties in with a growing literature looking at the market's evaluation of female artists (Bocart, Gertsberg, and Pownall 2018; Cameron, Goetzmann, and Nozari 2019).

Also Andonov, Kräussl, and Rauh (2021) highlight the importance of investor preferences. They argue that ESG considerations of public institutional investors, such as public pension funds, sovereign wealth funds and government agencies, can partially explain their underperformance in infrastructure. Such investors thus seem willing to trade off financial returns against nonpecuniary benefits, in a way similar to impact investors in the venture capital industry (Barber, Morse, and Yasuda 2021). Variation in preferences is more likely to affect investor prices and returns in illiquid markets.

In addition to differences in preference-driven private values, heterogeneity in beliefs about resale values can drive variation in investor behavior in markets for durable assets. Pénasse, Renneboog, and Scheinkman (2021) build a speculative art trading model with short-sale constraints and fluctuating differences in beliefs in the spirit of Hong, Scheinkman, and Xiong (2006). They then study the effects of the negative shock to the expected (future) asset supply (or "float") caused by an artist's premature death. The model predicts permanent increases in prices *and* trading volume as both the value and the frequency of exercise of the "resale option" associated with art ownership go up. Comparing auction price and volume trends for artists that died unexpectedly to those for otherwise similar artists that lived longer, they find evidence in support of these predictions.

The earlier mentioned-paper of Giglio et al. (2021) highlights another important source of (cross-sectional and time-series) variation in beliefs about the common-value component of residential real estate, namely, climate change risk assessment. They find that transaction prices of properties in flood zones correlate negatively with a "climate attention index" constructed from real estate listings. The paper belongs to a fast-growing literature on the pricing of climate risk, explored in the March 2020 issue of the *Review of Financial Studies* on "Climate Finance" (cf. Hong, Karolyi, and Scheinkman (2020) and the references therein). Much of this literature focuses on housing and its exposure to sea level rise and wildfire risk. While the early evidence on the effect of climate risk exposure on housing values is mixed (Bernstein, Gustafson, and Lewis 2019; Murfin and Spiegel 2020), Garnache (2020) and Eichholtz, Steiner, and Yönder (2019) document lower prices for residential and commercial real estate, respectively, when disaster risk is more salient. Other recent papers focus explicitly on heterogeneity in beliefs between agents (Baldauf, Garlappi, and Yannelis 2020; Keys and Mulder 2020; Bernstein et al. 2021).

The horizon-decomposition of housing returns inferred from very long-horizon leaseholds, as highlighted above, combined with the fact that housing values respond to climate risk, makes housing a suitable asset to infer the discount rates to be applied to climate mitigation investment. Such investments have uncertain benefits that accrue in the distant future, and how to discount these benefits is an issue of both great importance and confusion. Since such investments are hedges and the damages from climate change that they offset are largest in the near term, Giglio et al. (2021) argue that nearby benefits should be discounted at very low rates and further-out benefits at higher (but still very low) rates. These discount rates change the cost-benefit calculus on climate change mitigation investments relative to the received wisdom on discount rates in Nordhaus (2013).

Finally, Han et al. (2021) focus on how financial constraints affect equilibrium behavior of sellers and buyers. Using a regression discontinuity design in the empirical part and a search model in the theoretical part of the paper, they show how regulatory changes on down payment constraints have subtle effects on the various price segments of the housing market. A macroprudential policy aimed at curbing price growth in Toronto in the $1 million housing market segment backfired because it generated bidding wars in the segment just below the $1 million cutoff.

3.3 Private values in other asset markets

Private values are not just relevant for real assets. Bellon et al. (2021) consider the utility that individuals derive from owning their private business. The authors exploit a quasi-natural experiment in which certain households receive large cash windfalls from mineral right claims, while others do not. The windfalls result in the creation of more incorporated businesses (businesses with employees), helping to overcome liquidity constraints. The windfalls also allow individuals to remain self-employed for longer. The latter effect does not seem to be driven by the alleviation of financial constraints, but rather by a demand for the nonpecuniary or private benefits of being self-employed (Moskowitz and Vissing-Jørgensen 2002; Hurst and Pugsley 2011).

Finally, we want to highlight that private values may affect investment decisions—and thus, potentially, valuations—outside the RPVA class. We already mentioned the recent research on the nonpecuniary benefits derived by impact investors in private equity and venture capital. But even liquid financial assets' valuations may be affected by the nonfinancial preferences of investors. Bauer, Ruof, and Smeets (2021) survey investors in a Dutch pension fund, who were given a vote on whether the fund should focus more on sustainability issues. The proposal received strong support. This support appeared to be mainly driven by investors' social preferences rather than a belief that sustainability is good for financial performance. A follow-up survey showed that investors' support did not weaken after they learned about the actual implementation of the sustainable investment policy. The findings of the paper are consistent with recent lab experiments showing that investors' moral preferences affect their valuations and allocations (Bonnefon et al. 2019; Humphrey et al. 2020).

4 Moving Forward

In this final section of our paper, we outline some, in our view, particularly exciting research areas that hold promise for much additional work in the near future. Our goal is not to give an exhaustive overview of all current research on RPVA. Instead, we focus on a selective set of issues related to the ownership and trading of real assets. We thus largely ignore research related to, for example, private values in financial assets, the financing of real asset acquisitions, or the effect of macro factors and credit cycles on price levels in real asset markets. For housing, the latter literature is surveyed in Davis and Van Nieuwerburgh (2014) and Guerrieri and Uhlig (2016).

4.1 Price formation and return heterogeneity in real estate markets

4.1.1 Realistic models of search and bargaining.

Real assets are the quintessential illiquid assets. They trade infrequently and in thin markets because of the uniqueness of each asset's physical characteristics and the heterogeneity in investors' subjective valuations, which is in turn due to heterogeneity in preferences, financial constraints, and beliefs about future fundamentals. Han and Strange (2015) review the existing literature on search in housing markets. It strikes us as an important task to build richer search and matching models that can be confronted with detailed asset-level data (asset features, buyer and seller characteristics, time on the market, transaction prices, etc.). Some papers have recently pushed in the direction of modeling real-world features of housing markets. Ngai and Tenreyro (2014) study the effects of seasonality in housing market thickness (and thus in the quality of buyer-seller matches). Piazzesi, Schneider, and Stroebel (2020) focus on geographical segmentation in search. Arefeva (2020) builds a dynamic search model that accounts for bidding wars between potential home buyers with heterogeneous valuations. Burnside, Eichenbaum, and Rebelo (2016) present a model of social dynamics in which agents' beliefs about housing market fundamentals change through meetings with other agents; Bailey et al. (2018) use social network data demonstrating the empirical relevance of this mechanism. Data from online platforms are helpful to understand the drivers of actual search behavior (Gargano, Giacoletti, and Jarnecic 2020; Piazzesi, Schneider, and Stroebel 2020).

Researchers have also started to use search models to analyze the commercial real estate market. The paper by Sagi (2021) included in this issue is a prime example. Badarinza, Ramadorai, and Shimizu (2020) analyze how counterparties' affinity with each other can mitigate cross-border contracting frictions, leading to a matching of buyers with sellers of the same (or proximate) nationality. Ghent (2020) focuses on market segmentation by liquidity preferences and explains why delegated investors concentrate their commercial real estate investments in the most liquid markets. There is scope for much more work in this area, in particular as new empirical work documents the variation in preferences (Cvijanović, Milcheva, and van de Minne 2020) or in transaction prices

(Spaenjers and Steiner 2020) across different investor types in the commercial real estate space.

4.1.2 The geography of real estate investing.

One group of real estate investors that has been studied increasingly is foreign or nonlocal buyers. These investors have been blamed for pushing up house prices, aggravating existing housing affordability issues. Favilukis and Van Nieuwerburgh (2021) build a spatial equilibrium model of a city to quantify the effect of an out-of-town inflow on local residents' welfare and house prices. Empirical work by Chinco and Mayer (2016), Badarinza and Ramadorai (2018), Barcelona, Converse, and Wong (2019), Davids and Georg (2020), Gorback and Keys (2020), and Li, Shen, and Zhang (2020) shows that investment demand from out-of-town or out-of-country buyers can drive up local house prices, which gives an interesting contrast with earlier papers on the effects of immigration (Saiz and Wachter 2011; Sá 2015).

Asymmetric information is a key characteristic of real estate markets (Garmaise and Moskowitz 2004; Kurlat and Stroebel 2015; Stroebel 2016), and may be particularly important in cross-border transactions. Foreign home buyers may try to lower asymmetries by searching in "preferred habitats" with high proportions of same-nationality households (Badarinza and Ramadorai 2018). Agarwal et al. (2019a) focus on ethnic matching between buyers and sellers. Agarwal, Sing, and Wong (2019) and Badarinza, Ramadorai, and Shimizu (2020) emphasize the importance of investors' nationalities in commercial real estate transactions, highlighting the roles of learning and trust, respectively, when transacting under asymmetric information. There are natural connections between this work and an emerging body of research in the trade literature recognizing the importance of informational frictions (e.g., Chaney 2014). The international finance literature rarely considers cross-border trade in RPVA. Taking into consideration the specific trading costs and market illiquidity in this asset class strikes us an important direction for future work in international finance.

Nonlocal investors may differ from local ones on other dimensions than their information set alone. For example, Cvijanović and Spaenjers (2020) argue that wealthy out-of-country buyers in the Paris housing market realize lower capital gains because of their lower bargaining intensity, not because of higher information asymmetries.

4.1.3 Inequality in housing markets.

A growing literature studies the role of housing for the dynamics of inequality. Real estate assets and mortgage debt occupy a preeminent place in the household wealth portfolio, especially for middle-class households. House price and mortgage rate dynamics therefore trigger large shifts in that part of the wealth distribution (Rognlie 2016; Knoll, Schularick, and Steger 2017; Bach, Calvet, and Sodini 2020; Fagereng et al. 2020; Kuhn, Schularick, and Steins 2020). The wealth-building aspect of home ownership, emphasized in Sodini, Nieuwerburgh, and Vestman (2017), contributes to rising financial wealth inequality when house prices go up. Existing research also suggests that the location of upbringing (Chetty, Hendren, and Katz 2016; Miller and Soo 2021), as well as home ownership and housing returns (Cooper and Luengo-Prado 2015; Lovenheim and Mumford 2013; Been et al. 2021; Hacamo 2021), may have important long-run and even intergenerational effects. The full effects of lifetime experiences in real estate markets remain to be uncovered.

Long-standing issues of racial and ethnic differences in access to the mortgage market and home ownership have received relatively little attention in the finance literature, at least until recently. New work in this area includes Ghent, Hernández-Murillo, and Owyang (2014), Bayer et al. (2017), Bayer, Ferreira, and Ross (2018), Gerardi, Willen, and Zhang (2020), Stein and Yannelis (2020), Ambrose, Conklin, and Lopez (2021), Bhutta and Hizmo (2021), Giacoletti, Heimer, and Yu (2021), and, in the context of new FinTech business models, Bartlett et al. (2019) and Fuster et al. (2020). Appel and Nickerson (2016) study the long-run effects of "redlining" policies that restricted access to credit in poor and minority urban neighborhoods. Avenancio-Leon and Howard (2020) document racial inequalities in property taxation. Future work could dig deeper into demographic variation in the risk-return characteristics of owned housing, and, in the spirit of Agarwal et al. (2019a), the role of race and ethnicity in housing search and matching dynamics. It could also analyze how financial contract design can promote durable home ownership across all income levels.

Other dimensions of inequality are worth exploring more as well. For example, Sakong (2020) finds that poorer households realize lower returns in the housing market because they are more likely to buy when prices are high and to sell when prices are low. Goldsmith-Pinkham and Shue (2020) show a substantial gender gap in housing returns stemming from differences in both market timing and execution prices. However, Andersen et al. (2020) argue that much of the difference in negotiated prices between single men and single women reflect gender differences in preferences and demand for property characteristics.

4.2 Joint dynamics of prices and quantities

4.2.1 Demand-based asset pricing approaches.

The discussion in the previous subsection highlighted the importance of investor heterogeneity. Using the tools of demand-based asset pricing developed by Koijen and Yogo (2019), Koijen and Van Nieuwerburgh (2021) use rich data on the identity of buyers and sellers to study whether different types of investors have different valuations for asset characteristics. The coefficients of the hedonic pricing model come to depend on the investor composition. The ultimate goal for the literature is to build a model that can jointly account for prices, quantities (holdings and transactions), and liquidity measures (e.g., inventory, time on the market) in the time series and in the cross-section.

4.2.2 Endogenous supply.

For most real assets, supply changes endogenously and often with long lags. These "hog cycles" in development amplify price cycles in secondary markets. Land, which is an option on a future building or infrastructure asset, is much more volatile than structures (Davis and Heathcote 2005). Some recent papers emphasize the role of supply in explaining housing price dynamics. Head, Lloyd-Ellis, and Sun (2014) models the response of housing construction to income shocks in a search-and-matching model. Nathanson and Zwick (2018) study how the interaction between development constraints and disagreement about future demand affects house prices. Ben-David, Towbin, and Weber (2019) infer the dynamics of house price expectations from the joint dynamics of prices and demand-supply disparities. Combining richer models of supply with demand-based models is a promising area for future work.

4.2.3 Role of speculators and arbitrageurs in art and housing.

For both art and housing, a lot can still be learned about the role played by "investors"—buyers driven by expectations of capital gains rather than consumption motives—in generating the time dynamics of both prices and volume. One type of investor aims to profit from marketwide price increases. Bayer et al. (2020) document substantial entry by such (amateur) "speculators" during housing boom periods—completely mistiming the market. DeFusco, Nathanson, and Zwick (2020) and Gao, Sockin, and Xiong (2020) argue that variation in speculative activity can play a role in amplifying housing market cycles. By contrast, Griffin, Kruger, and Maturana (2020) find no consistent relation between different proxies for speculation and prices in the early 2000s housing boom and bust. Bayer, Mangum, and Roberts (2021) shows how speculative activity is contagious and spills over geographically. Investors may be subject to larger fluctuations in the availability and cost of credit over time and a have different propensity to default on mortgages (Albanesi, De Giorgi, and Nosal 2019). The impact of investors on house prices may thus change over the course of the credit cycle. An interesting question to explore further is how taxes or other regulations targeting speculators affect outcomes and welfare (Chi, LaPoint, and Lin 2021; Favilukis and Van Nieuwerburgh 2021). More broadly, relatively little work pursues the public finance aspects of real estate, such as property taxation and zoning, and how they affect prices, quantities, and population flows (e.g., Favilukis, Mabille, and Van Nieuwerburgh 2019).

Other financially driven art and housing buyers act as intermediaries or arbitrageurs, buying undervalued assets—often from forced sellers—and bringing them back to the market quickly. In the art auction model of Lovo and Spaenjers (2018), such "flipping" behavior arises endogenously because of market illiquidity, and happens no matter what the state of the economy is. In the same spirit, Bayer et al. (2020) contrast the stabilizing role of liquidity-providing "middlemen" for house prices with the destabilizing role of speculators. Driven by the emergence of machine-learning-based automated property valuation methods (Glaeser, Kincaid, and Naik 2018; Lindenthal and Johnson 2020), one of the most important developments in the housing market is the emergence of "iBuyers," studied recently by Buchak et al. (2020). We foresee much more work on the role and (expected) impact of such players on prices and quantities, and their cyclical properties, in the various segments of the housing market.

4.2.4 Role of expectations and behavioral biases.

A quickly growing literature looks into how households' investment choices in the housing market are driven by their (subjective) experiences, their (potentially biased) expectations of future price rises, and the interaction of the two (Piazzesi and Schneider 2009; Burnside, Eichenbaum, and Rebelo 2016; Glaeser and Nathanson 2017; Bailey et al. 2018; Armona, Fuster, and Zafar 2019; Kuchler and Zafar 2019; Bottan and Perez-Truglia 2020; Liu and Palmer 2021). DeFusco, Nathanson, and Zwick (2020) and Pénasse and Renneboog (2020) emphasize the role of extrapolative expectations in fueling speculative booms for the housing and the art market, respectively. The two-way feedback loop between (implicit or explicit) expectations on the one hand and investment behavior and outcomes on the other hand deserves further study.

There is also scope for more work on how housing market beliefs drive credit demand (e.g., Bailey et al. 2019; De Stefani 2020) and supply (e.g., Kaplan, Mitman, and Violante 2020), which may feed back to price movements. The relative importance of beliefs and credit conditions in accounting for boom and bust dynamics in the housing market remains an unsettled issue (Favilukis, Ludvigson, and Van Nieuwerburgh 2017; Greenwald and Guren 2020).

On the seller side, starting with Genesove and Mayer (2001), a literature has developed stressing the importance of loss aversion in explaining the positive correlation between prices and volume observed in the housing market. The loss aversion effect interacts with the down payment effect, typically attributed to Stein (1995). However, recent work by Bracke and Tenreyo (2020) and Andersen et al. (2021) disputes this commonly accepted explanation, arguing that loss aversion does not play a very significant role over and above simple anchoring. Beggs and Graddy (2009) show evidence for the existence of anchoring in the art market. A better theoretical understanding of household decision-making when it comes to listing/consignment decisions—and the role of behavioral biases therein—clearly would be helpful in order to explain the observed price and volume dynamics.

4.3 Intermediaries

Intermediaries (e.g., real estate agents, art auction houses) play a crucial role in real asset markets. A number of papers study the relation between house prices and (excess) entry into the real estate agent profession (e.g., Hsieh and Moretti 2003; Begley, Haslag, and Weagley 2020). However, the impact of time-series and cross-sectional variations in broker quality and behavior on transaction outcomes is arguably understudied. A recent exception is Gilbukh and Goldsmith-Pinkham (2019), who find that houses listed by inexperienced brokers have a lower probability of sale, and that this effect is stronger during a housing bust. They propose a housing search model in which brokers enter and exit endogenously, leading to cyclical variation in the distribution of intermediaries' experience. For the art market, Bruno, Garcia-Appendini, and Nocera (2018) argue that auction houses with artist-specific experience are better at predicting price outcomes.

Some other research focuses on the distorted incentives and conflicts of interest of real estate agents. Levitt and Syverson (2008) show that brokers sell their clients' houses more quickly and at lower prices than their own. However, recent work that applies textual analysis to broker listings argues this result may be due to an omitted variable bias (Liu, Nowak, and Smith 2020). Still, real estate agents sometimes have clear informational advantages that may allow them to, for example, "cherry-pick" cheaper listings or to obtain larger discounts from weak sellers (Agarwal et al. 2019b). Barwick, Pathak, and Wong (2017) find that real estate agents steer buyers to high-commission properties. There is clearly scope for more work here. Related to earlier-mentioned issues, future studies could also dig deeper into the role of real estate agents in the matching (or not) of counterparties of different nationalities or racial or ethnic groups, and the effects on transaction outcomes.

An understudied aspect of intermediaries is their role as information producers or providers. Some recent papers show how real estate advertisements provide otherwise difficult to observe information about properties' quality (Liu, Nowak, and Smith 2020; Nowak and Smith 2020; Shen and Ross 2021). Other work focuses on presale appraisals of items' market values. For example, Aubry et al. (2020) show that art auction house estimates are systematically biased, which could be due to behavioral biases, but also to strategic reasons. Similar mechanisms may play a role in housing appraisals as well (Salzman and Zwinkels 2017). Future research should help improve our understanding of the competitive considerations that underlie intermediaries' asset valuations, and their effects on the equilibrium behavior of buyers and sellers. Already some evidence points to appraisals causally affecting transaction prices (Aubry et al. 2020; Lu 2020).

4.4 Alternative ways to invest in real assets

Institutional investors access real estate and infrastructure investments both through public equity and debt markets and through private equity and debt markets. The general trend seems to be for an increasing allocation to alternative assets held outside public equity vehicles. Andonov, Kräussl, and Rauh (2021) ask an important question in this issue: do investors hold RPVA investments in the right vehicles? Do commingled closed-end private equity funds provide a good structure for pension funds, sovereign wealth funds, or endowments to invest in real assets given the long-term nature of their liabilities? How does the after-fee performance of such investments compare to coinvestments or direct asset investments? Do pension funds have the expertise to pull off such direct investments successfully, maybe by forming consortia, as was done in Canada (Lipshitz and Walter 2020)? Do investors shy away from public markets since it absolves them from having to mark positions to market, creating an "illiquidity premium," as suggested by Gupta and Van Nieuwerburgh (2021)? More empirical work is needed to carefully measure the risk-adjusted performance (before and after fees) of the various modes of investing in real assets. More theoretical work is needed to develop the optimal contractual structures for different types of institutional investors.

Both for real estate and for collectibles, some popular discussion revolves around "tokenization."

Limited academic research has tackled this topic so far. For collectibles, Vorsatz (2020) develops a model of tokenization and argues that it can be welfare improving. A complementary perspective is offered by Whitaker and Kräussl (2020), who argue that a fractional equity system for artworks can be a tool for diversified investment and democratized access to the art market, while allowing artists to retain a share in the upside potential that their work creates. There is room for new models of financing that unlock some of the value and help share the risk in RPVA assets.

4.5 Prices and preferences in collectibles markets

We can think of the private use value associated with the possession of an artwork as an "emotional dividend" (Lovo and Spaenjers 2018), which is worth what the owner would be willing to pay for one period of enjoyment. Barring pressure from investment demand, including the occasional need for a discrete and portable store of wealth (Oosterlinck 2017), prices of artworks and other collectibles are thus determined at the intersection of the distribution of purchasing power and that of tastes. Research has indeed shown a strong impact of wealth dynamics on the willingness-to-pay for collectibles (Aït-Sahalia, Parker, and Yogo 2004; Hiraki et al. 2009; Goetzmann, Renneboog, and Spaenjers 2011; Dimson, Rousseau, and Spaenjers 2015). Oster and Goetzmann (2003) study the role played by urban concentrations of wealth in the economics of local museums, emphasizing the social dimension of the nonmonetary dividends supplied by art. Moving from wealth to tastes, common (and seemingly lexicographic) preferences for certain highly ranked experiences can clearly have unusual economic effects supporting extreme and puzzling variations in prices for practically indistinguishable goods. The details of collectors' preferences and their associated values are difficult to measure and model economically, but may have first-order effects. Differential preferences can derive from variation in past aesthetic experiences, social signaling, identity construction, and many other factors (Spaenjers, Goetzmann, and Mamonova 2015).

Research into the pricing of aesthetic features has arguably been hampered by blunt econometric tools. Hedonic regressions typically project the characteristics of artworks to prosaic indicator variables, with the most relevant being the artist. Advances in computer vision and machine learning have opened up new possibilities for studying the subtleties of the pricing of style and features detectable optically (Pownall and Graddy 2016; Ma, Noussair, and Renneboog 2019; Aubry et al. 2020). Future work may build on new methods that visually compare objects to each other and computationally measure creativity (Elgammal and Saleh 2015). There also may be scope for research that constructs crowdsourced proxies for attractiveness, as already has been done to evaluate metropolitan areas (Carlino and Saiz 2019).

Also new statistical methods applied to transaction and art historical data can enable a better understanding of the formation of aesthetic tastes and the dynamics of fashion. Goetzmann et al. (2016) develop an empirical classification of styles based on a manifold clustering algorithm applied to auction prices. Fraiberger et al. (2018) use network analysis to model the paths of highly successful contemporary artists, showing the importance of early access to prestigious central institutions, suggesting a high level of demand coordination.

Finally, there is definitely room for more experimental research examining the drivers of private enjoyment and willingness-to-pay. As noted before, Adams et al. (2021), in this issue, study experimentally how appreciation of artworks depends on the (perceived) gender of the artist. Other recent studies have generated further insights into the aesthetic experience. Ma, Noussair, and Renneboog (2019) study how colors can affect emotions and valuations. Newman and Bloom (2012) explore when and for which reasons original artworks and artifacts are considered more valuable than duplicates. Related research finds that people value objects that enhance their sense of proximity to the artist or to collectors with similar preferences (Newman and Smith 2016; Smith, Newman, and Dhar 2016).

As more sophisticated methods for the study of aesthetics become available, future researchers can build on insights from both neuroaesthetics (Chatterjee and Vartanian 2014) and neuroeconomics. Interestingly, neurological research suggests that the relation between experienced utility and prices may not be a one-way street (Plassmann et al. 2008), arguably providing a biological microfoundation for models in which the price of a collectible directly enters the utility function (Mandel 2009).

4.6 Big challenges for real estate and infrastructure markets

The Covid-19 crisis has raised important questions about the future of cities and the future of work, with direct and indirect implications for housing markets, commercial real estate markets (office, e-commerce), and infrastructure (e.g., safety and financial viability of public transit). Gupta et al. (2021) study changes in residential rents and prices in urban versus suburban locations resulting from pandemic-induced household migration. Ling, Wang, and Zhou (2020) study the impact of the pandemic on asset-level commercial real estate across different categories, largely resulting from temporary restrictions on business activity. Delventhal, Kwon, and Parkhomenko (2020) and Davis, Ghent, and Gregory (2021) study housing prices in spatial equilibrium models where households choose where to locate when the technology for working from home improves. The pandemic has also underscored the need for a better understanding of how public health shocks affect real estate markets (Wong 2008; Custódio, Cvijanović, and Wiedemann 2020; D'Lima and Thibodeau 2021; Francke and Korevaar 2021).

Climate change and the energy transition it has set in motion directly affects the built environment and the infrastructure that supports it. Technological innovations, such as driverless cars (Zakharenko 2016), and the sharing economy (Calder-Wang 2020) intersect with the climate imperative in interesting ways. Better cost-benefit analysis of investments in energy efficiency and a quantification of the risk of economic obsolescence (stranded real assets) are needed. The increased focus on sustainability by institutional and retail investors in equity and debt markets (green bonds) and in property markets (green buildings) will continue to be an important research theme.

Finally, there are large unmet infrastructure needs in the developed world, but even more so in developing countries where most of the growth in the world population takes place (Walter 2016). Infrastructure investments run up against fiscal constraints everywhere. Capturing some of the newly created value of infrastructure additions (Gupta, Van Nieuwerburgh, and Kontokosta 2020), for example, through property taxes, can be a useful tool in a broader arsenal of financing options. Much work is needed to assess risk and return of infrastructure projects in emerging markets and to find ways to bridge the financing gap (Gardner and Henry 2021).

References

Adams, R., R. Kräussl, M. Navone, and P. Verwijmeren. 2021. Gendered Prices. *Review of Financial Studies* This issue.

Agarwal, S., H.-S. Choi, J. He, and T. F. Sing. 2019a. Matching in Housing Markets: The Role of Ethnic Social Networks. *Review of Financial Studies* 32:3958–4004.

Agarwal, S., J. He, T. F. Sing, and C. Song. 2019b. Do Real Estate Agents Have Information Advantages in Housing Markets? *Journal of Financial Economics* 134:715–35.

Agarwal, S., T. F. Sing, and L. Wong. 2019. Information Asymmetries and Learning in Commercial Real Estate Markets. Working paper.

Albanesi, S., G. De Giorgi, and J. Nosal. 2019. Credit Growth and the Financial Crisis: A New Narrative. Working paper.

Ambrose, B. W., J. N. Conklin, and L. A. Lopez. 2021. Does Borrower and Broker Race Affect the Cost of Mortgage Credit? *Review of Financial Studies* 34:790–826.

Andersen, S., C. Badarinza, L. Liu, J. Marx, and T. Ramadorai. 2021. Reference Dependence in the Housing Market. Working paper.

Andersen, S., J. Marx, K. M. Nielsen, and L. Vesterlund. 2020. Gender Differences in Negotiation: Evidence from Real Estate Transactions. NBER Working Paper 27318.

Andonov, A., R. Kräussl, and J. Rauh. 2021. Institutional Investors and Infrastructure Investing. *Review of Financial Studies* This issue.

Appel, I., and J. Nickerson. 2016. Pockets of Poverty: The Long-Term Effects of Redlining. Working paper.

Arefeva, A. 2020. How Auctions Amplify House-Price Fluctuations. Working paper.

Armona, L., A. Fuster, and B. Zafar. 2019. Home Price Expectations and Behaviour: Evidence from a Randomized Information Experiment. *Review of Economic Studies* 86:1371–410.

Aubry, M., R. Kräussl, G. Manso, and C. Spaenjers. 2020. Biased Auctioneers. Working paper.

Avenancio-Leon, C., and T. Howard. 2020. The Assessment Gap: Racial Inequalities in Property Taxation. Working paper.

Aït-Sahalia, Y., J. A. Parker, and M. Yogo. 2004. Luxury Goods and the Equity Premium. *Journal of Finance* 59:2959–3004.

Bach, L., L. E. Calvet, and P. Sodini. 2020. Rich Pickings? Risk, Return, and Skill in Household Wealth. *American Economic Review* 110:2703–47.

Badarinza, C., and T. Ramadorai. 2018. Home Away from Home? Foreign Demand and London House Prices. *Journal of Financial Economics* 130:532–55.

Badarinza, C., T. Ramadorai, and C. Shimizu. 2020. Gravity, Counterparties, and Foreign Investment. Working paper.

Bailey, M., R. Cao, T. Kuchler, and J. Stroebel. 2018. The Economic Effects of Social Networks: Evidence from the Housing Market. *Journal of Political Economy* 126:2224–76.

Bailey, M., E. Dávila, T. Kuchler, and J. Stroebel. 2019. House Price Beliefs And Mortgage Leverage Choice. *Review of Economic Studies* 86:2403–52.

Baldauf, M., L. Garlappi, and C. Yannelis. 2020. Does Climate Change Affect Real Estate Prices? Only If You Believe In It. *Review of Financial Studies* 33:1256–95.

Barber, B. M., A. Morse, and A. Yasuda. 2021. Impact Investing. *Journal of Financial Economics* 139:162–85.

Barcelona, W., N. Converse, and A. Wong. 2019. U.S. Housing as a Global Safe Asset: Evidence from China Shocks. Working paper.

Barclays. 2012. Profit or Pleasure? Exploring the Motivations Behind Treasure Trends. Technical report.

Bartlett, R., A. Morse, R. Stanton, and N. Wallace. 2019. Consumer-Lending Discrimination in the FinTech Era. Working paper.

Barwick, P. J., P. A. Pathak, and M. Wong. 2017. Conflicts of Interest and Steering in Residential Brokerage. *American Economic Journal: Applied Economics* 9:191–222.

Bauer, R., T. Ruof, and P. Smeets. 2021. Get Real! Individuals Prefer More Sustainable Investments. *Review of Financial Studies* This issue.

Bayer, P., M. Casey, F. Ferreira, and R. McMillan. 2017. Racial and Ethnic Price Differentials in the Housing Market. *Journal of Urban Economics* 102:91–105.

Bayer, P., F. Ferreira, and S. L. Ross. 2018. What Drives Racial and Ethnic Differences in High-Cost Mortgages? The Role of High-Risk Lenders. *Review of Financial Studies* 31:175–205.

Bayer, P., C. Geissler, K. Mangum, and J. W. Roberts. 2020. Speculators and Middlemen: The Strategy and Performance of Investors in the Housing Market. *Review of Financial Studies* 33:5212–47.

Bayer, P., K. Mangum, and J. W. Roberts. 2021. Speculative Fever: Investor Contagion in the Housing Bubble. *American Economic Review* Forthcoming.

Been, V., I. Ellen, D. Figlio, A. A. Nelson, S. Ross, A. E. Schwartz, and L. Stiefel. 2021. The Effects of Negative Equity on Children's Educational Outcomes. Working paper.

Beggs, A., and K. Graddy. 2009. Anchoring Effects: Evidence from Art Auctions. *American Economic Review* 99:1027–39.

Begley, T. A., P. H. Haslag, and D. Weagley. 2020. Dream Chasers: The Draw and the Downside of Following House Price Signals. Working paper.

Bellon, A., J. A. Cookson, E. P. Gilje, and R. Z. Heimer. 2021. Personal Wealth and Self-Employment. *Review of Financial Studies* This issue.

Ben-David, I., P. Towbin, and S. Weber. 2019. Expectations During the U.S. Housing Boom: Inferring Beliefs from Actions. Working paper.

Bernstein, A., S. B. Billings, M. T. Gustafson, and R. Lewis. 2021. Voting with their Sandals: Partisan Residential Sorting on Climate Change Risk. Working paper.

Bernstein, A., M. T. Gustafson, and R. Lewis. 2019. Disaster on the Horizon: The Price Effect of Sea Level Rise. *Journal of Financial Economics* 134:253–72.

Bhutta, N., and A. Hizmo. 2021. Do Minorities Pay More for Mortgages? *Review of Financial Studies* 34:763–89.

Bocart, F., M. Gertsberg, and R. A. J. Pownall. 2018. Glass Ceilings in the Art Market. Working paper.

Bonnefon, J.-F., A. Landier, P. Sastry, and D. Thesmar. 2019. Do Investors Care About Corporate Externalities? Experimental Evidence. Working paper.

Bottan, N. L., and R. Perez-Truglia. 2020. Betting on the House: Subjective Expectations and Market Choices. NBER Working Paper 27412.

Bracke, P., and S. Tenreyo. 2020. History Dependence in the Housing Market. *American Economic Journal: Macroeconomics* Forthcoming.

Bruno, B., E. Garcia-Appendini, and G. Nocera. 2018. Experience and Brokerage in Asset Markets: Evidence from Art Auctions. *Financial Management* 47:833–64.

Buchak, G., G. Matvos, T. Piskorski, and A. Seru. 2020. iBuyers: Liquidity in Real Estate Markets? Working paper.

Burnside, C., M. Eichenbaum, and S. Rebelo. 2016. Understanding Booms and Busts in Housing Markets. *Journal of Political Economy* 124:1088–147.

Calder-Wang, S. 2020. The Distributional Impact of the Sharing Economy on the Housing Market. Working paper.

Cameron, L., W. N. Goetzmann, and M. Nozari. 2019. Art and Gender: Market Bias or Selection Bias? *Journal of Cultural Economics* 43:279–307.

Carlino, G. A., and A. Saiz. 2019. Beautiful City: Leisure Amenities and Urban Growth. *Journal of Regional Science* 59:369–408.

Chambers, D., E. Dimson, and C. Spaenjers. 2020. Art as an Asset: Evidence from Keynes the Collector. *Review of Asset Pricing Studies* 10:490–520.

Chambers, D., C. Spaenjers, and E. Steiner. 2021. The Rate of Return on Real Estate: Long-Run Micro-Level Evidence. *Review of Financial Studies* This issue.

Chaney, T. 2014. The Network Structure of International Trade. *American Economic Review* 104:3600–34.

Chatterjee, A., and O. Vartanian. 2014. Neuroaesthetics. *Trends in Cognitive Sciences* 18:370–5.

Chetty, R., N. Hendren, and L. F. Katz. 2016. The Effects of Exposure to Better Neighborhoods on Children: New Evidence from the Moving to Opportunity Experiment. *American Economic Review* 106:855–902.

Chi, C.-C., C. LaPoint, and M.-J. Lin. 2021. Flip or Flop? Tobin Taxes in the Real Estate Market. Working paper.

Chinco, A., and C. Mayer. 2016. Misinformed Speculators and Mispricing in the Housing Market. *Review of Financial Studies* 29:486–522.

Cooper, D., and M. J. Luengo-Prado. 2015. House Price Growth When Children Are Teenagers: A Path to Higher Earnings? *Journal of Urban Economics* 86:54–72.

Credit Suisse. 2017. Global Wealth Report 2017. Technical report.

Custódio, C., D. Cvijanović, and M. Wiedemann. 2020. Opioid Crisis and Real Estate Prices. Working paper.

Cvijanović, D., S. Milcheva, and A. van de Minne. 2020. Preferences of Institutional Investors in Commercial Real Estate. *Journal of Real Estate Finance and Economics* Forthcoming.

Cvijanović, D., and C. Spaenjers. 2020. "We'll Always Have Paris": Out-of-Country Buyers in the Housing Market. *Management Science* Forthcoming.

Davids, A., and C.-P. Georg. 2020. The Cape of Good Homes: Exchange Rate Depreciations, Foreign Demand and House Prices. Working paper.

Davis, M., and S. Van Nieuwerburgh. 2014. Housing, Finance and the Macroeconomy. In G. Duranton and W. Strange, eds., *Handbook of Regional Economics*. North Holland: Elsevier Science B.V.

Davis, M. A., A. C. Ghent, and J. Gregory. 2021. The Work-at-Home Technology Boon and its Consequences. Working paper.

Davis, M. A., and J. Heathcote. 2005. Housing and the Business Cycle. *International Economic Review* 46:751–84.

De Stefani, A. 2020. House Price history, Biased Expectations, and Credit Cycles: The Role of Housing Investors. *Real Estate Economics* Forthcoming.

DeFusco, A. A., C. G. Nathanson, and E. Zwick. 2020. Speculative Dynamics of Prices and Volume. Working paper.

Delventhal, M. J., E. Kwon, and A. Parkhomenko. 2020. How Do Cities Change When We Work from Home? Working paper.

Dimson, E., P. L. Rousseau, and C. Spaenjers. 2015. The Price of Wine. *Journal of Financial Economics* 118:431–49.

D'Lima, W., and M. Thibodeau. 2021. Health Crisis and Housing Market Effects - Evidence from the U.S. Opioid Epidemic. Working paper.

Eichholtz, P., M. Korevaar, T. Lindenthal, and R. Tallec. 2021. The Total Return and Risk to Residential Real Estate. *Review of Financial Studies* This issue.

Eichholtz, P., E. Steiner, and E. Yönder. 2019. Where, When, and How Do Sophisticated Investors Respond to Flood Risk? Working paper.

Eiling, E., E. Giambona, R. Lopez Aliouchkin, and P. Tuijp. 2020. Homeowners' Risk Premia: Evidence from Zip Code Housing Returns. Working paper.

Eisfeldt, A., and A. Demers. 2015. Total Returns to Single Family Rentals. NBER Working Paper 21804.

Elgammal, A., and B. Saleh. 2015. Quantifying Creativity in Art Networks. Technical Report.

Fagereng, A., L. Guiso, D. Malacrino, and L. Pistaferri. 2020. Heterogeneity and Persistence in Returns to Wealth. *Econometrica* 88:115–70.

Favilukis, J., S. C. Ludvigson, and S. Van Nieuwerburgh. 2017. The Macroeconomic Effects of Housing Wealth, Housing Finance, and Limited Risk Sharing in General Equilibrium. *Journal of Political Economy* 125:140–223.

Favilukis, J., P. Mabille, and S. Van Nieuwerburgh. 2019. Affordable Housing and City Welfare. Working paper.

Favilukis, J., and S. Van Nieuwerburgh. 2021. Out-of-Town Home Buyers and City Welfare. *Journal of Finance* Forthcoming.

Fraiberger, S. P., R. Sinatra, M. Resch, C. Riedl, and A.-L. Barabási. 2018. Quantifying Reputation and Success in Art. *Science* 362:825–9.

Francke, M., and M. Korevaar. 2021. Housing Markets in a Pandemic: Evidence from Historical Outbreaks. *Journal of Urban Economics* Forthcoming.

Fuster, A., P. Goldsmith-Pinkham, T. Ramadorai, and A. Walther. 2020. Predictably Unequal? The Effects of Machine Learning on Credit Markets. *Journal of Finance* Forthcoming.

Gao, Z., M. Sockin, and W. Xiong. 2020. Economic Consequences of Housing Speculation. *Review of Financial Studies* 33:5248–87.

Gardner, C., and P. B. Henry. 2021. Global Infrastructure: Potential, Perils, and a Framework for Distinction. Working paper.

Gargano, A., M. Giacoletti, and E. Jarnecic. 2020. Attention and Search: Micro-Evidence on Housing Market Momentum. Working paper.

Garmaise, M. J., and T. J. Moskowitz. 2004. Confronting Information Asymmetries: Evidence from Real Estate Markets. *Review of Financial Studies* 17:405–37.

Garnache, C. 2020. Does the Salience of Risk Affect Large, Risky Asset Prices? Working paper.

Gavazza, A., and A. Lizzeri. 2021. Frictions and Intermedation in Product Markets. Mimeo.

Genesove, D., and C. Mayer. 2001. Loss Aversion and Seller Behavior: Evidence from the Housing Market. *Quarterly Journal of Economics* 116:1233–60.

Gerardi, K., P. Willen, and D. H. Zhang. 2020. Mortgage Prepayment, Race, and Monetary Policy. Working paper, Federal Reserve Bank of Boston.

Ghent, A. C. 2020. What's Wrong with Pittsburgh? Delegated Investors and Liquidity Concentration. *Journal of Financial Economics* Forthcoming.

Ghent, A. C., R. Hernández-Murillo, and M. T. Owyang. 2014. Differences in Subprime Loan Pricing Across Races and Neighborhoods. *Regional Science and Urban Economics* 48:199–215.

Ghent, A. C., W. N. Torous, and R. I. Valkanov. 2019. Commercial Real Estate as an Asset Class. *Annual Review of Financial Economics* 11:153–71.

Giacoletti, M. 2021. Idiosyncratic Risk in Housing Markets. *Review of Financial Studies* This issue.

Giacoletti, M., R. Z. Heimer, and E. G. Yu. 2021. Using High-Frequency Evaluations to Estimate Discrimination: Evidence from Mortgage Loan Officers. Working paper.

Giglio, S., M. Maggiori, J. Stroebel, and A. Weber. 2021. Climate Change and Long-Run Discount Rates: Evidence from Real Estate. *Review of Financial Studies* This issue.

Gilbukh, S., and P. S. Goldsmith-Pinkham. 2019. Heterogeneous Real Estate Agents and the Housing Cycle. Working paper.

Glaeser, E. L., M. S. Kincaid, and N. Naik. 2018. Computer Vision and Real Estate: Do Looks Matter and Do Incentives Determine Looks. NBER Working Paper 25174.

Glaeser, E. L., and C. G. Nathanson. 2017. An Extrapolative Model of House Price Dynamics. *Journal of Financial Economics* 126:147–70.

Goetzmann, W., and L. Peng. 2006. Estimating House Price Indexes in the Presence of Seller Reservation Prices. *Review of Economics and Statistics* 88:100–12.

Goetzmann, W. N., P. W. Jones, M. Maggioni, and J. Walden. 2016. Beauty Is in the Bid of the Beholder: An Empirical Basis for Style. *Research in Economics* 70:388–402.

Goetzmann, W. N., L. Renneboog, and C. Spaenjers. 2011. Art and Money. *American Economic Review* 101:222–6.

Goetzmann, W. N., and A. C. Whitaker. 2021. Estimation of the Value of Art in U.S. Households. Mimeo.

Goldsmith-Pinkham, P., and K. Shue. 2020. The Gender Gap in Housing Returns. NBER Working Paper 26914.

Gomes, F., M. Haliassos, and T. Ramadorai. 2021. Household Finance. *Journal of Economic Literature* Forthcoming.

Gorback, C. S., and B. J. Keys. 2020. Global Capital and Local Assets: House Prices, Quantities, and Elasticities. NBER Working Paper 27370.

Greenwald, D. L., and A. Guren. 2020. Do Credit Conditions Move House Prices? Working paper.

Griffin, J. M., S. Kruger, and G. Maturana. 2020. What Drove the 2003–2006 House Price Boom and Subsequent Collapse? Disentangling Competing Explanations. *Journal of Financial Economics* Forthcoming.

Guerrieri, V., and H. Uhlig. 2016. Housing and Credit Markets: Booms and Busts. In J. B. Taylor and H. Uhlig, eds., *Handbook of Macroeconomics*, vol. 2, 1427–96. Elsevier.

Gupta, A., J. Peeters, M. Vrinda, and S. Van Nieuwerburgh. 2021. Flattening the Curve: Pandemic-induced Revaluation of Urban Real Estate. Working paper.

Gupta, A., and S. Van Nieuwerburgh. 2021. Valuing Private Equity Investments Strip by Strip. *Journal of Finance* Forthcoming.

Gupta, A., S. Van Nieuwerburgh, and C. Kontokosta. 2020. Take the Q Train: Value Capture of Public Infrastructure Projects. NBER Working Paper 26789.

Hacamo, I. 2021. The Babies of Mortgage Market Deregulation. *Review of Financial Studies* 34:907–48.

Han, L. 2013. Understanding the Puzzling Risk-Return Relationship for Housing. *Review of Financial Studies* 26:877–928.

Han, L., C. Lutz, B. Sand, and D. Stacey. 2021. The Effects of a Targeted Financial Constraint on the Housing Market. *Review of Financial Studies* This issue.

Han, L., and W. C. Strange. 2015. The Microstructure of Housing Markets. In *Handbook of Regional and Urban Economics*, vol. 5, 813–86. Elsevier. ISBN 978-0-444-59533-1.

Head, A., H. Lloyd-Ellis, and H. Sun. 2014. Search, Liquidity, and the Dynamics of House Prices and Construction. *American Economic Review* 104:1172–210.

Hiraki, T., A. Ito, D. A. Spieth, and N. Takezawa. 2009. How Did Japanese Investments Influence International Art Prices? *Journal of Financial and Quantitative Analysis* 44:1489–514.

Hong, H., G. A. Karolyi, and J. A. Scheinkman. 2020. Climate Finance. *Review of Financial Studies* 33:1011–23.

Hong, H., J. Scheinkman, and W. Xiong. 2006. Asset Float and Speculative Bubbles. *Journal of Finance* 61:1073–117.

Hsieh, C.-T., and E. Moretti. 2003. Can Free Entry Be Inefficient? Fixed Commissions and Social Waste in the Real Estate Industry. *Journal of Political Economy* 111:1076–122.

Humphrey, J., S. Kogan, J. Sagi, and L. Starks. 2020. The Asymmetry in Responsible Investing Preferences. Working paper.

Hurst, E., and B. W. Pugsley. 2011. What Do Small Businesses Do? *Brookings Papers on Economic Activity* 73–142.

Jordà, , K. Knoll, D. Kuvshinov, M. Schularick, and A. M. Taylor. 2019. The Rate of Return on Everything, 1870–2015. *Quarterly Journal of Economics* 134:1225–98.

Kaplan, G., K. Mitman, and G. L. Violante. 2020. The Housing Boom and Bust: Model Meets Evidence. *Journal of Political Economy* 128:3285–345.

Keys, B. J., and P. Mulder. 2020. Neglected No More: Housing Markets, Mortgage Lending, and Sea Level Rise. NBER Working Paper 27930.

Knoll, K., M. Schularick, and T. Steger. 2017. No Price Like Home: Global House Prices, 1870–2012. *American Economic Review* 107:331–53.

Koijen, R. S. J., and S. Van Nieuwerburgh. 2021. The Commercial Real Estate Ecosystem. Mimeo.

Koijen, R. S. J., and M. Yogo. 2019. A Demand System Approach to Asset Pricing. *Journal of Political Economy* 127:1475–515.

Korteweg, A., R. Kräussl, and P. Verwijmeren. 2016. Does it Pay to Invest in Art? A Selection-Corrected Returns Perspective. *Review of Financial Studies* 29:1007–38.

Korteweg, A., and M. Sorensen. 2016. Estimating Loan-to-Value Distributions: Estimating Loan-to-Value Distributions. *Real Estate Economics* 44:41–86.

Kotova, N., and A. L. Zhang. 2020. Liquidity in Residential Real Estate Markets. Working paper.

Kuchler, T., and B. Zafar. 2019. Personal Experiences and Expectations about Aggregate Outcomes. *Journal of Finance* 74:2491–542.

Kuhn, M., M. Schularick, and U. I. Steins. 2020. Income and Wealth Inequality in America, 1949–2016. *Journal of Political Economy* 128:3469–519.

Kurlat, P., and J. Stroebel. 2015. Testing for Information Asymmetries in Real Estate Markets. *Review of Financial Studies* 28:2429–61.

Levitt, S. D., and C. Syverson. 2008. Market Distortions When Agents Are Better Informed: The Value of Information in Real Estate Transactions. *Review of Economics and Statistics* 90:599–611.

Li, Z., L. S. Shen, and C. Zhang. 2020. Capital Flows, Asset Prices, and the Real Economy: A "China Shock" in the U.S. Real Estate Market. Working paper.

Lindenthal, T., and E. B. Johnson. 2020. Machine Learning, Architectural Styles and Property Values. *Journal of Real Estate Finance and Economics* Forthcoming.

Ling, D. C., C. Wang, and T. Zhou. 2020. A First Look at the Impact of COVID-19 on Commercial Real Estate Prices: Asset-Level Evidence. *Review of Asset Pricing Studies* 10:669–704.

Lipshitz, C., and I. Walter. 2020. Public Pension Reform and the 49th Parallel: Lessons from Canada for the U.S. *Financial Markets, Institutions & Instruments* 29:121–62.

Liu, C. H., A. D. Nowak, and P. S. Smith. 2020. Asymmetric or Incomplete Information about Asset Values? *Review of Financial Studies* 33:2898–936.

Liu, H., and C. Palmer. 2021. Are Stated Expectations Actual Beliefs? New Evidence for the Beliefs Channel of Investment Demand. Working paper.

Lovenheim, M. F., and K. J. Mumford. 2013. Do Family Wealth Shocks Affect Fertility Choices? Evidence from the Housing Market. *Review of Economics and Statistics* 95:464–75.

Lovo, S., and C. Spaenjers. 2018. A Model of Trading in the Art Market. *American Economic Review* 108:744–74.

Lu, G. 2020. How Machine Learning Reduces Racial Price Differentials in the U.S. Housing Market. Working paper.

Ma, M. X., C. N. Noussair, and L. Renneboog. 2019. Colors, Emotions, and the Auction Value of Paintings. Working paper.

Mandel, B. R. 2009. Art as an Investment and Conspicuous Consumption Good. *American Economic Review* 99:1653–63.

Miller, S., and C. K. Soo. 2021. Do Neighborhoods Affect the Credit Market Decisions of Low-Income Borrowers? Evidence from the Moving to Opportunity Experiment. *Review of Financial Studies* 34:827–63.

Moskowitz, T. J., and A. Vissing-Jørgensen. 2002. The Returns to Entrepreneurial Investment: A Private Equity Premium Puzzle? *American Economic Review* 92:745–78.

Murfin, J., and M. Spiegel. 2020. Is the Risk of Sea Level Rise Capitalized in Residential Real Estate? *Review of Financial Studies* 33:1217–55.

Nathanson, C. G., and E. Zwick. 2018. Arrested Development: Theory and Evidence of Supply-Side Speculation in the Housing Market. *Journal of Finance* 73:2587–633.

Newman, G. E., and P. Bloom. 2012. Art and Authenticity: The Importance of Originals in Judgments of Value. *Journal of Experimental Psychology. General* 141:558–69.

Newman, G. E., and R. K. Smith. 2016. The Need to Belong Motivates Demand for Authentic Objects. *Cognition* 156:129–34.

Ngai, L. R., and S. Tenreyro. 2014. Hot and Cold Seasons in the Housing Market. *American Economic Review* 104:3991–4026.

Nordhaus, W. D. 2013. *The Climate Casino: Risk, Uncertainty, and Economics for a Warming World*. New Haven London: Yale University Press. ISBN 978-0-300-21264-8.

Nowak, A. D., and P. S. Smith. 2020. Quality-Adjusted House Price Indexes. *American Economic Review: Insights* 2:339–56.

Oosterlinck, K. 2017. Art as a Wartime Investment: Conspicuous Consumption and Discretion. *Economic Journal* 127:2665–701.

Oster, S., and W. N. Goetzmann. 2003. Does Governance Matter? The Case of Art Museums. In E. L. Glaeser, ed., *The Governance of Not-for-Profit Organizations*, 71–100. University of Chicago Press.

Peng, L., and T. G. Thibodeau. 2017. Idiosyncratic Risk of House Prices: Evidence from 26 Million Home Sales: Idiosyncratic Risk of House Prices. *Real Estate Economics* 45:340–75.

Piazzesi, M., and M. Schneider. 2009. Momentum Traders in the Housing Market: Survey Evidence and a Search Model. *American Economic Review: Papers & Proceedings* 99:406–11.

Piazzesi, M., M. Schneider, and J. Stroebel. 2020. Segmented Housing Search. *American Economic Review* 110:720–59.

Plassmann, H., J. O'Doherty, B. Shiv, and A. Rangel. 2008. Marketing Actions Can Modulate Neural Representations of Experienced Pleasantness. *Proceedings of the National Academy of Sciences* 105:1050–4.

Pownall, R. A. J., and K. Graddy. 2016. Pricing Color Intensity and Lightness in Contemporary Art Auctions. *Research in Economics* 70:412–20.

Pénasse, J., and L. Renneboog. 2020. Speculative Trading and Bubbles: Evidence from the Art Market? Working paper.

Pénasse, J., L. Renneboog, and J. A. Scheinkman. 2021. When a Master Dies: Speculation and Asset Float. *Review of Financial Studies* This issue.

RARE. 2013. RARE Guide to Listed vs. Unlisted Infrastructure. Technical report.

Rognlie, M. 2016. Deciphering the Fall and Rise in the Net Capital Share: Accumulation or Scarcity? *Brookings Papers on Economic Activity* 2015:1–69.

Sagi, J. S. 2021. Asset-Level Risk and Return in Real Estate Investments. *Review of Financial Studies* This issue.

Saiz, A., and S. Wachter. 2011. Immigration and the Neighborhood. *American Economic Journal: Economic Policy* 3:169–88.

Sakong, J. 2020. Cyclical Housing Transactions and Wealth Inequality. Working paper.

Salzman, D., and R. C. J. Zwinkels. 2017. Behavioral Real Estate. *Journal of Real Estate Literature* 25:77–106.

Shen, L., and S. Ross. 2021. Information Value of Property Description: A Machine Learning Approach. *Journal of Urban Economics* 121:103299–.

Smith, R. K., G. E. Newman, and R. Dhar. 2016. Closer to the Creator: Temporal Contagion Explains the Preference for Earlier Serial Numbers. *Journal of Consumer Research* 42:653–68.

Sodini, P., S. V. Nieuwerburgh, and R. Vestman. 2017. Identifying the Benefits from Home Ownership: A Swedish Experiment. Working paper.

Spaenjers, C., W. N. Goetzmann, and E. Mamonova. 2015. The Economics of Aesthetics and Record Prices for Art Since 1701. *Explorations in Economic History* 57:79–94.

Spaenjers, C., and E. Steiner. 2020. Do Private Equity Investors Create Value? Evidence from the Hotel Industry. Working paper.

Stein, J. C. 1995. Prices and Trading Volume in the Housing Market: A Model with Down-Payment Effects. *Quarterly Journal of Economics* 110:379–406.

Stein, L. C. D., and C. Yannelis. 2020. Financial Inclusion, Human Capital, and Wealth Accumulation: Evidence from the Freedman's Savings Bank. *Review of Financial Studies* 33:5333–77.

Stroebel, J. 2016. Asymmetric Information about Collateral Values. *Journal of Finance* 71:1071–112.

Sá, F. 2015. Immigration and House Prices in the UK. *Economic Journal* 125:1393–424.

van Binsbergen, J., M. Brandt, and R. Koijen. 2012. On the Timing and Pricing of Dividends. *American Economic Review* 102:1596–618.

Van Nieuwerburgh, S. 2019. Why Are REITs Currently So Expensive? *Real Estate Economics* 47:18–65.

Vorsatz, M. B. 2020. Collectibles Tokenization & Optimal Security Design. Working paper.

Walter, I., ed. 2016. *The Infrastructure Finance Challenge*. Open Book Publishers. ISBN 978-1-78374-293-6 978-1-78374-294-3 978-1-78374-295-0 978-1-78374-296-7 978-1-78374-297-4.

Whitaker, A., and R. Kräussl. 2020. Fractional Equity, Blockchain, and the Future of Creative Work. *Management Science* 66:4594–611.

Wong, G. 2008. Has SARS infected the property market? Evidence from Hong Kong. *Journal of Urban Economics* 63:74–95.

World Economic Forum. 2014. Infrastructure Investment Policy Blueprint. Technical report.

Zakharenko, R. 2016. Self-Driving Cars Will Change Cities. *Regional Science and Urban Economics* 61:26–37.

Appendix. Size of the Real and Private-Value Asset Class

This appendix describes the data sources and calculations behind Table 1, which computes the total value of the stock of RPVA in the United States. The three main data sources are the *Financial Accounts of the United States* of the Federal Reserve Board (FAUS); the *Fixed Assets Accounts* of the Bureau of Economic Analysis (FAA); and Vorsatz (2020).

Residential real estate

We use the 2020.Q3 value for FAUS series LM155035015.Q: *Households; owner-occupied real estate including vacant land and mobile homes at market value*. This series excludes the assets belonging to nonprofit organizations from the household and nonprofit sector.

Commercial real estate

We compute the 2020.Q3 value as the sum of:

- FAUS series LM165035005.Q: *Nonprofit organizations; real estate at market value*
- FAUS series LM105035005.Q: *Nonfinancial corporate business; real estate at market value*
- FAUS series LM115035005.Q: *Nonfinancial noncorporate business; real estate at market value*
- the market value of real estate held by equity REITs,

where we calculate the latter component as the sum of the aggregate market capitalization of equity REITs from NAREIT as of November 2020 and financial liabilities of equity REITS (FAUS series FL124190005), and subtract financial assets of equity REITs (FAUS series FL124090005). Real estate assets held by equity REITs are estimated at $1.70 trillion in 2020.Q3.

While we prefer the market valuation methodology used in the FAUS data, it is limited in its breakdown of subcategories of CRE. To estimate the subcategory breakdown, we employ table 2.1: *Current-Cost Net Stock of Private Fixed Assets, Equipment, Structures, and Intellectual Property Products by Type* in the FAA, which offers detailed estimates of the cost of different types of structures. Because the FAA computes book values (which reflect depreciation) and the FAUS computes market values, we use the FAA data only to compute shares, and then multiply these shares by the aggregate CRE market value from the FAUS. The latest FAA data available are for 2019. We consider the following subcategories:

- Multifamily: *residential structures, five or more units* (line 71)
- Office (line 38)
- Retail: *multimerchandise shopping* (line 44), *food and beverage establishments* (line 45), and *other commercial* (line 47), which consists of auto dealerships, garages, service stations, drug stores, restaurants, mobile structures, and other structures used for commercial purposes
- Industrial: *warehouses* (line 46) and *manufacturing* (line 48)
- Hospitality: *lodging* (line 60) and *amusement and recreation* (line 61)
- Health care (line 39), which consists of hospitals, special care, and medical buildings
- Student housing: *other residential* (line 75), which consists primarily of dormitories and of fraternity and sorority houses

Alternatively, one can value commercial real estate in a bottom-up manner using data on CRE transactions. Koijen and Van Nieuwerburgh (2021) use data from Real Capital Analytics on all sales above $10 million of CRE assets in the four core sectors (apartments, office, retail, and industrial) between 2001 and 2020 to estimate a hedonic pricing model for each sector and geographic market. They then revalue the stock of all assets that ever traded over this 20-year period as of the end of 2019. The column labeled "RCA data" in Table 1 reports the results.

The main breakdown in Table 1 shows nontrivial values for noncore CRE sectors. The latter have been growing in importance relative to the four core sectors over the past decade. Some classify cell phone towers and data centers as CRE assets as well. In our calculations, those are included as infrastructure.

Agricultural real estate

We use the estimate of the year 2020 value of farm real estate according to the *U.S. farm sector financial indicators* published by the U.S. Department of Agriculture in February 2021.

Infrastructure

We focus on privately held infrastructure assets in the United States. As before, we use FAA table 2.1. We decompose infrastructure assets into the following components:

- Power (line 50)
- Electrical transmission equipment (line 17)
- Communication (line 53)
- Transportation (line 62)
- Water, sewage, and waste treatment (line 66)
- Petroleum and gas (line 55)
- Mining (line 56)
- Social infrastructure: *religious* (line 58) and *educational and vocational* (line 59)

Collectibles

Estimates for the worldwide value of the different collectible categories shown in Table 1 come from Vorsatz (2020). We thank the author for generously sharing his data. To estimate the total value of the float for these items, he combines a survey of the collectibles holdings of high net worth individuals (Barclays 2012) with year 2017 data on the distribution of wealth (Credit Suisse 2017). His Appendix C contains the details. To transform his global estimates to U.S. values, we multiply by the estimated share of the United States in worldwide household wealth according to Credit Suisse (2017), which is 33%. Finally, we group together "fine art pictures & paintings" and "fine art sculptures."

Apart from the categories shown in the table, Vorsatz (2020) also estimates the aggregate value of worldwide holdings of a number of other collectible types. Using the same methodology as before would lead to the following estimates of the value of U.S. holdings: $819 billion for classic cars, $567 billion for coins, $480 billion for tapestries and rugs, $345 billion for wine, and $209 billion for stamps. These numbers strike us as implausibly large given what we know about annual turnover in these markets. One explanation is that wealthy households overestimate the market value of their holdings in these collectible types. In particular, collections of coins, stamps, and wine often consist of large numbers of items with relatively limited resale values. Another explanation is that the survey oversampled owners of collectibles that are less widely-held than precious jewelry, fine art, and antique furniture.

Noncorporate business equity

We take the 2020.Q3 value for FAUS series LM112090205.Q: *Nonfinancial noncorporate business; proprietors' equity in noncorporate business (net worth)*, and subtract real estate equity computed as the difference between series LM115035005.Q: *Nonfinancial noncorporate business; real estate at market value* and series FL114123005.Q: *Nonfinancial noncorporate business; loans; liability*.