



WHITEPAPER

Residential PropTech

Real Estate Technology

Opportunities Created by the
Digitization and Disintermediation
of the Housing Market

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Abstract

Real Estate Technology, also known as PropTech, a portmanteau of the words “property” and “technology”, is revolutionizing the way people research, rent, buy, sell, and manage property, especially residential property. Real estate transactions historically have tended to be slow, complex, and expensive, making the sector ripe for disruption. The earliest PropTechs, i.e., online marketplaces such as Zillow, Redfin, and Trulia, got their start in the U.S. around 20 years ago, but PropTech has since spread to many other countries. In 2020, the global market for PropTechs used in the residential real estate market was worth nearly \$21 billion, and is growing at rate of between 10% and 16% per year.

Venture capital investments in PropTech have rebounded since swooning in 2020 due to COVID-19, and 2021 saw the largest number to date of successful PropTech exits, as well as significant M&A activity. These are also some attractive opportunities for small investors in the sector.

Introduction

PropTech (sometimes also referred to as Real Estate Technology or ReTech) is a portmanteau of the words “Property” and “Technology”. PropTech is the digital transformation of the real estate industry, in order to optimize the way people research, rent, buy, sell, and manage property. It converges in some areas with two other “techs”, i.e., FinTech (financial technology) and construction technology (ConTech). As long as a FinTech or ConTech technology solves a real estate industry problem or is used by people working in the real estate industry, it can be considered as a type of PropTech.

PropTech is revolutionizing both the residential and commercial real estate sectors. This report focuses on the residential real estate market, which accounted for an estimated two-thirds of the global PropTech market in 2020.

While the digital transformation of the real estate industry has lagged behind some other sectors, real estate has been ripe for disruption for some time. Real estate transactions tend to be slow, complex, and expensive. These costs and frictions have wider implications. Historically, much of the U.S.’ economic dynamism has had its roots in the willingness of workers and entrepreneurs to relocate in search of new opportunities. To the extent the high cost and difficulty of real estate transactions reduces this mobility, it can impede economic growth¹.

The reasons for these inefficiencies are complex, but many of them result from oligopolistic practices within the real estate industry that are discussed later in this report. For now, it is enough to say that new technologies have been eroding these oligopolistic practices.

For example, as more people become comfortable with the idea of selling their own homes, and buyers can tour properties virtually from home, many real estate agents are at risk of becoming obsolete. On the plus side, real estate professionals who adopt and implement new property technologies in their practices can increase their competitiveness.

Meanwhile, it is becoming less and less clear that a residential real estate agent needs to be part of a large brokerage when all the data, technology and support services they require are accessible via the internet. Conventional brokerages, like agents, need to re-evaluate their value propositions to establish whether they provide a level of brand, support, infrastructure and service that enables agents to be more effectively complete, more efficiently operate and in the end deliver service more profitably².

Real Estate Industry Background

Size of the Real Estate Market

1. Overall Real Estate Market

The global real estate market is difficult to quantify. Published estimates of the total global real estate market in 2020 vary widely, e.g., from \$2.7 trillion³ to \$7.3 trillion⁴. According to other sources, the value of the global residential real estate market alone was \$9.3 trillion in 2020.⁵ None of these estimates are documented with respect to definitions, sources, or methodology, making it difficult to assess their relative credibility.

Published estimates of the US real estate market are somewhat less varied, ranging from \$986 billion in 2020 to \$1.2 trillion, but the lack of documentation still makes the figures hard to compare. They are also difficult to reconcile with other data, such as US home sales.

In 2020, 6.5 million homes were sold in the US⁶ at an average price of \$246,000⁷, for a total residential sales value of \$1.6 trillion. Meanwhile, another source estimates the value of US commercial real estate transactions at \$478 billion in 2020⁸, but this figure seems low in comparison to residential transactions.

2. Size of the Real Estate Brokerage Market

The global real estate brokerage market was worth an estimated \$960 billion in 2020, of which some \$750 billion (78%) was accounted for by residential brokerages. Growing at a compound annual growth rate (CAGR) rate variously estimated at between 5% and 8%, the overall real estate brokerage market should be worth \$1.2 trillion - \$1.4 trillion by 2025.

The global residential brokerage segment is projected to grow to between \$900 billion and \$1.1 trillion by 2025. This projected growth rate reflects the overall strength of the real estate market, as well as the impact of brokerage companies restructuring their operations and recovering from the operational challenges of the COVID-19 pandemic, such as social distancing, remote working and the closure of commercial activities.⁹

According to one report, the US real estate brokerage industry earned revenues of \$106 billion in 2019¹⁰. Assuming this estimate is accurate, residential brokerage revenues in the neighborhood of \$110 billion - \$115 billion in 2020 are plausible in the context of the surging home market.

Major Steps in the Residential Home Buying Process and Timeline

Table 1: Residential Home Buying Steps and Timeline

The entire process of buying a home can take more than four months or it can take significantly less time, according to the following timeline. The main stages and steps in the process are summarized below.

Stage/Step	Brief Description	Average Time Required to Complete
Mortgage pre-approval	Buyer obtains offer from a lender indicating type and amount of mortgage loan the buyer can qualify for	1-3 days
Connecting home buyer and seller	Three-stage process	Average 10 weeks total
1. List and market property	Seller and their agent list property on Multiple Listing Service (MLS), prepare and obtain exposure for marketing materials	
2. Buyer general property research	Buyer inspects real estate listings, attends showings and open houses	
3. Home search and selection	RE agent brings buyer together with seller of a suitable home	
The offer and negotiating the terms of the sale	The offer describes terms buyer is willing to offer seller; seller can accept or counter offer	1-3 days
Mortgage application and loan processing	Seek and obtain formal approval of mortgage loan from lender	3-4 weeks total
1. Mortgage application	Buyer chooses prospective lender and submits loan paperwork and required supporting documentation	
2. Appraisal	Determine fair market value of property	
3. Inspection	Determine condition of property	
4. Title search and title insurance	Verify that the seller can transfer property ownership to the buyer free and clear.	
5. Underwriting	Lender determines risks of approving buyer for loan and any conditions that buyer must meet before receiving “clear to close” notice	
Closing	Buyer/seller sign necessary paperwork and loan proceeds are transferred to seller	1 day

Source: Better.com

1. Mortgage Pre-Approval

It is advisable for a prospective home buyer to get pre-approved for a mortgage loan before doing any more than searching the online property listings. A pre-approval letter is a no-commitment letter that gives the buyer a reliable estimate of the maximum size of the loan they are likely to qualify for, based on their income and assets and the results of a soft credit pull. The letter helps the buyer to

determine their price range and increases their leverage when they are ready to make an offer. Most sellers ask for a pre-approval letter as proof that the buyer will be able to secure financing if their offer is accepted. It usually takes 1-3 days to obtain a pre-approval letter from a conventional lender.

2. Connecting the Home Buyer and Seller

Bringing the buyer together with a seller is a three-stage process. In the first stage, the seller engages a real estate agent, unless they are adopting a “for sale by owner” model. The seller and their agent collect property information and take photos for posting on the Multiple Listing Service (MLS), where it is available to buyers through their agents and, more recently, websites and apps like Zillow, Redfin and Realtor.com. The seller’s agent then plans and executes a marketing strategy (e.g., realtor tours and open houses, media advertising), often using a piecemeal approach involving both legacy paper forms and PC applications.

In the second stage, the buyer collects data on potential homes from a combination of print and online media and in some cases word-of-mouth referrals. The buyer may also attend some property showings and open houses to obtain additional market insights.

In the third stage, the buyer enters into an agency agreement with a real estate agent to act on their behalf in bringing about a transaction, in exchange for a specified commission. The buyer’s agent finds properties for the buyer, based on the latter’s requirements, and may represent the buyer in negotiations with the seller. The same agent generally cannot represent both buyer and seller.

The time required for a buyer to find a property to bid on varies, but on average, the whole process takes about 10 weeks from start to finish.

3. The Offer and Negotiating the Terms of the Sale

The buyer, working in consultation with their agent, decides on a price and other terms they are prepared to offer for the selected property. There is no fixed time for the seller to respond, but most will either accept, reject, or counter the buyer’s offer within 24 to 48 hours. It may be necessary to negotiate back and forth on things like price, contingencies, and closing date until the buyer and seller come to an agreement.

4. Mortgage Application and Loan Processing

The process of applying for a mortgage and getting it approved has a number of steps, some of which can overlap but together typically take between 3-4 weeks.

Once they have a home under contract, the buyer begins the search for financing. Traditionally, the buyer has shopped around for the best interest rates and other terms, directly or with the assistance of a mortgage broker. When they have settled on a prospective lender, the buyer submits an application, which asks for information about the property as well as the applicant’s employment history and finances. In return, within 3 days of the application submission, the lender provides the applicant with a “loan estimate”, i.e., a standardized document that contains the monthly payment, interest rate, and other associated costs of the proposed mortgage. The mortgage application process typically takes less than a day.

Filling out the mortgage application is the easy part. Next, the application moves into processing. Processing involves several overlapping steps, including the appraisal, inspection, title search and title insurance, and underwriting.

As soon as the buyer locks in their interest rate and pays the appraisal fee, the lender will order an appraisal. The purpose of the appraisal is to determine the fair market value of the home, based on factors such as the prices as which similar homes in the same area have been selling recently. A traditional appraisal can take up to a week to complete.

The home inspection is a review of the overall condition of a home. Depending on what the inspector finds, the buyer may choose to ask the seller to perform repairs, renegotiate, or cancel the purchase agreement altogether. The inspection itself usually only takes a few hours to perform, but it can take up to a week to receive the report back from the inspector.

While the inspectors and appraisers are at work, the buyer's agent (or in some cases their attorney or the loan processor) will order a title search and title insurance, a process that can take 1-2 weeks to complete. The title refers to the legal ownership of the home. A title search is done to ensure that the seller can transfer property ownership to you free and clear. Title issues can arise if there are any outstanding judgments or liens against the current or previous owners for items such as unpaid child support or owed taxes. If such issues are found, the seller is responsible for resolving them before the sale can move forward. Title insurance is intended to protect the buyer and lender from such surprises.

While the appraisal, inspection, and title work are being completed, the lender thoroughly reviews all the information the buyer provided to verify that it is accurate and that the buyer has an acceptable debt/income ratio. This underwriting process usually takes 10-15 days, but may take longer if the buyer's financial circumstances merit it.

Once the application is accepted, the buyer receives a conditional approval. Conditions might include providing additional documentation or the sale of the buyer's current home, or results from an appraisal. When all conditions are met, the buyer receives a "clear to close" notice.

5. Closing

Closing (sometimes also referred to as "settlement" or "escrow") is the final step in a home sale, when the various parties in a mortgage loan transaction sign all the documents necessary to transfer ownership of the property from the seller to the buyer.

Depending on the state in which the transaction takes place, all the parties may sit around a table and sign all the documents at once. Alternatively, the closing can take several weeks as the signatures of each party are collected separately. It may be possible under some circumstances to electronically sign documents, either in advance of closing or at the closing table. A closing may even be conducted by mail or even online.

As described above, the residential home buying process is slow and complex, with a lot of inefficiencies—manual processes and middlemen—involved. Certainly, some of these inefficiencies reflect the intrinsic complexity of the real estate market. Real estate is not a fungible commodity like stocks: Even on a street of identical houses, each house experiences different levels of noise and traffic, is in various states of repair, and has unique views of surrounding areas.¹¹

A different class of inefficiencies result from old analog technologies and information asymmetries that have enabled real estate industry incumbents to occupy the middle ground between buyers and sellers, buyers and lenders, and receive handsome compensation for helping to bring them together. Existing laws and regulations have tended to protect existing business models and discourage new entrants.

A Manual, Labor Intensive Process

Much of PropTech is based on the conviction that technology can be harnessed to break down these barriers, either through digitization or disintermediation. Modern digital technologies have the potential to streamline and speed up many legacy real estate processes, starting of course with the home search but extending into many other areas such as:

- Mortgage pre-approval
- 3D virtual home tours
- Property appraisals
- Title search and insurance
- Underwriting
- Closing formalities

These processes are some of the “low-hanging fruit” of real estate processes that are candidates for digitization and various automated tools and services already exist to perform them. However, the most optimistic PropTech advocates believe that digitization has made what was once the primary role of the real estate agent – information gatekeeper – obsolete.¹² As such, they believe that agents and the brokerages that employ them are ripe for disintermediation.

“With data unleashed, just what does the agent contribute to a transaction? Any agent will run through a list of things – local knowledge, negotiation skills, process oversight and at the very least, saving the consumer the time of doing or learning all these things. But when some types of real estate agents are described as ‘... the coin slot on the pay toilet...’ you have to wonder if consumers consider any of that ‘value’ worth the commission.”¹³

Anyone can transfer real estate without being an agent. Licensing is only required if someone plans to represent another party in a real estate transaction. And unlike other industries, the barriers to becoming a real estate agent are low in all but a handful of states.¹⁴

Every so often a new startup launches with the goal of becoming “the OpenTable of real estate.” Their general plan is to aggregate all the sellers and agents in town, post the inventory with available showing times, and have buyers schedule viewings without dealing with a human, other than possibly a low-cost assistant who shows up for the viewing to represent the seller.¹⁵

Nevertheless, real estate agents are still there, and their continued sizable commissions (see next section) suggest that the market still rewards their role as positive and necessary. The challenge facing home buyers and sellers is not only about access to data, but also that

“Finding a home is as much an emotional decision as it is quantitative. Individuals have unique utility functions, yet can’t articulate or understand all the components (often making irrational decisions in the heat of the moment). A skilled agent carefully re-evaluates the search during their interactions through a series of explicit questions (what did you think?), passive observation (looks like the small kitchen turned her off), and deduction of revealed preferences (I wonder why this house excites them). The agent decides whether to make significant adjustments to the search, or in extreme cases, politely cease working with the client. For now, brokers can distill for us a process that so far hasn’t been properly captured in a database schema, a block of text, a set of photos, or even a virtual reality tour”¹⁶

This is not to say that traditional real estate agents are not vulnerable to competition from virtual or “tech” brokerages such as Real or Compass. However, the tech brokerages are a technology-enabled evolution of the traditional brokerage rather than a completely new model.

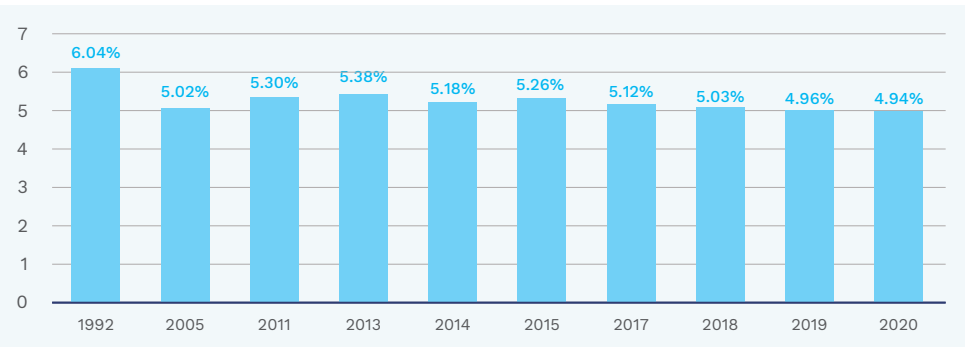
Most tech brokerages form relationships with independent real estate agents, whose role it is to generate leads and promote the interests of their clients. The tech brokerage supports the agents with mobile technology tools designed to build their brand, generate leads, manage deals and get technical and other staff support remotely. Tech brokerages generally do not provide office space for their agents, which is the main reason why they can charge lower commissions than traditional brokers. Some tech brokerages charge extra-low or no commissions at all, making their money from the sale of optional extra services such as “staging” a home for sale.

Real Estate Brokers' and Agents' Commissions

Most real estate brokers and agents work on commission, i.e., they receive a percentage of the sale price after the property is sold. While the terms “real estate agent” and “real estate broker” are often used interchangeably, there is an important difference. A real estate agent is a professional who facilitates real estate transactions under a brokerage. A broker is a real estate professional who hold a broker’s license and may work independently to facilitate real estate transactions or start their own brokerage and employ real estate agents to work for them.

The property seller is responsible for negotiating the commission with the broker, and pays the entire commission out of the sales proceeds. Average commissions have been trending downward, as shown in the figure below. Nevertheless, due to the large market size, the value of commissions is still immense.

Figure 1: Average U.S. Real Estate Commission Rate Trends 1992 – 2020



Sources: Statista, Real Trends

According to Real Trends the average realtor’s commission reached a historical low of 4.94% in 2020, compared to over 6% in the early 1990s. The downward trend in commissions reflects a number of influences, including:

- Increasing willingness among sellers to try to negotiate a lower commission
- A strong housing market, which makes it easier to sell a desirable property, and drives up prices, offsetting reductions in the commission percentage
- Competition among brokers, recently including discount brokers like Redfin offering to sell a property for a lower percentage of the price or even a flat fee.¹⁷

For consumers and realtors, billions of dollars are at stake. Based on total U.S. home sales of \$1.6 trillion in 2020 (see below), the potential total dollar value of commissions was about \$80 billion at the current 5% commission rate compared to the \$96 billion the commissions would have been worth at 6%. However, due to strong home sales over the past year, some estimates put projected 2021 U.S. commissions at \$100 billion for the first time in history.¹⁸

The commission paid is divided among at least four, and as many as six parties, if referral fees are involved. First, the fee is divided equally between the seller’s and buyer’s broker. In other words, both brokers received an average of a little under 2.5% of the sale price in 2020. The broker splits their fee with the individual agent at varying proportions, sometimes half, so the agent is probably down to less than 1.25% of the sales price.

To put these numbers in perspective, a 1.25% agent's commission in July 2020 was worth about \$4,784 based on average home price of \$382,700. In 2013, when commissions were at a 10-year high and agents' share was around 1.35% of the average \$324,400 home price, the dollar value of the average commission was \$4,363. In other words, a real estate agent earned about 10% more from a typical home sale in 2020 than they did in 2013, or about the same as the overall rate of inflation. Average commissions received thus remained nearly constant between 2013 and 2020, even in the face of growing competition from discount brokerages.

Wide variations in real estate agents' total incomes also suggests that bringing real estate buyers and sellers together in a successful sale requires a skill set that is not merely a commodity. In most US cities, the median agent earns between \$30,000-\$50,000 a year while top agents earn over \$200,000. In high-demand markets, the spread can be 10x or more. Among the many explanations for earnings variability, the most important difference is the agent's closing rate, i.e., the number of houses sold or leases signed per year¹⁹.

These data suggest that the market still places a positive value on real estate agents' services and that, at the very least, the time has not yet come for their complete disintermediation. Competition from discount or tech brokerages as well as other factors will probably continue to place downward pressure on commission rates. This pressure, among other things, will give traditional real estate brokerages and agents a greater incentive to reduce their overhead costs and increase their sales effectiveness by investing more in digital technology and automation, i.e., PropTech tools.

Property Technology Background

What Is PropTech?

PropTech is the digital transformation of the real estate industry, in order to optimize the way people research, rent, buy, sell, and manage property.

How Is PropTech Defined?

PropTech (sometimes also referred to as real estate technology or ReTech) is a portmanteau of the words “Property” and “Technology”. It converges in some areas with two other “techs”, i.e., FinTech (financial technology) and construction technology (ConTech). As long as a FinTech or ConTech technology solves a real estate industry problem or is used by people working in the real estate industry, this report treats it as a type of PropTech.

PropTech is used in both residential and commercial real estate.

- Residential PropTech re-imagines the processes between individuals and real estate or property management companies, e.g., looking for a new home or apartment, financing new residential purchases, paying rent online, securing insurance, engaging home improvement professionals, etc.
- Commercial PropTech disrupts the business models between businesses, such as lease and sales compensation, property marketing, building operations, building ownership information, property investments, and construction projects.²⁰

This report focuses on residential PropTech. There are various types of PropTech, including but not limited to the following:

- Property search PropTechs: identify properties that meet the potential buyer or lessor’s selection criteria
- Buy, sell or lease PropTechs: Bring owner and buyer/lessee together, negotiate a price and terms and close the deal
- Finance and investment PropTechs: Obtain mortgage or other type of financing
- Marketing PropTechs: Bring opportunities to the attention of buyers or investors
- Facilities and operations PropTechs: Operate and maintain property
- Shared space PropTechs: Facilitate shared access to property between two or more parties

Every type of PropTech, with the possible exception of shared spaces PropTech, is used in the residential real estate market.

Is PropTech Global or Primarily a U.S. Trend?

The earliest PropTechs, i.e., online marketplaces such as Zillow, Redfin, and Trulia, got their start in the U.S. While the U.S. has arguably continued to be the market leader, PropTech has spread to many other countries, including but not limited to the UK, France, Germany, Israel, Bahrain, China, India, Singapore, and Japan.

Data on the size of different regional markets for PropTech are difficult to obtain, but available data on the market for FinTech, which is closely linked to PropTech (see below), suggest that the US, UK, Germany, China, and India are probably the largest country markets for PropTech.

PropTechs and Their Roles in the Home Buying Process

The following figure shows the various steps in the residential home buying process per Table 1, compares the traditional and PropTech processes for accomplishing them, and identifies corresponding PropTech providers.

Table 2: Role of PropTech in the Residential Home Buying Process

Step	Traditional Process	PropTech Process	Proptech Benefits	PropTech Providers
Mortgage pre-approval	Buyer submits financial data to lender and authorizes credit check, the5 waits to receive pre-approval letter.	Buyer submits financial data online along with credit check authorization.	Faster pre-approval (usually less than 1 day vs. up to 3 days for traditional process).	Better, SoFi, Morty, Blend, LoanDepot
Connecting home buyer and seller				
List and market property	Seller engages agent who obtains property specifications and photos for posting on MLS; conducts realtor tours; implements typically piecemeal or ad hoc advertising / marketing strategy.	Seller may opt to work with “tech” rather than conventional brokerage; list and search portals obtain property data from MLS; prepare and distribute 3D virtual tours; organize and track marketing campaign using advanced automated tools. Seller may also decide to sell directly to an iBuyer.	Wider, more impactful exposure for property; more effective marketing increases probability of a fast sale at a good price; save on tech brokers’ lower commissions. Selling to an iBuyer drastically shortens sales cycle, giving seller ready access to cash.	Zillow, Trulia SmartZip, Liondesk, RealScout, FirePoint, Homespotter RoOomy, Kuula, Lapentor, Animoto, TourWizard, LiveTour, Matterport Strike (formerly Housesimple), eMoov, Offerpad, Opendoor, Knock
Buyer property research	Buyer consults classified ads and/or online listings.	Buyer uses PropTech portal.	Comprehensive listings, continually updated, online tools (e.g., rent calculator), ability to apply directly online.	Zillow, Trulia, Redfin, Realtor.com, Homes.com Zumper, ApartmentList, Rent.com, Apartments.com
Home selection	Agent brings qualified leads to buyer’s attention with additional background information, organizes property tours, culminating in selection of a target home or homes.	Buyer may opt to work with “tech” rather than conventional brokerage.	Savings from tech brokerage’s lower fees.	
The offer	Buyer and their agent submit their offering price and other terms for the seller, who may accept or counter it, with negotiations to follow.	PropTechs enable buyers to “sweeten” their offer by making it all-cash.	Increase likelihood that seller will accept offer, especially in a competitive bidding environment.	Homeward Knock Ribbon
Mortgage application and loan processing				
Property appraisal	Human appraiser relying on personal judgement as well as data.	Automated, AI-powered valuation models.	Faster, possibly more accurate appraisals.	HouseCanary Quantarium
Inspection	Human inspector performs detailed on-site property inspection and writes report.	Pre-built templates, report formats reduce time to complete inspection.	Faster inspections.	Neuralspect Spectora
Title search/insurance	Labor-intensive, time-consuming manual search of public records.	Use technology to search records quicker and without agents.	Quicker search, lower insurance cost.	Spruce Doma Blueprint Title
Underwriting	Loan officer reviews buyer financial, property data, usually with the aid of underwriting software.	Use AI to automate many income, asset and lending decisions.	Enables human underwriters to handle more loan decisions, may reduce risk.	Candor Argus Tavant Touchless Lending
Closing	Parties to the transaction sign and exchange documents required to transfer property ownership.	Used technologies such as blockchain and smart contracts to simplify and streamline the closing process.	Faster closings with fewer middlemen and lower costs of main parties.	SafeChain Qualia JetClosing

1. Mortgage Pre-Approval

PropTech (FinTech) lenders such as Better, SoFi, Morty, Blend, and LoanDepot allow prospective home buyers to get a loan pre-approval based on a hard credit check online without interacting with a loan officer.

2. Connecting Buyer with Seller

To begin with, the seller may decide to engage a so-called “tech brokerage” to represent them in the sale of their property. Traditionally, most residential and commercial property sales and commercial property leases have been handled by brokers, who bring the parties together and help them to negotiate a deal, in exchange for a percentage of the selling price or the value of the lease.

Tech brokerages such as Compass or Real are competing for business with traditional brokerages. Most tech brokerages form relationships with independent real estate agents, whose role it is to generate leads and promote the interests of their clients. The tech brokerage supports the agents with mobile technology tools designed to build their brand, generate leads, manage deals and get technical and other staff support remotely. Tech brokerages generally do not provide office space for their agents, which is the main reason why they can charge lower commissions than traditional brokers. Some tech brokerages charge extra-low or no commissions at all, making their money from the sale of optional extra services such as “staging” a home for sale.

Some tech brokerages go one step further and buy properties on their own account from the seller. In addition to Zillow (see above), these so-called “iBuyers” include the PropTechs Opendoor, Offerpad, and Knock. These iBuyers use automated valuation technology to make cash offers on homes quickly. iBuying enables homeowners to sell their home without a broker or real estate agent, saving them money and time and providing them with ready cash to purchase another property.

Many potential buyers and renters, especially of residential properties, used to start their search by inspecting the classified ads in the newspaper, looking at realtor ads, or talking to friends and acquaintances. Today, they are more likely to start with a third-party online real estate listing and search portal like Zillow or Trulia for properties to buy, or Zumper or Rent.com for rentals. (The percentage of U.S. home buyers who found their home online exceeded 50% for the first time in 2016²¹.)

Over time, Zillow, Trulia and their peers have sought to add value to their websites by offering free content such as community information and mortgage payment calculators for buyers, and price estimates for sellers. Some have gone even further, blurring the distinction between list and search services, brokerages, and other real estate services. For example, Zillow has started its own licensed brokerage (Zillow Home), buys homes directly through Zillow Offers, and provides mortgage, title and escrow services through Zillow Home Loans.

Real estate agents who work for a tech brokerage are not the only agents who use digital tools that streamline their workflows and increase productivity. Real estate agents traditionally have been slower than other professions to adopt digital technologies²². Driven partly by growing competition from tech brokerages, more and more agents are adopting PropTech solutions like SmartZip, LionDesk, and RealScout that make use of technologies like predictive analytics to target likely sellers, manage leads, and communicate/collaborate with their clients.

However, while agent tools’ main purpose is to assist the individual agent in prospecting for new business and serving their clients as efficiently as possible, marketing management solutions such as VTS, Buildout, and Sharplaunch are used by brokerages to organize and streamline their marketing operations with database, pipeline reporting, website management, marketing analytics and other back-office tools.

Real estate brokerages have other PropTech Tools available to support their marketing efforts, including indoor/outdoor mapping and 3D virtual tours. Indoor

mapping tools from Matterport and others can be used to give prospective commercial real estate clients an idea of how an office space they are interested in might be configured to meet their needs. Interactive outdoor maps provide prospects with a birds-eye view of the area surrounding a property, including public transport, restaurants, and other amenities. 3D video tours provide an immersive experience that allows prospects to do their own walkthroughs of available properties from anywhere, anytime.

3. The Offer and Negotiating the Terms of the Sale

The traditional offer-counteroffer-negotiation process in residential real estate transactions has not yet been significantly disrupted by PropTech, with the exception of several PropTechs that enable buyers to make all-cash offers. In a competitive bidding situation, an all-cash offer can mean the difference between a successful bid and a rejection.

PropTechs in this segment include Homeward and Reali. Unlike a typical iBuyer, which purchases the seller's home from them, possibly for less than they could sell it for in the open market, Homeward has a Buy with Cash program that enables approved homeowners to make cash offers and then buy back the home from Homeward, once a mortgage has been approved and funded. Knock provides a pre-approved loan to home sellers to purchase and move into their new home before their current home is sold. Reali's Cash Offer program gives homebuyers a competitive edge by pre-approving a borrower's qualified amount through their Reali Loans program, which works as a bridge loan to a final mortgage.

4. Mortgage Application and Loan Processing

Once a prospective buyer has obtained a property under contract, the search for financing begins. Traditionally, the buyer has shopped around for the best interest rates and other terms, directly or with the assistance of a mortgage broker. Many borrowers find applying for and securing a traditional mortgage or loan to be a difficult and time-consuming process requiring the submission of a lot of paperwork and supporting documentation, as well as extensive interaction with a loan officer, all without assurance that the loan application will be approved.

The obstacles to obtaining traditional real estate financing have created an opportunity for mortgage and lending-oriented PropTechs such as Better, SoFi, Morty, Blend, and LoanDepot. Proptech mortgage lenders that allow prospective home buyers to get a loan pre-approval based on a hard credit check online without interacting with a loan officer, have been capturing a growing share of the mortgage market. Proptech lenders reduce the time it takes to process a loan by roughly 10 days as compared with the average processing time for mortgages.

PropTech lenders are not the only mortgage lenders that are investing in digitizing and streamlining the mortgage process. Blend is an example of a PropTech that sells technology to mortgage originators that allows them to move their originations to the cloud, cutting the time and difficulty it takes consumers to get approved and reducing the risk of making bad loans.

Other PropTechs help to streamline various steps in the loan process, shortening the approval process while increasing its transparency and reducing lender risk. For example, automated valuation models (AVMs) such as HouseCanary and Quantarium models have been used for several years, particularly in the single-family residential (SFR) market. These AVMs work well and are more efficient than traditional human appraisers, especially when the type of home under appraisal is commoditized (e.g. a large suburban residential subdivision).

However, even within the SFR market AVMs have their limitations. Current regulations prohibit AVMs for many federally insured loans, or for mortgages with sale prices in excess of \$400,000. Furthermore, due to the various subjective factors that go into SFR appraisals, many lenders recognize that AVMs are more helpful as a starting point rather than the final estimate of value.²³

Though the literal definition of a "home inspection" is a visual review of a property, technology can enable qualified inspectors to "see" more, and most im-

portantly, “interpret” more about an existing or prospective new home. New technologies such as drones, thermal imaging and inspection drones are used by a growing number of home inspectors to gain a more comprehensive view of the property’s condition without the need for intrusive or destructive inspections.

These technologies go beyond PropTech as the term is used in this report, but can be used in conjunction with PropTechs such as NeuralSpect or Spector, software tools whose pre-built templates and report formats help to ensure the completeness of the inspection, while reducing the time require to complete the inspection report. Some also provide features such a video with voice-over narration and comment sharing between inspector and buyer.²⁴

Insurtechs such as Doma (formerly States Title), Spruce and Blueprint Title have begun to make their presence felt in the title and closing industry, by replacing a manual and labor-intensive process of writing title insurance, with an automated data-driven approach that should lead to reduced wait times, modernized title insurance transactions, increased competition, and reduced costs for home buyers and others in need of title insurance.²⁵

Before mortgage loan underwriting PropTechs like Candor, Argus and came onto the scene, mortgage lenders were desperate to hire underwriters. Some lenders found themselves forced to offer signing bonuses to qualified underwriters and base salaries of \$150,000²⁶. PropTech offered lenders a way out of this predicament by automating much of the underwriting process, boosted existing underwriters’ productivity and leading to faster and possibly lower-risk credit decisions.

5. Closing

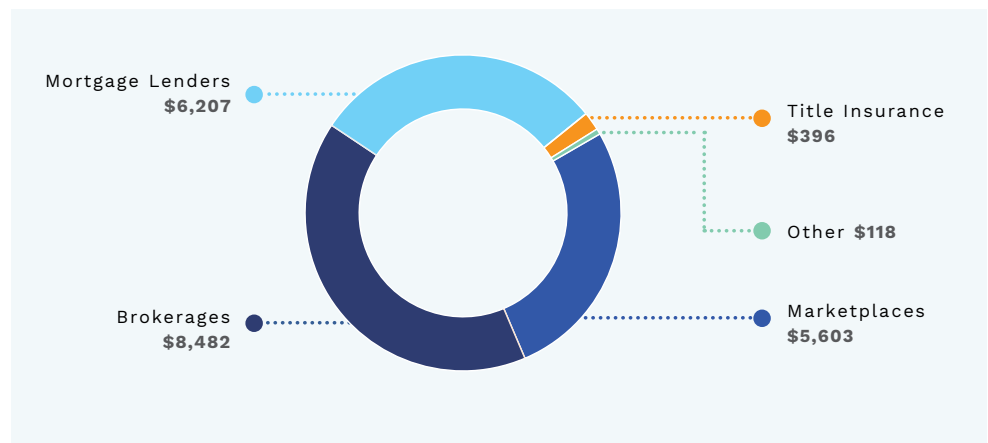
The closing process is both time-consuming and exacting: one incorrect or missing document can delay the whole process. Title and closing PropTechs such as SafeChain, Qualia and JetClosing have emerged that leverage systems, processes and technologies such as blockchain and smart contracts to simplify the closing process, remove unnecessary middlemen, lower costs for main parties and speed up closing deals.

Potential Market Size

1. Market Size and Segmentation

PropTech companies with a focus on the residential real estate market earned an estimated \$20.8 billion in revenues in 2020, based on a tabulation of financial statements published by some PropTechs companies (especially larger, publicly held ones such as Zillow and Redfin and revenue estimates for other companies obtained from a variety of online sources such as Dun & Bradstreet. The \$20.8 billion figure is conservative, because revenue data or estimates could not be found for every PropTech company identified, and the tabulation may have missed some smaller companies.

Figure 2: Residential PropTech Industry Revenues, 2020 (\$ Millions)



Source: company disclosures, Dun & Bradstreet

Tech brokerages are the largest segment of the residential PropTech market, with estimated 2020 revenues of almost \$8.5 billion (40.7% of the total market), followed by mortgage finance (\$6.2 billion or 29.8%), and online marketplaces (\$5.6 billion or 26.9%). The markets for other residential PropTechs such as title insurance, automated valuation models and closing platforms are relatively less developed, with total identified revenues of \$514 million or 2.5% of the total PropTech market. However, and as noted earlier, this segment of the real estate industry is also a target of technology-focused firms.

Doma Holdings, a PropTech firm that seeks to streamline and automate the title, escrow and closing, estimates that this segment of the overall home buying transaction is \$23 billion, of which it believes it has <1% market share. However, Doma Holdings, as well as others in this area, are likely to expand broadly into other sub-sectors of the home ownership industry, and the market sizes for those segments are significant: ²⁷

Table 3: Market Size of Select Home Ownership Subsectors

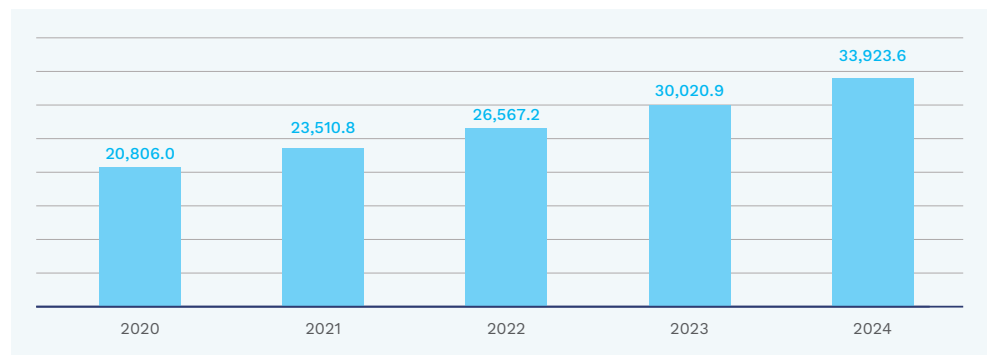
Home Ownership Sub-Sector	Estimated Market Size
Mortgage origination	\$66 billion
Loan servicing	\$32 billion
Title insurance	\$16 billion
Appraisal and settlement services	\$8 billion
Escrow and closing services	\$7 billion
Home warranty	\$3 billion

Source: Doma Holdings

2. Growth Trends

The residential PropTech market is projected to grow at a CAGR of between 10% and 16%, or a mean CAGR of 13%, between 2020 and 2024. The lower (10%) CAGR comes from a report on the PropTech industry published in July 2020.²⁸ The higher CAGR of 16% is approximately the same CAGR as that forecast for the FinTech industry, which is similar to the PropTech industry in general and overlaps important sub-segments of PropTech, such as mortgage lending, data analytics and InsurTech²⁹. Growing at a mean CAGR of 13%, total residential PropTech revenues are projected to approach \$34 billion by 2024.

Figure 3: Projected Residential PropTech Industry Revenues 2020-2024 (\$ Millions)



Source: Internal calculations, bases on a 2020 market of \$20.806 billion per Fig. 2 and a projected CAGR of 13% per text.

3. Market Drivers

A number of factors are driving the overall growth of the residential PropTech market, including the following.

Overall Growth of the Housing Market

As the number and size of housing transactions grow, so does the market for residential PropTech.

From 6.5 million homes sold in 2020 (see earlier), the U.S. housing market is projected to increase to 7.1 million homes in 2021, before settling back to 6.7 million units in 2022³⁰. The outlook beyond 2022 is less certain, but between 2011 and 2020, U.S. home sales increased at an average CAGR of almost 4%. At this rate, sales could conceivably reach 7.2 million units by 2024.

Measured in dollar terms, the U.S. housing market is growing even faster. The value of the U.S. housing market could grow from \$1.6 trillion in 2020 (see above) to more than \$2 trillion in 2021 if current trends continue, a year-on-year increase of 25%.

Reasons for the superheated U.S. housing market include the COVID-19 pandemic (see below), as well as historically low interest rates. The 30-year fixed mortgage average rate was less than 3% in mid-2020, the lowest level in 50 years³¹.

Data on the number of homes sold globally are difficult to obtain, but value estimates of the global housing market suggest that the same story is repeating itself in other countries. One research report projected that the value of the global residential real estate market could increase at a CAGR of 9%³², well below recent increases in the U.S. market but still indicative of a hot housing market.

Housing Supply Shortage

Even as the number of home sale increases, young adults and others in the U.S., Europe and other countries wishing to establish households, are having difficulty finding affordable housing.

According to the National Association of Realtors (NAR), the inventory of existing homes for sale in the U.S. hit all-time low of 1.03 million units in January 2021, which the NAR considers inadequate in relation to the current demand³³. The result is that competition for homes is keeping buyers from closing deals while at the same time driving up prices.

Reasons for the housing stock shortfall include underbuilding. In the U.S., for example, the National Association of Realtors (reports that there has been what they designate an “underbuilding gap” of 5.5 million to 6.8 million housing units since 2001³⁴. Part of the reason for the underbuilding is shortages of land, labor and materials but, according to some reports, the underbuilding has been to some extent intentional. Some builders are prioritizing the completion of homes the customers have already contracted and paid for, while other builders are waiting until longer in the construction phase to price a home and put it up for sale because of how volatile construction costs are³⁵.

Low housing inventories and the attendant high prices have driven would-be home buyers into the rental market, pushing rents up sharply. Average U.S. home rents were up 4.9% - 8.3% year-over-year in August 2021, depending on the number of bedrooms³⁶.

This shortage of housing for sale has encouraged the development of innovative ways to screen large number of housing opportunities (e.g., online marketplaces) and gain an advantage in the bidding process that follows (such as securing a mortgage commitment faster from a non-conventional lender).

Growth in the Humber of Millennial Homebuyers

The same demographic group that is at the forefront of those seeking housing, i.e., the “Millennial” generation born between 1981 and 1997, share some significant

characteristics across international boundaries that make them an attractive market for PropTechs, such as :

- They are the most digitally literate generation, having grown up with smartphones and mobile apps.
- They have largely embraced the “sharing economy” and its PropTech manifestations, such as space sharing and crowdfunding.
- They value quick, transparent access to information and will access a variety of sources to get it.
- Being relatively young, many of them have not yet formed strong relationships with banks or other legacy financial institutions.

COVID-19 Pandemic

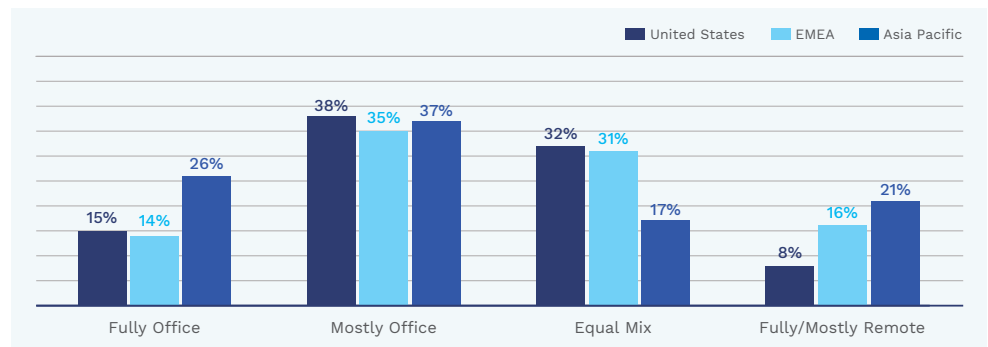
The impact of the COVID-19 pandemic on the residential PropTech market has been complex. For example, a significant number of city dwellers who lost their jobs due to the pandemic or whose employers have been allowing them to work remotely having been moving to smaller cities and the suburbs where there is presumably less risk of contracting the virus, and the cost of living (including housing) is lower.

An analysis of U.S. Postal Service (USPS) change-of-address forms indicates that over 15.9 million people in the U.S. moved in 2020. vs. 15.3 million the year before. Many of these change-of-address forms were temporary, indicating that the filers planned to move back to their old address in less than six months, but a significant number of the moves were permanent³⁷. A Pew Research Center survey conducted to better understand pandemic moving trends found that 28% of survey participants moved because they feared contracting COVID-19 if they stayed where they were living, 20% said they wanted to be closer to their family, and 18% gave financial reasons, including the loss of a job.³⁸

In addition to seeking new localities, many people making long-term moves during the pandemic have evolved in their housing preferences. For example, as working from home (WFH) increasingly becomes the norm, home buyers are looking for extra space to accommodate their home offices as well as create a buffer between them and other family members, especially children.

The WFH movement may have permanently changed workforce location requirements as corporations seek to turn workers’ homes into office space. Large corporations are evaluating the potential for certain staff to work remotely on a permanent basis, or on a hybrid basis where office attendance is expected for only part of the week. A poll conducted in the spring of 2021 by CBRE indicates that corporations do not expect employees to go to the office 5 days a week, and a substantial number of them expect at least a hybrid schedule.³⁹ This has resulted in corporations also re-evaluating their office space leasing requirements, because a hybrid schedule would allow workers to save time and money by commuting less, while corporations could reduce overhead expenses. Indeed, this shift in office strategy has impacted commercial real estate markets as 144 million SF of office space was given up from Q2 2020 through September 2021.⁴⁰ Ultimately, increased workforce mobility could continue to drive home sales as location becomes less of a requirement.

Figure 4: CBRE Research on Sentiment Toward Office Attendance



Source: CBRE research, Spring 2021

Investing in PropTech

Another way that the COVID pandemic has affected the PropTech industry is through the requirements it created for remote working and social distancing. On-site property tours in the company of a real estate agent have been replaced by virtual visits, while agents conducted much of the rest of their business from home or other remote location.

Venture capital investments in PropTech declined during the COVID-19 pandemic, from \$31.6 billion in 2019 to \$23.8 billion in 2020, or a decrease of nearly 25%. However, while VCs were taking a respite from PropTech investments, the pandemic was forcing the real estate industry to accelerate its adoption of PropTech, setting the stage for a 2021 rebound in VC investment.⁴¹ In 2021, the PropTech sector also saw the largest number to date of successful exits via IPOs and SPACs as well as significant M&A activity⁴².

What do these trends mean for the individual investor? Individual investors who believe that PropTech is an attractive investment opportunity have several options, including the following.

REITs

One strategy available to would-be PropTech investors is to buy shares in REITs, or real estate investment trusts. REITs are entities that own or finance income-producing real estate across a range of property sectors.

Residential REITs own and manage various forms of residences and rent space in those properties to tenants. Residential REITs include REITs that specialize in apartment buildings, student housing, manufactured homes and single-family homes. Within those market segments, some residential REITs also focus on specific geographical markets or classes of properties. Many of the operators of these properties use PropTech with the resultant benefits to their bottom line, but as a PropTech investment strategy, REITs do not provide direct exposure to the highest-growth PropTech companies.

Individual stocks

Another potential investment strategy is to buy shares in individual residential PropTechs, such as Move, Zillow, Redfin Lending, Matterport, and States Title (since renamed Doma Holdings) that have gone public, either by an IPO by an alternative route known as a Special Purpose Acquisition Company or SPAC. In either case, one goes to an online brokerage or full-service broker, specifies a stock and executes a market or limit order. Buying their shares subject to the same idiosyncratic and systemic risks as any other type of stock investment.

ETF of PropTech Company Stocks

Exchange-traded funded or ETFs are a third way for investors to gain exposure to residential PropTech. ETFs are easy to purchase, cost-effective, scalable, and liquid, in addition to offering straightforward tax treatment (e.g., short- or long-term capital gains).

ETF Managers Group, a fund manager specializing in thematic ETFs, recently filed with the SEC to launch the ETFMG Real Estate Tech ETF. The new ETF, a passive fund to be listed on the NYSE, will track the Prime Real Estate Technology Index, which covers companies worldwide that take part in the PropTech business in areas including:

- Listing, advertising, and marketing properties for sale or rent
- Providing real estate brokerage services,
- Providing property insurance,
- Providing or facilitating property loans
- Providing software, data, or other technology services to real estate companies.

The index composition, factsheet, methodology, and additional educational material is available on the Prime Indexes website, at www.PrimeIndexes.com.

Conclusion

It is probably premature to predict that PropTech is going to cause the complete disintermediation of legacy residential real estate players such as realtors and mortgage lenders by PropTech disruptors, at least in the near to mid-term. A more likely outcome is that the disruptors will continue to increase their current market share over the next few years, while many legacy players will fight back, using digital automation tools initially developed by the PropTech industry. Nevertheless, technology-oriented firms are looking to disrupt the industry through automation, but also by bypassing some of the traditional service providers. As a result, there are attractive investment opportunities for both large and small investors across the range of PropTech activities. The large market size, strong growth drivers, high fees, and changing consumer and corporate behavior make the real estate industry a big target for technology firms.

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