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Toward a Critical Housing Studies Research Agenda on Platform Real Estate

Abstract: The pace and scope of digital innovation targeting the real estate industry has intensified over the past decade. This article is therefore concerned with the digitization of the residential real estate industry, and how critical housing scholars might shape a research agenda on this transformation. We set out platform logic, digital labor, and financialization as a conceptual vocabulary for studying new digital modalities of real estate practice. Platform logic highlights questions of power and politics relating to the data collection capacities potentially obscured by platforms' convenience and ease of use. Digital labor points to how platform real estate may change relationships among incumbent real estate professionals, investors and property owners, and tenants and residents. Financialization shifts the focus to how digital platforms participate in the contemporary political economy of housing. The article concludes with an agenda for critical housing research on digital real estate platforms.

Introduction

The social scientific study of digital phenomena long ago moved past understanding the Internet as an "e-elsewhere" (Ford 2003, 148), instead emphasizing how digital technologies are embedded in a "network of social, cultural, and economic relationships that crisscrosses and exceeds the Internet" (Terranova 2013, 34). Contemporary social scientists understand the digital in terms of the role human agency and material infrastructures play in the design and use of digital technologies; how digital experiences are contextually situated and embodied in 'real' space; the politics involved in networked space; and the interweaving of digital networks, real—and urban—space, and subjectivities (Ash, Kitchin, and Leszczynski 2016; J. Cohen 2007; Gandy 2005; Haraway 1990). As part of how we use and interact with space, the digital is materially grounded in everyday life and inseparable from the power relations therein (Graham, Zook, and Boulton 2013; Bar 2001; Kling, Rosenbaum, and Sawyer 2005).

Because housing is a crucial vector of social and spatial inequality and thus of contentious power dynamics, the impact of digital technologies on residential real estate demands close study. While digital technology is not new to the real estate industry (see for example Sawyer et al. 2003), the pace and scope of innovation targeting the industry has intensified over the past decade (Baum 2017). This intensification is associated with a wave of recent technological advances including cloud and mobile computing and the growing prominence of the platform business model (discussed shortly), which has been strongly backed by venture capital investment (Langley and Leyshon 2017). Global venture capital funding into real estate technology companies has grown substantially in recent years, achieving 63% annual compound growth between 2012 and 2017 and reaching £8.5 billion in 2017 by one recent estimate (Ivens and Barbiroglio 2018, cited in Shaw 2018). Going much further than property listings, real estate technology companies are rolling out an array of digital platforms—primarily encountered as apps on smartphones and tablet computers or as websites—including construction management, home insurance, home sales, property valuation, and property management (Griffith 2018; Perry 2018).

Such technologies are changing the capitalist relations of real estate (Koh, Wissink, and Forrest 2016; Sumption and Hooper 2014; Shaw 2018), rescaling notions of place (Gurran and Phibbs 2017), reconfiguring the terrain of cities (Atkinson 2016; Ley 2017), increasing the volume and velocity of real estate data (Rogers 2017a), changing tenancy management practices (Fields 2019a), and facilitating mobilities of real estate consumers and capital (Tseng 2000; Robertson and Rogers 2017). The ability to derive value from real estate data drives efforts to accumulate and trade such data, and link it to other data sources (Rogers 2017b; Sadowski 2019). However, housing studies has been slow to generate a coherent agenda around digital real estate technologies. This article is therefore concerned with the digitization of the residential real estate industry, and how critical housing scholars might approach this transformation to shape a research agenda.

Taking inspiration from work in information studies (Sawyer, Crowston, and Wigand 2014; Sawyer, Wigand, and Crowston 2005), business and management (Dixon et al. 2005), and geography (Shaw 2018), we argue a digital research agenda for housing studies must eschew technological determinism in favor of sensitivity to the interrelations between the digital and the wider forces that influence its role in changing the real estate industry. For example, Sawyer and colleagues (2014) show that while the introduction of information communication technologies (ICTs) has changed the work of U.S. real estate agents, who now routinely rely on a wide range of digital technologies (including smartphones, digital lock boxes, email, and photos and videos) and data, this process has unfolded in highly personalized and indeterminate ways due to the embeddedness of real estate work in social relations.

We offer a series of entry points for housing researchers to conceptualize new digital modalities of real estate practice. We suggest these can be translated into analytic tools to study how a specific set of digital technologies—namely, platforms—reshape the operation of power within housing markets, modify relationships among real estate stakeholders, and bear upon the political economy of housing. In line with a socio-technical perspective, we do not take these outcomes as given, but as emergent and shaped within specific social, spatial, and organizational contexts (see also Shaw, 2018). That is, digital technologies are not merely

technical—nor can they ever be neutral, because the power relations that determine who shapes and benefits from platforms, algorithms, and models are profoundly uneven (see for example Daniels 2013; Eubanks 2018; Leszczynski 2016; Noble 2018). For the purposes of this article, we concentrate on platforms designed for housing search, sales and acquisition, and leasing and management. We focus particularly on platforms geared toward investors, professionals, and tenants—including the broader ecosystem of 'big data', algorithms and analytics used to facilitate residential real estate management and investment. Following Shaw (2018) we use the term 'platform real estate' to designate these digital real estate technologies.

The article is structured as follows. The second section provides an overview of digital platforms and the platform business model, and outlines an emergent typology of platforms for property trading, operations, and data. Our analysis draws selectively on case studies from this typology. Sections three through five approach the question of how we might analyze platform real estate from the vantage points of "platform logic" (Andersson Schwarz 2017), digital labor, and financialization. While these are not the only perspectives from which platform real estate may be analyzed, they point to key questions and issues for critical housing studies.

Understanding digital real estate technologies in terms of platform logic points to questions of power and politics relating to the data collection capacities of platforms, capacities that platforms' convenience and ease of use may obscure. Deploying a digital labor theory of data value can show how platform real estate is poised to change relationships among incumbent real estate professionals, investors and property owners, and tenants and residents as digital technologies facilitate longstanding dynamics of capitalist production and exploitation. Financialization shifts the focus to how digital platforms participate in the contemporary political economy of housing. We conclude the article by outlining a potential research agenda on digital real estate technologies that emphasizes classification and calculation, data as capital (cf. Sadowski 2019), the potential restructuring of real estate industry professional roles, and the political economy of real estate platforms.

Toward a typology of real estate platforms

The digital architectures known as platforms emerged in the mid-2000s as web services like YouTube and Facebook allowed web users to not only consume, but also to generate content, and to interact and share information with each other (Barns in press). This development inaugurated a switch away from 'one to many' communication (as seen in traditional radio and television for example) toward 'many to many' communication, exchange, and participation (Barns in press, 7). The permeability of the platform ecosystem is the key to their ability to efficiently connect different user groups, whose interaction makes value exchange possible. Opening up platforms like Facebook and Google Maps to third party applications was crucial to the development of the platform-as-marketplace. This move enables platforms to benefit from outside innovation, drawing activity, users, and revenue while still retaining control (particularly over the valuable data collected through use) (Barns in press; Srnicek 2017).

The terminology of platform 'users' thus refers less to consumers than to "producers and creators of value and generators of data" (Langley and Leyshon, 2017, 7). User interaction is at the core of the platform business strategy and the tendency for platforms to "constantly morph and evolve" (Barns in press, 10) to add value. Zillow exemplifies this plasticity, starting as a real estate listing website in 2006 that by 2019 developed into a multi-function advertising, rental management (Zillow Rental Manager), and home buying (Zillow Offers) platform, with plans to build a mortgage lending business as well (Levy 2019). To summarize, platforms operate as multi-sided markets: the technology works as an intermediary, organizing connections between market agents, e.g. between buyers and sellers (eBay), drivers and riders (Uber), hosts and guests (Airbnb) and seeking to leverage network effects, i.e. to add value through increasing the number of users and their engagement with the platform, often by pivoting to (or adding) new business models (Langley and Leyshon 2017; Srnicek, 2017).

Platforms have significantly changed some established industries, most notably the taxi and hotel industries via Uber and Airbnb respectively. However beyond attention to the role of

Airbnb in kickstarting and accelerating gentrification, and compounding rental price pressures in some cities (see Gurran and Phibbs 2017; Wachsmuth et al. 2017), public and academic debates about real estate and digital economic circulation is limited. This oversight limits our ability to understand the social and geographical significance of a wave of digital platforms designed to facilitate investment in residential real estate both within nation-states and across international borders (Dal Maso *et al.* 2019). An inventory of these developments is beyond the scope of this article. We provide here a highly selective typology[1] to indicate some of the key ways in which the digital is transforming real estate investment through residential real estate *trading*, *operations*, and *data platforms* (see table 1 for an overview of platforms discussed in this article).

Technology and real estate terminology for such advances is often called 'proptech' or 'realtech' (see Baum, 2017; Maarbani, 2017). However, as Shaw (2018) argues, this terminology can be both definitionally muddy and technologically essentialist. The term 'platform real estate' better encapsulates the connective capacities and paths of action related to ownership, use, and exchange of land and buildings (Shaw, 2018) afforded by the digital advances we focus on in this article.

A large number of *trading platforms* for buying and selling real estate connect property owners with customers, enabling remote investment in which both parties may potentially be geographically distant from the property itself. Since about 2012 several platforms have emerged within the US that offer the capability for online end-to-end transactions. Platforms including Roofstock, HomeUnion, Entera, and Opendoor variously connect buyers, sellers, brokers, and agents to facilitate everything from searching for homes and listing properties for sale to submitting bids, negotiating offers, and completing sales. Juwai is a transnational and cross-cultural "knowledge enterprise and data broker" (Robertson and Rogers 2017, 2401) platform hosted in China that connects middle-class and super-rich Chinese investors with sales agents in Australia, North America, and Europe to enable cross-border and cross-cultural

[1] We expect further scholarship on digital real estate technologies to substantially extend this initial survey of platform real estate; indeed Shaw (2018) has already begun to do so.

residential real estate purchases (Dal Maso *et al.* 2019). Targeting both institutional and small-scale investors, trading platforms frequently list properties in terms of investment criteria such as yield and rents, and are often enriched with features like custom valuation algorithms and proprietary bid optimization tools.

Operational platforms allow investors to outsource or automate many aspects of the rental and property management process (Fields 2019a). In the context of remote property transactions, such platforms fulfill a need to market, lease, and manage real estate at a distance from the product. Operational platforms mediate between property owners, tenants, and vendors (e.g. contractors). Some, such as US-based OneRent, cover the entire property management process, but many are designed for discrete aspects of operations such as leasing, maintenance, or evictions, and can be combined as needed. For example, RentBerry, based in the US but now operating internationally in high-pressure rental markets such as London, functions as a platform where prospective tenants negotiate rents with landlords, and also automates other aspects of the rental process such as tenant screening and rent collection. TaskEasy, a platform for exterior home maintenance (e.g. snow removal, lawn care), links US-based property owners with contractors. Through the ClickNotices platform, owners of US apartment buildings are able to connect with legal professionals in order to outsource and automate evictions. Crucially, operational platforms also collect data that may be used to refine investment and asset management strategies, including relationships with tenants and vendors.

A host of tech-powered data and property valuation solutions fill out the platform real estate ecosystem for housing. These services aim to provide comprehensive data on local property markets on a national or international basis, and analyze markets with artificial intelligence, machine learning and big data. In the US, HouseCanary works as a super multi-sided market, connecting investors, agents, appraisers, and lenders with a nationwide dataset and predictive analytics of property values at the city, post-code, block, and property scale. In Australia, Domain.com.au and RealEstate.com.au interface between buyers, property managers, agents, appraisers, and financial institutions, providing market intelligence to estimate sales prices and

set rents, and offering property and neighborhood reports. Data platforms for residential real estate offer more continuous market monitoring than traditional real estate data, which is often reported on a quarterly basis and (in the US) is notoriously fragmented or 'dirty', i.e. incomplete, containing outdated or duplicate information, or otherwise inaccurate or inconsistent.

While inevitably incomplete, this initial typology of *trading*, *operational*, and *data platforms* highlights the range of digital real estate services now available to housing investors, consumers, and professionals. Furthermore, the majority of these platforms are situated in the regions we work within, namely the US and the Asia-Pacific. This is not necessarily an accurate reflection of the geography of residential platform real estate, which is being developed in and for a range of housing markets globally, including, *inter alia*, South Africa (Sethi 2017), Germany (where Berlin is a hub for startup culture, e.g. McCarthy 2018), and the UK (Carey, Jee, and Macaulay 2018). Further research should thus explore platform real estate in a wider range of contexts, adapt the conceptual tools we outline here, and propose new approaches for understanding digital real estate technologies beyond our case study sites, including peripheral and emerging economies in the global South and post-socialist states. We now introduce platform logic, digital labor, and financialization as three perspectives by which housing researchers may critically study platform real estate.

Table 1: Real estate platforms

	Primary function(s)	Headquarters
Trading platforms		
Compass https://www.compass.com/	Buy, sell, and rent residential real estate	New York City (United States)
Entera https://www.entera.ai/	Buy single-family properties to rent or fix and flip	San Francisco, California (United States)
HomeUnion https://www.homeunion.com/	Buy single-family rental properties	Irvine, California (United States)
Juwai https://www.juwai.com/	Facilitating overseas investment in residential real estate by Chinese buyers	Shanghai and Hong Kong (China)
Opendoor https://www.opendoor.com/	Sell, buy, or trade in owner-occupied homes or investment properties	San Francisco, California (United States)
Roofstock https://www.roofstock.com/	Buy and sell occupied single-family rental properties	Oakland, California (United States)
Operational platforms		
Biddwell https://www.biddwell.com/	Rental rate negotiation for residential properties	Vancouver, British Columbia (Canada)
ClickNotices https://www.clicknotices.com/	Delinquency management and landlord-tenant case management	Annapolis, Maryland (United States)
Mynd https://www.mynd.co/	Residential rental property management	Oakland, California (United States)
OneRent https://www.onerent.co/	Residential rental property management	San Jose, California (United States)
RentBerry https://rentberry.com/	Rental rate negotiation for residential properties	San Francisco, California (United States)
Rently https://use.rently.com/	Self-viewing of residential rental properties	Los Angeles, California (United States)
SMS Assist https://www.smsassist.com/	Multisite property management for retail, residential, financial services, and restaurants	Chicago, Illinois (United States)
TaskEasy https://www.taskeasy.com/	Lawn care and exterior maintenance for businesses and homeowners	Salt Lake City, Utah (United States)
Data platforms		
HouseCanary https://www.housecanary.com/	Valuation and analytics for residential real estate	San Francisco, California (United States)
Domain https://www.domain.com.au/	Property data and marketing for residential real estate	Sydney, New South Wales (Australia)
RealEsate.com.au https://www.realestate.com.au/	Research and market insights for residential real estate	Melbourne, Victoria (Australia)

Conceptual entry point 1: Platform logic

Drawing on the notion of platform logic advanced by Andersson Schwarz (2017) focuses our attention on matters of control, corporate dominance, and the profit driven platform's drive for capital accumulation. These matters can be obscured by the technical affordances of "efficacy, convenience, and generativity" we have come to associate with digital platforms (Andersson Schwarz 2017, 5). Despite the social and economic possibilities platforms entail, the interplay of code-based control at the scale of individual platforms and the cumulative social effects of platforms writ large (Andersson Schwarz 2017) demands critical study so as to better understand the operation of power and politics accompanying the integration of platforms into everyday life. Whereas Schwarz (2017) highlights questions of geopolitical power associated with a handful of the largest corporate platforms, here we are concerned with platform real estate as part of the wider 'information dragnet' (Fourcade and Healy, 2017) by which data is harvested and analyzed for the purpose of capital accumulation and social ordering (Beer 2017; Fourcade and Healy 2013; Sadowski 2019).

In terms of possibilities, platforms provide a digital infrastructure that intermediates between at least two, and often more, user groups, so that actors on either side of a transaction or interaction can find one another (Langley and Leyshon 2017; Srnicek 2017). In other words, platforms bring together users, effectively allowing them to create markets, or enfold existing markets into digital infrastructure (Srnicek 2017); in the case of real estate, these market sectors include finance and capital investment, residential real estate, commercial real estate, and management (Shaw, 2018). But platforms are not merely utilities facilitating interaction: they set the rules of connectivity, and in so doing "platforms intervene", shaping markets and market interactions (Gillespie 2015, 1; Langley and Leyshon 2017; Andersson Schwarz 2017; Srnicek 2017).

It is important to bring into the foreground that platform real estate revolves around the profit objectives associated with the capitalist ownership and exchange of space (Shaw, 2018). As such, real estate platforms are likely to intervene on behalf of the interests of investors, landlords, and property owners. For example, Rentberry, a "global home rental platform"

(Rentberry, 2018) started in high-demand markets like San Francisco, is an *operational platform* that helps prospective tenants and landlords find each other. Or, as the company states in its profile on startup listing service AngelList (2017), “we unite tenants and landlords in one closed-loop rental platform”. Landlords use Rentberry to create listings with a suggested rent. The platform then markets listings, screens tenants, facilitates contract signings, and collects rent and maintenance requests. Prospective tenants use RentBerry to submit an offer for rent and security deposit; like eBay the platform notifies them when they are outbid, and they can increase their offer in response. Landlords choose the winning bid. RentBerry offers automation of many aspects of the rental process and transparency of demand for rental units on the platform.

In relation to the rules of connectivity set by Rentberry, the promise of automation and transparency depend on the condition that use of the platform automatically creates data: platform operators enjoy “privileged access to record” (Srnicek 2017, 58). The possibility of using RentBerry to “create a rental application and use it until you’re home” (RentBerry 2017) is an effect of this code-based control (Andersson Schwarz 2017). Through completing a rental application, prospective tenants disclose significant amounts of data about themselves including their job, education, roommates, social media profiles, credit reports, and feedback from previous landlords, which RentBerry analyzes with artificial intelligence and natural language processing to provide an overall recommendation for each tenant (AI Business 2016). The promise of transparency and control characteristic of digital real estate platforms turns on data generated in the process of use, including the very tools by which user groups perform transparency and control, e.g. dashboards, valuation tools, and calculators. Such data collection is a condition of using platforms, and is central both to how they frame their added value to users, and to building the market value of the platform itself.

Indeed, 21st century capitalism is defined by “data-as-capital” (Sadowski 2019, 2), and platforms have emerged as the business model best suited to serving as “an extractive apparatus for data” (Srnicek 2017, 63). Once extracted, data capital can be used to create value by profiling and managing people and things (Sadowski, 2019). The key condition of use for digital

platforms—large-scale harvesting of data—enables standardization through deploying a set of categories shared across all users, in turn making it possible to classify (or profile) users (Bowker and Star 2000). Thus, the 'fields' a prospective tenant might fill out to create their application on RentBerry (and similar platforms such as Biddwell, based in Canada) underpin the ability to profile the "recommended tenant", or to offer "intelligent predictive pairing" of tenants and listings. Invisibly shaping "how objects and content are organized and circulated" (Star and Bowker 2006; Easterling 2014, 13), standardization and classification are central to how platforms' data extraction capabilities work as a form of power/knowledge that govern everyday life (Sadowski, 2019).

The way digital real estate platforms collect standardized information and use it to measure, sort and rank people, properties, and markets creates what Fourcade and Healy (2013) term classification situations. Here, categories such as the (un)recommended tenant or the (un)worthy investment carry economic rewards and punishments that contribute to socio-spatial stratification. The tendency for market institutions to classify in this way is not new, as the history of mortgage market redlining in the US illustrates (Fourcade and Healy 2013). What *is* new is the "information dragnet" by which data is continuously captured at a scope and depth not previously possible and by a range of institutions beyond the state, the automation of classification and its extension to new settings and markets, the ability to follow people or entities across different networks and platforms to build a more complete picture, and of course data's value generating possibilities (Fourcade and Healy 2017; Sadowski 2019). For example, data platforms like HouseCanary provide valuation and market forecasting tools for specific properties and markets by using machine learning to sift through data sources that include assessor records and property listing services as well as search and social media data, mortgage records, capital markets data, and more. HouseCanary depends on the information dragnet to build its dataset, but with data on 100 million properties, it also helps constitute the information dragnet, offering up multiple data products designed for homebuyers, appraisers, lenders, real estate agents, and investors.

It is necessary to look critically at processes of data collection and classification underway

within platform real estate. Key considerations here include social, political, and historical contexts; contingent consequences; and whose interests are served (Dalton, Taylor, and Thatcher 2016; Fourcade and Healy 2017; Pasquale 2015). For example, digital real estate platforms are deeply intertwined with the capitalist norms of private property (Rogers 2017a), and are often situated in imperial and settler-societies where the wealth accumulation associated with property ownership is defined by longer histories of racialized dispossession (Keenan 2015). For example, this historical context is crucial to understanding how the user data amassed by Facebook enables a "process of sorting and slotting people" (Fourcade and Healy 2017, 14) to create racially disparate experiences of ads for housing and mortgages on Facebook Marketplace (Fields 2019b) that reinforce existing patterns of advantage and disadvantage. Classificatory systems reflect structural biases in society and involve issues of control over and access to information, (mis)representation, and inclusion and exclusion (Noble 2018).

Furthermore, whiteness is "embedded in the infrastructure and design" of digital technologies (Daniels 2013, 696) and the tech industry more broadly (Sandvig et al. 2016; US Equal Employment Opportunity Commission 2016), wherein historical colonial legacies can be leveraged to forge "ongoing market value for Western platform capitalist enterprises" (Dal Maso *et al.* 2019: 13). This context makes it likely (but not given) that digital real estate platforms are uploading twentieth century real estate ideologies into twenty-first century information technologies (Rogers 2017a), i.e. serving the interests of people and places already benefiting from property-led accumulation, while simultaneously neglecting or undermining the interests of marginalized people and places.

As a conceptual tool, platform logic facilitates looking closely at the dynamics that both enable and result from the possibilities of platform real estate. It points toward investigation of how use of individual real estate platforms requires acquiescing to control rooted in their technical structure and design, and the wider operation of the information dragnet comprised by the wider interconnectivity of platforms (real estate and otherwise). Such work might entail, *inter alia*, the study of how platform interfaces support the classification of people, housing, and

neighborhoods; possibilities for designing platforms that work against the dominant political economy of housing; and the interconnectivity of different real estate platforms and the flows of data between them.

Conceptual entry point 2: Digital labor

Whereas understanding platform real estate in terms of platform logic entails a focus on the power and politics that are embedded within the seemingly neutral digital infrastructures, we now align our analytical attention on questions relating to labor. While there are many theories of labor and value that could be applied to platform real estate, such as anthropological theories of value, we outline three intersecting ways of using digital labor in analyses of platform real estate from the Marxist tradition. The first is unwaged digital labor (Scholz 2013), or the "immaterial labor" (Lazzarato 1997) that exploits the users' "cognitive surplus" (Shirky 2010) to produce cultural products with economic value (i.e. commodities, see: Scholz 2013, 2). The second is the digitally-mediated waged labor associated with the shift of labor markets to the internet (Kenney and Zysman 2016; Scholz 2013; De Stefano 2015). This includes 'free' public sector data and the government-funded labor required to produce it. The third is automation and the illusion that there is a form of non-human-labor that is producing real estate data, such as the operation of artificial intelligence, algorithms and sensors in the internet of things (Srnicek 2017).

Platform real estate analyses using these three theories of digital labor are useful because they move us well beyond a technical analyse of platform real estate by rendering more visible the broader socio-technical arrangements that produce these digital systems. Understanding these broader socio-technical arrangements is important because the labor that is used within these digital systems, which is sometimes called digital labor, is a form of relational power that can be used to empower or exploit, to oppress or to organize. Analysing how and why different groups use their digital labor reveals the ways ideology, policy, economics, and legal and cultural practices are reproduced in technical form by the makers and users of platform real estate.

When a real estate actor—whether a property owner, tenant, sales agent or investor—is asked to expend their digital labor to engage with or participate in a real estate (trans)action they are drawn into established property market relations and contexts. For example, in Australia, it is increasingly common for Australian's to search for a house to purchase or a property to rent on a real estate platform such as Domain.com.au, which is an Australian digital property portal and real-estate business. Specific rights and entitlements are afforded to or withheld from Australian users of the platform in the process. These rights and entitlements are based on government policy and legislation, which have been translated into digital code, such as the right to secure a pathway to homeownership via private property (e.g. as a real estate buyer on Domain.com.au) or the inability to maintain housing security as a rental tenant (e.g. as a rent seeker on Domain.com.au). Cases like Domain.com.au show that real estate rights, obligations, and limitations are rarely established by the technical capacities, algorithms or coding schemas of digital technologies *themselves*, instead they are part of the broader socio-technical arrangements within which platform real estate is produced. Real estate rights and exclusions are established, maintained, protected, and defended by nation-states, local and global real estate companies, rental managers, property owners and others with vested interests in the protection of private property and rentier forms of capitalism, but digital labor of one form or another is often required to reproduce them in digital form.

An obvious way of theorizing this notion of digital labor is via Marx's (2013 [1867]) labor theory of value, with its associated ideas of labor exploitation and relations of production. Marx's insights show that digital technologies did not give birth to property or capital, nor free or waged labor and its exploitation (Ross 2013, 23). Rather, Marxist inspired digital labour theory provides a set of analytical tools that can show how the designers of platform real estate are utilizing property, capital and labour in their platforms. Deploying a Marxist notion of digital labor in an analysis allows the researcher to move beyond the technicality of the real estate technology—such as an analysis of Domain.com.au as an ideological-free piece of technical software—to expose the technology as value-ridden and yet another site of Marxist exploitation. In broad terms, a Marxist analysis of Domain.com.au, located at the intersections of labor, commodities, property, rent and the rentier, would show that this digital

real estate technology is not a causal agent, at least not in it's own right, but rather would show how Domain.com.au transmits the longstanding capitalist relations Marx was interested in via a new digital technology.

More specifically, an analysis of the unwaged digital labor on Domain.com.au would expose the supposedly 'free' labor undertaken by users of a digital platform without the expectation or realization of financial remuneration. This could include adding personal information about how much a person is willing to spend to purchase a property or pay in rent. As Sadowski (2019) reminds us, data "is not out there waiting to be discovered as if it already exists" (p. 2), it is produced through labor. But the way people labor on behalf of large tech companies (e.g., Google, Facebook, Amazon) is different to the labor expended on digital real estate platforms (e.g., Domain.com.au), because what is at stake in the conditions of exchange is different. Real estate is not pursued for leisure, though investors might derive pleasure from buying, selling and renting property, and indeed, these activities may strongly influence their subjectivity and define their identity. Domain.com.au collects data from the users' real estate and rental search behavior and sells it on to real estate sales agents to help them to design their sales strategies. For example, this user behavior could include using the platform to filter search results by suburb, sales or rent price, or property type; but Domain.com.au also collects data on when and how many times a potential customer accesses a real estate sales listing. These data (and more) are combined to make predictions about the kinds of properties potential investors are and are not interested in acquiring, the most appealing and unappealing markets, and demand for particular properties or suburbs.

Thus, the activities carried out on real estate platforms—regardless of whether they result in a transaction—produce data that helps to generate value in these companies (Dal Maso *et al.* 2019). In the aggregate, such information may help to shape the platform's strategy about what kinds of markets to expand into, withdraw from, or avoid. Real estate platforms thus derive value by extracting data that is generated from user labor, which they can be refined by drawing in other data sources, e.g., data on real estate sales and local market rents (Rogers 2017b; Sadowski 2019). Analyzing the use of unwaged digital labor in platform real estate provides one way of understanding the types of data that are being generated by these

companies, and how this data is used to create company value. Another way is to analyze the use of waged digital labor by these companies.

Waged digital labor, which is sometimes called gig economy labor, often consists of the labor that is associated with incumbent industries or businesses that are newly mediated by platforms. Consider work-on-demand, where “traditional working activities... are offered and assigned through mobile apps”, and businesses offering the work set standards for and manage workers who complete tasks locally (De Stefano 2015, 5). Familiar to many through platforms such as the ridesharing app Uber, work-on-demand is increasingly common to digital real estate platforms. In 2016, the Domain Group (i.e., Domain.com.au) acquired a 35% or A$15 million stake in OneFlare.com.au. Oneflare is a digital platform that connects Domain customers with local trade service providers, such as plumbers or electricians. Another example of this type of work-on-demand model is TaskEasy in the US, which allows property owners to outsource yard care to contractors. The TaskEasy platform “handles customer marketing and acquisition, job scheduling, daily routing, billing and other business functions” on behalf of established yard care businesses, or contractors who may be working part-time for extra money, or cobbling together income from multiple tasking platforms (TaskEasy 2019). TaskEasy manages contractors through the smartphone app they are required to use. The aim is to cut labor costs through automating driving routes to jobs and using metadata with time and location stamps as an audit trail to target fraud and inefficiency (Fields 2019a). In this case, “the platform operator has unprecedented control over the compensation for and organization of work, while still claiming to be only an intermediary” (Kenney and Zysman 2016, 62).

Thus analyzing the use of outsourced waged labor, much like the analysis of unwaged digital labor, can expose the types of data that are being generated by these companies, but it also raises questions about the digital control and regulation *of* labor. The outsourcing of rental maintenance to work-on-demand contractors might come with the erosion of employment benefits and employment security, or the fragmentation of work schedules, or the curtailing of bargaining power. Centralizing real estate transactions and associated services on their

platform, via work-on-demand or similar models, allows these real estate tech companies to both disperse with any formal commitments to worker rights and protections while simultaneously capturing some of the value of the work-on-demand businesses who use their platform; all of which builds value in the real estate platform company (Kenney and Zysman 2016; Pasquale 2016; Staab and Nachtwey 2016).

This labor outsourcing, and the platform economy more broadly, is often build on public investment, government-funded labor and public sector data (Srnicek 2017; Mazzucato 2015). Therefore, analyzing the roles that governments play in collecting and sometimes digitizing real estate and financial data is a third modality of digital labor inquiry. While government data pertaining to property holdings, urban planning, land records, and so forth, are utilized by tech companies in their real estate platforms (Keenan 2015), the governments' data collection and processing often runs silently in the background. Thus, the government, government policy and the law are integral to the structures that enable platform real estate to function and to be profitable. A government department might be the provider of tax-payer funded labor to produce digital data, or they may act as a real estate, financial, planning and other data collector. For example, data platform HouseCanary in the US uses a range of publicly available data to help develop the comprehensive, granular, nationwide dataset powering its valuation, forecasting, and appraisal products. The platform adds value to the public data by standardizing the notoriously fragmented local data characteristic of the US, thereby creating products that may be sold back to public sector clients or sold on to new private sector clients. Therefore, interrogating the labor value of data can expose the complex public-private structures that enable platform real estate.

In the state of New South Wales (NSW) in Australia, the NSW Land Title Registry records freehold land titles that underwrite the real estate market in the state. The privatization of the land registry in 2017 sparked public debate about the private sector operator's ability—which is majority owned by superannuation and infrastructure financing companies—to keep this critical data secure and to use this public data in ethical ways. In this case, there were strong calls for the government to continue to fund and administer the registry (i.e., fund and oversee

the human labor) on security and accountability grounds. The Mortgage Electronic Registration System in the US is another example (Keenan 2015). Analyzing these types of cases with a focus on government-funded labor can expose the ways in which the state is acting as a data creator and/or provider to private sector technology companies. This type of analysis raises different ethical questions about labor, accountability and the security of platform real estate data.

Finally, the work of algorithms and the automation of some real estate practises and operational tasks are almost certainly affecting the roles of those who work in the real estate and services industries in ways that can be analysed by digital labor theory too. Algorithms and automation are central to contemporary conversations about digital labor, popularly (mis)framed in terms of robots taking jobs from humans (see Kishan, Son, and Rojanasakul 2017 "Robots are coming for these Wall Street jobs"; Kolhatkar 2017 “Welcoming our new robot overlords”). So profound is the work of algorithms in the platform economy that “it is no exaggeration to say that software was formerly embedded in things, but now things—services as well as objects—are woven into software-based network fabrics” (Kenney and Zysman 2016, 64).

In the housing space, work on algorithms and the automation is useful for showing how labor obsolescence is being produced by digitizing and moving online some of the more routine everyday practices of tenancy management. For example, Rently in the US automates the process of showing vacant rental properties by allowing prospective tenants to use a lock-box code sent to their smartphone to access and view properties themselves, thereby reducing the need for leasing agents. Platform real estate is exposing tenancy management to a form of digital rationalisation, wherein each step in the tenancy management process is understood as an instrumental task that might possibly be checked off by a rental management algorithm, introducing a “new kind of distributed labor [that] does not need to be performed by payroll employees” (Ross 2013, 20). But this is not always the case. Unlike Rently, prestige real estate brokers Sotheby’s (2019; n.p.) suggest their high-end real estate services are “tailored through technology” but their service still relies on interpersonal, face-

to-face relations; thus gender, class and race are likely to significantly influence the way automation is rolled out and its effects.

The work of algorithms can also be seen through the preponderance of dashboards and other reporting systems in platform real estate, like Mynd, a property management platform promising landlords "rich, up-to-the-minute data on maintenance updates to rental income status and beyond. You'll be a tap and swipe away from your rental properties, the same way you are with your stock market and other investments" (2017, n.p.). Automation is thus fundamentally transforming once people-heavy real estate services in a variety of ways across different markets and housing communities. And as note above, the level of labor transition and/or automation is likely to vary across different types of markets (e.g., by asset class) and tenure groups (e.g., by social class), and digital labor theory can help us to find and analyze these differences.

Therefore, the three theories of digital labor outlined above allow us to show how the broader socio-technical arrangements that produce platform real estate are subsequently (re)configuring the human labor within the sphere of real estate practice. Digital labor theory provides a set of conceptual tools to investigate different socio-technical arrangements and the types of human labor and real estate practice that have been coded into them, including those that resist and subvert capitalist interests. Just as digital laborers in other economic spheres have used platforms to organize labor actions and resistance (see Woodcock 2017 on worker resistance in the gig economy), real estate actors may also use their labor subversively. For example, Justfix.nyc is a platform that assists New York City tenants to document their housing issues in an effort to better manage their disputes with landlords or to support their legal actions (Schwartz 2016). Digital platforms can also be used to organize worker-owned cooperatives (Scholz 2016). Such examples remind us that digital labor relations are not fixed, but subject to struggle, meaning it is not inevitable that they reproduce capitalist exploitation.

Conceptual entry point 3: Financialization

A focus on financialization entails asking how digital platforms may govern and reshape geographies of real estate investment and flows of finance capital, and how they may enable

the development of new financial instruments based on real estate, or otherwise help integrate real estate into global financial markets. These questions call upon us to engage with critical accounts of housing and political economy under financialized capitalism (Aalbers and Christophers 2014; Aalbers 2016; Fernandez and Aalbers 2016), logistics (Bernes 2013; Cowen 2014; Danyluk 2017), and digital economic circulation (Langley and Leyshon 2017; Srnicek 2017). We highlight three areas for investigation based on this interdisciplinary body of work. First, the role of platforms in facilitating capital circulation and surplus capital absorption, either by sinking capital into the development of platforms themselves or by governing the deployment of capital to invest in real estate as a commodity. Second, how platforms may work to coordinate and secure capital turnover. Third, the way platforms potentially help constitute real estate as a financial asset class. While we treat these ideas separately for practical purposes, they are of course interlinked.

The first area of investigation--how platforms may facilitate capital circulation and surplus capital absorption, requires a brief history of platform capitalism (see Srnicek 2017 for a more comprehensive account). An important factor for our purposes is the post-1970s buildup of a "global wall of money" associated with the growth of assets managed by institutional investors and the trade surpluses of emerging economies, loose monetary policy, and the expansion of corporate profits held in offshore tax havens (Fernandez and Aalbers 2016). In the 1990s the U.S. telecommunications sector "became the favoured outlet" for this wall of money, which both developed the physical infrastructure for commercial internet (making today's digital economy possible) and created a speculative bubble that burst in 2001. (Srnicek, 2017, 20). Soon after, financial instruments based on mortgage debt became a key site for absorbing investment capital, once again creating a speculative bubble—this time in the interlinked housing and financial markets—that burst in 2008 (Newman 2009; Soederberg 2014). States responded by holding interest rates close to zero for nearly a decade (Fleming 2015); the ensuing reduction of investment returns pushed capital toward riskier strategies, including private equity and venture capital, and into property to escape stock market volatility (Ivory, Protess, and Bennett 2016; Mooney 2016; Srnicek 2017).

Since 2008, investment capital—particularly venture capital—has flowed into tech companies with platform business models based on recent advances in technology (such as automation, cloud computing, and the like, see Langley and Leyshon 2017; Srnicek 2017). At the same time, the crisis was reimagined as a real estate investment opportunity, with price declines and a proliferation of distressed assets drawing capital on the hunt for yield (Beswick et al. 2016; Fields 2018; Rogers 2017a). Because the post-2008 tech boom coincided with the housing bust, real estate platforms can soak up surplus capital in two ways: directing it first toward property investments and second into the development of platforms that "disrupt" the traditional real estate industry.

Trading platforms illustrate these twofold dynamics of surplus capital absorption. In 2017, real estate brokerage platform Compass became one of the first "proptech unicorns", indicating a valuation of $1 billion US or more (Armstrong 2017). Between 2014 and 2018, Compass raised $1.2 billion US, with recent sizable investment by the Qatar Investment Authority and the SoftBank Vision Fund (Crunchbase 2019a). Similarly, Opendoor, another unicorn, raised over $1 billion US in just four years with a model of automating home sales by bidding on homes sight unseen, agreeing to buy them after an inspection, and then reselling them at a markup (Crunchbase 2019b; Loizos 2017). Such well-capitalized trading platforms are still rare; more typical is Roofstock (for buying and selling occupied rental properties), which since 2015 has raised $75.3 million from venture capital funds (Crunchbase 2019c). Discourses of progress about the transformative impact of digital platforms on real estate transactions accompany all these business models. For example, Roofstock (2017) argues single-family rental "is an industry ripe for disruption...Roofstock turns the old way of investing on its head, bringing transparency and efficiency to create a better way to transact...*enabling investors to treat their real estate investments more like stock portfolios*" (emphasis added). Yet such surplus capital absorption strategies can lead to speculative booms and busts that affect people on the ground more adversely than the architects of such strategies.

We further suggest that platforms contribute to coordinating and securing capital turnover. That is, they serve a logistical purpose by organizing "capital in technical ways that aim to make

every step of its 'turnover' productive" (Mezzadra and Neilson 2013, 12). Logistics governs and coordinates supply chains to afford the circulation of commodities (Danyluk 2017; Bernes 2013). The "seemingly banal and technocratic" nature of logistics can obscure its politics, i.e. remaking space on behalf of regimes of capital accumulation that reinforce unequal power relations (Cowen 2014, 4; Chua et al. 2018). Thus, while commonly referring to the role of transport and communications in calibrating the physical flow of goods, today logistics is better understood as a fundamental logic of contemporary capitalism: "a calculative rationality and suite of spatial practices aimed at facilitating circulation" (Chua et al., 2018, 618; see also Mezzadra and Neilson, 2013).

Real estate platforms embody this principle of circulatory, frictionless flow. For example, data platform HouseCanary (2017) offers property valuation and forecasting at multiple geographical scales (down to the block level), using artificial intelligence and machine learning to "see into the future of real estate" and "make better, *faster*, real estate decisions with technology" (emphasis added). Similarly, the race by platforms like Opendoor to enable home buying with just a few clicks seeks to accelerate real estate investment (Casselman and Dougherty 2019). The effort to align the speed of investments in homes with that of information transmission speaks to an ideal of "eliminating friction and resistance" from capital turnover, even in the case of a notoriously 'sticky' commodity like residential real estate (Mezzadra and Neilson 2015, 7; Bernes 2013). It is worth asking questions about whose purposes are served by this ideal of speed, and the extent to which it may actually undermine the historical stability of real estate investment and the political economies that stability underwrites (Casselman and Dougherty 2019).

Operational platforms such as Rently (automated keyless entry to vacant rental properties) and SMS Assist (property maintenance) also appeal to the notion of unimpeded capital turnover. Their calculative capabilities add value and maximize profit through offering data and analytics. For example, Rently not only reduces labor costs (maximizing the productivity of leasing agents by enlisting prospective tenants in the work of viewing rental properties); it enables property management companies and owners of rental portfolios to make decisions based on data (e.g.

reports of inquiries, showings, and feedback), and allows properties to be shown more frequently and efficiently by automating this process. SMS Assist generates data with which owners can monitor how long maintenance jobs take, flag problem tenants, and inform investment decisions. These value-adding capabilities point to how the logistical uses of platform real estate also entail power relations (Cowen 2014). Consider, for example, how the ability to verify the billable hours of a contractor against metadata from the app used to check in and out of maintenance jobs introduces new modes of surveillance into the embodied activities of workers (Fields 2019a). The politics of platform real estate logistics demand critical inquiry.

Finally, we suggest platforms may help constitute real estate as a financial asset class and allow for the "penetration" of financial instruments "into new areas of society" (Jacobs and Manzi 2019: 2). Platforms simultaneously work on the subjectivities of investors to reinforce understandings of homes as assets, and create data that underpins financial assets. The standardized data generated through use of the platform, for example as tenants pay rent or submit maintenance requests through resident portals, is presented through dashboards and analytics that measure, sort, and rank. Trading and data platforms encourage a similar calculative mentality. For example trading platform Entera uses artificial intelligence to match single-family rental properties with an investor-specified profile (such as gentrifying neighborhoods in the Midwest) and to promise confident investments. Such capabilities change the embodied experience of investment decisions through how property and place are made visible. In the terms of social studies of finance, platforms afford calculative agency to define and value goods (Çalışkan and Callon 2010; Jacobs and Manzi 2019).

Calculative agency is vital to creating, marketing, and monitoring financial assets such as the rent-backed financial instruments recently rolled out by corporate landlords managing large portfolios of single-family rental homes in the US. Because single-family rental homes were never previously been owned or managed at scale, much less been the site of structured finance opportunities, historical market performance data was essentially non-existent before 2009 (Fields 2018). Real estate platforms can provide crucial information with which credit

rating agencies and bondholders can evaluate the new instruments, thus providing the "transparency and comparability" (Bitterer and Heeg 2012, n.p.) necessary to the development of new real estate asset classes, and their reception by investors. Platform real estate stands to cultivate new sensibilities of investment that align with financialization, and to generate information that materially supports this process.

Real estate platforms are predominantly with the aim of enhancing the exchange value of housing. This reality suggests the possibility they will reinforce the political economy of housing under financialized capitalism by supporting the central role of housing in capital circulation, enabling the continued absorption of the global wall of money into property, nurturing ideologies and practices of housing chiefly as a vehicle for capital accumulation. As such, financialization is a crucial conceptual tool for analyzing platform real estate.

Conclusions

As Maarbani (2017) argues, "new technologies are reimagining every aspect of the way in which real estate is procured, developed, managed and utilised" (p.1): the industry's new battleground is real estate tech and the data capital being mobilised in excess of the bricks and mortar of actual properties (Fields 2019a; Rogers 2017b; Sadowski 2019). Digital platforms for real estate trading, operations, and data are a crucial mechanism for the changes Maarbani (2017) describes. Platforms are a longstanding object of inquiry in media studies (see Plantin et al. 2018 for an overview) and, more recently, in social science (e.g. Rosenblat 2018; van Dijck, Poell, and Waal 2018; van Doorn 2017; Wachsmuth and Weisler 2018), where a handful of geographers and urban scholars have begun to attend to the interplay of platforms and real estate (e.g. Dal Maso *et al.* 2019; Fields 2017; Rogers 2017a; Shaw 2018).

Though the field of housing studies is well-placed to shape a theoretical and analytic agenda around platform real estate, a conceptual vocabulary has yet to give shape to such an agenda. It is vital for housing scholars to recognize and interrogate digital transformations of housing and home. In this article we have contributed three entry points to guide critical inquiry into platform real estate: platform logic, digital labor, and financialization. While by no means complete, the initial conceptual vocabulary we have set out in this article provides

fertile ground for housing scholars to generate new, interdisciplinary insights about platform real estate. Below, we detail a range of ways housing scholars could apply the concepts outlined in this article to elaborate on the classificatory and calculative aspects of real estate platforms, the role of data as capital (cf. Sadowski 2019), how platforms may restructure real estate industry roles, and the political economy of real estate platforms.

Platform logic, drawn from work on the sociology of media, encourages housing scholars to analyze the affordances of platforms in terms of underlying 'code-based control' (Andersson Schwarz 2017, 6) at the level of individual platforms, and the role of data capital in the classificatory work of the wider platform ecosystem. Here, housing scholars might investigate: the basis and consequences of tenant categorization tools; the circulation and repurposing of data on users, houses, and places between different platforms and data brokers, and; how users perceive the tradeoffs associated with real estate platforms.

Attending to digital labor in the context of platform real estate opens up a wealth of questions. These include how automation may make some forms of labor by real estate professionals obsolete while creating new industry roles; the private commodification of public sector data produced via government-funded labor; dynamics of surveillance and control over precarious gig economy workers, and; the status of platform use as unwaged digital labor that generates data with which platform operators can derive value.

While the dynamics of financialization have been analysed extensively in housing studies, platform real estate is an important new component of these dynamics. Of particular interest is: the role of venture capital in shaping platform real estate business models (see Langley and Leyshon, 2017, on how platforms 'perform' the structure of VC investment); the investment patterns and processes platforms engender—including management at a distance by everyday investors, and; the potential for platforms to provide the calculative tools and data needed to underpin novel asset classes (see Fields, 2019 on this process in the U.S. rental market).

Across this set of conceptual tools, we have emphasized the importance of a historicised stance and resisting the urge to endorse technological determinism. We can do this, we argue, by attending to social, cultural, political and economic relations, rather than conceptualising platform real estate solely in technological terms. Real estate actors are not "passive *data subjects"* (Isin and Ruppert 2015, 4), and technologies taken in isolation do not have causal agency (Ross 2013). Platform real estate is not separable from the social contexts in which it emerges. Just as these contexts are not fixed, neither are the subjectivities of digital real estate actors, nor the uses and consequences of platform real estate. Critical housing scholars must therefore not only investigate and verify the extent to which real estate platforms exacerbate housing as a vector of inequality, but seek out counter-examples of platforms that pursue housing justice. For example, radical digital housing practices may deploy digital technologies to document dispossession (e.g. the Anti-Eviction Mapping Project), supply data to explore the impacts of platform real estate (e.g. Inside Airbnb), or provide tools tenants may use to organize and take action against landlords (e.g. Justfix.nyc). Such practices seek to work against dominant ideologies of housing that privilege "private property ownership, market allocation mechanisms and accumulation strategies" (Aalbers and Christophers 2014, 384).

In a 21st century echo of the impacts of the early 17th century invention of the surveyor's chain (see Shaw , 2018), the advances associated with Tech Boom 2.0—including cloud and mobile computing, digital platforms, and automated, data-driven decision-making tools—are dramatically reshaping how housing is bought and sold by homeowners and investors (Casselman and Dougherty 2019), operated by landlords (Fields 2019a) and inhabited by us all (Maalsen and Sadowski 2019). Yet there is a continuity as well as a rupturing (or *dis*ruption in tech language) associated with the digitization of real estate (Rogers 2017b). Existing social, cultural, political and economic structures often change more slowly than technology, generating novel interactions among platform real estate and 'old' housing questions, such as those concerning real estate citizenship and property-owning democracies that so dominated nations like the United States, United Kingdom, and Australia in the 20th century (Rogers 2017a). Platforms are, therefore, set to play a key role in (re)producing housing markets and underwriting their distributional consequences—for better or worse,

making it vital for critical housing scholars to build knowledge about this digitization of real estate practice.

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