Housing and Macroeconomics

Leung, Charles Ka Yui

City University of Hong Kong

November 2022

Housing and Macroeconomics[Ω]

Charles Ka Yui Leung[Ξ]

This version: November 2022

Summary

Until recently, the literature ignored the interactions between housing and macroeconomics. Thanks to many researchers' contributions, the macro-housing field is in development. This review complements previous research and highlights a few areas that have made significant progress lately. They are the rental market and related issues, housing affordability, people's beliefs and expectations, and the interactions between the aggregate and regional markets. Theoretical models have become increasingly realistic and hence can be solved only numerically. While the recent literature has provided essential policy lessons, it has yet delivered a "paradigm" for future research. There are also open questions that remain to be answered.

Keywords: aggregate and regional shocks, belief and expectation, rental market, housing

JEL Classification: E10, E30, G50, R20, R30

[Ω] Acknowledgement: This article is prepared for the *Oxford Research Encyclopedia of Economics and Finance*. The author thanks all the co-authors, colleagues, and friends for many stimulating thoughts over the years, especially Kuang-Liang Chang, Nan-Kuang Chen, Yongheng Deng, Yifan Gong, Eric Hanushek, Fred Kwan, Steve Malpezzi, Joe Ng, Tim Riddiough, Jim Shilling, Edward Tang, Chung Yi Tse, Ping Wang, Kuzey Yilmaz, Matthew Yiu, among others. The usual disclaimer applies.

[Ξ] Correspondence: Leung, Department of Economics and Finance, City University of Hong Kong, Kowloon Tong, Hong Kong, kycleung@cityu.edu.hk

1. Introduction

This article reviews the literature on housing and macroeconomics.[1] We begin with a few observations. First, while "housing" and "macroeconomics" have been studied for decades, joint study is a relatively new field (Leung, 2004). For instance, within the JEL classification system provided by the American Economic Association, category "E" is Macroeconomics and Monetary Economics.[2] It is interesting that while another relatively new field, "Macro-Based Behavioral Economics" is included as E7, "Macroeconomics and housing" or "Macroeconomics and real estate" is not found.[3] Similarly, while category "R" is devoted to Urban, Rural, Regional, Real Estate, and Transportation Economics, "Housing and Macroeconomics" or "Real Estate and Macroeconomics" cannot be found.[4]

Such mutual exclusion may stem from the missing housing market in the traditional macroeconomic model. A typical Macroeconomics textbook often focuses on determining the general price level and inflation, wage and employment, and the gross domestic output (GDP). Housing is never an important topic.[5]

---

[1] Recent research has confirmed that residential properties, commercial real estate, industrial real estate, real-estate-backed securities, land, etc., also have deep connections with the macroeconomy. It is beyond the scope of this article to review the literature. Interested readers should consult Bhattacharya (2022), Fu and Vaird (2022), Hattori and Yoshida (2022), Kahn et al. (2022), Leung and Chen (2006), Ng et al. (2022), Ogawa (2022), Ogawa et al. (1996), Riddiough (2022), Sagi (2021), among others.

[2] The JEL classification system can be found here: https://www.aeaweb.org/econlit/jelCodes.php?view=jel&print. Notice that JEL classification is a complicated issue in itself. According to Cherrier (2017, p.546), "… When John Pencavel, then editor of the Journal of Economic Literature (JEL), initiated in 1988 the revision that created the classifications we use today, it took him two days to work out how to classify microeconomics. But macroeconomics took no less than two years of controversy. Previous revisions had also been very difficult,… The history of the JEL codes is thus essentially a story of how economists have perceived their discipline."

[3] E0 is "General," E1 is "General Aggregative Models," E2 is "Consumption, Saving, Production, Investment, Labor Markets, and Informal Economy," E3 is "Prices, Business Fluctuations, and Cycles," E4 is "Money and Interest Rates," E5 is "Monetary Policy, Central Banking, and the Supply of Money and Credit," E6 is "Macroeconomic Policy, Macroeconomic Aspects of Public Finance, and General Outlook."

[4] R0 is "General," R1 is "General Regional Economics," R2 is "Household Analysis," R3 is "Real Estate Markets, Spatial Production Analysis, and Firm Location," R4 is "Transportation Economics," R5 is "Regional Government Analysis."

[5] Housing is often mentioned on a few occasions. In the study of national income accounting, students of macroeconomics are reminded that the value of primary housing market transactions, but not the counterpart of the secondary housing market, is included in the GDP to avoid double counting. Empirically, the secondary housing market is much larger than its primary counterpart in the United States and many economies. Second,

Fortunately, the undergraduate textbook is only sometimes a good indicator of the research frontier. Many have contributed to the overlapping research interest in housing and macroeconomics.[6] For instance, following the spirit of Cooley and Prescott (1995), Leung and Ng (2019) report the stylized facts of the U.S. housing market variables, including the real house price, the new house sold, vacancy rate, and real residential investment. They find that at business cycle frequency (i.e., periodicity of 6 to 32 quarters), the correlations between the housing market and macroeconomic variables are generally weakened. In contrast, the correlations between the housing market and macro-financial variables were strengthened after the Global Financial Crisis (GFC) in 2008.[7] Ng (2022) examines whether a similar weakening occurs between housing prices and macroeconomic variables among the OECD countries. While the correlations between housing prices and GDP have weakened in Austria, Belgium, Denmark, France, Iceland, Ireland, Israel, South Korea, Netherlands, and Norway, the correlations between housing prices and unemployment rates have strengthened in France, Iceland, Italy, and Lithuania.[8] In other words, significant heterogeneity exists among nearby countries.

Our second observation is that housing and macroeconomic research have dramatically changed. Housing research, and urban economics in general, has extended from the intra-city spatial allocation to become more connected to other fields, such as environmental

---

housing rent, but not the housing price, is a component of the consumer price index (CPI), although the latter is reported at least as frequently as the former in the media. For instance, see Hubbard and O'Brien (2022).

[6] Among others, see Bardhan et al. (2012), Baxter (1996), Ben-Sahfar et al. (2008), Chang (2000), Chen et al. (2015), Chen and Leung (2008), Chen and Wang (2007), Davis and Heathcote (2005), Edelstein and Kim (2004), Glaeser (2013), Greenwood and Hercowitz (1991), Hendershott et al. (2010), Iacoviello (2005), Justiniano et al. (2016), Kaplan et al. (2020), Kiyotaki and Moore (1997), Kwan et al. (2015), Leung (1999, 2001, 2003, 2004, 2007, 2014, 2022), Leung et al. (2006), Leung and Quigley (2007), Leung and Tsang (2023), Malpezzi (2017), Ortalo-Magné and Rady (2006), Tse and Leung (2002), Wang and Xie (2022), etc.

[7] The macroeconomic variables include the real GDP, unemployment rate, CPI, non-residential investment, consumption, and trade surplus. The macro-financial variables include the Federal Fund rate (FFR), term spread, TED spread, external finance premium, and stock market index (S&P 500).
Leung and Ng (2019) also discuss the literature on bankruptcy and mortgage contracts, search and belief, urban policy, human capital, etc.

[8] See also Green (2022).

economics, health economics, labor economics, finance, etc. It also looks beyond the advanced economies and contributes to our understanding of emerging markets (Bryan et al., 2019; Case et al., 2005; Deng et al., 2000; Eichholtz et al., 2010; Fu and Viard, 2021; Glaeser et al., 2004, 2010; 2019; Glaeser and Kahn, 2010; Goldstein and Moses, 1973; Huang et al., 2015; Malpezzi, 1999, 2001, 2018, 2020; McDonald and McMillen, 2010; Quigley and Van Order, 1995; Tiwari and Rao, 2022; Wu et al., 2012, 2016).

For macroeconomics, changes are more methodological. It switches from an ad hoc econometric model to a representative agent model with micro-foundation and then to a heterogeneous agents model (Ahn et al., 2018; Azariadis, 2018; Kaplan and Violante, 2018; Krueger et al., 2016; Lubik and Surico, 2010; Lucas, 1976; Lucas and Sargent, 1978). It also relies more on micro-econometric techniques than time series models over time (Glandon et al., 2022). All these changes have important implications for macro-housing research. Several authors have reviewed the macro-housing literature (Davis and Van Nieuwerburgh, 2014; Duca et al., 2021; Leung and Ng, 2019; Piazzesi and Schneider, 2016). This chapter complements the existing works by highlighting more recent developments and leaves an exhaustive literature review for future research.

1. Rental Market and related issues

Rental market research may be one of the most active areas in macro-housing, and it deserves such devotion. According to OECD (2022), the average homeownership rate of the OECD countries, including "own outright" and "owner with mortgage," is about 70%, suggesting that a significant fraction of the population lives in rental housing. It is not surprising that there is extensive literature on "tenure choice" (i.e., rent or own) in urban economics.[9] The housing affordability literature also starts to

[9] Notice that in labor economics, “job tenure” refers to the duration a worker remains with the same employer, which is very different from the notion of “tenure” in urban economics. Among others, see Lazear (1991) for more details.

pay attention to the rental market.[10] Yet, in classical macro-housing papers (Davis and Heathcote, 2005; Iacoviello, 2005; Kiyotaki and Moore, 1997; Ortalo-Magne and Rady, 2006), the rental market is typically assumed away. Some studies consider the rental market in a dynamic equilibrium setting (Kan et al., 2004; Leung, 2007, 2014). However, the rental option is not exercised in equilibrium due to the representative agent assumption. Some search-theoretic works model both the for-sale and rental markets (Burnside et al., 2016; Leung and Tse, 2017; Ngai and Sheedy, 2020).[11] When households move out of their original houses and search for new ones, they live in rental housing. For convenience, the rents are assumed to be exogenous or insensitive to the market tightness of the for-sale market.

There are efforts to endogenize both the rent and price in an equilibrium setting. For instance, Chambers et al. (2009a, b) build a life-cycle model with endogenous rent and price. They focus on matching the age-dependent homeownership rate and how the mortgage contract choice would affect the homeownership decision. The rent-to-price ratio is not a target of their calibration. Halket and Vasudev (2014) build another life-cycle model with endogenous rent and price. They focus on how the homeownership rate increases and mobility decrease over the life cycle. Their model matches the renter moving rate, but the equilibrium rent-to-price ratio is not a calibration target. Halket and Pignatti Morano di Custoza (2015) propose a competitive search model. Their calibration suggests that the rent-to-price ratio is between 3% to 4% in all submarkets, which seems to be at odds with the micro-evidence (Colonnello et al., 2021; Waltl, 2018). Yao (2021) extends the framework of

This paper cannot do justice to reviewing the enormous literature on tenure choice in urban economics. Among others, see Dietz and Haurin (2003), Goodman and Kawai (1982), Goodman and Mayer (2018), Haurin et al. (2002), Kan (2000), MacRae and Struyk (1977), Ortalo-Magné and Rady (2008), Painter et al. (2001), and the reference therein.

[10] For instance, see Albouy et al. (2016), Malpezzi (2020, 2023), Yılmaz and Yeşilırmak (2023).

[11] See also Genesove and Han (2012), Krainer (2001), among others.

Chambers et al. (2009a, b) and allows developers to choose between building houses for owners or apartments for renters. She can match the inter-city differences in price and rent in the United States. Parkhomenko (2020) study a spatial equilibrium model with an endogenous level of regulation. Like Ortalo-Magné and Prat (2014), owners in his model have incentives to choose an excess degree of regulation and enjoy a higher rent level. Since renters are mobile across cities, land use regulation distorts rent and labor allocation in equilibrium. However, since homeowners are the majority in the U.S., deregulation might not lead to significant aggregate welfare gains.[12]

Some authors build equilibrium models of the rental market and apply them to local markets. For instance, Huang et al. (2018) studied a set of 132 popular real estate development (RED) in Hong Kong. Using the conventional matching estimator, they calculate the RED-level rent-to-price ratios and find those ratios differ significantly across RED and systematically vary with the average income level, the education level, and the demographic characteristics of the households in the RED. Han et al. (2022) study the housing market in Toronto and how the transaction taxes change people's choice of rental vs. purchase of housing.[13]

Greenwald and Guren (2021) stress that the operation of the rental market is crucial to our understanding of how the credit market would affect the housing market. In an earlier period (1965~97), the price-rent ratio of the United States varied, but its movement is uncorrelated to the change in the homeownership rate. Starting in 1997, the price-rent ratio and homeownership displayed positive co-movement most of the time. They show that if the rental and owner-occupied markets are perfectly segmented, in the sense that one cannot convert owner-occupied housing into rental

[12] This result contrasts Herkenhoff et al. (2018), where regulation is exogenous.
[13] Landvoigt et al. (2015) also consider an assignment model and apply it to the housing market in San Diego. However, the rent-to-price ratio is not their focus.

housing and vice versa, the price-rent ratio and homeownership rate would be uncorrelated. On the other extreme, if the markets are frictionless in that one can costlessly trade between the rental and owner-occupied markets, the price-rent ratio and homeownership rate would also be uncorrelated. It is only in the intermediate "frictional" case, i.e., when one can convert the rental and owner-occupied housing units into one another with cost, then the price-rent ratio and homeownership rate would be positively correlated. Based on these observations, they provide both reduced form and structural estimation. They find that credit supply can explain between 35% and 54% of the rise in price-rent ratios over the 2000s housing boom. Moreover, the house price dynamics generated by the calibrated dynamic equilibrium model are close to that under perfect segmentation, suggesting significant frictions in American rental markets.

Conventional theoretical models typically assume that renters pay rent. In practice, it might be different. Just like homeowners may fail to pay the monthly mortgage payment to the point that they might default on their loans, renters may fail to pay rent.[14] According to Collinson et al. (2022, p.1), "More than two million eviction court cases are filed in the United States each year. These cases predominantly involve low-income and minority households. About half of proceedings end in a court order for eviction: a judgment requiring the tenant to vacate the property." Moreover, there are significant cross-country differences. Collinson et al. (2022, p.1) report that the "U.S. is an outlier in the number of eviction cases per renter household, with a rate 1.5 times higher than the next-highest country (Canada)," among OECD countries. Using quasi-experimental instrumental variables (IV), Collinson et al.

[14] The literature on mortgage default is too large to be reviewed here. Among others, see Deng et al. (2000), Jones and Sirmans (2015, 2019), Kalikman and Scally (2022), LaCour-Little (2008), Leung and Ng (2019), and the reference therein.

(2022) argue that in Cook County (which includes Chicago) and New York City, eviction increases homelessness and reduces earnings. Extensive literature shows that homelessness can cause other social problems.[15]

Naturally, one would ask why evictions arise in the first place. And can we or should we reduce evictions? Some recent research may shed light on these critical questions. For instance, Corbae et al. (2022) build a directed search model of the rental market when renters face idiosyncratic labor income shocks. Under some parameterization, eviction is an equilibrium outcome. Abramson (2021) builds an overlapping generations model in which households face idiosyncratic labor income shocks, and the housing supply is endogenous. He then calibrates the model with detailed microdata from San Diego county in the United States. He then conducts counterfactual experiments. It is well known that rent control does not necessarily reduce the equilibrium rent and improve the welfare of renters, as the housing supply is endogenous in the long run.[16] By the same token, Abramson (2021) finds that the "Right-to-Counsel," which makes it harder for the landlords to evict, would not decrease the equilibrium eviction rates, as default is an endogenous decision. On the contrary, rental assistance reduces eviction and homelessness. Even considering the tax burden, rental assistance policy can improve social welfare. In other words, there may be no free lunch in "solving" the eviction and homelessness problem. In other words, there may be no free lunch in “solving” the eviction and homelessness problem.[17]

[15] The literature is too large to be reviewed here. Among others, see An et al. (2022), Clifford et al. (2019), Cobb-Clark and Zhu (2017), Cohen (2022), Grech and Raeburn (2019), and the reference therein.
[16] The literature on rent control is too large to be reviewed here. Among others, see Diamond et al. (2019), Glaeser and Luttmer (2003), and the reference therein.
[17] The United States is not the only country facing the homeless problem. For instance, see O'Flaherty et al. (2018) for the case of Australia.

More generally, governments intervene in the rental market as they intervene in the owner-occupied market. According to OECD (2022), "renting at subsidised rates is most common in the United Kingdom (20%), France (19%) and Ireland (18%), and is also common in Iceland, and Finland."[18] There are two primary forms of subsidy: the government provides rent subsidies to targeted households searching for their desired units or directly provides public rental units. Some countries provide both forms of assistance.

As predicted by economic theories, different government subsidies always bring a crowding-out effect, meaning that the total housing supply would not increase as much as the government policy would desire because the private sector supply would reduce. Empirically, crowding out is often less than one-to-one, meaning that for every housing unit a government policy intends to increase, the total housing supply increases by less than a unit.[19] Moreover, there are cases where appropriately designed public housing policies can assist the economic recovery after WWII.[20]

On the other hand, government subsidies need to be eventually financed by the tax. Thus, the question is whether the benefit of such government interventions in the rental market outweighs the cost. Moreover, the general equilibrium effect can be significant. Hence, structural models are needed. For instance, combining the conventional wisdom of Alonso and Tiebout models, Hanushek et al. (2011), Hanushek and Yilmaz (2007, 2011, 2022) build a series of urban models to match an

[18] OECD (2022) also remarks that "Austria, Denmark and the Netherlands – countries where support for subsidised rental housing is traditionally sizable -- are not considered here due to data limitations." Hence, the subsidized rental housing in those countries could also be considerable.

[19] The literature is too large to be reviewed here. Among others, see Chen and Nong (2016), Malpezzi and Vendell (2002), Murray (1983), Sinai and Waldfogel (2005), and the reference therein.

[20] For instance, see Dalmazzo et al. (2022) for the case of Italy, Li and Yu (1990) for Hong Kong, and Phang and Helble (2016) for Singapore.

"average" American city and examine different public policy options.[21] Leung et al. (2012) show that in the Hanushek-Yilmaz framework, housing voucher brings higher social welfare than public housing. Gong and Leung (2020) calibrate a model that matches some stylized facts in the American labor and housing markets. They find that combining school finance consolidation and public housing at the city's edge could lead to a Pareto improvement. Yılmaz and Yeşilırmak (2023) extend the Hanushek-Yilmaz framework and compare the impacts of housing vouchers and transportation vouchers in different socio-economic outcomes.[22] Most of these papers are calibrated to match the U.S. situation. Given that the institutional settings and market structure vary significantly across countries, there may not be a "universally optimal" policy for the rental market. More research efforts would be needed.

2. Housing Affordability and related issues.

Housing affordability (HA) may need little motivation. With more than 500,000,000 entries in Google, HA is probably qualified as one of the "global concerns." Since there are several papers written on this topic recently, and we also touched on the subject in the previous section, we would only provide a few remarks (Ben-Shahar et al., 2020b; Deng et al., 2019; Gabriel and Painter, 2020; Leung, 2022; Leung and Tsang, 2023; Malpezzi, 2023).

First, there are several ideas of HA, and we must be careful to measure HA. For instance, one commonly used indicator is the median house price-to-income ratio (PIR). In practice, people do not collect information about the PIR for each household and then compute the median. Instead, they take the ratio of the median house prices and the median income as a proxy. Hence, when a significant portion of the

[21] There are other research efforts to combine the insights of Alonso and Tiebout, such as de Bartolome and Ross (2003). They focus on the interactions between the inner-city and suburban, which are ex-ante different, while Hanushek-Yilmaz's models focus on ex-ante identical communities.
[22] See also Ben-Shahar et al. (2020a).

population is absorbed by public rental housing, as in the case of Hong Kong, the median buyer in the private housing market would have a higher income than the median person of the income distribution. Thus, the median house price ratio to the median income is a biased indicator of the median PIR. In other words, the housing unaffordability of economies like Hong Kong is primarily inflated (Leung et al., 2020b).

Moreover, since income and house prices are endogenous variables and evolve with the economy, the PIR is a stochastic process. It is vital to notice that there is a cyclical component of the PIR which is mean-reverting (Leung and Tang, 2023). Hence, the "explosive dynamics of house price-to-income ratio" may be exaggerated.

More fundamentally, as Glaeser (2011) observed, the accommodation of human beings can be more spread out spatially, yet people choose to live in cities.[23] Cities can facilitate consumption, human capital accumulation, trading, and production (Behrens et al., 2014; Berliant and Wang, 2019). Some cities could be more efficient in generating production or consumption than others, attracting people to reside there. Due to natural or artificial reasons, “attractive” cities could be “slow” in generating “enough” housing supply (Green et al., 2005; Gyourko et al., 2013; Saiz, 2010). Hence, the housing prices and rents in those places would adjust and become a device to sort people across potential locations of residence (Couture et al., 2021; Duranton and Puga, 2014; Eeckhout et al., 2014; Glaeser and Gottlieb, 2009; Parkhomenko, 2022). In a sense, housing in certain places would always be “unaffordable” to some

[23] Glaeser (2011) states, “Two hundred forty-three million Americans crowd together in the 3 percent of the country that is urban…. On a planet with vast amounts of space (all of humanity could fit in Texas—each of us with a personal townhouse), we choose cities. Although it has become cheaper to travel long distances, or to telecommute from the Ozarks to Azerbaijan, more and more people are clustering closer and closer together in large metropolitan areas. Five million more people every month live in the cities of the developing world, and in 2011, more than half the world’s population is urban.”

people in equilibrium. Even people who could "afford" to live in any city may find it in their interest to stay away from certain "expensive cities."

There are other senses of HA. For instance, some people could only afford rent but not own it in certain places. This is the focus of the tenure choice literature, which is beyond this paper's scope. We have mentioned a few of the contributions in the previous section, and we highlight a few more here. For instance, Yao (2023) calibrates a life-cycle model and shows the rising population share of college graduates and the growing college premium may explain why the homeownership rate of young people has decreased in the United States. In the spatial equilibrium model of Parkhomenko (2022), when the price-rent and price-wage ratios grow faster in large cities than in smaller ones, some middle-income renters would leave large cities and move to smaller cities to become homeowners.

Couture et al. (2022) study within-city affordability. They show that if households' preferences are non-homothetic, higher-income people will move to the downtown where local amenities are available. This encourages developers to increase the supply of high-quality neighborhoods and, because the land supply is limited, decrease the supply of low-quality communities, pushing up the rent faced by the lower-income renters. Their model can explain a significant share of urban gentrification since 1990 and the cross-city spatial sorting between 1990 and 2014.

Favilukis et al. (2022) build a model of overlapping generations of risk-averse agents who face idiosyncratic income and mortality risks. They can choose among 3 locations for residence: Outside MSA, Gateway MSA (urban core), and Gateway MSA (suburban area). The city government of Gateway MSA imposes rent regulations on rent-stabilized (RS) units and constrains the growth rate of rent in RS units to be below the market counterpart. Developers must produce a certain fraction

of RS units in their development. RS units are allocated through a random lottery without income being means-tested. Thus, the distortions created by RS units can grow with the tenure of their tenants. They calibrate the Gateway MSA (urban core) to match Manhattan of New York City, the Gateway MSA (suburban area) to match the other 24 counties of New York MSA, and the Outside MSA to match the next 74 largest MSA of the United States. They conduct a series of policy experiments. Among other results, they find that expanding the scope of RS units could lead to welfare gains because the "insurance" role of RS units could outweigh the welfare loss from different distortions.

A common theme among these recent researches is the insight that there is a location choice among different cities on top of the traditional tenure choice (rent versus own).[24] The idiosyncratic labor income nature is increasingly emphasized on the household side. Thus, policy-relevant affordability analysis calls for increasingly complicated models.

3. Expectation and related issues.

Economists have long been aware of the role expectation could play and the possibility of an "irrational market."[25] Since Agarwal and Varshneya (2022), Kuchler et al. (2022) recently reviewed the literature on the relationship between the housing market and expectation; we complement their efforts by providing some simple remarks.

First, even in a representative agent context, housing market expectation can be a subtle issue if the monetary policy is endogenous. For instance, in Adam and

[24] For city economies like Hong Kong and Singapore, the city-level choice disappears. And for countries like China which imposes stringent spatial friction, the city-level choice may also be limited (Deng et al., 2020; Gai et al., 2021; Garriga et al., 2021).

[25] For instance, John Keynes has many famous quotes, such as “markets can remain irrational a lot longer than you and I can remain solvent.” See John Maynard Keynes’ quotes, https://www.goodreads.com/author/quotes/159357.John_Maynard_Keynes?page=4

Woodford (2021), agents might *overestimate* the probability of housing shortage due to distorted beliefs. As a result, they might channel too many resources to housing construction and *under-provide* non-durable consumption goods. To correct such distorted beliefs, the monetary authority might need to *respond aggressively* to the house price increase, even when such a response is unnecessary under rational expectation.[26]

Second, there is considerable discussion on the empirical determinants of house prices. In particular, is the house price driven by "economic fundamentals" or non-fundamental factors such as market sentiments?[27] It is assumed that economic agents can read all the economic statistics. However, it might not be accurate. For instance, Runge and Hudson (2020) find that while the British public understands the inflation rate, half of them need to understand the meaning of economic growth. Kladivko and Österholm (2020) find that the surveyed Swedish can predict the direction of unemployment but not the direction of inflation. Empirical research also identifies a systematic difference between the views of economists and the general public.[28] These findings are interesting because central banks and international agencies have produced many materials, available for download, to assist the general public in understanding economics and finance.[29]

The theory of "rational inattention" provides a potential explanation (Maćkowiak et al., 2021, Sims, 2003). When agents have a limited capacity to possess information,

[26] For empirical evidence of whether and how much the Federal Reserve responds to the stock and housing prices, see Aastveit et al. (2021), among others.
[27] There is a discussion on whether institutions, financial market conditions, and geography should be considered "fundamentals." It is beyond the scope of this paper to discuss that literature. Among others, see Duca et al. (2021), Garriga et al. (2019), Garriga and Hedlund (2020), Gelain et al. (2018), Girardin and Joyeux (2022), Glaeser (2013), Lai and Van Order (2022), Leung and Tang (2022), Leung and Tse (2017), Ling et al. (2015), Oikarinen et al. (2018), Saiz (2010), Soo (2018), Van Eyden et al. (2022), and the reference therein.
[28] For instance, see Brandts et al. (2022), Caplan (2002).
[29] For instance, see Giovannini (2008).

they pay attention to a specific data set and ignore the other information. An alternative explanation is that the general public is simply confident that they can predict better than the economists and hence discredit the economists' advice. For instance, Goodspeed (2022) finds that "during periods of high inflation and inflation regime change,…, the average consumer forecast is more accurate than" professional forecasts.[30] Future research may explore further along these lines.

4. Regional economy, regional market

As we mentioned earlier, macroeconomics has experienced much change in recent years. One development is related to the importance of large firms and production networks. Since Kydland and Prescott (1982), business cycle fluctuations are explained by aggregate shocks in macroeconomics (King and Rebelo, 1999; Rebelo, 2005). Later research suggests that "micro shocks" may also lead to aggregate fluctuations under at least two situations. First, some firms are disproportionally large. Second, firms are located in a production network and use one another's output as inputs (e.g., Acemoglu et al., 2012, 2017; Baqaee and Farhi, 2020; Carvalho and Gabaix, 2013; Carvalho and Grassi, 2019; Gabaix, 2011). Such theories are confirmed by more recent empirical work (Atalay, 2017; Joya and Rougier, 2019; Su, 2021). While different firms can form a production network, different regions within a country can also create a production network. This is indeed another development in macroeconomics, which is to recognize the importance of spatial differences and the interactions among regional economies (Chodorow-Reich, 2020; Pinto and Sarte, 2022; Redding and Rossi-Hansberg, 2017). For instance, heterogeneous regional housing markets respond differently to the same national policy, such as the monetary

[30] Xiao (2022) built a model of heuristic where agents underuse prior probabilities when calculating the posterior probabilities. His model predictions are consistent with the professional forecasters' estimate of GDP.

policy (Fratantoni and Schuh, 2003).[31] Different cities may have different housing supply elasticities due to geographical or political-economic reasons (Saiz, 2010). Leung and Teo (2011) build a multi-region, dynamic stochastic general equilibrium (MR DSGE) model with a representative agent in each region. In that framework, they show that differences in regional housing supply functions, which lead to different regional supply elasticities, can generate non-trivial cross-regional co-movement in house prices and investment. On the other hand, Herkenhoff et al. (2018) built an MR DSGE model with a representative family for the whole country. They aggregate 48 continent U.S. states into eight regions. They find that "deregulating just California and New York back to their 1980 land-use regulation levels would raise aggregate productivity by as much as 7% and consumption by as much as 5%."[32]

However, these researches did not incorporate the possibility of over-leverage and bankruptcy, which is one of the main drivers of the Great Recession.[33] In a series of papers, Mian and Sufi (2011, 2014), Mian et al. (2013) explore the relationships among loan-to-value (LTV) ratio, consumption, and tradeable and non-tradeable sector employment at the ZIP code level.[34] Their reduced form estimation shows that communities experiencing a larger deterioration of their household balance sheet would also experience more job loss in the non-tradeable sector employment and display a higher marginal propensity to consume (MPC) out of housing wealth. Those communities may be more financially constrained.[35] Interestingly, the relationship

[31] See also Lai and van Order (2022).
[32] See also Tonetii (2018).
[33] See also Kehoe et al. (2016, 2018).
[34] There are more than 41,000 ZIP codes in the USA. See https://facts.usps.com/42000-zip-codes/#:~:text=There%20are%2041%2C683%20ZIP%20Codes%20in%20the%20country.&text=ZIP%20Codes%20range%20from%2000501,to%2099950%20in%20Ketchikan%2C%20AK
[35] See also Christelis et al. (2021), Kaplan et al. (2014), Kaplan and Violante (2014), among others.

between housing net worth shock and tradeable sector employment change from 2007 to 2009 is close to zero. Thus, their research establishes a link between the local labor and housing markets.[36]

The papers by Mian and Sufi (2011, 2014), Mian et al. (2013) inspire studies of regional business cycles. For instance, Beraja et al. (2019a) study the monetary transmission mechanism in an environment where collateral constraint, refinancing of mortgage, and consumption spending interact. Their structural estimation results suggest that the refinancing channel is essential. Moreover, "large variation in house price growth that was strongly correlated with local economic activity meant that monetary stimulus largely flowed to the locations that needed it least" (p.180).[37] This research may serve as a reminder to consider the regional differences in policy-making.

Beraja et al. (2019b) revisit the results of the Mian paper series by constructing a business cycle model that matches regional and aggregate data. They show analytically that the "wage elasticity with respect to the employment change" are fundamentally different at the aggregate and regional level. For instance, the interest rate would respond to the aggregate shock but not the regional shock. Regional shocks may be important to the movements in the local labor markets but not the aggregate counterpart. Based on the structural estimation using both regional and aggregate data, they find that the regional wage (i.e., at the state level) is much more flexible than the aggregate counterpart. And while the aggregate demand shocks are essential to explain the aggregate employment during the Great Recession, it is not so in the subsequent recovery.

[36] Liu and Williams (2019) also find substantial heterogeneity in states' response to a federal tax cut.
[37] See also Eichenbaum et al. (2022).

Jones et al. (2022) examine the extent to which the shocks to household credit are responsible for the cross-sectional and aggregate movements of employment and consumption. Like the Mian paper series, they find that states that experience more significant decreases in household debt also experience more considerable reductions in consumption and employment. Yet there may be other shocks that drive the movements. Jones et al. (2022) proceed in the following ways to quantify the importance of household credit shocks. They build a structural model in which households hit by liquidity shocks would have difficulty extracting home equity for consumption. In addition, there are other shocks in the model. They include the shocks on the time preference (the degree of patience-ness), the disutility of work (the willingness to work), housing preference (the desire to trade housing with consumption goods), and productivity, each with a regional-specific and an aggregate version. There is also a stochastic disturbance term in the monetary policy. They then estimate the model to match both regional and aggregate data.[38] They find that for 2007-2010, household credit shocks explain no more than a quarter of the decrease in employment. On the other hand, for 2007-2012, the household credit shocks could explain up to 40% of the cross-regional differences in employment and consumption. Part of the reason is the gradual deleveraging of the households leads to a gradual decrease in the natural interest rate. Thus, the significance of the housing and mortgage markets may vary over time.

Mabille (2020) builds an overlapping generations model in the spirit of Favilukis et al. (2022). Agents have a locational choice, which is to choose between two regions (high-price and low-price) that differ in terms of amenities and construction costs.

[38] There are some subtle differences in the estimation methods between Beraja et al. (2019b) and Jones et al. (2022). Please see the papers for details.

Agents also have tenure choice, which is to rent or own. Since income risk is idiosyncratic and risk-sharing is incomplete, loan-to-value (LTV) and payment-to-income (PTI) constraints can bind; some agents have to rent in equilibrium. The model is calibrated to match aggregate and regional facts of the United States. The model naturally mimics that the young homeownership rate drops more in the high-price region than in the low-price counterpart. The counterfactual experiment shows that place-based subsidies are more effective. Mabille (2020) also shows how we can combine that study of affordability with recognizing regional market differences. These papers demonstrate that a new generation of structural macro-housing models with aggregate shock and regional heterogeneity can complement the large-scale reduced form estimation. In particular, it helps us to identify to what extent the regional differences are given and to what extent those differences come from economic agents' decisions. Such an understanding often leads to a more accurate estimate of what policies can (and cannot) achieve.

There are other significant developments in macro-housing research, such as the issue of endogenous housing supply (Epple et al., 2010; Fan et al., 2022; Leung et al., 2020a; Sun and Yiu, 2022). COVID-19 might also bring both short-term and long-term changes. First, the work-from-home (WFH) movement may change the demand for space (Aksoy et al., 2022; Van Nieuwerburgh, 2022), etc. Second, the labor supply has decreased (Chetty et al., 2022; Greenwood et al., 2022). Future research on macro-housing should study the implications of all these changes.

Theoretical models become increasingly realistic and may generate little analytical results. Instead, models become more "calibrate-able" and built to match micro data. We might not have a "paradigm" or a "work-horse" model for the macro-housing literature. Instead, the model design is influenced by the research questions and data available. At the same time,

technology has empowered those models to compute the aggregate implications in terms of output or consumption, or welfare. Such may be the future macro-housing research.

References

Aastveit, K.A., Francesco Furlanetto, F. & Francesca Loria, F. (2021). Has the Fed Responded to House and Stock Prices? A Time-Varying Analysis, forthcoming in *Review of Economics and Statistics*.

Abramson, B. (2021). The Welfare Effects of Eviction and Homelessness Policies, mimeo.

Acemoglu, D., Carvalho, V. M., Ozdaglar, A. & Tahbaz-Salehi, A. (2012). The Network Origins of Aggregate Fluctuations. *Econometrica* 80(5), 1977–2016.

Acemoglu, D., Ozdaglar, A. & Tahbaz-Salehi, A. (2017). Microeconomic Origins of Macroeconomic Tail Risks. *American Economic Review* 107(1), 54–108.

Adam, K. & Woodford, M. (2021). Robustly optimal monetary policy in a new Keynesian model with housing, *Journal of Economic Theory*, 198(C), Article 105352.

Agarwal, S. & Varshneya, S. (2022) Financial crisis and the U.S. mortgage markets – a review, chpt 9, in C. K. Y. Leung ed., *Handbook of Real Estate and Macroeconomics*, Northampton, M.A., USA.

Ahn, S., Kaplan, G., Moll, B., Winberry, T. and Wolf, C. (2018). When inequality matters for macro and macro matters for inequality. *NBER Macroeconomics Annual*, 32(1): 1–75.

Aksoy, C.G., Barrero, J.M., Bloom, N., Davis, S.J., Dolls, M., Zarate, P., (2022). Working from home around the world. Forthcoming in *Brookings Papers on Economic Activity*.

Albouy, D., Ehrlich, G. & Liu, Y. (2016). Housing Demand, Cost-of-Living Inequality, and the Affordability Crisis, NBER Working Paper No. 22816.
https://www.nber.org/papers/w22816

An, X., Gabriel, S. A. & Tzur-Ilan, N. (2022). More than Shelter: The Effect of Rental Eviction Moratoria on Household Well-Being, *American Economic Review Papers and Proceedings, 112, 308–312.*

Atalay, E. (2017). How Important Are Sectoral Shocks?, *American Economic Journal: Macroeconomics*, 9(4), 254-280.

Azariadis, C. (2018). Riddles and Models. *Journal of Economic Literature*, 56(4), 1538-1576.

Baqaee, D. R. & Farhi, E. (2020). Productivity and Misallocation in General Equilibrium, *Quarterly Journal of Economics*, 135(1), 105-163.

Bardhan, A., Edelstein, R. and Kroll, C. (Ed.) (2012). *Global Housing Markets: Crises, Policies, and Institutions*. New York: John Wiley.

Baxter, M. (1996). Are Consumer Durables Important for Business Cycles. *Review of Economics and Statistics* 78(1): 147-155.

Behrens, K., Duranton, G. & Robert-Nicoud, F. (2014). Productive Cities: Sorting, Selection, and Agglomeration, *Journal of Political Economy*, 122(3), 507-553.

Ben-Shahar, D., Gabriel, S. & Golan, R. (2020a) Can't get there from here: Affordability distance to a superstar city, *Regional Science and Urban Economics*, Article 103357.

Ben-Shahar, D., Gabriel, S. & Oliner, S. (2020b) New research on housing affordability, *Regional Science and Urban Economics*, Article 103438.

Ben-Shafar, D., Leung, C. and Ong, S. E. (Ed.) (2008). *Mortgage Market Worldwide.* Oxford: Blackwell.

Beraja, M., Fuster, A., Hurst, E. & Vavra, J. (2019a). Regional Heterogeneity and the Refinancing Channel of Monetary Policy, *Quarterly Journal of Economics,* 134(1), 109-183.

Beraja, M., Hurst, E. & Ospina, J. (2019b). The Aggregate Implications of Regional Business Cycles, *Econometrica*, 87(6), 1789-1833.

Berliant, M. & Wang, P. (2019). General Equilibrium Theories of Spatial Agglomeration, In the *Oxford Research Encyclopedia of Economics and Finance*, Oxford University Press. https://oxfordre.com/economics/view/10.1093/acrefore/9780190625979.001.0001/acrefore-9780190625979-e-550

Bhattacharya, P. S. (2022). Land and Macroeconomics, chpt 3, in C. K. Y. Leung ed., *Handbook of Real Estate and Macroeconomics*, Northampton, M.A., USA.

Brandts, J., Busom, I., Lopez-Mayan, C. & Panadés, J. (2022). Dispelling misconceptions about economics, *Journal of Economic Psychology*, 88, article 102461.

Bryan, G., Glaeser, E. and Tsivanidis, E. (2019). Cities in the Developing World, NBER Working Papers 26390. http://www.nber.org/papers/w26390

Burnside, C., Eichenbaum, M., Rebelo, S. (2016). Understanding Booms and Busts in Housing Markets, *Journal of Political Economy*, 124, 1088–1147.

Caplan, B. (2002). Systematically Biased Beliefs About Economics: Robust Evidence of Judgemental Anomalies from the Survey of Americans and Economists on the Economy, *Economic Journal*, 112(479), 433-458.

Carvalho, V. M., & Gabaix, X. (2013). The Great Diversification and Its Undoing, *American Economic Review,* 103 (5): 1697–1727.

Carvalho, V. M. & Grassi, B. (2019). Large Firm Dynamics and the Business Cycle, *American Economic Review*, 109(4), 1375-1425.

Case, K. E., Quigley, J. M. & Shiller, R. J. (2005). Comparing Wealth Effects: The Stock Market versus the Housing Market, *B.E. Journal of Macroeconomics*, 5(1), 1-34.

Chambers, M.S., Garriga, C. & Schlagenhauf, D. (2009a). Accounting for changes In the homeownership rate, *International Economic Review*, 50(3), 677-726.

Chambers, M.S., Garriga, C. & Schlagenhauf, D. (2009b). The loan structure and housing tenure decisions in an equilibrium model of mortgage choice, *Review of Economic Dynamics*, 12, 444–468.

Chang, K. L. & Leung, C. K. Y. (2022). How did the asset markets change after the Global Financial Crisis? chpt 12, in C. K. Y. Leung ed., *Handbook of Real Estate and Macroeconomics*, Northampton, M.A., USA.

Chang, Y. (2000). Comovement, Excess Volatility, and Home Production. *Journal of Monetary Economics* 46(2): 385-396.

Chen, J. & Nong, H. (2016). The heterogeneity of market supply effects of public housing provision: Empirical evidence from China, *Journal of Housing Economics*, 33, 115–127.

Chen, N. K., Cheng, H. L. and Chu, H. L. (2015). Asset Price and Monetary Policy: The Effect of Expectations Formation. *Oxford Economic Papers* 67(2): 380-405.

Chen, N. K., and Leung, C. (2008). Asset Price Spillover, Collateral and Crises: with An Application to Property Market Policy. *Journal of Real Estate Finance and Economics* 37(4): 351-385.

Chen, N. K. and Wang, H. J. (2007). The Procyclical Leverage Effect of Collateral Value on Bank Loans-Evidence from The Transaction Data of Taiwan. *Economic Inquiry* 45(2): 395-406.

Cherrier, B. (2017). Classifying Economics: A History of the "JEL." *Journal of Economic Literature*, 55(2), 545-579.

Chetty, R., Friedman, J. N., Hendren, N., Stepner, M. & the Opportunity Insights Team (2022). The Economic Impacts of COVID-19: Evidence from a New Public Database Built Using Private Sector Data, working paper.

Chodorow-Reich, G. (2020). Regional data in macroeconomics: Some advice for practitioners, *Journal of Economic Dynamics and Control*, 115, Article 103875.

Christelis, D., Georgarakos, D., Jappelli, T., Pistaferri, L. & Rooij, M. v., (2021). Heterogeneous wealth effects, *European Economic Review*, forthcoming.

Clifford, B., Wilson, A. & Harris, P. (2019). Homelessness, health and the policy process: A literature review, *Health Policy*, 123, 1125-1132.

Cobb-Clark, D. A. & Zhu, A. (2017). Childhood homelessness and adult employment: the role of education, incarceration, and welfare receipt, *Journal of Population Economics*, 30, 893-924.

Cohen, E. (2022). The Effect of Housing First Programs on Future Homelessness and Socioeconomic Outcomes, Federal Reserve Bank of Kansas City Working Paper.

Collinson, R., Humphries, J. E., Mader, N. S., Reed, D. K., Tannenbaum, D. I., & Dijk, W. v. (2022). Eviction and Poverty in American Cities, NBER Working Paper No. 30382, http://www.nber.org/papers/w30382.

Colonnello, S., Marfe, R. & Xiong, Q. (2021). Housing Yields, mimeo.

Cooley, T. and Prescott, E. (1995). Economic Growth and Business Cycles. In T. Cooley (ed.), *Frontiers of Business Cycle Research*, Princeton: Princeton University Press**.**

Corbae, D., Glover, A. & Nattinger, M. (2022). Equilibrium Eviction, mimeo.

Couture, V., Gaubert, C., Handbury, J. & Hurst, E. (2021). Income Growth and the Distributional Effects of Urban Spatial Sorting, https://erikhurst.com/wp-content/uploads/2021/11/gentrification_nov2021.pdf

Dalmazzo, A., de Blasio, G., Poy, S. (2022). Can Public Housing Trigger Industrialization? *Journal of Housing Economics*, 57, article 101853.

Davis, M. and Heathcote, J. (2005). Housing and The Business Cycle. *International Economic Review* 46(3): 751-784.

Davis, M. and Van Nieuwerburgh, S. (2014). Housing, Finance and The Macroeconomy, NBER Working paper No. 20287. http://www.nber.org/papers/w20287

de Bartolome, C. A. M. & Ross, S. L. (2003). Equilibria with local governments and commuting: income sorting vs income mixing, *Journal of Urban Economics*, 54(1), 1-20.

Deng, Y., Qin, Y. & Wu, J. (2019) Superstar cities and the globalization pressures on affordability, *Journal of Housing Economics*, Article 101638.

Deng, Y., Quigley, J. M. and Van Order, R. (2000). Mortgage Terminations, Heterogeneity and the Exercise of Mortgage Options, *Econometrica*, 68(2), 275-308.

Deng, Y., Tang, Y., Ping Wang, P. & Wu, J. (2020). Spatial Misallocation in Chinese Housing and Land Markets, NBER Working Papers 27230, http://www.nber.org/papers/w27230

Diamond, R., McQuade, T. & Qian, F. (2019). The Effects of Rent Control Expansion on Tenants, Landlords, and Inequality: Evidence from San Francisco, *American Economic Review*, 109, 3365-94.

Dietz, R. D. and Haurin, D. R. (2003). The social and private micro-level consequences of homeownership, *Journal of Urban Economics*, 54, 401-450.

Duca, J. V., Muellbauer, J. & Murphy, A. (2021). What Drives House Price Cycles? International Experience and Policy Issues, *Journal of Economic Literature,* 59(3), 773-864.

Duranton, G. & Puga, D. (2014). The Growth of Cities, in P. Aghion & S. Durlauf (ed.), *Handbook of Economic Growth*, vol. 2, chapter 5, 781-853, Elsevier.

Edelstein, R. and Kim, K. H. (2004). Special Issue on Housing and The Macroeconomy: The Nexus. *Journal of Housing Economics* 13 (4): 247-248.

Eeckhout, J., Pinheiro, R. & Schmidheiny, K. (2014). Spatial Sorting, *Journal of Political Economy*, 122(3), 554 – 620.

Eichholtz, P., Kok, N. and Quigley, J. M. (2010). Doing Well by Doing Good? Green Office Buildings, *American Economic Review*, 100(5), 2492-2509.

Eichenbaum, M., Rebelo, S. & Wong, A. (2022). State-Dependent Effects of Monetary Policy: The Refinancing Channel, *American Economic Review*, 112(3), 721-761.

Epple, D., Brett Gordon, B. & Sieg, H. (2010). A New Approach to Estimating the Production Function for Housing, *American Economic Review*, 100(3), 905-924.

Fan, Y., Leung, C. K. Y. & Yang, Z. (2022) Financial Conditions, Local Competition, and Local Market Leaders: The Case of Real Estate Developers, *Pacific Economic Review*, 27, 131-193.

Favilukis, J., Mabille, P. & Van Nieuwerburgh, S. (2022) Affordable Housing and City Welfare, *Review of Economic Studies*, forthcoming.

Fratantoni, M. & Schuh, S., (2003). Monetary policy, housing, and heterogeneous regional markets. *Journal of Money, Credit and Banking,* 35 (4), 557–589.

Fu, S. and Viard, V. B. (2022). A Mayor's Perspective on Tackling Air Pollution, chpt 16, in C. K. Y. Leung ed., *Handbook of Real Estate and Macroeconomics*, Northampton, M.A., USA.

Gabaix, X**. (**2011). The Granular Origins of Aggregate Fluctuations. *Econometrica* 79(3), 733–72.

Gabriel, S. & Painter, G. (2020) Why affordability matters, *Regional Science and Urban Economics*, Article 103378.

Gai, Q., Guo, N., Li, B., Shi, Q. & Zhu, X. (2021). Migration Costs, Sorting, and the Agricultural Productivity Gap, working paper.

Garriga, C. & Hedlund, A. (2020). Mortgage Debt, Consumption, and Illiquid Housing Markets in the Great Recession, *American Economic Review*, 110(6), 1603-1634.

Garriga, C., Hedlund, A., Tang, Y. & Wang, P. (2021). Rural-urban migration and house prices in China, *Regional Science and Urban Economics*, 91, Article 103613.

Garriga, C., Manuelli, R. & Adrian Peralta-Alva, A. (2019). Macroeconomic Model of Price Swings in the Housing Market, *American Economic Review*, 109(6), 2036-2072.

Gelain, P., Lansing, K. L. & Natvik, G. J. (2018). Explaining the Boom–Bust Cycle in the U.S. Housing Market: A Reverse-Engineering Approach, *Journal of Money, Credit and Banking*, 50(8), 1751-1783.

Genesove, D. and Han, L. (2012). Search and matching in the housing market, *Journal of Urban Economics*, 72(1), 31-45.

Giovannini, E. (2008). Understanding Economic Statistics: An OECD perspective, https://www.oecd.org/sdd/41746710.pdf

Girardin, E. & Joyeux, R. (2022). Testing for real estate bubbles, chpt 6, in C. K. Y. Leung ed., Handbook of Real Estate and Macroeconomics, Northampton, M.A., USA.

Glaeser, E L (2011). *Triumph of The City,* New York: Penguin Press.

Glaeser, E L (2013). A Nation of Gamblers: Real Estate Speculation and American History, *American Economic Review,* 103(3), 1-42.

Glaeser, E. L. & Gottlieb, J. D. (2009). The Wealth of Cities: Agglomeration Economies and Spatial Equilibrium in the United States, *Journal of Economic Literature*, 47(4), 983-1028.

Glaeser, E. L., Hanushek, E. A. & Quigley, J. M. (2004). Opportunities, race, and urban location: the influence of John Kain, *Journal of Urban Economics*, 56(1), 70-79.

Glaeser, E. L. & Kahn, M. E. (2010). The greenness of cities: Carbon dioxide emissions and urban development, *Journal of Urban Economics*, 67(3), 404-418.

Glaeser, E. L., Kerr, W. R. and Ponzetto, G. A.M. (2010). Clusters of entrepreneurship, *Journal of Urban Economics*, 67(1), 150-168.

Glaeser, E. L., Kim, H. and Luca, M. (2019). Nowcasting the Local Economy: Using Yelp Data to Measure Economic Activity," NBER Chapters, in K. Abraham, R. Jarmin, B. Moyer, M. Shapiro ed., *Big Data for Twenty-First-Century Economic Statistics*, National Bureau of Economic Research, Inc.

Glaeser, E. L., & Luttmer, E. (2003). The Misallocation of Housing Under Rent Control. *American Economic Review*, 93(4), 1027-1046.

Glandon, P. J., Kuttner, K., Mazumder, S., Caleb Stroup, C. (2022). Macroeconomic

Research, Present and Past, NBER Working Paper No. 29628.

http://www.nber.org/papers/w29628

Goldstein, G.S. and Moses, L. N. (1973) A Survey of Urban Economics, *Journal of Economic Literature*, 11(2), 471- 515.

Gong, Y. & Leung, C. K. Y. (2020). When education policy and housing policy interact: Can they correct for the externalities?, Journal of Housing Economics, vol. 50(C).

Gong, Y. & Leung, C. K. Y. (2021). Does Space Matter? The Case of a Cap on the Housing Expenditure Share, paper presented in AREUEA conference.

Goodman, A. C., M. Kawai, M. (1982). Permanent income, hedonic prices and demand for housing: New evidence, *Journal of Urban Economics*, 12, 214-237.

Goodman, L. S. & Mayer, C. (2018). Homeownership and the American Dream, *Journal of Economic Perspectives*, 32, 31-58.

Goodspeed, T. (2022). Trust the Experts? Relative Performance of Inflation Expectations, 1946-2022, available at https://live-hoover9.pantheonsite.io/sites/default/files/research/docs/22120-Goodspeed.pdf

Grech, E. & Raeburn, T. (2019). Experiences of hospitalised homeless adults and their health care providers in OECD nations: A literature review. *Collegian*, 26, 204-211.

Green, R. (2022). Is housing still the business cycles? Perhaps not. in C. K. Y. Leung ed., *Handbook of Real Estate and Macroeconomics*, Northampton, M.A., USA.

Green, R., Malpezzi, S., & Mayo, S. (2005). Metropolitan-specific estimates of the price elasticity of supply of housing, and their sources. *American Economic Review*, *95*(2), 334–339.

Greenwald, D. L. & Guren, A. (2021). Do Credit Conditions Move House Prices? Mimeo.

Greenwood, J., Guner, N. & Kopecky, K. (2022) Substance Abuse during the Pandemic: Implications for Labor-Force Participation, NBER Working paper No. 29932. http://www.nber.org/papers/w29932

Greenwood, J. and Hercowitz, Z. (1991). The Allocation of Capital and Time over the Business Cycle. *Journal of Political Economy* 99(6): 1188-1214.

Gyourko, J., C. Mayer, and T. Sinai (2013): "Superstar Cities," *American Economic Journal: Economic Policy*, 5(4), 167–99.

Halket, J. and Pignatti Morano di Custoza, M. (2015). Homeownership and The Scarcity of Rentals, *Journal of Monetary Economics* 76: 107-123.

Halket, J. and Vasudev, S. (2014). Saving Up or Settling Down: Home Ownership over The Life Cycle. *Review of Economic Dynamics* 17(2): 345-366.

Han, L., Ngai, L. R. & Sheedy, K. D. (2022). To Own or to Rent? The Effects of Transaction Taxes on Housing Markets, mimeo.

Hanushek, E., Sarpça, S. & Yilmaz, K. (2011). Private Schools and Residential Choices: Accessibility, Mobility, and Welfare, *B.E. Journal of Economic Analysis & Policy*, 11(1), 1-34.

Hanushek, E. & Yilmaz, K. (2007). The complementarity of Tiebout and Alonso, *Journal of Housing Economics*, 16(2), 243-261.

Hanushek, E. & Yilmaz, K. (2011). Urban Education, Location, and Opportunity in The United States. In N. Brooks, K. Donaghy, and G. Knaap (Ed.), *Oxford Handbook of Urban Economics and Planning* (pp. 583-615). Oxford: Oxford University Press.

Hanushek, E. & Yilmaz, K., (2022). Residential location and education in the United States. in C. K. Y. Leung ed., *Handbook of Real Estate and Macroeconomics*, Northampton, M.A., USA.

Hattori, T. and Yoshida, J. (2022). The Bank of Japan as a Real Estate Tycoon: Large-Scale REIT Purchases, chpt 2., in C. K. Y. Leung ed., *Handbook of Real Estate and Macroeconomics*, Northampton, M.A., USA.

Haurin, D. R., Dietz, R. D. and Weinberg, B. A. (2002). The impact of neighborhood homeownership rates: A review of the theoretical and empirical literature, *Journal of Housing Research*, 13, 119-151.

Hendershott, P., Hendershott, R., & Shilling, J. (2010). The mortgage finance bubble: Causes and corrections. *Journal of Housing Research*, *19*(1), 1–16.

Herkenhoff, K., Ohanian, L. E. & Prescott, E. C. (2018). Tarnishing the Golden and Empire States: Land-Use Regulations and the U.S. Economic Slowdown, *Journal of Monetary Economics,* 93, 89-109.

Huang, D., Leung, C. K. Y. & Qu, B. (2015). Do Bank Loans and Local Amenities Explain Chinese Urban House Prices? *China Economic Review* 34, 19-38.

Huang, D., Leung, C. K. Y. & Tse, C. Y. (2018). What account for the differences in rent-price ratio and turnover rate? A search-and-matching approach, *Journal of Real Estate Finance and Economics*, 57(3), 431-475.

Hubbard, G. & O'Brien, A. P. (2022). *Economics*, 8th edition, New York: Peearson.

Iacoviello, M. (2005). House Prices, Borrowing Constraints, and Monetary Policy in The Business Cycle. *American Economic Review* 95(3), 739-764.

Jones, C., Midrigan, V. & Philippon, T. (2022). Household leverage and the recession, *Econometrica*, 90(5), 2471-2505.

Jones, T. & Sirmans, G. S. (2015). The Underlying Determinants of Residential Mortgage Default, *Journal of Real Estate Literature*, 23, 167-205.

Jones, T. & Sirmans, G. S. (2019). Understanding Subprime Mortgage Default, *Journal of Real Estate Literature*, 27:1, 27-52.

Joya, O. & Rougier, E. (2019). Do (all) sectoral shocks lead to aggregate volatility? Empirics from a production network perspective, *European Economic Review*, 113(C), 77-107.

Justiniano, A., Primiceri, G., & Tambalotti, A. (2016). A simple model of subprime borrowers and credit growth. *American Economic Review*, *106*(5), 543–547.

Kahn, M., Wu, J., Sun, W. and Zheng, S. (2022). Industrial parks and urban growth: A political economy story in China, chpt 14, in C. K. Y. Leung ed., *Handbook of Real Estate and Macroeconomics*, Northampton, M.A., USA.

Kalikman, P. L. & Scally, J. (2022). Mortgage Default: A Heterogeneous-Agent Model, mimeo.

Kan, K. (2000). Dynamic Modeling of Housing Tenure Choice, *Journal of Urban Economics*, 48(1), 46-69.

Kan, K., Kwong, S. K. S., Leung, C. K. Y. (2004). The dynamics and volatility of commercial and residential property prices: theory and evidence, *Journal of Regional Science,* 44(1), 95-123.

Kaplan, G., Mitman, K. & Violante, G. L. (2020). The Housing Boom and Bust: Model Meets Evidence, *Journal of Political Economy*, 128(9), 3285-3345.

Kaplan, G. & Violante, G. L. (2014). A Model of the Consumption Response to Fiscal Stimulus Payments, *Econometrica*, 82(4), 1199-1239.

Kaplan, G. & Violante, G. L. (2018). Microeconomic Heterogeneity and Macroeconomic Shocks, *Journal of Economic Perspectives*, 32(3), 167-194.

Kaplan, G., Violante, G. L. & Weidner, J. (2014). The Wealthy Hand-to-Mouth, *Brookings Papers on Economic Activity*, 45(1), Spring, 77-153.

Kehoe, P. J., Midrigan, V. & Pastorino, E. (2016). Debt Constraints and the Labor Wedge, *American Economic Review*, 106(5), 548-553.

Kehoe, P. J., Midrigan, V. & Pastorino, E. (2018). Evolution of Modern Business Cycle Models: Accounting for the Great Recession, *Journal of Economic Perspectives*, 32(3), 141-166.

King, R. G. and Rebelo, S. (1999), Resuscitating Real Business Cycles, in J. B. Taylor and M. Woodford (eds.), Handbook of Macroeconomics, Amsterdam: Elsevier, 928–1002.

Kiyotaki, N. and Moore, J. (1997). Credit Cycles. *Journal of Political Economy* 105(2): 211-248.

Kladivko, K. & Österholm, P. (2020). Can Households Predict where the Macroeconomy is Headed? Available at: https://www.econstor.eu/bitstream/10419/244569/1/wp2020-11.pdf

Krainer, J. (2001). A theory of liquidity in residential real estate markets. *Journal of Urban Economics*, 49, 32-53.

Krueger, D., Mitman, K. and Perri, F. (2016). Macroeconomics and Household heterogeneity.

Chap. 11 in *Handbook of Macroeconomics*, vol. 2A, edited by J. B. Taylor and H. Uhlig. Elsevier.

Kuchler, T., Piazzesi, M. & Stroebel, J. (2022). Housing Market Expectations, NBER Working Paper No. 29909, http://www.nber.org/papers/w29909

Kwan, Y. K., Leung, C. K. Y., & Dong, J. (2015). Comparing consumption-based asset pricing models: The case of an Asian city. *Journal of Housing Economics*, *28*, 18–41.

Kydland, F. E. & Prescott, E. C. (1982). Time to Build and Aggregate Fluctuations, *Econometrica*, 50, 1345–1370.

LaCour-Little, M. (2008). Mortgage Termination Risk: A Review of the Recent Literature, *Journal of Real Estate Literature*, 16, 295-326.

Lai, R. N. & Van Order, R. A. (2022). Disaggregating house price dynamics, chpt 7, in C. K. Y. Leung ed., *Handbook of Real Estate and Macroeconomics*, Northampton, M.A., USA.

Landvoigt, T., Piazzesi, M. & Schneider, M. (2015). The Housing Market(s) of San Diego, *American Economic Review*, 105(4), 1371-1407.

Lazear, E. (1991). Labor Economics and the Psychology of Organizations, *Journal of Economic Perspectives*, 5(2), 89-110.

Leung, C. (1999). Income Tax, Property Tax, and Tariff in A Small Open Economy. *Review of International Economics* 7(3): 541-554.

Leung, C. (2001). Relating International Trade to The Housing Market. *Review of Development Economics* 5(2): 328-35.

Leung, C. (2003). Economic Growth and Increasing House Price. *Pacific Economic Review* 8(2): 183-190.

Leung, C. (2004). Macroeconomics and Housing: a review of the literature. *Journal of Housing Economics,* 13, 249-267.

Leung, C. K. Y. (2007). Equilibrium correlations of asset price and return, *Journal of Real Estate Finance and Economics,* 34, 233-256.

Leung, C. K. Y. (2014). Error correction dynamics of house price: An equilibrium benchmark, *Journal of Housing Economics,* 25, 75-95.

Leung, C. K. Y. ed. (2022). *Handbook of Real Estate and Macroeconomics*, Northampton, M.A., USA.

Leung, C., & Chen, N. K. (2006). Intrinsic cycles of land price: A simple model. *Journal of Real Estate Research*, *28*(3), 293–320.

Leung, C., Leong, Y. C. F., & Wong, K. S. K. (2006). Housing price dispersion: An empirical investigation. *Journal of Real Estate Finance and Economics*, *32*(3), 357–385.

Leung, C. K. Y. & Ng, C. Y. J. (2019). Macroeconomic Aspects of Housing. In the *Oxford Research Encyclopedia of Economics and Finance*, Oxford University Press. https://oxfordre.com/economics/view/10.1093/acrefore/9780190625979.001.0001/acrefore-9780190625979-e-294

Leung, C. K. Y., Ng, J. C. Y. & Tang, E. C. H. (2020a). What do we know about Housing Supply? The case of Hong Kong, *Economic and Political Studies*, 8(1), 6-20.

Leung, C. K. Y., Ng, J. C. Y. & Tang, E. C. H. (2020b). Why is the Hong Kong housing market unaffordable? Some Stylized facts and estimations, *Quarterly Bulletin*, *Central Bank of the Republic of China (Taiwan)*, 42 (1), 5-58. https://www.cbc.gov.tw/tw/cp-705-111879-488e5-1.html

Leung, C. K. Y. & Quigley, J. (2007). Special Issue on Macroeconomics, Regulation, and Housing: Introduction. *Journal of Housing Economics* 16: 99-101.

Leung, C. K. Y., Sarpça, S. & Yilmaz, K. (2012). Public housing units vs. housing vouchers: Accessibility, local public goods, and welfare, *Journal of Housing Economics*, 21(4), 310-321.

Leung, C. K. Y. & Tang, E. C. H. (2023). The dynamics of the house price-to-income ratio: Theory and evidence, *Contemporary Economic Policy*, 41, 61-78.

Leung, C. K. Y. & Teo, W. L. (2011). Should the optimal portfolio be region-specific? A multi-region model with monetary policy and asset price co-movements, *Regional Science and Urban Economics*, 41(3), 293-304.

Leung, C. K. Y. & Tsang, K. P. (2023). A special issue on housing affordability: An introduction, *Contemporary Economic Policy*, 41, 7-8.

Leung, C. K. Y. & Tse, C. Y. (2017). Flipping in the housing market, *Journal of Economic Dynamics and Control*, 76, 232-263.

Li, S. M. & Yu, F. L. (1990). The redistributive effects of Hong Kong's public housing programme 1976-86. *Urban Studies,* 27, 105–117.

Ling, D. C., Ooi, J. T. L. & Le, T. T. T. (2015). Explaining House Price Dynamics: Isolating the Role of Nonfundamentals. *Journal of Money Credit and Banking*, 47(S1), 87– 125.

Liu, C. & Williams, N. (2019). State-level implications of federal tax policies, *Journal of Monetary Economics*, 105(C), 74-90.

Lubik, T. and Surico, P. (2010). The Lucas critique and the stability of empirical models, *Journal of Applied Econometrics*, 25(1), 177-194.

Lucas, R.E., (1976). Econometric policy evaluation: A critique, in: K. Brunner and A.H. Meltzer, eds., The Phillips curve and labor markets, Carnegie-Rochester conferences on public policy 1 (North-Holland, Amsterdam).

Lucas, R. E. and Sargent, T. J. (1978). After Keynesian macroeconomics, in *After the Phillips curve: Persistence of high inflation and high unemployment*. Federal Reserve Bank of Boston, Boston, M.A.

Mabille, P. (2020). The Missing Home Buyers: Regional Heterogeneity and Credit Contractions, working paper.

Maćkowiak, B., Matějka, F. & Wiederholt, M. (2021). Rational Inattention: A Review, ECB working paper.

MacRae, C.D., Struyk, R.J. (1977). The Federal Housing Administration (FHA), tenure choice, and residential land use, *Journal of Urban Economics*, 4(3), 360-378.

Malpezzi, S. (1999). Economic analysis of housing markets in developing and transition economies, in: P. C. Cheshire & E. S. Mills (ed.), *Handbook of Regional and Urban Economics*, volume 3, chapter 44, pages 1791-1864, Elsevier.

Malpezzi, S. (2001). The Contributions of Stephen K. Mayo to Housing and Urban Economics, *Journal of Housing Economics*, 10(2), 72-108.

Malpezzi, S. (2017). Residential Real Estate in The U.S. Financial Crisis, The Great Recession, and Their Aftermath. *Taiwan Economic Review* 45(1): 5-56.

Malpezzi, S. (2018). The Wisconsin Program in Real Estate and Urban Land Economics: A Century of Tradition and Innovation. University of Wisconsin-Madison, Mimeo.

Malpezzi, S. (2020). Global Perspectives on Real Estate and Urban Development in a Time of Stress. University of Wisconsin-Madison, Mimeo.

Malpezzi, S. (2023) Housing affordability and responses during times of stress: A preliminary look during the COVID-19 pandemic, *Contemporary Economic Policy*, 41, 9-40.

Malpezzi, S. & Vandell, K. (2002) Does the low-income housing tax credit increase the supply of housing?, *Journal of Housing Economics*, 11(4), 360-380.

McDonald, J. & D. McMillen, D. (2010). *Urban Economics and Real Estate: Theory and Policy*, 2nd Edition, New York: Wiley.

Mian, A. & Sufi, A. (2011). House Prices, Home Equity-Based Borrowing, and the U.S. Household Leverage Crisis, *American Economic Review*, 101(5), 2132-2156.

Mian, A. & Sufi, A. (2014). What Explains the 2007-2009 Drop in Employment? *Quarterly Journal of Economics*, 82(6), 2197-2223.

Mian, A., Rao, K. & Sufi, A. (2013). Household Balance Sheets, Consumption, and the Economic Slump, *Quarterly Journal of Economics*, 128(4), 1687-1726.

Murray, M. (1983). Subsidized and Unsubsidized Housing Starts: 1961-1977, *Review of Economics and Statistics*, 65(4), 590-597.

Ng, J. C. Y. (2022). International Macroeconomic Aspects of Housing, chpt 11, in C. K. Y. Leung ed., *Handbook of Real Estate and Macroeconomics*, Northampton, M.A., USA.

Ng, J. C. Y., Leung, C. K. Y. and Chen, S. (2022). Corporate Real Estate Holding and Stock Returns: Testing Alternative theories with international Listed firms, *Journal of Real Estate Finance and Economics*, forthcoming.

Ngai, L. R., Sheedy, K. (2020). The Decision to Move House and Aggregate Housing-Market Dynamics *Journal of the European Economic Association*, 18(5), 2487-2531.

OECD (2022). Housing tenures, https://www.oecd.org/els/family/HM1-3-Housing-tenures.pdf (retrieved 2022/07).

O'Flaherty, B., Scutellab, R., & Tseng, Y.P. (2018). Private information, exits from homelessness, and better ways to operate rehousing programs, *Journal of Housing Economics*, 41, 93-105.

Ogawa, K. (2022). Real Estate Market and Consumption: Macro and Micro Evidence of Japan, chpt 1, in C. K. Y. Leung ed., *Handbook of Real Estate and Macroeconomics*, Northampton, M.A., USA.

Ogawa, K., Kitasaka, S. I., Yamaoka, H., and Iwata, Y. (1996). Borrowing constraints and the role of land asset in Japanese corporate investment decision. *Journal of the Japanese and International Economies*, *10*(2), 122-149.

Oikarinen, E., Bourassa, S.C., Hoesli, M. & Engblom, J. (2018). U.S. Metropolitan House Price Dynamics, *Journal of Urban Economics,* 64, 54-69.

Ortalo-Magné, F. & Prat, A. (2014). On the Political Economy of Urban Growth: Homeownership versus Affordability, *American Economic Journal: Microeconomics,* 6(1), 154-181.

Ortalo-Magné, F. and Rady, S. (2006). Housing Market Dynamics: On The Contribution of Income Shocks and Credit Constraints. *Review of Economic Studies* 73(2): 459-485.

Ortalo-Magné, F. and Rady, S. (2008). Heterogeneity within communities: A stochastic model with tenure choice, *Journal of Urban Economics*, 64(1), 1-17.

Parkhomenko, A. (2020). Local Causes and Aggregate Implications of Land Use Regulation, retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3739183 .

Parkhomenko, A. (2022). Homeownership, Polarization, and Inequality, retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3854352 .

Painter, G., Gabriel, S., Myers, D. (2001). Race, Immigrant Status, and Housing Tenure Choice, *Journal of Urban Economics*, 49(1), 150-167.

Phang, S. Y., & Helble, M. (2016). Housing policies in Singapore, retrieved from https://www.adb.org/sites/default/files/publication/181599/adbi-wp559.pdf

Piazzesi, M. and Schneider, M. (2016). Housing and Macroeconomics (Working paper No. 22354). http://www.nber.org/papers/w22354

Pinto, S. M. & Sarte, P. D. (2022). From the Regional Economy to the Macroeconomy, chpt 13, in C. K. Y. Leung ed., *Handbook of Real Estate and Macroeconomics*, Northampton, M.A., USA.

Quigley, J. M. and Van Order, R. (1995). Explicit Tests of Contingent Claims Models of Mortgage Default, *Journal of Real Estate Finance and Economics*, 11(2), 99-117.

Rebelo, S. (2005). Real Business Cycle Models: Past, Present, and Future, *Scandinavian Journal of Economics*, 107(2), 217–238.

Redding, S. J. & Rossi-Hansberg, E. (2017). Quantitative Spatial Economics, *Annual Review of Economics*, 9(1), 21-58.

Riddiough, T. (2022). Pension Funds and Private Equity Real Estate: History, Performance, Pathologies, Risks, chpt 15, in C. K. Y. Leung ed., *Handbook of Real Estate and Macroeconomics*, Northampton, M.A., USA.

Runge, J. & Hudson, N. (2020). Public Understanding of Economics and Economic Statistics, available at https://www.escoe.ac.uk/publications/public-understanding-of-economics-and-economic-statistics/

Sagi, J. S. (2021). Asset-level risk and return in real estate investments. *Review of Financial Studies,* 34, 3647–3694.

Saiz, A. (2010). The Geographic Determinants of Housing Supply, *Quarterly Journal of Economics,* 125(3), 1253-1296.

Sims, C. A. (2003). Implications of rational inattention. *Journal of Monetary Economics*, 50(3), 665-690.

Sinai, T. & Waldfogel, J. (2005). Do low-income housing subsidies increase the occupied housing stock?, *Journal of Public Economics*, 89(11–12), 2137-2164.

Soo, C. K. (2018). Quantifying Sentiment with News Media across Local Housing Markets, *Review of Financial Studies*, 31(10), 3689–3719.

Su, H. L. (2021). Financial Frictions, Capital Misallocation, and Input-Output Linkages, retrieved from https://drive.google.com/file/d/1F3GbAHBNO6Y65PAGD3BRvYDrVK6EgJU2/view .

Sun, W. & Yiu, M. (2023) Financial conditions and the well-being of the real estate sector—A bottom-up default analysis on five ASEAN Economies, *Contemporary Economic Policy*, 41, 41-60.

Tiwari, P. and Rao, J. (2022). The Housing Conundrum in India, chpt 4, in C. K. Y. Leung ed., *Handbook of Real Estate and Macroeconomics*, Northampton, M.A., USA.

Tonetii, C. (2018). Comment on "Tarnishing the golden and empire states: Land-use regulations and the U.S. economic slowdown," by Herkenhoff, Ohanian, and Prescott, *Journal of Monetary Economics,* 93, 110-113.

Tse, C. Y. & Leung, C. K. Y. (2002). Increasing Wealth and Increasing Instability: The Role of Collateral, *Review of International Economics*, 10(1), 45-52.

Van Eyden, R., Gupta, R., Andre, C. & Sheng, X. (2022). The effect of macroeconomic uncertainty on housing returns and volatility: evidence from US state-level data, chpt 8, in C. K. Y. Leung ed., *Handbook of Real Estate and Macroeconomics*, Northampton, M.A., USA.

Van Nieuwerburgh, S. (2022). The Remote Work Revolution: Impact on Real Estate Values and the Urban Environment, NBER Working Paper No. 30662, Retrieved from http://www.nber.org/papers/w30662

Waltl, S. (2018). Estimating quantile-specific rental yields for residential housing in Sydney, *Regional Science and Urban Economics*, 68, 204-225.

Wang, P., and Xie, D. (2022). Housing Dynamics: Theory Behind Empirics, (Working paper No. 30516). Retrieved from http://www.nber.org/papers/w30516

Wu, J., Gyourko, J. and Deng, Y. (2012). Evaluating Conditions in Major Chinese Housing Markets. *Regional Science and Urban Economics* 42(3) 531-543.

Wu, J., Gyourko, J. and Deng, Y. (2016). Evaluating The Risk of Chinese Housing Markets: What We Know and What We Need to Know. *China Economic Review* 39: 91-114.

Xiao, W. (2022). Understanding probabilistic expectations –a behavioral approach, *Journal of Economic Dynamics and Control*, 139, Article 104416.

Yao, Y. (2021). Land and the Rise in the Dispersion of House Prices and Rents across U.S. Cities, retrieved from https://drive.google.com/file/d/1thZ9ry-sFeTRpYa_b0L0KHtxYJr3McS7/view

Yao, Y. (2023). Accounting for the decline in homeownership among the young, *Contemporary Economic Policy*, 41, 79-102.

Yılmaz, K. & Yeşilırmak, M. (2023). Access to transportation, residential segregation, and economic opportunity, *Contemporary Economic Policy*, 41, 103-127.