# Real Estate Bubbles and Urban Development

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Real estate booms have regularly occurred throughout the world, leaving painful busts and financial crises in their wake. Real estate is a natural investment for more passive debt investors, including banks, because real estate's flexibility makes it a better source of collateral than production facilities built for a specific purpose. Consequently, passive capital may flow disproportionately into real estate and help generate real estate bubbles. The preference of banks for more fungible real estate assets also explains why real estate is so often the source of a financial crisis. Real estate bubbles can be welfare enhancing if cities would otherwise be too small, either because of agglomeration economies or building restrictions. But given reasonable parameters, the large welfare costs of any financial crisis are likely to be higher than the modest benefits of extra building. The benefits of real estate bubbles are welfare "triangles," while the costs of widespread default are welfare "rectangles."

*Keywords:* agglomeration economies, financial crises, real estate bubbles
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## I. Introduction

Housing prices increased 15.9% annually between 2003 and 2013 in the People's Republic of China's (PRC) most economically successful cities in real terms (Fang et al. 2016). Between 2011 and 2014, the PRC built 106.5 billion square feet of floor space (Glaeser et al. 2017). Inevitably, some have claimed that the PRC's property market is a bubble waiting to burst as real estate crises have been common in the developing world. The 1997/98 Asian financial crisis was associated with extensive building and declining real estate prices in Bangkok; Jakarta; and even Hong Kong, China. Japan's massive post-1990 real estate bust set the stage for that country's 2 lost decades.

Glaeser et al. (2017) argue that the PRC's real estate prices might maintain their value if new supply is limited over the next 15 years, but divining the future of Chinese real estate prices is not the purpose of this paper. This paper addresses

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the larger question of why real estate booms and busts are so common and whether they can be good for growth. The urban history of the United States (US) is replete with real estate speculation, and at least some of that speculation ended without catastrophe (Glaeser 2013).

Section II of this paper provides a brief discussion of past US and Asian real estate booms. Typically, bubble-like events have occurred at moments of extraordinary positive change, such as amid a revolution in transportation or building technology, or during periods of widespread industrial growth. Consequently, high prices were sensible given reasonable beliefs about the future demand for space. High prices were also often associated with large booms in building both structures and infrastructure. New York's traditional skyline owes its shape to that city's late-1920s real estate boom.

Section III provides a simple model to explain why real estate booms occur so frequently. Land has been the most common store of wealth throughout human history because it is harder to expropriate than other assets, both intrinsically and because Western law was partially built around the process of defending land ownership (Glaeser, Ponzetto, and Shleifer 2016). Well-defined property rights for land make it suitable collateral. Buildings are typically constructed for a less specific purpose than factories, which means that it is easier for creditors to realize value from foreclosed real estate. The attraction of real estate to passive debt investors means that credit booms have often enabled developers to make large and leveraged bets on real estate. Strong property rights and the relative flexibility of buildings in terms of their use do not make bubbles inevitable, but these forces do explain why excessive optimism can often lead to robust real estate markets.

In this paper's model, there are both passive and active investors, where active investors can manage their investments and passive investors must trust managers. In the event of a default, passive investors lose value, but they lose less value with real estate than with factories. Consequently, active capital, which is in limited supply, specializes in industry, while passive capital specializes in buildings. If there is overoptimism, then the flow of passive capital into real estate will rise and there will be a bubble. Since the supply of active capital is limited, overoptimistic beliefs increase the level of real estate investment more than they increase investment in export industries.

Olivier (2000) argued that there were conditions under which rational asset bubbles were growth enhancing and the same is true about irrational real estate bubbles. Urban economists have long believed that there are positive (as well as negative) externalities associated with working in cities. These agglomeration economies can mean that cities are too small in the absence of appropriate government policy. Cities can also be too small if government policy excessively restricts new construction. An irrationally optimistic belief about future demand in a city can lead to the city being overdeveloped relative to private profit maximization.

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Yet, overdevelopment may be optimal from a social perspective if agglomeration economies are at work as they appear to be in the PRC (Chauvin et al. 2017).

There are also negative externalities associated with urban living, such as congestion and contagious disease, which can be exacerbated by growth. Yet much of the new construction in the PRC appears to be replacing older, dilapidated, and (potentially) more dangerous structures with newer, safer buildings. Consequently, new construction may be reducing the downside risks of density in urban areas in the PRC.

In theory, real estate bubbles can be welfare enhancing but there is no guarantee that any bubble will produce such a positive outcome. Most importantly, real estate bubbles lead to foreclosures and potentially widespread social costs from financial dislocation. In section IV, I show that, given reasonable parameter values, the foreclosure-related losses from a burst bubble are likely to be higher than the benefits from encouraging additional building. Given moderate agglomeration economies, the losses from foreclosure need to be tiny (under 1% of total market value) for even the most well-designed bubble to increase overall urban wealth. The upside of bubbles grow as agglomeration economies increase, but it is hard to imagine many settings in which bubbles are desirable. Fundamentally, the benefits of a bubble (correcting an externality) are second order, while the costs (value lost due to defaults and foreclosures) are first order.

Real estate bubbles can also lead to welfare losses because there is too much construction or because construction occurs at the wrong time. In countries dominated by a primate city, such as Indonesia or the Republic of Korea, building in the wrong place is unlikely to occur. Similarly, it is almost inconceivable that there is too much growth in the PRC's first-tier cities such as Beijing, Shanghai, and Shenzhen. The risk of overbuilding is most acute in lower-tier cities that have benefited from the general exuberance surrounding the PRC's rapid economic growth but do not ultimately have the fundamentals to produce demand that is greater than supply.

The risk of incorrect timing is also real. New York's Empire State Building was not fully occupied until after World War II, more than 15 years after its completion. Today, large vacancy rates in many lower-tier cities in the PRC imply that delayed construction might have been optimal from a purely building cost point of view. Yet the costs of construction are likely to be higher in the future; therefore, it is hard to be confident about the costs of building too quickly.

History seems to support the view that the larger costs of real estate bubbles come from financial dislocation rather than from overbuilding. Many have argued that the chaos surrounding the subprime mortgage meltdown in the US in 2007 played a major role in the global recession that followed. By contrast, the costs of the Los Angeles real estate boom and bust of the 1980s, which largely did not involve banks, seem to have been trivial.

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The implication of this discussion is that curtailing investment in real estate directly can be difficult and even harmful. Larger welfare gains could be realized from ensuring that the financial system faces less risk from potential real estate downturns. Yet political leaders who are faced with declining real estate prices or economic stagnation often see credit as a tool for juicing growth or at least promoting stability. Encouraging lending in a high-priced market creates the possibility that a real estate bust will spread across the larger financial and (ultimately) real estate sectors of the economy.

## II. Real Estate Bubbles in United States History and in Asia Today

Throughout US history, real estate has been a dominant speculative asset. The financial crises of 1797, 1819, 1837, 1857, and 2007, as well as the savings and loan crisis that began in 1989, were all closely tied to real estate speculation. The Japanese bust of 1990 and the 1997/98 Asian financial crisis were also closely tied to real estate. This section of the paper briefly discusses the course and consequences of some of these events.

### Early Real Estate Bubbles in United States History

Real estate companies, including the Virginia Companies of London and Plymouth, founded the first English colonies in the Americas. Their investors hoped to get rich by developing land on the eastern seaboard of North America. North America seemed to offer virtually limitless land that was only weakly defended by Native Americans. For centuries, speculators like George Washington, Benjamin Franklin, and Robert Morris tried to amass vast empires of farmland in the American interior. Morris, the preeminent financier of the revolutionary period, accumulated a great mountain of debt to fund purchases of millions of acres. His inability to service that debt touched off a banking crisis in 1797.

The Louisiana Purchase opened the American interior further and public land sales set off a frenzy of purchasing in states like Georgia after the conclusion of the War of 1812. Cotton, not wool, had proven to be the ideal crop for the new industrial mills of England, and the US' southern frontier had ideal conditions for growing cotton. If cotton prices stayed high, agricultural revenues would easily have justified the high prices paid in 1819 for Georgia cotton-growing land (Glaeser 2013). But cotton could also be grown throughout much of the warmer parts of the world and prices did not stay high. Land prices crashed in 1819, which set off another banking crisis.

Banks and real estate were intimately related because land could readily serve as collateral. The early industrial enterprises of England were largely self-financed through retained earnings, but the cotton farms that provided the raw materials for

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those companies could be bank financed since banks could readily realize the value in land, while factories required skilled managers. The slaves that worked the land could easily be debt financed since they were geographically transferable. There was also a slave bubble in 1819 in the US that accompanied the property bubble that same year (Baptist 2014).

The US' geographic and economic expansion led to rising land, cotton, and slave prices during the 1830s. This decade's boom boosted prices not only for agricultural land, but also for urban land from New York to Chicago. State-chartered banks expanded when President Andrew Jackson refused to renew the charter of the Second Bank of the United States. They lent heavily to real estate speculators. When Jackson's Specie Circular order of 1836 required public land to be purchased only with silver and gold, land prices began to fall. Ultimately, the financial chaos created by the bust would disrupt the US economy for 5 years.

These booms had real consequences and the optimism about the value of western land helped encourage the development of the US' transport infrastructure. Early canal builders, including George Washington, were partially motivated by a desire to unlock the value of their own western land. Riverboats and railroads were built in anticipation of increasing western agricultural output. John Jacob Astor did not just buy up New York land during this period, he also developed that land into usable urban space.

By the 1840s, railroad shares were starting to replace frontier land as the preeminent speculative investment. Railroads required so much capital, but also created so much upside, that investors were willing to provide equity investments despite the considerable risks and realities of insider expropriation. At the same time, land never stopped serving as an object of overoptimism. The Panic of 1857 was precipitated by the failure of Ohio Life Insurance and Trust Capital, which had been founded as a tool for investing eastern money in mortgages on western land (Haeger 1979). Ohio Life Insurance and Trust Capital had moved from land to railroads, while some of its dealings may have also reflected mismanagement (Calomiris and Schweikart 1991). Declining wheat prices in 1857, generated by a rich harvest and reduced European demand after the end of the Crimean war, lowered the appeal of western land and the railroads that served this land (Huston 1983). The US was an overwhelmingly rural country in 1857 and falling land prices rocked eastern financial institutions.

**The Boom of the Roaring 1920s and the 1929 Bust**

The Great Depression is far more associated with the stock market collapse of 1929 than with a real estate market bust, but property values closely paralleled shifts in the Dow Jones Industrial Average during this time. In the 1920s, real estate prices boomed in New York City until a bust that began in 1929. Nicholas and Scherbina (2013) report that the average nominal price per square foot rose from

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$3.89 in 1921 to $6.91 per square foot in 1929 before falling to $2.39 by 1935. In real terms, the price fluctuations were less dramatic, but the quality-adjusted real price index still declined by over 30% between 1929 and 1931. Wheaton, Baranski, and Templeton (2009) document a similar drop in the value of New York City commercial real estate after 1929.

Ebullient investors lent the funds for the purchase and development of New York City real estate. Securities, backed by commercial real estate mortgages, boomed during the 1920s. At their height in 1925, real estate-backed securities represented one-fifth of all newly issued corporate debt (Goetzmann and Newman 2010). Naturally, much of this lending went sour in the 1930s. Nicholas and Scherbina (2013) document the enormous increase in the proportion of sales of foreclosed properties between 1929 and 1934, which captures the stress that collapsing real estate values put on the banking system.

Yet the Manhattan real estate boom of the 1920s was not without its upside. New York City experienced a building boom that still shapes the city. Goetzmann and Newman (2010) show that New York built over 25 buildings with a height of over 70 meters during each of the 5 years after 1926. During the 1927–1931 period, New York built over 35 such buildings, a pace of new construction that the city has never repeated. In 1920, all of New York's taller buildings were around Wall Street. By 1931, there was a great forest of skyscrapers in midtown Manhattan surrounding Grand Central Terminal.

This wave of building culminated in the great skyscraper race of 1929 and 1930. The 792-foot Woolworth Building had loomed as the tallest building in New York City and the world for 17 years, but in rapid succession it was replaced by 40 Wall Street (927 feet), the Chrysler Building (1,046 feet), and the Empire State Building (1,250 feet). The Empire State Building came in considerably under budget because the Great Depression severely reduced building costs. It would be known as the Empty State Building for years because of its vacancies and only became profitable in 1950.

Clark and Kingston's (1930) *The Skyscraper* provides a remarkably detailed picture of the economics of construction during the late 1920s. In 1929, construction costs were sufficiently low that tall buildings looked enormously profitable even given rising land prices. Clark and Kingston's error, which was presumably the error made by most New York builders during this period, is that they failed to anticipate the pressure that abundant supply would put on office rents. Basic economics tells us that prices must ultimately be tied to supply costs and therefore skyscraper building could never remain a source of boundless profits. Rents were sure to fall, with or without the stock market crash.

Yet the welfare effects of New York's skyscraper boom are far from obvious, assuming that the post-1929 financial crisis would have occurred without the real estate bust. The 42nd Street epicenter of the building boom runs primarily through two zip codes (10017 and 10036) that collectively employed over 300,000 people

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who earned over $40 billion in wages in 2014, according to County Business Patterns. That building boom created the central business district of New York City, which has been a primary example of agglomeration economies at work for decades. The overconfident overbuilt and many lost money, but they also created an enduring economic dynamo.

**The Savings and Loan Crisis and the 2007 Mortgage Market Meltdown**

The two most recent real estate crises in the US were strongly associated with problems in the credit market. The US experienced a robust real estate cycle during the 1980s and early 1990s, although the savings and loan crisis largely preceded the decline in real estate prices. These banking entities invested in real estate, but the fundamental issue was with their incentives rather than with the real estate market.

The standard narrative about the savings and loans crisis is that in the late 1970s the thrift industry's cost of capital rose with interest rates, but its revenues did not increase since these were tied to a stock of fixed-rate mortgages that paid low, preinflation interest rates. In response to these financial troubles, Congress deregulated savings and loans institutions starting in 1980 while continuing to insure depositors through the Federal Savings and Loan Insurance Corporation. These deregulated entities, whose cost of capital was independent of their actual risk of default, behaved in textbook fashion. They loaded up on risk, some of it in real estate, since shareholders and management would benefit if the bets paid off and taxpayers would pay if the bets failed. In various cases, there was also insider expropriation and influence peddling.

This story is connected to real estate primarily because real estate was the major business of savings and loans institutions. These initially modest institutions came into existence to help middle-income individuals save and borrow to become homeowners. Naturally, when they started to overlend, they expanded their core business. For example, many extended the duration of commercial real estate loans from short-term capital to builders to long-term capital that supported eventual owners. Real estate played a central role in the savings and loan crisis because it is such a basic asset and these were relatively simple institutions. Unfortunately, even relatively simple institutions betting on basic assets can impose billions of dollars of costs upon taxpayers.

The US real estate convulsion that lasted from 1996 until 2012 was both larger and more complicated. Between 1996 and 2006, prices rose dramatically in many markets. The boom began in supply-constrained, high-income coastal markets and then gradually spread inland (Ferreira and Gyourko 2015). An ocean of mortgage-backed securities and a significant increase in subprime lending accompanied this price boom. Mian and Sufi (2008) document that prices rose more in areas that gained access to subprime lending, but there is still debate about whether easy credit caused the larger boom. Glaeser, Gottlieb, and Gyourko (2012)

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show that the downward shift in interest rates after 2000 appears too small to explain the massive rise in prices given reasonable rational models connecting prices to rents.

During the boom years, there was substantial momentum in housing prices: high-price growth in an area from 2004 to 2005 predicted even stronger price growth from 2005 to 2006. Over the longer-time horizon, however, mean reversion was nearly perfect. On average, price declines from 2006 to 2012 almost completely wiped out price growth from 2000 to 2006.

The real estate boom in the 1980s was focused almost entirely in areas with relatively inelastic housing supply (Glaeser, Gyourko, and Saiz 2008). In the 2000s, even elastically supplied cities such as Phoenix experienced robust price growth, although there was still a strong connection between inelastic supply and price growth during the period. The later price declines were most severe in cities that had price booms and elastic supply, presumably because prices were depressed in these areas because of the abundant new construction.

Between 2000 and 2007, the number of housing units in the US increased by 12.8 million units, or an average of 1.8 million units per year. The number of vacant units in the US rose by 4.2 million units in the same period. This large building boom left the US with a sizable housing inventory that helped depress construction for the next 7 years. From 2007 to 2014, the number of homes in the US only grew by 4.9 million units.

There were certainly social costs from overbuilding in cities like Las Vegas and Phoenix, but these costs were orders of magnitude less important than the financial disruption that followed the mortgage market meltdown (Glaeser 2013). Starting with the collapse of Bear Sterns and Lehman Brothers in 2008, global financial institutions teetered for years after real estate prices fell. The impacts of financial disarray on the larger economy are hard to accurately assess but the total economic costs of the financial crisis are surely in the trillions of dollars.

Europe experienced a parallel real estate boom starting in the late 1990s. Spain, for example, experienced a particularly sharp construction and price boom between 1997 and 2007, followed by a similar bust. Bardhan, Edelstein, and Tsang (2008) link this growth to globalization and greater integration into the European Union. Spanish banks were conservatively regulated but still suffered. The regional *caja* (saving institutions), which were more lightly regulated, were decimated because of the housing bust. Spain may have been the most extreme European case, with booms and busts also occurring in Austria, France, Germany, and Italy, among other countries.

## The Japanese Asset Boom and Bust

In the 1980s, Japan was the global economic superstar. Its postwar economic rebirth was astonishing. Japanese cars and electronics were ubiquitous around the

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world. In 1955, per capita gross domestic product (GDP) in Japan was about one-tenth of that in the US. By 1980, per capita GDP at current exchange rates was higher in Japan than in the US.

Japan was not just an astonishingly successful economy, it also had a relatively compact geography and a single dominant metropolitan area. Japanese regulations have long constrained land development and agriculture is strongly protected. Consequently, demand for space in Tokyo has traditionally been high. A significant amount of the optimism about Japan's future translated into optimism about the value of land in the capital city.

Average commercial land prices rose 53% in real value between 1985 and 1990, according to the Japan Real Estate Institute. In Japan's six largest cities, commercial land prices rose 269% over the same period, with real residential land prices increasing 149%.

This boom was gigantic by any measure and so was the subsequent bust. In 2015, commercial real estate in Japan's six large cities was worth only 14% of its value in real terms in 1990. Nationwide, commercial real estate in 2015 was valued at 22% of its value in 1990. Residential real estate had lost over 50% of its real value in the 25 years after the boom. The decline in Japan's real estate values occurred most rapidly in the six largest cities. Furthermore, both the 1990s and the 2000s were terrible decades for Japanese real estate investors.

The upside to the real estate boom was considerable construction in Tokyo and elsewhere. The number of nonwooden housing units in Tokyo increased by 254,000 between 1986 and 1990, while the number of wooden houses declined by 100,000. Builders created 524 million more square feet of living space in nonwooden structures during those years, which was substantially more than they had built in the years before 1985. Given the enduring strength of the Tokyo agglomeration, the boom era new construction seems like a lasting benefit from the boom.

The downside of the boom was that the subsequent bust set off 2 lost decades of stagnant growth for Japan. It can be argued that 20 years of slow growth were the result of balance sheet problems in banks and businesses that started with declining real estate and stock values. While this view is disputed, it seems certain that the welfare consequences of overbuilding were dwarfed by any macroeconomic consequences of the bust, even if the real estate bust were responsible for only one-fiftieth of the larger malaise in Japan's economy.

**The 1997/98 Asian Financial Crisis**

The 1997/98 Asian financial crisis was a seminal event in the recent economic histories of Hong Kong, China; Indonesia; the Republic of Korea; Malaysia; and Thailand. These economies had been doing well during the 1990s. In 1997, however, investors quickly lost confidence in their currencies, asset prices

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tumbled, and the International Monetary Fund stepped in. The macroeconomic consequences were significant, if relatively short-lived.

Much of the economic debate around these crises has focused on contagion in the currency markets and the role of the International Monetary Fund. Yet Quigley (2001) and Semlali and Collyns (2002) provide evidence suggesting that real estate lending was a major part of the lending boom and subsequent bust. Quigley documents the rise in prices, commercial office supply, and vacancy rates in the years before the crisis. He notes that real estate was an enormously important asset. In Thailand, for example, Bangkok real estate was apparently valued at almost 50% of the country's GDP. He points out that nonperforming real estate loans were a large part of the banking sector's portfolio across the region. Before the crisis, real estate loans appear to have comprised between 30% and 40% of total bank loans in Malaysia and Thailand, and between 40% and 55% of total bank loans in Hong Kong, China during the same period.

In a sense, the 1990s Asian real estate boom was eminently justifiable. All of these economies were growing well and were, like Japan, centered on a single large metropolitan area. Investors thought that demand in Bangkok; Seoul; Jakarta; Kuala Lumpur; and Hong Kong, China was likely to continue to rise. Real estate seemed like a far safer investment than most private companies because of the opaque governance structures that prevailed in these economies at the time. Traditionally, as legal systems develop, real property becomes secure long before more complex forms of investment. Moments of optimism during early stages of growth tend to turn into real estate booms.

The fact that these economies are dominated by a single major metropolitan area somewhat limits the ability for a real estate boom to produce extremely wasteful structures. Today, space in Bangkok; Seoul; Jakarta; Kuala Lumpur; and Hong Kong, China is still in short supply. Once again, the supply effects of the boom appear to have been largely benign.

Real estate troubles preceded the full-blown crisis and seem to have helped generate anxiety about the health of the financial sectors in these countries. Thailand appears to have been the hardest hit by the real estate bust because it suffered from the bursting of a large property price bubble and an underdeveloped financial system (Semlali and Collyns 2002). By contrast, the property bust was less consequential in the Republic of Korea and Indonesia, partially reflecting better financial regulations. Malaysian banks weathered the storm particularly well as more stringent bank regulation seems to have stopped a real estate bust from turning into a wholesale recession.

**The Real Estate Boom in the People's Republic of China**

Chinese real estate today seems to be following the same script as these earlier property price booms. Prices in the PRC have risen dramatically over the

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past decade (Fang et al. 2016). A massive construction boom has accompanied this rise. There has been large-scale lending to real estate developers, leaving the banking system exposed to any future real estate bust. The government has reacted to a slowdown in the growth of housing prices by encouraging more lending to private homebuyers.

Optimism about Chinese real estate prices is entirely understandable. The PRC's economic growth has been miraculous in recent decades. The country is rapidly urbanizing and the number of rural Chinese who could potentially urbanize is enormous. Moreover, there are a few metropolitan areas, including Shanghai, Shenzhen, and Beijing, that are spectacularly productive. Agglomeration effects appear to be quite strong in the PRC (Chauvin et al. 2017).

Because the PRC has many major metropolitan areas, the potential for wasteful investment is much higher than in other countries. While it is almost impossible to imagine that there will be too much construction in Beijing or Shanghai, tales of ghost cities in the interior of the PRC have circulated for years. Glaeser et al. (2017) estimate vacancy rates of 20% in many Chinese cities. Vacant homes include both those that are owned by developers and those that are owned by ordinary investors who have chosen to leave them vacant rather than renting them out. It seems possible that there has been some overbuilding in some of the PRC's third- and fourth-tier cities.[1]

Investment in real estate in the PRC also seems to reflect relatively well-defined property rights for real property. Between June 2001 and June 2016, the Shanghai Stock Exchange Composite Index increased only 32% in nominal terms and actually fell in real terms. Perhaps because of governance problems within Chinese firms, investing in equities has not been a high-return strategy. By contrast, owning apartments seems like a way to potentially benefit from the PRC's growth without having to trust corporate management.

The PRC is unusual in that the public sector has played an outsized role in nudging the real estate cycle along. Local leaders are rewarded based on economic performance and real estate development represents a simple way of ensuring jobs and growth. Moreover, local governments in the PRC lack access to a steady stream of annual property tax revenues and must instead depend on the revenues generated by the sale of local land to real estate developers. As the large banks are also public institutions, the public sector is in a position to both free land for real estate development and supply the credit for real estate developers.

The power of the PRC's public sector means that the government has an outsized ability to control the future of the country's real estate market. Glaeser et al. (2017) simulate potential prices for real estate in the PRC in 20 years under different

[1]First-tier cities in the PRC are the well-known megacities such as Beijing and Shanghai. Second-tier cities are provincial capitals such as Nanjing and Suzhou. Third-tier cities are less well known, but still large places, typically with a GDP over $20 billion. Fourth-tier cities are smaller, but many are still quite large by western standards.

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supply scenarios. If supply growth continues at current levels, it seems likely that future prices will be significantly below current prices. But if the government acts to sharply reduce the amount of new construction, which is well within its power, then prices could remain stable in the long run. Naturally, there would be significant costs from shutting down new supply, including slowing the rate of urbanization and reducing employment within the construction sector.

## III. Why Real Estate? Property Rights and Asset Bubbles

In several of the previous examples I have argued that real estate is a natural object of speculation because it is particularly well suited to be collateral. In many developing economies, property rights are much better defined for real estate than for other forms of investment. Even in the PRC, where the government still technically owns all the land, apartments seem far safer than corporate equities.

For lending, the essential distinction between real estate and other assets is transferability. Buildings are relatively general physical capital. Someone else can occupy a Tokyo office building or a Las Vegas home without a huge loss in value. Machinery that was custom built for a company is far less transferable. Consequently, customized corporate assets make far worse collateral than real property. In some contexts, property markets are thick, making it easier for banks and their regulators to assess the value of real estate. However, this advantage is far from universal. For example, assessing the value of real estate in the PRC's third- and fourth-tier cities can be almost impossible.

### Urban Development with Agency Problems in Investment

This section discusses investment in buildings versus export-oriented manufacturing when corporate governance is imperfect. There is free entry into the export industry, where capital and labor is transformed into a numeraire output good with a Cobb–Douglas technology function: $AK^{\alpha}L^{1-\alpha}$. Capital is itself made from the output good, which serves as the numeraire with a price of 1. In the next section, I will consider how investment changes when $A$ depends on the size of the city, but here I treat it as exogenous.

There is also free entry into the building sector, where housing is produced with land and the numeraire good, referred to as structure in this context, with a second Cobb–Douglas technology function: $\mathit{Housing\ Space} = \frac{1}{1-\sigma}\mathit{Land}^{\sigma}\,\mathit{Housing\ Capital}^{1-\sigma}$. Housing capital is again produced with the numeraire output good. The price of housing space is endogenous and denoted $P_H$. The wage is denoted $w$. Total land available in the city equals $M$.

Worker utility is Cobb–Douglas in earnings and housing, meaning that if a worker has an income of $w$, she will spend a fraction of that income $\gamma w$ on housing

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and indirect utility will equal $wP_H^{-\gamma}$.[2] Workers can live in another locale, earn $w_0$, and pay one per unit of housing. The spatial equilibrium ensures that $P_H = (\frac{w}{w_0})^{\frac{1}{\gamma}}$.

The timing of the model is that in the first period developers borrow money, buy land and housing capital, and produce housing space. In that same period, industrialists borrow and build manufacturing capital. At the start of the second period, industrialists hire workers who buy housing space. At the end of the second period, industrialists sell their output.

We consider two possibilities for worker mobility. Our primary assumption is that workers move to the city at the start of the second period. Our alternative is that workers commit to their decision to move at the beginning of the first period. The timing is immaterial in this section when there are no aggregate shocks or surprises.

In a frictionless world without financing and agency problems, $w = \tilde{\alpha} A^{\frac{1}{1-\alpha}}$ and $P_H = A^{\frac{1}{(1-\alpha)\gamma}} (\frac{\tilde{\tilde{\alpha}}}{w_0})^{\frac{1}{\gamma}}$, where $\tilde{\alpha} = \alpha^{\frac{\alpha}{1-\alpha}}(1-\alpha)$.[3] As workers receive their reservation utilities and firms earn zero profits, land value is the only measure of social surplus. In this benchmark case, it equals $MA^{\frac{1}{(1-\alpha)\sigma\gamma}} (\frac{\tilde{\tilde{\alpha}}}{w_0})^{\frac{1}{\sigma\gamma}}$.

I now introduce financing frictions into the model. I assume a supply $\bar{I}$ of active investors who can manage their own projects. The quantity $\bar{I}$ combines the actual wealth of these investors and whatever other financing they may have acquired. Active investors may lose money, but they do not default. There is also an entirely elastic supply of passive investors who can only lend to external managers.

I rule out equity investing by passive investors by assuming that profits are nonverifiable and then managers would always completely expropriate outside passive investors through self-dealing. I do, however, assume that these investors can ensure that loaned funds are spent entirely on capital or buildings, which can be seized in the case of default. Consequently, the only feasible financial contracts are collateralized loans.

I introduce a risk of default on such loans by passive investors by assuming that there is some uncertainty about the timing of new cash flow. All debt is payable at the end of the first period. With probability $1 - \rho$, real estate developers can presell homes to investors at that date. With the same probability, industrialists can presell their output to consumers at that date and repay the debt and hire labor with purchase order financing. With probability $\rho$, both types of firms face a liquidity shock and must give their assets to the lender. I assume that lenders never grant forbearance, possibly because of financial regulations. In the event of a liquidity shock, lenders foreclose and acquire either the homes or the industrial capital.

[2]Direct utility is defined as $\frac{c^{1-\gamma} h^{\gamma}}{(1-\gamma)^{1-\gamma}\gamma^{\gamma}}$, where $c$ refers to nonhousing consumption and $h$ refers to housing consumption.

[3]In this case, total housing supply equals $\frac{MA^{\frac{1-\sigma}{(1-\alpha)\sigma\gamma}}}{1-\sigma}(\frac{\tilde{\tilde{\alpha}}}{w_0})^{\frac{1-\sigma}{\sigma\gamma}}$, total population equals $\frac{MA^{\frac{1-\sigma\gamma}{(1-\alpha)\sigma\gamma}} \tilde{\alpha}^{\frac{1-\sigma\gamma}{\sigma\gamma}} w_0^{\frac{-1}{\sigma\gamma}}}{(1-\sigma)\gamma}$, and total output equals $\frac{MA^{\frac{1}{(1-\alpha)\sigma\gamma}} \tilde{\alpha}^{\frac{1}{\sigma\gamma}} w_0^{\frac{-1}{\sigma\gamma}}}{(1-\sigma)(1-\alpha)\gamma}$.

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There are social losses from defaults on debt contracts, which reflect both legal costs and the manager-specific nature of investment. When a manager defaults and the lender acquires the asset, a fraction $\delta$ of manufacturing capital is destroyed and a fraction $\theta\delta$ of housing is destroyed, with $\theta < 1$. The parameters $\delta$ and $\theta$ can be interpreted as reflecting the quality of the legal system.

This difference between manufacturing capital and real estate provides the fundamental asymmetry of the model. Real estate is more fungible and less specific than factories. It is easier for a bank to resell apartments than to resell an industrial plant. Throughout the world, the connection between the banking system and the real estate sector is particularly strong because real estate is relatively transferable collateral. The market for real estate in third-tier Chinese cities may be thin, but reselling manufacturing plants in such cities is likely also difficult.

Since default costs are higher for manufacturing, active investors will have a comparative advantage in that industry. Depending on parameter values, active investors may operate in both industries while passive investors lend only in real estate, or passive investors may lend in both industries while active investors operate only in manufacturing, or the two types of investors may specialize completely.

The shocks in this model are essentially liquidity shocks and not shocks to real output. Consequently, without the losses from asset reallocation, then there would be no social losses from these shocks. As active capital is essentially taking an equity stake in their investments, there are no losses from these shocks. The key problem is that the debt contract must specify repayment before the good is finally sold so that some firms are forced to repay before they acquire cash flow.

In real estate, both active and passive investors will try to minimize the cost of a unit of structure, which implies a structure-to-land ratio of $\frac{P_L(1-\sigma)}{\sigma}$, where $P_L$ refers to land costs. The nominal interest rate "$r$" will ensure that X dollars invested yields X dollars in expected returns, since investors are assumed to be risk neutral. Given optimal investment and a price of land, $P_L$, one unit of investment in real estate will generate returns of $P_H(\frac{\sigma}{P_L(1-\sigma)})^\sigma$ (which equals 1 + r) if there is no default and $1 - \theta\delta$ times that amount otherwise.

In the Appendix, I prove the following propositions detailed below.

*Proposition 1:* There exist four values $\bar{I}_1 > \bar{I}_2 > \bar{I}_3$, where $(\frac{1-\rho\delta}{1-\rho\theta\delta})^{1+\frac{\alpha}{\sigma\gamma(1-\alpha)}}\bar{I}_2 = \bar{I}_3$, such that if $\bar{I} > \bar{I}_1$, then only active capital invests in either sector; if $\bar{I}_1 > \bar{I} > \bar{I}_2$, then active capital invests in both sectors and passive capital also invests in real estate; if $\bar{I}_2 > \bar{I} > \bar{I}_3$, then only active capital invests in manufacturing and only passive capital invests in real estate; and if $\bar{I}_3 > \bar{I}$, then passive capital invests in both sectors and active capital only invests in manufacturing.

The values of $\bar{I}_1$, $\bar{I}_2$, and $\bar{I}_3$ are all rising with $A$ and $M$ and falling with $\rho$, $\theta$, $\delta$, and $w_0$. Whenever passive capital invests in a sector, then the level of total investment in that sector is also rising with $A$ and $M$ and falling with $\rho$, $\theta$, $\delta$, and $w_0$. The population level is always rising with $A$ and falling with $w_0$. Whenever

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there is any passive investment in either sector, population is also rising with $M$ and falling with $\rho$, $\theta$, and $\delta$.

Proposition 1 characterizes the basic structure of the model and provides the explanation for why real estate appeals to passive investors. Since real estate is good collateral, debt lending orients itself toward real estate. Consequently, there ends up being greater social losses from defaults and foreclosures in real estate than in the export sector of the economy.

Whenever active capital is abundant, then only active capital invests in either sector since it accrues fewer losses from default. When active capital is slightly less abundant, then passive capital moves into real estate. When active capital is even less abundant, then there is a segregation of capital, where active capital invests in manufacturing and passive capital invests in real estate. When active capital is truly rare, then passive capital invests in both sectors and active capital only invests in manufacturing.

The cutoffs for the level of active capital are always increasing in $A$ and M, meaning that as the city becomes more productive or has more land, the incentive for passive capital to move into the city increases. Higher values of $w_0$ make the city relatively less appealing and reduce the inflow of passive capital. The three values that increase the default costs that passive capital potentially faces ($\rho$, $\theta$, and $\delta$) make it less likely that passive capital will enter the market.

These same parameters also determine the amount of capital invested in the city, assuming there is passive capital, and the size of the city. When $A$ and $M$ are larger, the city's population increases. Unsurprisingly, city size depends on city productivity and available land. When $\rho$, $\theta$, and $\delta$ are larger, the city shrinks. If foreclosure is associated with substantial reductions in productive capacity, either in the real estate sector or in the export sector, the city will be smaller. Somewhat surprisingly, neither $\theta$ nor $A$ impacts the ratio of export capital to real estate structures because foreclosure costs in real estate impact both types of capital in exactly the same way.

Later, I will focus on the case, which seems to be most relevant for developing economies, where active capital is relatively rare and invests only in manufacturing and passive capital invests only in real estate. The range of values for which the segregated equilibrium exists is dependent on $(\frac{1-\rho\delta}{1-\rho\theta\delta})^{1+\frac{\alpha}{\sigma\gamma(1-\alpha)}}$, which implies that the range of parameters for which this equilibrium occurs is larger when $\theta$ is lower. This segregation of capital across sectors will be particularly common when the asymmetry in foreclosure costs between real estate and factories is particularly large.

## Embedding Bubbles into the Model

I model a bubble as simply an erroneous belief about the future state of the economy. In principle, this erroneous belief could be about any parameter, but $A$

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(the level of productivity) makes a particularly natural source of error. I will not model where this mistaken belief comes from, but rather simply assume that the error exists and examine the consequences. I assume that the error exists only in the first period; by the second period true productivity has been revealed. The most natural assumption about the bubble is that it occurs during the first period when building and capital investment occurs, but that reality reasserts itself before hiring occurs in the second period.

At this point, it begins to matter whether workers decide to move during the first period, with overoptimistic beliefs, or at the start of the second period. If workers move based on bubbly beliefs, then they will earn less than their outside option in the second period and end up paying for some of the cost of the bubble. An alternative assumption is that firms precommit to workers' wages, which is easiest to imagine if industrialists have active capital. If workers make their moving decision in period one, then the bubble impacts all actors symmetrically and Proposition 2 results.

*Proposition 2:* The bubble causes $\bar{I}_1$, $\bar{I}_2$, and $\bar{I}_3$ to increase. If only active capital invests, then the bubble has no impact on investment. If passive capital invests only in real estate and active capital invests in both sectors, then investment in both sectors rises by a factor of $(\frac{\hat{A}}{A})^{\frac{1}{(1-\alpha)\gamma\sigma}}$. If active capital invests only in manufacturing and passive capital invests only in real estate, then the bubble again has no impact on manufacturing and causes real estate investment to increase by a factor of $(\frac{\hat{A}}{A})^{\frac{1}{\alpha+\sigma\gamma-\alpha\sigma\gamma}}$. If passive capital is in both sectors, then investment in both sectors increases by a factor of $(\frac{\hat{A}}{A})^{\frac{1}{(1-\alpha)\gamma\sigma}}$.

The bubble increases the appeal of the city to passive capital. Active capital will also anticipate higher returns, but since active capital is supply inelastic, this has no impact on investment or city size. The added appeal caused by overoptimism makes it more likely that passive capital will be present in one or both sectors.

When active capital is present in both sectors, then investment will increase in both sectors because passive capital flows into the real estate sector, which then leads active capital to flow into manufacturing. A bubble therefore leads the real estate sector to be especially vulnerable to defaults.

When there is segregation of the types of capital, then there is no impact on manufacturing investment, but the size of the real estate sector increases. The growth of the real estate sector is somewhat muted in this scenario because manufacturing is not growing along with the bubble. This fact implies that prices and wages will end up being lower in equilibrium because the bubble has increased the relative importance of real estate in the city.

When passive capital is in both sectors, then again the bubble leads to balanced growth of both sectors. In this case, there will be a wave of defaults in both manufacturing and real estate, although the defaults will be rarer in manufacturing because of the presence of active capital. The growth due to the bubble will be larger than in the case where the two types of capital are segregated.

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This model draws a distinction between real estate capital and export industry capital based on the ease of reallocating that capital in the event of default. The greater ease of managing real estate means that arm's-length lending is easier in real estate. Consequently, overoptimism leads to more lending to real estate developers and more real estate busts. This logic perhaps explains why real estate busts play such an outsized role in financial crises in the developing world.

## IV. Can Real Estate Bubbles Be Good?

In the previous section, I addressed only the positive implications of asset bubbles for investment in the export industry and real estate. In this section, I turn to the welfare consequences of such bubbles. I will first assume a standard market failure: agglomeration economies. In the absence of liquidity effects, this market failure will imply that modest overoptimism is welfare enhancing. I will then reintroduce the welfare costs of illiquidity, which can mean that real estate busts have large negative social costs.

Throughout this section, I will assume that only active capital invests in manufacturing and only passive capital invests in real estate. I will also compare the case in which workers move in the first period with the case in which workers move in the second period, but I will assume that manufacturing firms have committed to provide wages that deliver the workers' reservation utility. I will assume that $\rho = 0$ so that there are no exogenous liquidity shocks.

### Welfare-Enhancing Real Estate Bubbles and Agglomeration Economies

To create a positive impact of overoptimism, I assume an agglomeration economy: productivity rises as city size increases. Formally, the productivity parameter $A$ equals $A_0 N^{\epsilon}$, with $\epsilon > 0$. This type of agglomeration externality will mean that decentralized city size will be too small relative to the first best. Excessive land use restrictions will also lead to underbuilding. Just as bubbles can help builders internalize agglomeration economies, they can encourage builders to undo the unfortunate effects of too much regulation.

As in many spatial equilibrium models, worker utility will not be impacted by the externality since worker utility is also pinned down by the reservation locale. As long as passive capital receives expected returns of 1, then all benefits of internalizing the externality would go to active capital and land owners. I adopt the definition of social surplus as the total amount of manufactured good created minus the costs of building housing minus the costs of providing sufficient consumption so that workers receive their reservation utility.

As I will discuss in the next subsection, real estate bubbles will always lead to liquidity crises in this model. Builders borrow at rates so that borrowers will be repaid exactly their costs of capital based on the bubbly beliefs. When reality

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strikes, then no one can cover their debts and all real estate is foreclosed upon. Manufacturing capital does not face foreclosure since it is entirely owned by active capital equity investors.

The structure of this model does not allow bubbles to be self-fulfilling since they always end in defaults. Nonetheless, incorrect beliefs can create feedback that roughly goes in the direction of those beliefs. For example, assume that beliefs were not about some fundamental technology, but rather about housing prices. Given the right assumptions about technology, it would be possible for optimistic beliefs to lead to enough building for agglomeration economies to propel housing demand upward and for pessimistic beliefs to lead to economic weakness and low housing demand.

To illustrate the upsides of the bubbles, I first assume that $\theta = 0$. The passive investors are surprised that the bubble turns out to be incorrect. While there will be defaults, there will be no costs from default. When worker hiring occurs in the first period, manufacturing firms believe that $A_0$ can equal either $\hat{A}_0$, reflecting that manufacturing firms share the same beliefs as the builders. When worker hiring occurs in the second period, manufacturing firms correctly perceive $A_0$. The difference in beliefs reflects the possibility that hiring decisions may be made later than decisions about construction.

Proposition 3 discusses how incorrect beliefs influence the surplus maximizing population and building stock, where surplus maximizing is defined as maximizing the total amount of rents potentially shared by the industrialists and the owners of land.

*Proposition 3:* Total surplus is maximized if hiring occurs in the first period and both builders and manufacturing firms believe that $\hat{A}_0 = \frac{1+\epsilon-\alpha}{1-\alpha} A_0$. If hiring occurs in the second period but real estate developers believe $\hat{A}_0 = \frac{1+\epsilon-\alpha}{1-\alpha} A_0$, then the building stock will equal the surplus-maximizing level, while the city population will be lower than the surplus-maximizing level. If hiring occurs in the second period, then some builder overoptimism is still surplus increasing but the optimal level of builder overoptimism is less than when hiring occurs in the first period.

Proposition 3 illustrates the upside of overoptimism. Agglomeration economies mean that the city is too small. Overoptimism on the part of builders leads to more construction. Overoptimism on the part of industrialists leads to more hiring. If hiring occurs in the first period and the bubble sets $\hat{A}_0 = \frac{1+\epsilon-\alpha}{1-\alpha} A_0$, then the error will exactly offset the agglomeration externality and the city's size will maximize total surplus.

If the builders and industrialists have different beliefs, which will happen if hiring occurs in the second period, then the city cannot have the optimal mix of housing stock and labor. In particular, if builders make decisions optimistically while industrialists have learned the truth before they hire, then the city will have an abundance of housing stock relative to its population. This will create the classic overbuilt urban areas that follow the burst of a bubble.

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Yet even when the industrialists are totally rational, some overoptimism on the part of builders is desirable from the perspective of increasing total surplus. The developers' extra construction will still help boost city size, which yields beneficial externalities. The optimal bubble is smaller in this case than in the case of universal irrational exuberance, which suggests that the errors are complementary.

For my calibration, I assume that $1 - \alpha = 0.65$ (labor's share of output), $\gamma = 0.3$ (housing's share of consumption), and $\epsilon = 0.05$ (the agglomeration effect). Labor's share of output is based on the share of labor compensation relative to GDP in the US, which was 60.4% in 2014, but has typically been closer to 65%. Housing's share of expenditures is based loosely on the current expenditure survey, which found that in 2015 the average US household had total expenditures of \$55,978 and spent \$18,409 of this on housing.[4] The usual agglomeration estimates are based on cross-section regressions connecting the logarithm of wages with the logarithm of area population or density and 0.05 is a standard number (Chauvin et al. 2017). Few results are strongly sensitive to moderate changes in these parameter values.

Based on these parameter values, when hiring occurs in the first period the optimal amount of overoptimism is 7.7%, meaning that ideally $\hat{A}_0 = 1.077A_0$. This suggests some value for ebullient expectations, but as overoptimism during a boom seems to run far above that level (Case et al. 2012), it suggests that bubbles rarely get the development level right. Lower values of the labor share will make this estimate higher. For example, if $1 - \alpha = 0.55$, the optimal amount of overoptimism is 9.1%. Higher agglomeration economies will also increase the optimal size of the bubble.

When hiring occurs in the second period, these same parameter values imply that the optimal bubble sets $\hat{A}_0 = 1.074A_0$, so the optimal bubble falls only slightly when hiring is based on accurate assessments of productivity. When hiring occurs in the second period, the benefits of the bubble fall dramatically but the optimal bubble size falls only modestly.

## Foreclosures and Overbuilding

I assumed previously that there would be no costs from foreclosures and illiquidity in the event of a burst bubble. This is empirically false and does not even sit well within the basic assumptions of the model. The natural assumption is that if $A_0$ reveals itself to be lower than expected, then builders—all builders in the model—will go into default. They had no expected equilibrium profits, even under bubbly beliefs. When reality is darker than the bubble, they have negative net equity and the only course is default and foreclosure. I will focus on the equilibrium where industry is funded entirely by active investors and there are no default costs in that industry, even if they share the same erroneous beliefs with the builders.

[4]As such, housing is 32.8% of total expenditure, but I reduced the share slightly because some housing expenditures reflect movable household furnishing.

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In reality, real estate companies still have equity cushions. Not every developer will go into default. I will let $\theta\delta$ continue to reflect the lost housing stock from default and foreclosure, but recognize that this represents an average of major and minor losses in the real world. This means that if there is a bubble then $\frac{x}{1-\theta\delta}$ units of precrisis space must be built to provide x units of postcrisis space. This reduction in usable space due to foreclosures is the fundamental cost of the bubble.

Under what conditions can a bubble be welfare enhancing if the bubble's burst generates a liquidity crisis? Proposition 4 compares an optimal bubble, which is defined as the bubble that maximizes social surplus given profit-maximizing and fully informed behavior in the manufacturing sector, with outcomes without a bubble. I use the notation $\mu = \gamma\,(1-\alpha+\epsilon)$.

*Proposition 4:* If a bubble occurs, the optimal bubble will set

$$\frac{\hat{A}_0}{A_0} = \left(\frac{(1-\alpha)\,(\mu+\alpha)+\epsilon\alpha}{(1-\alpha)\,(\mu+\alpha)+\epsilon\alpha-\epsilon}\right)^{\mu+(\alpha-\epsilon)} (1-\theta\delta)^{\mu},$$

but this will only increase surplus relative to the decentralized no-bubble equilibrium if

$$\left(1+\frac{\epsilon}{(\sigma\mu+(\alpha-\epsilon))\,(1-\alpha)}\right)^{\sigma\mu+(\alpha-\epsilon)}\left(1+\frac{\epsilon}{(\mu+(\alpha-\epsilon))\,(1-\alpha)}\right)^{-\mu-(\alpha-\epsilon)} < (1-\theta\delta)^{\mu}.$$

The proposition highlights how hard it is for a bubble to be socially optimal when there are losses from defaults. The first part of the proposition describes the optimal scenario, conditional upon a bubble occurring. Since any bubble will set off a wave of defaults, the returns to building fall because some housing capital is wasted in the default process and this wave of defaults is treated as a sunk cost in the proposition.

The first part of the proposition notes the optimal bubble involves two terms. The first term $\left(\frac{(1-\alpha)(\mu+\alpha)+\epsilon\alpha}{(1-\alpha)(\mu+\alpha)+\epsilon\alpha-\epsilon}\right)^{\mu+(\alpha-\epsilon)}$ pushes toward overoptimism to internalize the agglomeration externality. The second term $(1-\theta\delta)^{\mu}$ is less than 1. This term pushes toward pessimism because housing investment is actually less productive with a bubble because of the losses due to default. When they multiply to less than 1, then even conditional upon the defaults occurring, the optimal bubble is no bubble at all.

Yet even if they multiply to greater than 1, the bubble may still be welfare decreasing because of the sunk costs of the wave of defaults. That is particularly unlikely because the defaults impact all housing, not just the marginal housing generated by the bubble, and therefore are a welfare rectangle while the bubble's benefits are a welfare triangle. I now show what the model implies given reasonable

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parameter values and ask what is the maximum value of $\theta\delta$ that permits an optimal bubble to exist and for it to be welfare enhancing.

I continue to assume $1-\alpha = 0.65$ (labor's share of output), $\gamma = 0.3$ (housing's share of consumption), $\sigma = 0.33$ (land's share of usable space), and $\epsilon = 0.05$ (the agglomeration effect). The parameter $\sigma$ reflects the National Association of Home Builders' estimates that for much of the last 20 years the costs of finished lots have been approximately one-half the amount of nonlot-related construction costs.[5] If $\theta\delta = 0.2$, then the optimal bubble, conditional upon a bubble existing, will set $\frac{\hat{A}_0}{A_0} = 1.025$. Thus, expectations are not too far from reality. Indeed, as long as the defaults are going to happen anyway, it is optimal to have frothy beliefs as long as $\theta\delta < 0.29$.

However, given these parameter values, the optimal bubble yields relatively little overbuilding benefit and unless $\theta\delta$ is less than 0.01 it is not optimal to have the bubble at all. The losses from defaults will overwhelm the benefits of a slightly larger housing stock. When agglomeration effects are modest, the model predicts that bubbles will be counterproductive given a reasonable range of parameter values.

The agglomeration effect of 0.05 is well in line with US estimates, but it is at least possible that agglomeration effects can be much higher in some developing country contexts. Chauvin et al. (2017) found a density agglomeration effect (the coefficient of log earnings on log prefecture density) of 0.2 in the PRC. The coefficient on prefecture population was much smaller. If $\epsilon = 0.2$ and the other parameter values stay the same, then the optimal bubble equals $1.26 * (1-\theta\delta)^{.255}$; and if $\theta\delta = 0.2$, this would set $\frac{\hat{A}_0}{A_0} = 1.19$. Consequently, the predefault housing stock would be about 63% larger and the postdefault housing stock would be about 30% larger.

Yet even in the case of such massive agglomeration externalities, the optimal bubble will only be surplus enhancing if the value of $\theta\delta$ is sufficiently modest. Bubbles can only be welfare enhancing if the losses from default are reasonable and the agglomeration effects are extremely large.

What are reasonable values for $\theta\delta$? Typical estimates of foreclosures on ordinary apartments are quite high. Some estimates claim that almost 50% of the value of a home is lost through the foreclosure process. Ciochetti (1997) documented gross foreclosure recovery ratios, the ratio of value recovered relative to average loan balance, which averaged about 82% between 1986 and 1995. When total legal costs were included, the recovery ratio fell to 69%, but this also reflects reductions in market price relative to the time of the loan. Another way of benchmarking these costs is to compare them with annual depreciation costs for housing, which are typically thought to be about 1% per year. An alternative is to

[5] In 2015, the ratio fell to one-third, presumably because building had become concentrated in low-cost areas.

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assume a fixed period of vacancy as a result of the transfer (perhaps between 6 months and 1 year), which could mean losses of 5% to 10% of the value of the property if capitalization rates are 10%.

Our calculations represent a thought experiment that assumes that the bubble gets building right, although there is little reason to be so confident. An actual bubble might include substantial overbuilding and consequently produce losses from both extra construction and defaults. A bubble also might not lead to any extra building. In such a case, the bubble does nothing but create losses. This might occur, for example, in places where supply restrictions are severe. I now turn to a more detailed discussion of the costs of real estate bubbles.

The fundamental asymmetry between the benefits of bubbles (internalizing agglomeration economies) and the costs of bubbles (defaults) is that the benefits are classic welfare triangles and the costs are rectangles. The gain from the bubble is to internalize an externality and that generates benefits that are proportional to the change in the quantity times the gap between the price of housing and the true benefit of building. The cost of the bubble is the loss of a proportion of the entire stock of housing being built.

The upsides of the bubble are limited to its impacts on the building stock and do not include the beliefs of the manufacturing firms at the point of hiring. This assumption is perhaps appropriate given this paper's focus on real estate bubbles, but it is true that bubbly beliefs in manufacturing firms would be beneficial as well, especially when there are no defaults in manufacturing. If manufacturing capital was also wiped out in a crash, then the case for an export industry bubble would also weaken.

**The Real and Financial Downsides of Bubbles**

In the model, a bubble created a real sector advantage (the production of extra housing) and a financial sector cost (the losses due to defaults). In reality, bubbles may generate costs in all three sectors. As discussed above, if agglomeration effects are modest, then even mild overoptimism can lead to too much building. A bubble can also lead to building too soon as well. These costs can be significant, but they are still likely to be smaller than the costs associated with financial disruptions. In a sense, these other costs are welfare triangles, while the costs from defaults can be rectangles.

This claim about rectangles and squares was certainly true in the previous model. All builders received a shock in their costs because prices fell and they had to default. The loss equals $\theta$ times all of the construction in existence. If there had been overbuilding, the cost from this overbuilding is a triangle. On the margin, the extra housing is worth slightly less than its social value.

Does this logic about triangles and rectangles hold in a more general model or in the real world? In a world with linear supply and demand curves, the social cost

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of overbuilding should be equal to one-half the amount of overbuilding times the distance between the marginal cost of construction and marginal benefit. In the US at least, this gap appears to be relatively small (Glaeser 2013). Even after the bust in Las Vegas, prices did not fall far below construction costs and they seem to have recovered to roughly the costs of building new housing. My attempt to calibrate these quantities found them to be quite marginal relative to the larger wreckage of the economy.

The costs of default, however, can be extremely large and hit a significant portion of the population. They can spread beyond the real estate sector and cause the entire financial sector to freeze, which can have larger implications for a range of industries. I chose not to model those effects above, but they certainly exist.

In reality, price declines hit both builders and investors. The builders may represent a relatively small slice of the economy at any one time and some of them may be shielded by equity. Investors can represent a share of the stock of real estate, not just the flow, and consequently their financial difficulties can be extremely large. Their financial troubles course through the system because banks fail to collect the full outstanding value of loans. As banks get into trouble, the financial system freezes up. The losses from the financial side of a real estate bust are not Harberger triangles, but potentially a large implicit tax on the entire economy.

The PRC could conceivably prove an exception to my claim that finance-related losses from real estate busts are far more severe than the costs of overbuilding. The overbuilding in third- and fourth-tier cities does represent a significant amount of economic activity in the PRC. In 20 years, this building could be valued at significantly less than it is today, at least if building continues. This poses the possibility that Chinese overbuilding will prove to have far larger economic consequences than overbuilding in Las Vegas or Phoenix.

Both the PRC and the US share a feature that makes overbuilding much more likely than in either the Republic of Korea or Thailand: a large number of cities. When there is a single urban giant, then overbuilding typically means overbuilding in one city. If demand for urbanization continues, then demand in this city will continue. In a country with many cities, it is quite possible that demand in any particular city will be low, even if the demand for urban space is strong. The US has robust demand for urban space in New York and San Francisco, but not in Detroit or Cleveland. The heterogeneity of the PRC also means that it is possible that the PRC is building up the wrong cities.

The PRC's large vacancy rates also create the possibility that the PRC is building too soon rather than too much. The costs of vacancy and technological change were not included in the model described above, but building with the intention of leaving vacant is surely suboptimal. Yet, Glaeser et al. (2017) estimate vacancy rates of as much as one-fifth in Chinese cities. If depreciation runs at 1%–2% per year and if vacancy lasts for 20 years, then the waste from overbuilding could run as high as 40% of the value of construction.

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These potential losses should also be framed against technological change in the construction industry. If building technology is improving, then waiting could have yielded advantages of being able to use newer technology. Naturally, it is also possible that rising labor costs could mean that future construction is more expensive, which would reduce the costs of building vacant homes today.

The view that the real costs of overbuilding in the PRC could rival or exceed the financial costs of a real estate downturn also rests on assuming those financial costs will be small. The resources of the public sector make it conceivable that the financial sector will remain capitalized even if real estate prices drop significantly. If we are sufficiently optimistic about the ability of the public sector to eliminate financial market distress, then the PRC could be an exception. It could be the first place where overbuilding is more costly than financial distress.

While this is conceivable, it seems an unlikely outcome. If there is a bust in the PRC, which is far from certain, it seems more likely that it will fall in line with history. If that is the case, then the biggest risk will be financial sector distress rather than too many structures.

## V. Policy Responses to Real Estate Bubbles

In this section, I turn to a discussion about policies in response to real estate booms and busts, separating the policy discussion into two separate subsections. The first subsection deals with policies when a bust has already begun. This corresponds to the 2008–2010 period in the US when financial markets were falling and banks were facing insolvency (or at least illiquidity) problems. The second subsection deals with policies during a price boom. Broadly speaking, I will suggest that the right approach is to be soft on banks during the bust and tough during the boom.

I will not discuss other urban policies. However, if cities were to adopt policies that lead builders to internalize agglomeration economies, then bubbles are always counterproductive. The only positive role for bubbles in the model was to counter a tendency to build too little. If that tendency is eliminated, then bubbles lose their upside.

### Addressing a Financial Market Meltdown

At the point of a bust, when prices have begun to fall, the public sector has several possible policy approaches. The authorities can try to artificially buoy prices and hope to ride out the storm. They can follow the tough path charted by former US Treasury Secretary Andrew Mellon during the Great Depression and let banks fail. They can extend credit to banks and try to avoid major financial market dislocation.

The first path is essentially impossible in the world's developed economies. The US government did not have the power to prop up housing prices in 2008. The

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downward trend was just too great. Some observers have suggested that, even with easy credit, reasonable estimates of the impact of interest rates on prices suggest that this was unlikely. Indeed, interest rates did fall dramatically over the course of the subsequent recession, with no observable impact on housing prices. Glaeser, Gottlieb, and Gyourko (2012) estimate a semielasticity of prices with respect to interest rates of approximately 6.

Consequently, a decline in interest rates of 100 basis points would lead to an estimated 9% increase in housing prices. If the logic of Himmelberg, Mayer, and Sinai (2005) is correct, then this effect is likely to be weaker during times of low expected growth rates in future prices. The Republican party's proposals to massively reduce interest rates through subsidies to homeowners were never likely to do much to reverse the enormous slump in housing prices.

In the PRC, public capacity to boost prices is greater than in the US because the government has far more ability to take housing off the market. Large-scale public purchases are a much more direct and effective means of boosting prices than tinkering with the interest rate. While the US government could not spend $600 billion to buy two $300 billion homes, the PRC government could do just that and more. If those homes were then used for social housing it could remove excess supply and help keep prices afloat.

The big problem with this strategy is that if the government uses its purchasing power to set a price floor and if that price floor is higher than construction costs, then builders will continue to supply new homes. Eventually, even the public sector's ability to absorb excess stock in the PRC would be overwhelmed by a flood of newly supplied housing. This public purchasing strategy can only work if it is coupled with some other intervention that will limit the supply of new housing. In the PRC, this could be done by banning land sales for new construction for a period of 5–10 years.

The costs of such an intervention would be significant. Buying millions of homes and then using them for new purposes would waste a great deal of the value of the real estate. Shutting down the construction sector would create large scale unemployment and reduce the benefits coming from continued economic growth. While the authorities in the PRC could keep prices up, unlike in the US, this strategy seems to carry costs that outweigh the benefits as long as the PRC is taking other steps to reduce financial sector dislocations from a real estate bust.

Authorities in the US did not have the ability to keep housing prices in 2008–2010, but they did have a choice between supporting the banking sector or letting banks fail. The case for tough love was moral hazard. The profailure argument was that unless banks bore the costs of their mistakes they would keep on making new mistakes. Andrew Mellon himself also believed that the failure of banks would lead to a benevolent process where bad banks fail and are replaced by good banks.

The opposing view is that the benefits of reducing moral hazard are vastly outweighed by the costs of financial market chaos. Large-scale bank failures can

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have horrendous consequences for the larger economy as the Great Depression made clear. I have little to add to the large financial literature that focuses on the downside of banking failures (see, for example, Reinhart and Rogoff 2009), but there are two points about moral hazard worth emphasizing.

Errors are made by individuals and errors can presumably be reduced if individuals suffer sharply when they make mistakes. This view lies at the heart of the economics of crime and punishment. Bank failures, however, are a poorly targeted means of punishing the bankers who erred. Much of the costs of those failures will be paid by people who had little to do with the mistakes of the boom. The bankers themselves who made the biggest mistakes are likely to go into comfortable retirement despite the institutional failures. Effective punishment tightly targets malefactors, while the impacts of bank failures are not tightly targeted.

The US legal system makes it impossible to impose draconian punishments on overly optimistic bankers, but elsewhere such punishments are more conceivable. It is easy to imagine tough but fair punishments for public officials who unwisely encouraged overdevelopment. In systems where targeted punishments are possible, it makes little sense to risk financial chaos by getting tough on troubled financial institutions.

**Policies During the Boom**

While supporting the financial sector during a bust seems like an appropriate path to reduce systemwide risks, tougher government policies seem more appropriate during a boom. When a financial bust occurs, then failed banking institutions impose costs on everyone and the government will have to pay the costs of recapitalizing these institutions. The externalities associated with the bust make it appropriate to impose tougher regulations during a boom.

Regulations and Pigouvian taxes are potential tools to internalize the external costs of real estate speculation by financial institutions such as banks. The standard regulatory response is to mandate minimum capital levels. The capital cushion makes it less likely that the financial institution will eventually default on its debts and spread failure throughout the system. Basel III requirements focus on the ratio of capital to risk-weighted assets. Real estate impacts the risk weighting of assets. During the boom that preceded the global financial crisis, real estate assets were treated as relatively safe even though such investments had considerable downside risk.

In the US, the mean reversion of housing prices is well established empirically. Consequently, during a boom the risks of future downward movement are considerable and real estate becomes far riskier. Housing price mean reversion implies that real estate investments are riskier when prices have recently risen. Regulations could treat them as such. An alternative is to focus on the gap between

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prices and construction, and to increasingly treat real estate investments as riskier when that gap widens. Either approach would have pushed banks to add more capital during the recent boom, at least if they had considerable exposure to real estate.

These policies are not without costs as they would induce banks to hold less real estate-related capital, which could put a damper on the real estate market. But leaning against a booming market may be a perfectly reasonable role for financial regulators.

A secondary approach is to impose Pigouvian taxes on banks, almost assuredly in addition to maintaining capital requirements. These payments are essentially insurance payments against a bailout and they need to be calibrated against the risks of needing a bailout. The payment needs to rise with the risk of a bank's portfolio. Consequently, the insurance fees should be higher when banks are holding real estate assets during a boom. As in the case of risk-weighting assets, the downside risk can be measured either by assuming mean reversion in prices or by using the gap between prices and construction.

There are other public policies that encourage booms and encourage financial participations in booms that are also worth rethinking given the risks of financial distress. Recently, the PRC government responded to the housing boom by encouraging more, rather than less, lending to would-be homebuyers. Arguably, the US followed a similar strategy in the years before 2006 to create an "ownership society" as described by the George W. Bush Administration. These prolending strategies may temporarily boost prices, but they also increase the exposure of the banking system to real estate downturns. The goal of policies during the boom should be to reduce the exposure of the system, not to amplify the risks.

In some countries, other policies may inadvertently exacerbate the impacts of real estate bubbles. For example, in the PRC, the incentive of local governments to fund their operations through land sales has the potential to artificially increase the amount of real estate development. One natural alternative is for these local governments to switch to a standard annual property tax system for revenue generation. A related policy change would be to ensure that there are better safeguards on abuse of eminent domain. Better land-value assessments could achieve that end, especially if enforced at the central government level. Alternatively, current residents could be given greater ability to reject offers collectively. While giving every resident a veto is an invitation to holdout problems, requiring supermajority approval is much less likely to engender abuse.

Finally, the PRC's system of rewarding local officials for increasing GDP growth may deserve reappraisal. Encouraging large amounts of new construction is a simple means of increasing GDP. New construction can also overstate growth if apartments are valued at artificially high prices. One potential reform would be to treat GDP in the construction sector as distinct from export-related GDP. Providing stronger rewards for exported-related growth than for construction growth may work against any tendency to overbuild.

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## VI. Conclusions

Real estate bubbles have been pervasive throughout US history. Recent experiences in Asia have also illustrated how a boom-and-bust cycle in real estate can set off wider financial system distress. The PRC has experienced a great boom, but it is still unclear whether there will also be a great bust.

The tendency of speculation to center on real estate partially reflects the flexible nature of built space and the strong history of property law in developed economies. Lenders often see real estate as safer collateral than industrial investment. Consequently, passive capital is more likely to flow into real estate and the enthusiasm of passive capital is more likely to create real estate bubbles.

Both US and Asian history suggest that optimistic beliefs about real estate can have upsides. The development of a city can benefit from enthusiasm about property values. When there are positive externalities from urban expansion, then a real estate bubble can create social benefits. Overoptimism can lead builders to deliver the socially optimal level of space that they would not have otherwise produced given more accurate assumptions.

Yet, the financial costs of real estate bubbles are likely to overwhelm any such benefits. When foreclosures destroy value, then real estate bubbles have widespread consequences. During the 1997/98 Asian financial crisis and the global financial crisis that started in the US, banking sector troubles that began in real estate spread to the wider economy. The potential downside of real estate speculation makes it an important topic for policy makers.

The policy discussion in this paper backs the common view that supporting the financial system during a bust is likely to generate more benefits than costs. Bailing out banks does create moral hazard, but letting banks fail is an extremely socially expensive way to encourage discipline. Individual bankers pay only a small fraction of the actual costs imposed by a bank's failure.

If the public sector and the general public are going to pay significant costs in the event of a bust, then proactive policies during the boom may be beneficial. Real estate investments are risky after a large run-up in prices. Consequently, it may be appropriate for regulations to treat real estate investments as being particularly risky during such periods. It may also be appropriate to impose Pigouvian taxes on financial institutions that invest heavily in real estate during boom periods.

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## Appendix: Proofs of Propositions

**Proof of Proposition 1:**

In all equilibria, the wage and housing price and population will be a function of the quantities of effective housing space and capital. If $H_S$ denotes housing space at the start of the first period (after default losses) and $K_M$ denotes effective capital at the start of the first period (again after default losses), then $w = (1-\alpha)AK_M^{\alpha}N^{-\alpha}$ and $P_H H_S = \gamma(1-\alpha)AK_M^{\alpha}N^{1-\alpha}$. Using

$P_H = \left(\frac{w}{w_0}\right)^{\frac{1}{\gamma}}$, we have $\left(\frac{(1-\alpha)AK_M^{\alpha}N^{-\alpha}}{w_0}\right)^{\frac{1}{\gamma}} H_S = \gamma(1-\alpha)AK_M^{\alpha}N^{1-\alpha}$ or

$\left((1-\alpha)AK_M^{\alpha}\right)^{\frac{1-\gamma}{\alpha+\gamma-\alpha\gamma}}\left(\frac{H_S}{\gamma}\right)^{\frac{\gamma}{\alpha+\gamma-\alpha\gamma}} w_0^{\frac{-1}{\alpha+\gamma-\alpha\gamma}} = N$, $((1-\alpha)A)^{\frac{\gamma}{\alpha+\gamma-\alpha\gamma}}\left(\frac{\gamma K_M}{H_S}\right)^{\frac{\alpha\gamma}{\alpha+\gamma-\alpha\gamma}}$

$w_0^{\frac{\alpha}{\alpha+\gamma-\alpha\gamma}} = w$ and $((1-\alpha)A)^{\frac{1}{\alpha+\gamma-\alpha\gamma}}\left(\frac{\gamma K_M}{H_S}\right)^{\frac{\alpha}{\alpha+\gamma-\alpha\gamma}} w_0^{\frac{\alpha-1}{\alpha+\gamma-\alpha\gamma}} = P_H$.

In real estate, the supply of housing services satisfies $H_S = \frac{1-S_P\rho\theta\delta}{1-\sigma}M^{\sigma}K_H^{1-\sigma}$, where $S_P$ refers to the share of housing-related capital that is passive and $K_H$ is the total stock of housing-related capital (before default-related losses).

This implies that

$$((1-\alpha)A)^{\frac{\gamma}{\alpha+\gamma-\alpha\gamma}}\left(\frac{(1-\sigma)\gamma K_M}{1-S_P\rho\theta\delta}\right)^{\frac{\alpha\gamma}{\alpha+\gamma-\alpha\gamma}} M^{\frac{-\sigma\alpha\gamma}{\alpha+\gamma-\alpha\gamma}} K_H^{\frac{-(1-\sigma)\alpha\gamma}{\alpha+\gamma-\alpha\gamma}} w_0^{\frac{\alpha}{\alpha+\gamma-\alpha\gamma}} = w$$

and

$$((1-\alpha)A)^{\frac{1}{\alpha+\gamma-\alpha\gamma}}\left(\frac{(1-\sigma)\gamma K_M}{1-S_P\rho\theta\delta}\right)^{\frac{\alpha}{\alpha+\gamma-\alpha\gamma}} M^{\frac{-\sigma\alpha}{\alpha+\gamma-\alpha\gamma}} K_H^{\frac{-(1-\sigma)\alpha}{\alpha+\gamma-\alpha\gamma}} w_0^{\frac{\alpha-1}{\alpha+\gamma-\alpha\gamma}} = P_H.$$

The returns to one unit of active capital in manufacturing are

$$\frac{\alpha}{1-\alpha}((1-\alpha)A)^{\frac{1}{\alpha+\gamma-\alpha\gamma}}M^{\frac{\sigma(1-\alpha)\gamma}{\alpha+\gamma-\alpha\gamma}}\left(\frac{(1-\sigma)\gamma K_M}{1-S_P\rho\theta\delta}\right)^{\frac{(\alpha-1)\gamma}{\alpha+\gamma-\alpha\gamma}}K_H^{\frac{(1-\sigma)(1-\alpha)\gamma}{\alpha+\gamma-\alpha\gamma}}w_0^{\frac{\alpha-1}{\alpha+\gamma-\alpha\gamma}}$$

and the returns to passive capital would be $(1-\rho\delta)$ times that amount.

The marginal returns to active capital $(P_H M^{\sigma} K_H^{-\sigma})$ in real estate are

$$((1-\alpha)A)^{\frac{1}{\alpha+\gamma-\alpha\gamma}}M^{\frac{\sigma\gamma(1-\alpha)}{\alpha+\gamma-\alpha\gamma}}\left(\frac{(1-\sigma)\gamma K_M}{1-S_P\rho\theta\delta}\right)^{\frac{\alpha}{\alpha+\gamma-\alpha\gamma}}K_H^{\frac{-\alpha-\sigma\gamma+\alpha\sigma\gamma}{\alpha+\gamma-\alpha\gamma}}w_0^{\frac{\alpha-1}{\alpha+\gamma-\alpha\gamma}}$$

and the returns to passive capital are $(1-\rho\theta\delta)$ times that amount.

As $\theta < 1$, it is impossible to have both types of capital be indifferent between the two sectors. Active capital can be indifferent, in which case passive capital will strictly prefer real estate. Passive capital can be indifferent, in which case active capital will strictly prefer manufacturing. Consequently, it is only possible to have one type of capital investing in both sectors at once. This logic implies that there are four possible equilibrium outcomes: (i) only active capital is used in both sectors and in that case $K_M + K_H = \bar{I}$ and $S_P = 0$, (ii) active capital is used in both sectors and passive capital is also used in real estate so $K_M + K_H > \bar{I}$, (iii) active capital is used in manufacturing and passive capital is used in real estate and in that case $K_M = \bar{I}$, $S_P = 1$, and (iv) active capital is used in manufacturing and passive capital is used in both industries and in that case $K_M > \bar{I}$.

**Equilibrium 1: Only Active Capital**

In this case, the returns to active capital investment must be equalized between the two sectors, which implies that $\alpha K_H = (1-\alpha)(1-\sigma)\gamma K_M$ and consequently that $K_M = \frac{\alpha}{\alpha+(1-\alpha)(1-\sigma)\gamma}\bar{I}$ and $K_H = \frac{(1-\alpha)(1-\sigma)\gamma}{\alpha+(1-\alpha)(1-\sigma)\gamma}\bar{I}$. The returns to passive capital investing in real estate would be

$$(1-\rho\theta\delta)A^{\frac{1}{\alpha+\gamma-\alpha\gamma}}\alpha^{\frac{\alpha}{\alpha+\gamma-\alpha\gamma}}\left(\frac{1-\alpha}{w_0}\right)^{\frac{1-\alpha}{\alpha+\gamma-\alpha\gamma}}\left(\frac{\alpha+(1-\alpha)(1-\sigma)\gamma}{(1-\alpha)(1-\sigma)\gamma\bar{I}}M\right)^{\frac{\sigma\gamma(1-\alpha)}{\alpha+\gamma-\alpha\gamma}}$$

For this to be an equilibrium this must be less than 1, which implies that

$$\bar{I} > \frac{\alpha+(1-\alpha)(1-\sigma)\gamma}{(1-\alpha)(1-\sigma)\gamma}M\left((1-\rho\theta\delta)^{\alpha+\gamma-\alpha\gamma}A\alpha^{\alpha}\left(\frac{1-\alpha}{w_0}\right)^{1-\alpha}\right)^{\frac{1}{\sigma\gamma(1-\alpha)}}$$

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I let the value of $\bar{I}$ at which this holds with equality denoted $\bar{I}_1$; differentiation then gives us that $\bar{I}_1$ is rising with $A$ and $M$, and falling with $\rho$, $\theta$, $\delta$, and $w_0$.

**Equilibrium 2: Active Capital in Both Sectors, Passive Capital in Real Estate**

Once again, the returns to active capital investment must be equalized between the two sectors, which now implies that $\alpha(1 - S_P\rho\theta\delta)K_H = (1-\alpha)(1-\sigma)\gamma K_M$ and the returns to passive capital investing in real estate must equal 1. These two equalities imply that

$$K_H = M\left((1-\rho\theta\delta)^{\alpha+\gamma-\alpha\gamma} A\alpha^{\alpha}\left(\frac{1-\alpha}{w_0}\right)^{1-\alpha}\right)^{\frac{1}{\sigma\gamma(1-\alpha)}}$$

One condition for this equilibrium to exist is that this quantity is greater than $\frac{(1-\alpha)(1-\sigma)\gamma}{\alpha+(1-\alpha)(1-\sigma)\gamma}\bar{I}$, which is equivalent to requiring that $\bar{I}_1 > \bar{I}$. The second requirement is that the returns be equalized for the active investors, without any passive capital investing in manufacturing. The extreme of this range equilibrium occurs when there is essentially no active investment in real estate, but the returns are still equalized. In that case $S_P = 1$, $K_M = \bar{I}$, and this defines $\bar{I}_2$, which satisfies

$$\frac{\alpha(1-\rho\theta\delta)^{1+\frac{1}{\sigma}+\frac{\alpha}{\sigma\gamma(1-\alpha)}}M}{(1-\alpha)(1-\sigma)\gamma}\left(\frac{1-\alpha}{w_0}\right)^{\frac{1}{\sigma\gamma}} A^{\frac{1}{\sigma\gamma(1-\alpha)}}\alpha^{\frac{\alpha}{\sigma\gamma(1-\alpha)}} = \bar{I}_2$$

As long as $\bar{I} > \bar{I}_2$, then the returns in the real estate sector (with only active investment) will be low enough so that the returns can be equalized across the two sectors, but when $\bar{I} < \bar{I}_2$, then the returns will be higher in real estate than in manufacturing for the active investors and hence the two types of capital will specialize. As $\alpha(1-\rho\theta\delta) < \alpha + (1-\alpha)(1-\sigma)\gamma$, $\bar{I}_2 < \bar{I}_1$. Differentiation also gives us that $\bar{I}_2$ is rising with $A$ and $M$, and falling with $\rho$, $\theta$, $\delta$, and $w_0$.

**Equilibrium 3: Segregation of Passive and Active Capital**

When $\bar{I} < \bar{I}_2$, then the returns for active capital cannot be equalized across the two sectors. When $\bar{I}$ is still relatively abundant, then only active capital invests in manufacturing and only passive capital invests in real estate.

The return to passive capital in real estate is 1, which implies that $\left((1-\rho\theta\delta)^{\gamma(1-\alpha)}(1-\alpha)AM^{\sigma\gamma(1-\alpha)}((1-\sigma)\gamma\,\bar{I})^{\alpha} w_0^{\alpha-1}\right)^{\frac{1}{\alpha+\sigma\gamma-\alpha\sigma\gamma}} = K_H$, and this is increasing in $M$, $\bar{I}$, and $A$ and decreasing in $w_0$, $\rho$, $\theta$, and $\delta$.

This implies that the returns to active capital in manufacturing equal

$$\alpha\left((1-\rho\theta\delta)^{\gamma(1-\alpha)}(1-\alpha)^{(1-\alpha)(1-\sigma\gamma)}AM^{\sigma\gamma(1-\alpha)}\left((1-\sigma)\gamma\,\bar{I}\right)^{\sigma\gamma(\alpha-1)} w_0^{\alpha-1}\right)^{\frac{1}{\alpha+\sigma\gamma-\alpha\sigma\gamma}}$$

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This must be higher than $\frac{1}{1-\rho\theta\delta}$, which implies that $\bar{I} < \bar{I}_2$ and it must be lower than $\frac{1}{1-\rho\delta}$ (so that passive capital does not want to invest in manufacturing), which implies that $\frac{\alpha(1-\rho\delta)^{1+\frac{\alpha}{\sigma\gamma(1-\alpha)}}(1-\rho\theta\delta)^{\frac{1}{\sigma}}M}{(1-\sigma)(1-\alpha)\gamma}(\frac{1-\alpha}{w_0})^{\frac{1}{\sigma\gamma}}A^{\frac{1}{\sigma\gamma(1-\alpha)}}\alpha^{\frac{\alpha}{\sigma\gamma(1-\alpha)}} < \bar{I}$, which means that $\bar{I}$ must be greater than $(\frac{1-\rho\delta}{1-\rho\theta\delta})^{1+\frac{\alpha}{\sigma\gamma(1-\alpha)}}\bar{I}_2 = \bar{I}_3$. Differentiation gives us that $\bar{I}_3$ is rising with $A$ and $M$, and falling with $\rho$, $\theta$, $\delta$, and $w_0$.

**Equilibrium 4: Passive Capital in Both Sectors**

In this region, passive capital is active in both sectors and hence the expected returns to investing in both sectors for passive capital must equal 1. Active capital will only be in manufacturing. Equality of returns implies that $\frac{\alpha(1-\rho\delta)}{(1-\alpha)(1-\sigma)\gamma}K_H = K_M$, and

$$(1-\rho\theta\delta)^{\frac{1}{\sigma}}\left(\frac{1-\alpha}{w_0}\right)^{\frac{1}{\sigma\gamma}}A^{\frac{1}{\sigma\gamma(1-\alpha)}}M(\alpha\,(1-\rho\delta))^{\frac{\alpha}{\sigma\gamma(1-\alpha)}} = K_H.$$

Hence, both types of capital are rising with $A$ and $M$, and falling with $\rho$, $\theta$, $\delta$, and $w_0$. The value of $K_M$ must be greater than $\bar{I}$ in this equilibrium. Hence, $\bar{I}$ must be less than $\bar{I}_3$.

I have also shown that whenever there is passive capital investing in a sector, then the investment in that sector is rising with $A$ and $M$, and falling with $\rho$, $\theta$, $\delta$, and $w_0$. Since the population level is increasing in both types of capital and also rising with A and falling with $w_0$, then it follows that the population is always rising with $A$ and falling with $w_0$, and that when there is passive investment in either sector, population is rising $A$ and $M$, and falling with $\rho$, $\theta$, $\delta$, and $w_0$.

**Proof of Proposition 2:**

In this case, I simply replace $A$ with $\hat{A}$ in all the formulas and the proposition immediately follows.

**Proof of Proposition 3:**

I assume that the stock of manufacturing capital is fixed at $\bar{I}$ and that employment in manufacturing will be competitively determined and based on the true level of productivity. I will allow potentially different errors at the stage of building and at the stage of hiring, so that builders believe that $A_0 = \hat{A}_0$ and manufacturers believe that $A_M = \hat{A}_M$. Builders also expect that manufacturers will have a value of $\hat{A}_M$ equal to $\hat{A}_0$.

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Consequently, if the supply of housing is $H_S$, the city population will be

$$\left((1-\alpha)\hat{A}_M\bar{I}^{\alpha}\right)^{\frac{1-\gamma}{\gamma+(1-\gamma)(\alpha-\epsilon)}}\left(\frac{H_S}{\gamma}\right)^{\frac{\gamma}{\gamma+(1-\gamma)(\alpha-\epsilon)}} w_0^{\frac{-1}{\gamma+(1-\gamma)(\alpha-\epsilon)}},$$

the wage will be

$$\left((1-\alpha)\hat{A}_M\bar{I}^{\alpha}\right)^{\frac{\gamma}{\gamma+(1-\gamma)(\alpha-\epsilon)}}\left(\frac{H_S}{\gamma}\right)^{\frac{-\gamma(\alpha-\epsilon)}{\gamma+(1-\gamma)(\alpha-\epsilon)}} w_0^{\frac{\alpha-\epsilon}{\gamma+(1-\gamma)(\alpha-\epsilon)}},$$

and the price of housing will be

$$\left((1-\alpha)\hat{A}_M\bar{I}^{\alpha}\right)^{\frac{1}{\gamma+(1-\gamma)(\alpha-\epsilon)}}\left(\frac{H_S}{\gamma}\right)^{\frac{-(\alpha-\epsilon)}{\gamma+(1-\gamma)(\alpha-\epsilon)}} w_0^{\frac{\alpha-\epsilon-1}{\gamma+(1-\gamma)(\alpha-\epsilon)}}.$$

This implies that capital invested in housing will equal

$$\left(\frac{(1-\alpha)\hat{A}_0\bar{I}^{\alpha}((1-\sigma)\gamma)^{\alpha-\epsilon}}{w_0^{1+\epsilon-\alpha}}\right)^{\frac{1}{\sigma\gamma+(1-\sigma\gamma)(\alpha-\epsilon)}} M^{\frac{\sigma\gamma(1+\epsilon-\alpha)}{\sigma\gamma+(1-\sigma\gamma)(\alpha-\epsilon)}}.$$

The total supply of housing will equal

$$\left(\frac{(1-\alpha)\hat{A}_0\bar{I}^{\alpha}\gamma^{\alpha-\epsilon}}{w_0^{1+\epsilon-\alpha}}\right)^{\frac{1-\sigma}{\sigma\gamma+(1-\sigma\gamma)(\alpha-\epsilon)}}(1-\sigma)^{\frac{-\sigma\gamma-\sigma(1-\gamma)(\alpha-\epsilon)}{\sigma\gamma+(1-\sigma\gamma)(\alpha-\epsilon)}} M^{\frac{\sigma(\gamma+(1-\gamma)(\alpha-\epsilon))}{\sigma\gamma+(1-\sigma\gamma)(\alpha-\epsilon)}}.$$

The population level will equal

$$N=\left(\left(\frac{M}{(1-\sigma)\gamma}\right)^{\sigma\gamma}\frac{\left((1-\alpha)\bar{I}^{\alpha}\right)^{1-\sigma\gamma}\hat{A}_0^{1-\sigma\gamma}}{w_0}\right)^{\frac{1}{\sigma\gamma+(1-\sigma\gamma)(\alpha-\epsilon)}}\left(\frac{\hat{A}_M}{\hat{A}_0}\right)^{\frac{1-\gamma}{\gamma+(1-\gamma)(\alpha-\epsilon)}}.$$

Maximizing social surplus involves choosing $N$ and $K_S$, and a level of consumption for workers (denoted $c$) to maximize $A\bar{I}^{\alpha}N^{1+\epsilon-\alpha}-K_H-Nc$, subject to the constraint that workers receive their outside option or $\frac{c^{1-\gamma}h^{\gamma}}{(1-\gamma)^{1-\gamma}\gamma^{\gamma}}=w_0$, which implies that $c=(1-\gamma)\gamma^{\frac{\gamma}{1-\gamma}}w_0^{\frac{1}{1-\gamma}}(\frac{H_S}{N})^{\frac{-\gamma}{1-\gamma}}$. Hence, surplus maximization requires

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that maximizing

$$A_0\bar{I}^{\alpha}N^{1+\epsilon-\alpha}-K_H-(1-\gamma)\gamma^{\frac{\gamma}{1-\gamma}}\mathrm{N}^{\frac{1}{1-\gamma}}w_0^{\frac{1}{1-\gamma}}\left(\frac{M^{\sigma}K_H^{1-\sigma}}{(1-\sigma)}\right)^{\frac{-\gamma}{1-\gamma}},$$

which implies that

$$(1+\epsilon-\alpha)A_0\bar{I}^{\alpha}N^{\epsilon-\alpha}=\gamma^{\frac{\gamma}{1-\gamma}}\mathrm{N}^{\frac{\gamma}{1-\gamma}}w_0^{\frac{1}{1-\gamma}}\left(\frac{M^{\sigma}K_H^{1-\sigma}}{(1-\sigma)}\right)^{\frac{-\gamma}{1-\gamma}},$$

and

$$1=\frac{\gamma^{\frac{1}{1-\gamma}}(1-\sigma)}{K_H}\mathrm{N}^{\frac{1}{1-\gamma}}w_0^{\frac{1}{1-\gamma}}\left(\frac{M^{\sigma}K_H^{1-\sigma}}{(1-\sigma)}\right)^{\frac{-\gamma}{1-\gamma}}.$$

In the absence of externalities, this outcome can be decentralized with $P_H=\gamma^{\frac{1}{1-\gamma}}\mathrm{N}^{\frac{1}{1-\gamma}}w_0^{\frac{1}{1-\gamma}}(\frac{M^{\sigma}K_H^{1-\sigma}}{(1-\sigma)})^{\frac{-1}{1-\gamma}}$, which then implies an investment decision of $P_HM^{\sigma}K_H^{-\sigma}=1$, which then implies $\frac{\gamma^{\frac{1}{1-\gamma}}(1-\sigma)}{K_H}\mathrm{N}^{\frac{1}{1-\gamma}}w_0^{\frac{1}{1-\gamma}}(\frac{M^{\sigma}K_H^{1-\sigma}}{(1-\sigma)})^{\frac{-\gamma}{1-\gamma}}=1$, which is the same as the first best. That value of $P_H$ implies that $P_H^{\gamma}w_0=w$, which implies a hiring first-order condition of

$$(1-\alpha)A\bar{I}^{\alpha}N^{-\alpha}=\gamma^{\frac{\gamma}{1-\gamma}}\mathrm{N}^{\frac{\gamma}{1-\gamma}}w_0^{\frac{1}{1-\gamma}}\left(\frac{M^{\sigma}K_H^{1-\sigma}}{(1-\sigma)}\right)^{\frac{-\gamma}{1-\gamma}},$$

which is also the same as the first best.

The surplus-maximizing population level will equal

$$N=\left((1+\epsilon-\alpha)A_0\bar{I}^{\alpha}\right)^{\frac{1-\sigma\gamma}{\sigma\gamma+(1-\sigma\gamma)(\alpha-\epsilon)}}\left(\frac{M}{(1-\sigma)\gamma}\right)^{\frac{\sigma\gamma}{\sigma\gamma+(1-\sigma\gamma)(\alpha-\epsilon)}}w_0^{\frac{-1}{\sigma\gamma+(1-\sigma\gamma)(\alpha-\epsilon)}},$$

and the surplus-maximizing capital invested in housing will be

$$\left(\frac{(1+\epsilon-\alpha)A_0\bar{I}^{\alpha}((1-\sigma)\gamma)^{\alpha-\epsilon}}{w_0^{1+\epsilon-\alpha}}\right)^{\frac{1}{\sigma\gamma+(1-\sigma\gamma)(\alpha-\epsilon)}}M^{\frac{\sigma\gamma(1+\epsilon-\alpha)}{\sigma\gamma+(1-\sigma\gamma)(\alpha-\epsilon)}}$$

As the surplus-maximizing capital invested in housing is equal to $(\frac{1+\epsilon-\alpha}{1-\alpha})^{\frac{1}{\sigma\gamma+(1-\sigma\gamma)(\alpha-\epsilon)}}$ times the decentralized housing stock, then if $\hat{A}_0=\frac{1+\epsilon-\alpha}{1-\alpha}A_0$, the socially optimal level of housing will be built. That level of error can also produce the socially

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optimal level of population if $\hat{A}_M = \hat{A}_0$, but if $\hat{A}_M < \hat{A}_0$, then the housing stock will be at the surplus-maximizing level, but the level of population will be too small.

If manufacturing employment and the property market are decentralized, with firm beliefs equaling $\hat{A}_M$, then total surplus will equal

$$\left(\frac{A_0 - (1-\gamma)(1-\alpha)\hat{A}_M}{(1-\alpha)\hat{A}_M\gamma}\right)\left(\frac{(1-\alpha)\gamma^{\alpha-\epsilon}\hat{A}_M\bar{I}^{\alpha}M^{\sigma\gamma(1+\epsilon-\alpha)}}{w_0^{1+\epsilon-\alpha}(1-\sigma)^{\gamma(1+\epsilon-\alpha)}}\right)^{\frac{1}{\gamma+(1-\gamma)(\alpha-\epsilon)}} K_H^{\frac{(1-\sigma)\gamma(1+\epsilon-\alpha)}{\gamma+(1-\gamma)(\alpha-\epsilon)}}$$
$$- K_H,$$

and surplus-maximizing housing capital will satisfy

$$\left(\frac{\left(A_0 - (1-\gamma)(1-\alpha)\hat{A}_M\right)(1+\epsilon-\alpha)}{(1-\alpha)(\gamma+(1-\gamma)(\alpha-\epsilon))\hat{A}_M}\right)^{\frac{\gamma+(1-\gamma)(\alpha-\epsilon)}{\sigma\gamma+(1-\sigma\gamma)(\alpha-\epsilon)}}$$
$$\times\left(\frac{(1-\alpha)((1-\sigma)\gamma)^{\alpha-\epsilon}\hat{A}_M\bar{I}^{\alpha}M^{\sigma\gamma(1+\epsilon-\alpha)}}{w_0^{1+\epsilon-\alpha}}\right)^{\frac{1}{\sigma\gamma+(1-\sigma\gamma)(\alpha-\epsilon)}} = K_H.$$

If $\hat{A}_M = A_0$, then constrained optimal investment will equal

$$\left(1 + \frac{\epsilon}{(1-\alpha)(\gamma(1+\epsilon-\alpha)+\alpha-\epsilon)}\right)^{\frac{\gamma+(1-\gamma)(\alpha-\epsilon)}{\sigma\gamma+(1-\sigma\gamma)(\alpha-\epsilon)}}\left(\frac{A_0}{\hat{A}_0}\right)^{\frac{1}{\sigma\gamma+(1-\sigma\gamma)(\alpha-\epsilon)}}$$

times decentralized investment. Consequently, the optimal bubble is

$$\frac{\hat{A}_0}{A_0} = \left(1 + \frac{\epsilon}{(1-\alpha)(\gamma+(1-\gamma)(\alpha-\epsilon))}\right)^{\gamma+(1-\gamma)(\alpha-\epsilon)} < \frac{1+\epsilon-\alpha}{1-\alpha}.$$

The last inequality follows because $(1+\frac{Y}{X})^X$ is always increasing with $X$ when $X > 0, A > 0$.

**Proof of Proposition 4:**

The surplus without a bubble equals

$$\left(\frac{\alpha(1-\sigma\gamma)+\sigma\gamma}{(1-\alpha)(1-\sigma)\gamma}\right)\left(\frac{(1-\alpha)A_0\bar{I}^{\alpha}M^{\sigma\gamma(1+\epsilon-\alpha)}((1-\sigma)\gamma)^{\alpha-\epsilon}}{w_0^{1+\epsilon-\alpha}}\right)^{\frac{1}{\sigma\gamma+(1-\sigma\gamma)(\alpha-\epsilon)}}.$$

In the case of any bubble, housing supply is reduced to $1-\theta\delta$ times the housing stock because of defaults and foreclosures. Even the slightest bubble causes this

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loss. As discussed in the text, I assume that manufacturers and workers actually observe $A_0$, which implies that total surplus will equal

$$\left(\frac{\alpha+\gamma-\alpha\gamma}{(1-\alpha)\gamma}\right)\left(\frac{(1-\alpha)\gamma^{\alpha-\epsilon}A_0\bar{I}^{\alpha}((1-\theta\delta)M^{\sigma})^{\gamma(1+\epsilon-\alpha)}}{w_0^{1+\epsilon-\alpha}(1-\sigma)^{\gamma(1+\epsilon-\alpha)}}\right)^{\frac{1}{\gamma+(1-\gamma)(\alpha-\epsilon)}}K_H^{\frac{(1-\sigma)\gamma(1+\epsilon-\alpha)}{\gamma+(1-\gamma)(\alpha-\epsilon)}} - K_H,$$

and surplus maximizing housing capital will equal

$$\left(\frac{\dfrac{(1-\alpha)^{(1-\gamma)(1+\epsilon-\alpha)}((1-\sigma)\gamma)^{\alpha-\epsilon}A_0\bar{I}^{\alpha}((1-\theta\delta)M^{\sigma})^{\gamma(1+\epsilon-\alpha)}}{((\alpha+\gamma-\alpha\gamma)(1+\epsilon-\alpha))^{\gamma+(1-\gamma)(\alpha-\epsilon)}}}{w_0^{1+\epsilon-\alpha}(\gamma+(1-\gamma)(\alpha-\epsilon))^{\gamma+(1-\gamma)(\alpha-\epsilon)}}\right)^{\frac{1}{\sigma\gamma+(1-\sigma\gamma)(\alpha-\epsilon)}}.$$

Decentralized investment will equal optimal investment if

$$\frac{\hat{A}_0}{A_0}=\left(\frac{(\alpha+\gamma-\alpha\gamma)(1+\epsilon-\alpha))}{(1-\alpha)(\gamma+(1-\gamma)(\alpha-\epsilon))}\right)^{\gamma+(1-\gamma)(\alpha-\epsilon)}(1-\theta\delta)^{\gamma(1+\epsilon-\alpha)}.$$

This will only be greater than 1 if

$$\left(\frac{(1-\alpha)(\gamma+(1-\gamma)(\alpha-\epsilon))}{(\alpha+\gamma-\alpha\gamma)(1+\epsilon-\alpha))}\right)^{\frac{\gamma+(1-\gamma)(\alpha-\epsilon)}{\gamma(1+\epsilon-\alpha)}}<1-\theta\delta.$$

The term

$$\frac{(1-\alpha)(\gamma+(1-\gamma)(\alpha-\epsilon))}{(\alpha+\gamma-\alpha\gamma)(1+\epsilon-\alpha))}=1-\frac{\epsilon}{(\alpha+\gamma-\alpha\gamma)(1+\epsilon-\alpha)},$$

so if $\theta\delta$ is low enough, a bubble will increase the housing stock.

Assuming this condition is met so that any overoptimism is desirable, then the total surplus given the optimal bubble equals $\frac{\sigma\gamma+(1-\sigma\gamma)(\alpha-\epsilon)}{(1-\sigma)\gamma(1+\epsilon-\alpha)}$ times the capital stock.

This will be higher than the decentralized surplus without a bubble if and only if

$$\left(\frac{(\alpha(1-\sigma\gamma)+\sigma\gamma)(1+\epsilon-\alpha)}{(\sigma\gamma+(1-\sigma\gamma)(\alpha-\epsilon))(1-\alpha)}\right)^{\frac{\sigma\gamma+(1-\sigma\gamma)(\alpha-\epsilon)}{\gamma(1+\epsilon-\alpha)}} \times\left(\frac{(1-\alpha)(\gamma+(1-\gamma)(\alpha-\epsilon))}{(\alpha+\gamma-\alpha\gamma)(1+\epsilon-\alpha))}\right)^{\frac{\gamma+(1-\gamma)(\alpha-\epsilon)}{\gamma(1+\epsilon-\alpha)}}<1-\theta\delta.$$

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The term

$$\frac{(\alpha\,(1-\sigma\gamma)+\sigma\gamma)\,(1+\epsilon-\alpha)}{\sigma\gamma+(1-\sigma\gamma)\,(\alpha-\epsilon)\,(1-\alpha)}=1+\frac{\epsilon}{(\sigma\gamma+(1-\sigma\gamma)\,(\alpha-\epsilon))\,(1-\alpha)}$$

so the cutoff required for a bubble to be welfare improving is higher than the cutoff for a bubble to lead to more real estate investment. Using the notation $\mu=\gamma\,(1+\epsilon-\alpha)$, the condition can be rewritten as

$$\left(1+\frac{\epsilon}{(\sigma\mu+(\alpha-\epsilon))(1-\alpha)}\right)^{\sigma+\frac{\alpha-\epsilon}{\mu}}\left(1+\frac{\epsilon}{(\mu+(\alpha-\epsilon))(1-\alpha)}\right)^{-1-\frac{(\alpha-\epsilon)}{\mu}}<1-\theta\delta.$$

As the function $\left(1+\frac{\epsilon}{x(1-\alpha)}\right)^{x}$ is increasing with $x$ for $x>0$,

$$\left(1+\frac{\epsilon}{(1-\alpha)\,(\gamma+(1-\gamma)\,(\alpha-\epsilon))}\right)^{\gamma+(1-\gamma)(\alpha-\epsilon)}$$
$$>\left(1+\frac{\epsilon}{(\sigma\gamma+(1-\sigma\gamma)\,(\alpha-\epsilon))\,(1-\alpha)}\right)^{\sigma\gamma+(1-\sigma\gamma)(\alpha-\epsilon)}$$

and consequently,

$$\left(1+\frac{\epsilon}{(\sigma\gamma+(1-\sigma\gamma)\,(\alpha-\epsilon))\,(1-\alpha)}\right)^{\sigma\gamma+(1-\sigma\gamma)(\alpha-\epsilon)}$$
$$\times\left(1+\frac{\epsilon}{(1-\alpha)\,(\gamma+(1-\gamma)\,(\alpha-\epsilon))}\right)^{-\gamma-(1-\gamma)(\alpha-\epsilon)}<1,$$

so that there must always exist a value of $\theta\delta$ at which the bubble outcome is exactly as beneficial as the no-bubble outcome.

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