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JEL Classification: E21, O11, O16, O18

Keywords: Wealth inequality, Capital accumulation, Migration, Housing

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Unequal Transition: The Making of China's Wealth Gap*

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This paper studies the evolution of wealth inequality in urban China since its reform in the early 1990s. Motivated by the stylized facts along China's growth process, we propose a rich heterogeneous-agent dynamic equilibrium model with endogenous migration, occupation, and nondurable and durable consumption (housing) choices subject to various frictions to quantitatively assess the mechanisms behind the observed increase in wealth inequality. We find that the persistent financial market friction that entrepreneurs face plays a key role, as it ensures that the wealth brought by rapid capital accumulation is accrued predominantly to entrepreneurs. In addition, shutting down migration and entry barrier reforms mitigates the increase of the top 10% wealth share from the observed 19 percentage points to 14 and 10 percentage points respectively over the 1995-2021 period, though both lowering aggregate growth at the same time. A slower housing price appreciation, on the contrary, would exacerbate the rising wealth inequality.

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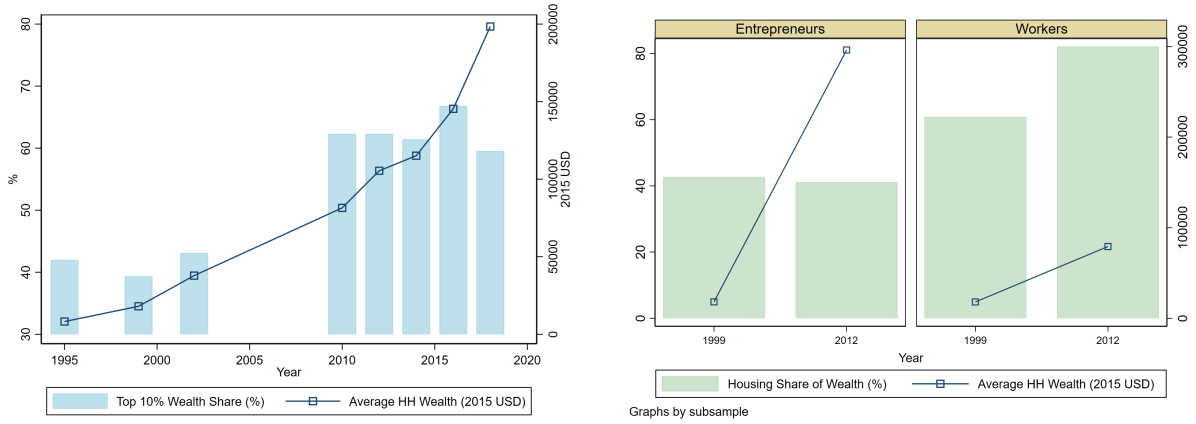
1 Introduction

China's income and wealth inequality has risen dramatically during its economic transition since the start of its market-oriented reforms in 1978. While the growth process has delivered income growth to the vast majority of the population, with the average real income of the bottom 50 percent multiplied by more than five from 1978 to 2015, the income of the top 10 percent rise much more, resulting in a widening gap between the rich and the poor: Wealth inequality, measured by the fraction of wealth owned by the wealthiest 10% households, has increased from around 40% in 1995 to over 60% in the 2010s (Figure 1.1 (a); also see Piketty et al. (2019)). A closer look at the composition of the wealth distribution reveals that wealth accrued to the entrepreneurial class grows much more rapidly over the reform period than that of the workers, and that housing wealth accounts for a very significant part of overall wealth especially for workers (Figure 1.1 (b)).



(a) Top 10% Wealth Share (%)

(b) Wealth Decomposition (%)

Figure 1.1: Top 10% Wealth Share and Wealth Composition in Urban China, 1995-2018

Note: This figure shows the wealth share of the wealthiest 10% households and the average household wealth over time in urban China (Panel (a)) as well as the share of housing wealth and the average household wealth for entrepreneurial and employed households respectively (Panel (b)). Details for data and method are in Appendix A.1.

While income and wealth inequality rises in most developed economies over the last few decades (Piketty, 2014), China stands out in two aspects: the speed at which the inequality rises and the concurrence of both widening inequality and rapid economic growth. The Chinese growth process has been shown to display the following features:[1]

[1] A more detailed literature review is found at the end of the introduction.

1. The SOE reforms allowed entry of private firms to previously state dominated sectors propelling output growth.
2. Private firms operated by entrepreneurs had limited access to formal financing, therefore facing financing constraints.
3. A long housing market boom followed the introduction of the housing market.
4. An urbanization process that saw gradual but massive rural to urban relocation of labor.

How are these features of the growth process linked in the making of the extraordinary rise of wealth inequality in China? If the expansion of the private sector drives the inequality up, does the presence of the financial constraint mitigate or exacerbate the rise? What role do the housing market boom and especially the soaring housing price play in this process? How important is rural-to-urban migration in accounting for the evolution of inequality?

In this paper, we propose a unified framework that includes the above features of the growth and reform process to study the accumulation and distribution of wealth in the Chinese economy. More specifically, we build an open economy dynamic equilibrium incomplete markets model with two sectors, rural/agriculture and urban/manufacturing, two occupations in urban areas, workers and entrepreneurs, and two goods, non-durable consumption and housing consumption good. In each period, hand-to-mouth rural residents working in agriculture choose whether to move to the urban area. Meanwhile, urban residents decide between being employed in a state-owned or private manufacturing firm and becoming an entrepreneur in the private manufacturing sector. The urban residents are also able to purchase housing units as a form of durable consumption good in addition to making the saving decision.

There are two "permanent" financial frictions in the model: a financing constraint a la Buera et al. (2011) faced by entrepreneurs and an interest rate wedge between household's deposit rate and firm's cost of borrowing.[2] More importantly, there are three time-varying frictions which are affected by policy that we model: a rural-to-urban migration barrier, an entry barrier to the private manufacturing sector, and a barrier to trading

[2]This reflects the fact that financial sector reform lags behind reforms in other sectors of the economy. The presence of these frictions remain largely constant throughout the reform process since 1990s. Even nowadays China's financial sector is still dominated by a few state owned banks. Buera and Shin (2013) made the same observation that reform in China and other Asian miracle economies was implemented amid underdeveloped financial markets.

housing units, all of which being reduced during the economic reform.[3] We calibrate this model to data moments describing the productivity growth, the wealth distribution, the urbanization rate, the private sector share, and the housing ownership rate among others along the entire transition path since 1995, the first year that household-level wealth data becomes available. We treat the data moments in 1995 as coming from a pre-reform steady state, where urban residents lived in state provided housing units that could not be traded, entry to the private sector as well as rural-to-urban migration were severely curtailed. From there, alongside the productivity growth in private manufacturing, the housing trading restriction is removed and the migration and private entry barriers are brought down gradually until the model settles down to a new steady state. We use data moments in 2012 in the middle of the transition to discipline the speed of change in those frictions.

The narrative that emerges from the calibration is as follows. The financing constraint in private manufacturing provides a strong saving's incentive to a growing entrepreneurial class, following the reduction of entry barrier to the private sector. If the entry to the private sector remained as high as in the pre-reform steady state, the increase of the top 10% wealth share over the transition period would almost be halved from the 19.03 percentage points in the baseline to 10.33 percentage points in the counterfactual, while annual urban output growth rate would be much lower at 7.23% as compared to the 10.75% in the baseline. This inequality generation process is then reinforced by the fact that higher rural-to-urban migration helps keep the wage down and the return to capital high. A counterfactual of eliminating rural-to-urban migration during the transition reduces the rise of the top 10% wealth share to 14.21 percentage points. On the other hand, an increase of land/housing supply that slows down the housing price appreciation from the 10% annual growth rate in the baseline to 2% in the counterfactual would exacerbate the rising wealth inequality and result in an increase of 26.46 percentage points during the same period. This result is consistent with the interpretation that housing market boom gives the majority of the urban population an attractive opportunity to accumulate wealth, given the suppressed deposit rate. As a result, housing price appreciation benefits the rich as well as the middle class and the relatively poor, therefore exerting an equalizing pressure on the wealth distribution.

An interesting and perhaps surprising result coming out of our analysis is that if the same

[3] Relaxations of these frictions reflect China's migration policy reform, SOE reform, and urban housing reform, which we provide details in Section 2.

reform process happened under perfect credit market in the private manufacturing sector, not only would the output growth be higher at 12.85% but also the top 10% wealth share would actually decline over the transition. This is because, on one hand, the entrepreneurs would have less incentive to save out of their financing constraint so that the saving rate of the entrepreneurs is reduced by more than a quarter relative to the baseline; on the other, the stronger demand for labor from entrepreneurs operating at their optimal size implied faster wage growth which benefit the majority of the urban population. In other words, the concurrence of rapid economic growth and rising wealth inequality observed in the Chinese case presents itself as a trade-off only in the context of an underdeveloped financial market. Had the private sector easier access to finance, the picture would look much different.

Our paper is related to three strands of literature. First, it is closely related to an empirical literature that documents the rising income and wealth inequality during China's economic transition (Khan and Riskin, 2005; Benjamin et al., 2008; Piketty and Qian, 2009; Li and Wan, 2015; Santaeulalia-Llopis and Zheng, 2018; Piketty et al., 2019; Sicular et al., 2020). In particular, we follow the methodology of Piketty et al. (2019), which combines household-level survey data with *Hurun's Rich List*, to construct the top 10% income share and top 10% wealth share in stylized facts and as calibration targets. While previous literature recognizes housing as an important contributor to wealth inequality or wealth mobility in China (Li et al., 2005; Li and Wan, 2015; Quadrini et al., 2021), we provide a unified framework with both entrepreneurial choice and housing choice in the presence of various frictions to quantitatively assess the respective role of several contributors to the growing wealth gap. Our results echo those obtained for the US that wealth accumulation at the top may be driven by a different force than that in the middle and at the bottom of the distribution (Kuhn et al., 2020).

Second, ours belongs to the group of quantitative macro models that examines various phenomena in China's economic transition: Song et al. (2011) study the implication of reallocation within manufacturing on growth and trade balance, Buera and Shin (2013) the impact of financial frictions on TFP and investment dynamics in China and other Asian miracle economies, Storesletten et al. (2019) the implication on the cyclical employment movement of structural transformation, and Garriga et al. (2021) the impact of rural-to-urban migration on housing prices. Our framework synthesizes all the aforementioned aspects of the transition to study the evolution of wealth inequality and to evaluate quantitatively the importance of difference elements in understanding the rising wealth gap in

China.

Last, methodology-wise our work builds upon and extends Quadrini (2000) and Cagetti and De Nardi (2006) in the tradition of Aiyagari (1994) along various dimensions to bring it closer to the economic reform and growth process of China. While these papers focus on the steady state, our model has time-varying frictions and we focus on transition dynamics along which both growth and distributional outcomes are observed and can be calibrated to.[4]

The rest of paper is organized as follows. In Section 2, we document the institutional background and stylized facts along the economic transition which are relevant for inequality. In Section 3, we present our quantitative framework. In Section 4, we calibrate the model and perform counterfactual exercises to quantitatively evaluate the role of different forces in driving the widening wealth gap. Concluding remarks follow in Section 5.

2 Institutional Background and Stylized Facts

We make use of various publicly available micro data from China from 1990 to the present times as well as the Chinese Statistical Yearbooks. The micro datasets we use include the China Household Income Project (CHIP) 1995-2002, and China Family Panel Studies (CFPS) 2010-2018, China Household Finance Survey (CHFS) 2011-2017, and Population Census 1990-2020. The economic reforms started in 1978 and accelerated since 1992 especially in urban areas. So wherever possible, we show time series aggregates since 1978, in order to present the full picture of the transition process.

Wealth Inequality Following the method in Piketty et al. (2019), we combine CHIP 1995 and 2002, CFPS 2010-2018 with *Hurun's Rich List* to construct the fraction of wealth owned by the wealthiest 10% of urban population as our baseline measure of wealth inequality.[5] Figure 1.1 (a) plots the evolution of wealth inequality from 1995, which is the earliest year

[4] Kaymak and Poschke (2016) and Hubmer et al. (2021) also use the transition dynamics of different versions of heterogeneous agent models, induced by changes in tax progressivity and income process, to study the evolution of wealth inequality in the US since the 1960s.

[5] A detailed description of the method is provided in Appendix A.1. We differ from Piketty et al. (2019) in that we regard a household rather than an adult as the unit of analysis. This is to recognize that housing purchase is typically a household-level decision. We confirm that the differences between these two views are minor in Appendix A.1. In addition, the average household size of a typical household in the top 10%, middle 40%, and bottom 50% respectively is quite stable over time.

for which household-level wealth information is available in China. The top 10% wealth share in urban China increases from a level around 40% to over 60% over a period of 20 years. To put that into perspective, the level of wealth inequality is well below that of western Europe in mid 1990s and now it's approaching the level of the US at a rate that doubles the rate at which wealth inequality is increasing in the US (Piketty et al., 2019). The speed at which inequality grows in China is startling by any international standard.

We focus on wealth inequality in urban areas, for mainly two reasons.[6] First, urban China is where wealth is increasingly concentrated. According to CHIP and CFPS data, the share of urban residents among the national top 10% wealthiest households increases from 30% in 1995 to 86% in 2002 and further to 89% in 2018 (see Table A.5 in Appendix).[7] This means since early 2000 the main drivers of wealth accumulation for the national top 10% have to do with changes that occur in urban areas. Second, almost all major economic reforms relevant for the urban sector in China were initiated in mid 1990s after Deng Xiaoping's 1992 southern tour. This means that the data we have are adequate for studying wealth inequality in urban China and we can interpret the data from the 1995 survey as coming from a pre-reform steady state in the urban sector. But the same cannot be said for rural China as economic reforms went on throughout 80s and 90s there.[8]

Capital Accumulation and Entrepreneurship Entrepreneurs as a rising class of *nouveau riche* emerge from the transition from a SOE-dominant planned system to a market based economy, and benefit from the rapid capital accumulation during the transition. The size of the SOE sector shrinks from employing as high as 85% of urban population in 1995 to 34% in 2002 and further to 13% in 2020 (see Figure A.4 in Appendix). As the SOEs retreat, the entry barriers of private firms are slowly lowered following the promulgation of the *Company Law* in 1994 which formally recognizes private ownership of capital (Jiang et al., 2022). Rapid capital accumulation by private firms, partly due to the motive of saving out of borrowing constraints facing an underdeveloped financial market, has been an impor-

[6] We define the urban or rural status as the status of permanent residence (*Changzhu Renkou*) following the National Bureau of Statistics' definition. That is, an urban resident is one who lives in an urban area for more than 6 months in a year. An urban permanent resident does not necessarily have an urban *hukou*.

[7] The low level of 30% in 1995 is mainly due to the fact that while land and housing are always included in rural households' wealth, the majority of urban households in early 1990s lived in state-provided accommodation and by construction had zero housing wealth. As housing market liberalization progressed in late 1990s, by 2000 most urban households become participants in the housing market.

[8] In Appendix, we show in Figure A.2 the wealth inequality in rural China, alongside that of the urban areas and of the nation. We leave the increase of rural wealth inequality to future research.

tant driving force of China transitional growth (Song et al., 2011).[9]

We calculate the stock of capital and its rate of return following the method in Bai et al. (2006), extend the series to 2017 and present them in Figure A.3.[10] From 1978-2017, China's real capital stock grows at an average annual rate of 11.09% (Panel (a)) and the return remains at a high level throughout 1978 to 2008 at above 15%, and between 10% and 15% in the past 10-15 years (Panel (b)). As we will show, this has significantly contributed to the concentration of wealth at the top, in a way similar to other developed economies (Cagetti and De Nardi, 2006).

A combination of rapid capital accumulation and a high rate of return generates enormous wealth for entrepreneurial households. The top panel of Table 2.1 presents the fraction of entrepreneurs and their wealth share during the transition. We define a household as entrepreneurial if there is at least one household member who engages in private or individual business operation.[11] In 1988, entrepreneurs only account for 1.07% of total population.[12] This ratio rises slightly to 2.67% in 1995. The wealth share of entrepreneurs was also limited, amounting to only 4.44% in 1995. Both the population and wealth share increase rapidly thereafter. In 2002, entrepreneurs' share in population more than doubles and arrives at 6.23%; their wealth share also increase to 8.18%. The 2002-12 has seen the largest increase in both the population and wealth share. Entrepreneur's population share rises to over 16% in urban population in 2012; together they account for more than 30% of urban wealth, after which both shares stay stable at those levels.

The importance of entrepreneurs accounting for the top wealth in China has also increased over time. The bottom panel of Table 2.1 lists the population and wealth share of entrepreneurs among the wealthiest 10%, of urban households. In 1995, the population share of entrepreneurs among wealthiest 10% of households is 4.57%, and the wealth

[9] Allen et al. (2005) documents that in 2000, the ratio of bank credit to private firms to GDP in China is 0.24, significantly lower than their sample average, 0.73, among 48 developed and developing countries.

[10] A detailed description of the method is provided in Appendix A.

[11] In CHIP 1995 and 2002, a household is defined as an entrepreneurial household if there is at least one household member whose primary occupation is "private firm employer or self employed" (*siying qiye guzhu huo geti huzhu*). In CFPS 2010-2018, if an household answers yes to the question, "Over the past year, is there any household member of your family who operate or participate in operating individual or private business?"

[12] This value is consistent with that from the Urban Household Survey Statistical Yearbook 1989, in which individual and private employers (*geti guzhu yu siyingzhe* accounts for 1.49% of urban employment in 1988. CHIP 1988 does not contain wealth information, we therefore cannot calculate entrepreneurs' wealth share in that year.

Table 2.1: Entrepreneurial Population and Wealth Share

Year	1988	1995	2002	2010	2012	2018
Population Share	1.07%	2.67%	6.23%	9.45%	12.08%	12.81%
Wealth Share		4.44%	7.71%	23.07%	33.85%	24.52%
Among Wealthiest 10% Households						
Pop. Share		4.57%	8.92%	16.96%	29.20%	21.17%
Wealth Share		5.32%	12.07%	30.74%	45.57%	30.16%

Data Source: CHIP 1988, 1995 and 2002; CFPS 2010, 2012, 2018; Hurun's rich list.

share is slightly larger at 5.32%. Even though these numbers are relatively small, they are both already bigger than entrepreneurs' share in total population. Similar as the trend in the previous table, entrepreneurs' population and wealth shares have a moderate increase from 1995-2002, followed by a substantial jump from 2002 to 2012 before tapering off. In 2012, entrepreneurs account for close to 30% of the wealthiest 10% of urban households, and their wealth account for around 46%. In Table A.8, we confirm that the entrepreneurial population and wealth shares among the wealthiest 5% and 1% of urban households are even larger than among the top 10%, and follow the same increasing trend over time.

Housing for Non-entrepreneurial Households While the rapid capital accumulation and growth process increases the entrepreneurial population and wealth shares, the underdevelopment of financial markets limits how much non-entrepreneurial households gain from the process. Over the past few decades, the real interest rate on bank deposits has been consistently lower than 2% in China (Fang et al., 2016). Instead, due to limited land supply and increasing housing demand fueled by rural-urban migration and rising urban income, urban housing prices grows at around 10% per annum in 2000s and 2010s, much higher than the interest rate on bank deposits.[13] As a result, most non-entrepreneurial households invest a large chunk of their wealth in housing, leading to a high housing-wealth ratio (Figure 1.1 (b)).

China started its housing reform in 1994, which was later extended to the whole country in 1998. Under the pre-reform planned economy system, state firms provided public

[13] Fang et al. (2016) collects micro level data from 120 cities from 2003-13, and finds that the hedonic housing price indices grows annually at 13.1%, 10.5% and 7.9% in first-, second-, and third-tier cities.

housing to its employees. After the housing reform, urban households are required to purchase houses from the market. Table 2.2 shows the average home-ownership rate and housing wealth ratio for non-entrepreneurial households from 1999-2017. In 1999, the first year after the national rollout of the housing reform, about 30% of urban residents still live in public house (See Table A.6) and about two-thirds of urban residents own their accommodation. In 2000s and 2010s, the home ownership rate has been relatively stable at around 80%.[14] The housing-wealth ratio is high in the sample period, reaching 82.10% in 2012. In the same year, the ratio for entrepreneurial households is 41.79% (See Table A.7 in Appendix).

Table 2.2: Home Ownership Rate and Housing Wealth Ratio for Non-entrepreneurial Households

Year	1999	2002	2012	2018
Home-Ownership Rate	66.19%	79.16%	84.49%	77.92%
Housing-Wealth (H-W) Ratio	60.84%	61.94%	82.10%	83.47%

Data Source: CHIP 1999, 2002; CFPS 2012, 2018.

Urbanization It should be clear from the discussion above that wealth accumulation process during the transition in urban China has much to do with the growth in the entrepreneurial private sector as well as the performance of the housing market. Both mechanisms are further aided by the urbanization which takes place concurrently as China relaxes the rural-urban migration restrictions such as the Hukou system (Tombe and Zhu, 2019).

Since 1978, the urban population share increases steadily from near 20% as reported in the 1982 Population Census to over 60% by the 2020 Population Census (Figure A.5 in Appendix). The non-primary sector employment share evolves in parallel to that of the urban population share, growing from 29.5% in 1978 to 76.4% in 2020 according to the National Bureau of Statistics.[15] This labor movement has two implications on the wealth

[14]Home ownership rate here refers to the fraction of households who own a house. The high home ownership rate is not driven by the existence of a large fraction of urban residents who own a house in the rural area, or residents who rent an apartment in big cities and own a house in smaller ones. If we narrow the definition to those who own the house they currently lives in, the home ownership rate in 2012 and 2018 reduces slightly to 81.08% and 75.80%.

[15]The fact that non-primary sector employment share increases faster than urban employment share from 1978-1995 is partly due to rural industrialization—rise of township and village enterprises—in the 1980s and early 1990s.

accumulation process. Firstly, a constant inflow of rural labor to the non-agricultural sector helps keep the wage rate in that sector low and maintain the relatively high return on capital which we show earlier. Secondly, as urban population grows, the demand for urban housing unit which needs to be purchased from the market since late 1990s puts upward pressure on housing prices (Garriga et al., 2021).

In sum, the stylized features of the transitional growth of the Chinese economy, which are relevant for wealth accumulation, can be summarized as the four points in the introduction: namely, the three policy-induced changes in the access to the private sector, the housing market, and the rural-to-urban migration together with the persistent friction in the financing condition. In what follows, we present a dynamic general equilibrium incomplete markets model that has all the above mentioned ingredients embedded, which will be the framework of our quantitative assessment.

3 The Model

In this section, we construct a discrete-time open economy dynamic equilibrium incomplete markets model to account for China's economic growth and evolution of wealth distribution during the growth process. The model builds on heterogeneous agent models with occupational choice under financial frictions (Cagetti and De Nardi, 2006; Buera and Shin, 2013). In the model, there are two regions: rural and urban. Both regions produce a same final good. Whenever it causes no confusion, we refer to the rural production the agriculture sector, and the urban production the manufacturing sector, with the term "manufacturing" standing for all non-agriculture activities in the urban area.[16] The pre-reform economy is characterized with low productivity and various frictions in migration, entrepreneurship, and housing market. The economic reform and growth process is modeled as a gradual improvement in manufacturing productivity as well as reductions in those frictions.

There is a continuum of infinitely lived agents who has the same preference and maximizes the discounted sum of utility as follows

$$\sum_{t=0}^{\infty} \beta^t u(c_t, h_t)$$

[16]This assumption simplifies the computation. Alternatively we can assume that the two regions produce different goods, and the prices of both goods are determined in the international market.

where β is the discount factor, and c_t and h_t denote consumption of the final good, and housing services respectively. The final good is the numeraire.

Urban households are characterized by a pair of abilities, (e, z), here $e \in E$ denotes the entrepreneurial ability and $z \in Z$ denotes the working ability. The sets E and Z contains a finite number of values and $(e, z) \in E \times Z$ evolves stochastically according to a Markov process with transition probability from (e, z) this period to (e', z') the next period given by $\Pi((e', z'), (e, z))$. The stochastic process embodies the idiosyncratic labor income shocks workers face and entrepreneurial risk entrepreneurs face. They start a period with a certain amount of financial wealth (and if they own their housing with housing wealth $p^h * h$), and make occupation, non-durable consumption, and saving (and if possible, housing) decisions. In terms of occupation, more specifically urban households can choose to work as an entrepreneur in the private sector or working as an employed worker in either the private or the state sector.

In what follows, we detail technology, market structure, frictions, and decision in the urban and rural sector separately.

3.1 The Urban Sector

The urban sector consists of SOEs and private firms and urban workers are perfectly mobile between SOEs and private firms.

3.1.1 SOEs

As the focus of the paper is the distribution of private wealth, we abstract from heterogeneity among SOEs, and model the SOE production as one single firm, which has access to the following decreasing-return-to-scale production function,

$$Y_{s,t} = A_{s,t} K_{s,t}^{\alpha_s} L_{s,t}^{\gamma_s}, \quad 0 < \alpha_s + \gamma_s < 1$$

$A_{s,t}$ is the TFP of SOEs in period t, which is a combination of true productivity, subsides, and all policy factors that give SOE an advantage over private firms; $K_{s,t}$ and $L_{s,t}$ are capital and labor input; α_s and γ_s is the elasticity of output with respect to capital and labor in SOE production, and $Y_{s,t}$ is SOE's final output. Denote r_t the interest rate determined in world market. The interest rate faced by firms is $r_t(1 + \tau_r)$ where τ_r captures inefficiency in domestic bank sector. We do not distinguish the interest rate differences faced by SOEs

and private firms as all SOE related distortions is summarized in $A_{s,t}$ Given the interest rate, depreciation rate, δ, and urban wage rate, w_t, the SOE maximizes the following profit

$$\pi_{s,t} = Y_{s,t} - [r_t(1+\tau_r) + \delta]K_{s,t} - w_t L_{s,t}.$$

3.1.2 Private firms

The manufacturing good can also be produced by private firms, each operated by an entrepreneur. Denote e_i the entrepreneur's ability in private firm i. Firm $i's$ production function is given by

$$y_{i,t} = A_{m,t} e_i \left(k_{i,t}^{\alpha} l_{i,t}^{1-\alpha}\right)^{\nu},$$

where $\alpha < 1$ and $\nu < 1$ governs the decreasing return, and $A_{m,t}$ is the aggregate productivity in the private manufacturing sector in period t. Firm $i's$ production depends on its entrepreneur's ability, e_i, as well as the aggregate productivity, $A_{m,t}$. Because of decreasing return to scale, the entrepreneurs earn positive profits.

Entrepreneurs who operate private firms face the urban wage w and the rental rate of capital $r(1+\tau_r)+\delta$ and are subject to a collateral constraint. Let $\pi(e,z,b,h^w)$ denote the profit of an entrepreneur as a function of (e,z,b,h^w):

$$\pi(e,z,b,h^w) \equiv \max_{k,\,l} \; A_m e \left(k^{\alpha} l^{1-\alpha}\right)^{\nu} - wl - [r(1+\tau_r)+\delta]k$$

subject to the financial friction

$$k \leq \lambda b + \lambda_h h^w.$$

The parameter λ captures under-development of the financial market. Given her own financial wealth b and housing wealth h^w, the entrepreneur can borrow up to $\lambda b + \lambda_h h^w$. The smaller the values of λ and λ_h, the more severe of financial frictions. Housing can be used as collateral, and its collaterability might potentially differ from financial wealth.

3.1.3 Urban Agent's Problem

An urban agent faces the following timeline of decisions. At the beginning of the period, an urban agent first makes an occupational choice – whether to operate a private firm as an entrepreneur or to work as an employed worker. She then receives earnings according to her occupation and the capital income from her savings. An urban agent lives in state provided houses before the housing reform. After the reform, she owns housing and can

make adjustment to her housing consumption. She makes non-durable consumption and saving decision before the end of the period.

Denote $V_u(e,z,b,h)$ the value function of an urban agent with entrepreneurial ability e, worker ability z, financial wealth b, and housing unit h. The occupational choice problem reads

$$V_u(e,z,b,h) = \max\{V_u^W(e,z,b,h), \theta_e V_u^W(e,z,b,h) + (1-\theta_e)V_u^E(e,z,b,h)\}$$

where the first branch is the value of choosing to be a worker, and the second branch is the value of choosing to be an entrepreneur. The parameter θ_e denotes entry barrier—a person who chooses to be an entrepreneur becomes one with probability $(1-\theta_e)$.

Denote the term $i^o(e,z,b,h^w), o = W, E$ the earnings of an urban resident with occupation o, which is either her wage or her income comes from operation profits. That is,

$$i^o(e,z,b,h^w) = \begin{cases} zw & \text{if } o = W \\ \pi(e,z,b,h^w)(1-\tau_e) & \text{if } o = E \end{cases}$$

The parameter τ_e captures distortions that affect entrepreneurial profit.

For urban agents before the housing reform, they are provided with government funded public housing $\bar{h}_u$.[17] Their value function reads

$$V_u^o(e,z,b,\bar{h}_u) = \max_{c,b'} \; u(c,\bar{h}_u) + \beta \mathbb{E}_{e',z'} V_u(e',z',b',\bar{h}_u), \quad o = W, E \tag{1}$$

subject to the budget constraint

$$c_m + b' \leq i^o(e,z,b,0) + b(1+r),$$

and a non-borrowing constraint,

$$b' \geq 0.$$

[17] All urban households are assumed to have the same unit of housing before the reform. In CHIP1995, the correlation coefficient between the market value of private housing wealth and non-housing wealth is 0.06. If we regress a dummy indicating private housing ownership on non-housing wealth, the coefficient is $1.01 * 10^{-6}$, which means, increasing non-housing wealth from the 10^{th} to the 90^{th} percentile, increases the probability of owning a private house by 4% in 1995. Given these small values, we therefore do not address the heterogeneity of public housing endowment at the starting point of reform.

Note that before the housing reform, the public housing has no market value, and cannot be used as a collateral.

After the housing reform, urban households need to purchase houses in the market, their value function is

$$V_u^o(e,z,b,h) = \max_{c,\, b',\, h' \in H} u(c,h') + \beta \mathbb{E}_{e',z'} V_u(e',z',b',h'), \quad o = W, E \tag{2}$$

subject to the budget constraint

$$c_m + b' + p_h h' \leq i^o(e,z,b,p_h h(1-\delta_h)) + b(1+r) + p_h h(1-\delta_h),$$

The household further faces the following non-borrowing constraint,

$$b' \geq 0.$$

Note here we do not allow workers to borrow to purchase houses, which we think is consistent with the fact that in data we calculate net housing—value of houses minus mortgage—in obtaining total household wealth. Note also that housing can be used as collateral. After the housing reform, we assume households can choose housing h' from a finite set $H = \{h_1, h_2, ..., h_N\}$. Indivisibility of housing allows the increase in housing price to be different than the risk free return, and avoid corner solutions where households hold zero financial wealth. Denote H_t^s the exogenous tradable housing supply at period t. Urban housing price is determined by urban housing market clearing condition which we specify when we discuss equilibrium.

Note that, from household's budget constraint, there are two kinds of income we do not track in the model. The first is SOE profit, which we assume collected by the government and does not affect private wealth. The second is the income generated from new housing, $p_t^h * \Delta H_t^s$, with $\Delta H_t^s \equiv H_{t+1}^s - H_t^s(1-\delta_h)$ denoting new houses in period t. We assume there is a competitive housing developing sector which employs a constant return to scale technology and uses as the only input land provided by the government. Income from new houses all goes to the public sector as land revenue.

3.2 The Rural Sector

The rural sector is run by a "representative" firm that employs labor as the only input and admits the following constant-return-to-scale technology

$$Y_{r,t} = A_{r,t} L_{r,t},$$

where $L_{r,t}$, $A_{r,t}$ and $Y_{r,t}$ denote agriculture employment, productivity and output.

Rural workers live in self-built houses, which gives them a housing service of $\bar{h}_r$ and is assumed to be hand-to-mouth with zero wealth. Rural households are identical except with regards to the net cost of migration, ϵ. Suppose the net cost of migration is given by $\tau_{m,t} + \xi\epsilon$, where the common component $\tau_{m,t}$ is a time-varying policy variable, ϵ is an individual characteristic, which is distributed as $\Phi(\epsilon)$ in the rural population and fixed over time, and ξ is a constant weight on the idiosyncratic component.

The migration choice for a rural worker with ϵ is

$$V_r(\epsilon) = \max\{\overline{V}_r(\epsilon), \mathbb{E}_z V_u(0, z, 0, \bar{h}_u) - \tau_m - \xi\epsilon\}$$

where $\overline{V}_r$ denotes the value of a rural worker staying in the rural. When a rural worker arrives at the urban, we assume she takes no entrepreneurial skill, carries zero wealth, and obtains a public housing before the reform. The value of living in the urban area, $V_u(0, z, 0, \bar{h}_u)$, is independent of ϵ. After the housing reform, we further impose the following assumption: an agent does not own houses upon the first period she migrates from rural to urban. Accordingly, in the post-reform era, the expected value of living in the urban area for a rural household is $\mathbb{E}_z V(0, z, 0, 0)$ in the Bellman equation.

The value function for a rural worker with ϵ who decides to stay in the rural is given by

$$\overline{V}_r(\epsilon) = u(c, \bar{h}_r) + \beta V_r(\epsilon) \tag{3}$$

Note that in each period a rural household consumes all income w_r, which is simply A_r and does not depend on ϵ. Denote the period utility as u^r. The optimal migration/location decision is given by a cutoff in ϵ such that for all households whose $\epsilon \leq \bar{\epsilon}$

defined below, they choose to migrate to urban areas

$$\bar{\epsilon} = [V_u(0, z, 0, \bar{h}_u) - \overline{V}_r(\epsilon) - \tau_m]/\xi. \tag{4}$$

Therefore the percentage of population that resides in the urban area in a stationary equilibrium ($\Phi(\bar{\epsilon})$) is an endogenous outcome. And it is conceivable that this proportion should be larger in an environment where as the urban manufacturing sector is much more productive than the agricultural sector, as this boosts EV_u.

3.3 Recursive Competitive Equilibrium

We define a stationary recursive equilibrium for an economic environment characterized by constant technology parameters (A_r, A_s, A_m) for the agricultural, SOE and private manufacturing sectors respectively and the constant policy parameters (τ_r, τ_e, τ_m) which represent the level of policy interventions in interest rate, entry to the private sector, and migration respectively.

Let $\mathbf{x} = (e, z, b, h)$ be an urban household's state vector, while ϵ is the rural household's only state variable. Without loss of generality denote $b \in [0, b_{max}] \equiv B$ and we already have $h \in H$. Therefore, the state space for urban households is $S = E \times Z \times B \times H$. Let the Borel $\sigma-$algebra associated with S be $\mathcal{A}^h$ and the typical subset be $(\mathcal{E} \times \mathcal{Z} \times \mathcal{B} \times \mathcal{H}) \equiv \mathcal{S} \in \mathcal{A}$. The space $(S, \mathcal{S})$ is a measurable space and for any subset $\mathcal{S}$, let $F(\mathcal{S})$ be the measure of agents in set $\mathcal{S}$. Define the transition function $Q((e, z, b, h), \mathcal{E} \times \mathcal{Z} \times \mathcal{B} \times \mathcal{H})$ as the probability that an individual with current state (e, z, b, h) transits to the set $\mathcal{E} \times \mathcal{Z} \times \mathcal{B} \times \mathcal{H}$ next period, $Q : S \times \mathcal{A} \to [0, 1]$ and

$$\begin{aligned} & Q((e, z, b, h), \mathcal{E} \times \mathcal{Z} \times \mathcal{B} \times \mathcal{H}) \\ = & \sum_{(e', z') \in \mathcal{E} \times \mathcal{Z}} I\left\{b'(e, z, b, h) \in \mathcal{B} \text{ and } h'(e, z, b, h) \in \mathcal{H}\right\} \Pi((e', z'), (e, z)), \end{aligned}$$

where I is an indicator function.

A stationary recursive equilibrium consists of i) interest rate r determined in the world market, wage rates (w, w_r), and housing price p_h; ii) policy functions for agricultural good consumption $c_r(\mathbf{x})$, manufacturing good consumption $c_m(\mathbf{x})$, occupation $o(\mathbf{x})$, savings $b'(\mathbf{x})$, and housing consumption $h'(\mathbf{x^h})$ for urban households, as well as consumption c_r^r and c_m^r for rural households; iii) value functions $V_u(\mathbf{x})$ for urban households specified in

(2) and $V_r(\epsilon)$ for rural households in (3); iv) exogenously given urban housing supply H^s; v) and invariant probability measures $F(\mathbf{x})$ for urban households, such that

1. Given prices, urban household makes the optimal occupational choice, consumption bundle choice, savings decision (and if before housing reform housing choice) and $V(\mathbf{x})$ is the associated value function;

2. Rural households indeed prefer to live in rural areas that is $\epsilon \leq \bar{\epsilon}$ as in (4) and they make optimal consumption bundle choices and the associated value function is $V_r(\epsilon)$;

3. The representative SOE and private entrepreneurs maximize profits;

4. Labor and housing markets clear:

   - In rural labor market, agricultural labor demand L_r equals supply

   $$L_r = 1 - \Phi(\bar{\epsilon})$$

   - In urban labor market, the sum of SOE labor demand L_s and entrepreneurs' labor demand $l(\mathbf{x})$ equals supply of labor

   $$L_s + \Phi(\bar{\epsilon}) \left(\int I\{o(\mathbf{x}) = e\} l(\mathbf{x}) dF(\mathbf{x}) \right) = \Phi(\bar{\epsilon}) \left(\int I\{o(\mathbf{x}) = w\} dF(\mathbf{x}) \right)$$

   - Urban housing market clears

   $$H^s = \Phi(\bar{\epsilon}) \int h'(\mathbf{x}) dF(\mathbf{x}).$$

5. For all $(\mathcal{E} \times \mathcal{Z} \times \mathcal{B} \times \mathcal{H}) \in \mathcal{A}$, the invariant probability measure F satisfies

$$F(\mathcal{E} \times \mathcal{Z} \times \mathcal{B} \times \mathcal{H}) = \int_{E \times Z \times B \times H} Q((e,z,b,h), \mathcal{E} \times \mathcal{Z} \times \mathcal{B} \times \mathcal{H}) dF(e,z,b,h)$$

4 Quantitative Analysis

Conceptually, we view the observed 26-year empirical growth process from 1995 to 2021 as a part of a transition from a *pre-reform* steady state to a hypothetical terminal steady state decades into the future. More specifically, we start from the steady state of a model economy without housing market and laden with migration barriers and private sector

distortions, representing the observable state in 1995. Then, in the first period after the initial steady state we open the housing market and from then on allow all urban households trade houses in the model. We simultaneously vary the frictions and rural and manufacturing productivities over the transition, until the model economy settles down in a hypothetical terminal steady state.

In particular, along the transition dynamics we let the productivity and friction-related parameters change in the following way: gradual change in manufacturing productivity A_m, SOE sector productivity A_s which can reflect both TFP and subsidy, at constant rates for 30 years, and stay at the level of the 30^{th} year afterward, A_r changes accordingly such that the rural urban wage gap is the same as data.[18] For entrepreneurial related frictions, we assume the profit distortion τ_e reduces to 0 in the post-reform era, and the entry barrier parameter, θ_e, declines gradually from a pre-reform level to a level in the 30th year, which we endogenously calibrate.[19] To reflect the fact that the reforms over entry barriers for private firms concentrated in the late 1990s and early 2000s, we assume that θ_e squared decreases linearly in the post-reform era so that a substantial portion of reduction occurs in the initial years.

The challenge for parameter calibration is that moments in the pre-reform steady state are affected by both deep parameters, which do not change over time, and parameters of the frictions which change after the reform. For example, entrepreneurial wealth share in 1995 is affected simultaneously by entrepreneurial ability and entry barriers. To well identify parameter values, we jointly calibrate the deep parameters and the parameters of the frictions to target moments in 1995, the initial steady state, and those in 2012, which is the 17th year along the transition. With the entire calibrated transition in hand, we then perform a series of counterfactual exercises by shutting down different forces to isolate the impact of various factors in contributing to the evolution of China's wealth inequality over the past decade.

[18] How TFP changes after the 30^{th} year affect the terminal steady state. It, however, has negligible effect on the transition during the initial 30 years, which is focus of our paper. We provide robustness check under different productivity growth assumptions after the 30^{th} year. Garriga et al. (2021) and Storesletten et al. (2019) also find that how parameters change after the T^{th} year has limited impact of the transition from the 1^{st} to the T^{th} year.

[19] Our assumption of reducing the profit distortion to 0 along the transition is without loss of generality. This is because we do not observe directly the ability of the entrepreneurs which affects the profit in a similar way as the profit distortion parameter. Therefore, the levels of the entrepreneurs' wealth share before and after the reforms can only identify two of the three parameters, the pre-reform profit distortion, the ability of the entrepreneurs, and the post-reform profit distortion, but not all three.

4.1 Calibration

Functional forms The periodic utility function is specified as

$$u(c,h) = \frac{[c^{1-\eta}(\underline{h}+h)^{\eta}]^{1-\sigma}-1}{1-\sigma}.$$

We assume that the type distribution in the rural population, $\Phi(\epsilon)$, follows a Pareto distribution,

$$\Phi(\epsilon) = 1-\epsilon^{-\zeta}, \quad \forall\, \epsilon \geq 1.$$

One period in the model corresponds to 1 year in the data. We set the interest rate on deposit at $r = 2\%$ in both the pre-reform steady state and along the transition, and set $\tau_r = 1.5$ so that the interest rate on firm loans is 5%.

We assume the processes for worker's ability and for entrepreneurial ability are independent. The logarithm of worker's ability follows an AR(1) process. The persistence parameter is set as 0.9127, following Fan et al. (2010) and Garriga et al. (2021). We set the standard deviation term to 0.35 such that the variance of logarithm of wage matches that in the CFPS 2010-12. We then discretize this AR(1) process to a 5-state Markov process. To account for the fact that wage inequality was institutionally depressed in the pre-reform era in the simplest manner, we assume a wedge, valuing between 0 and 1, on the two largest states such that the variance of logarithm of wage in the pre-reform steady state matches that in CHIP 1995. Entrepreneurial ability is assumed to take two states, 0 and $\bar{e}$, that is, an individual either has the ability to become an entrepreneur or not. Denote π_w and π_e the probability of agents staying at $e = 0$, and $e = \bar{e}$ respectively, for two consecutive periods.

We set the discount rate $\beta = 0.92$, physical capital depreciation rate $\delta = 0.10$, and housing depreciation rate $\delta_h = 0.03$. Parameters in the production function, α_s, α, γ, are chosen to match a labor income share of 50% (Song et al., 2011). That is, we set $\alpha_s = \alpha/(\alpha+\gamma) = 0.5$. The value $1-(\alpha+\gamma)$ represents the span of control and we choose $\alpha+\gamma = 0.85$, a value used in many macroeconomic research (Atkeson and Kehoe, 2007; Restuccia and Rogerson, 2008).

The productivity of the private manufacturing sector in the pre-reform steady state is normalized to 1. We choose the constant manufacturing TFP growth rate such that GDP per capita grows at an average rate of 8% at the initial 17 years in transition, as observed in

data from 1995-2012. The pre-reform productivity in the SOE sector, A_s is calibrated to SOE employment share in 1995. During the transition, the growth rate g_s is chosen to target SOE employment share in 2012. In both the pre-reform steady state and the transition, rural productivity is chosen such that the model produced time series on rural-urban wage gap that matches the data.[20]

The shape parameter of the Pareto distribution of the migration cost, ζ, and the migration barriers cannot be separately identified, therefore we normalize $\zeta = 1$. The weight on idiosyncratic migration cost, ξ, determines the elasticity of migration flow to changes in rural-urban wage gap. Imbert et al. (2022) finds that a 10% lower rural income leads to a 1.2 percentage point increase in rural emigration rate in China from 2000-05. We set ξ such that the model generates this semi-elasticity in the pre-reform steady state. The migration barriers, which changes from period to period, are set to match the time series on urban employment share.[21]

For the parameter on collaterability of financial wealth, we set $\lambda = 1.435$ following Curtis (2016). The transition probabilities π_w and π_e in entrepreneurial ability transition matrix are calibrated to match entrepreneur-to-entrepreneur and work-to-worker transition probabilities observed from CHFS 2010-12. There remain four entrepreneur related parameters, the pre-reform entrepreneurial profit distortion $\tau_{e,0}$, the initial entry barrier $\theta_{e,0}$, the value of entry barrier in the 30^{th} year, $\theta_{e,end}$, and entrepreneurial ability, $\bar{e}$ are calibrated to the entrepreneurial population and wealth shares in 1995 and 2012.

For the housing choice set $H = \{h_0, h_1, ..., h_N\}$, we choose $h_0 = 0$, so that households can choose not to purchase a house. We choose a large enough h_N and verify that a sufficiently small proportion of households purchase that size. We pick $N = 9$ and assume the house sizes are distributed between h_1 and h_N.[22] This gives us 4 housing related parameters: the preference parameter $\underline{h}$, the initial housing price, $p_{h,0}$, the lower bound of housing size h_1, and the collaterability of housing, λ_h. We choose these parameters to target the home ownership rate, housing wealth ratio for non-entrepreneurial and entrepreneurial households, and housing-wealth ratio for the bottom 50% in the household wealth distribution.

[20] In the model, the rural area only contains labor income. We measure rural-urban wage gap as the ratio of urban wage per capita to rural disposable income per capita from 1995-2018, and let the gap stay at the 2018 level for the remaining of the transition.

[21] For urban employment/population share, we linearly extrapolate the 1995-2020 data until it reaches 83%, which is the US urbanization rate in 2020, and stay at that level thereafter.

[22] In particular, we choose housing grid points such that $(h_{n+1})^{1/3} - (h_n)^{1/3}$ is a constant. We verify that the baseline results are robust to varying the the number of housing grid points.

The total housing supply H_t^S, which changes every year, is also treated as parameters. Fang et al. (2016) construct the aggregate housing price indices for three tiers of cities in China from 2003-2013. The average annual growth rate across all 120 cities in their sample is about 10%. During the transition in the model, we calibrate the time series of the aggregate housing supply such that the housing price grows at an annual rate of 10% for 30 years, and stay at the level of the 30^{th} year afterward.[23]

There are two remaining preference parameters, housing's share η, and intertemporal elasticity of substitution σ. We choose η to target 22.7% of housing expenditure share in total household expenditure.[24] The intertemporal elasticity of substitution σ affects households' saving motive, and we choose it such that top 10% households' wealth share in the pre-reform steady state matches that in 1995.

For each internally calibrated parameters, we calculate the distance between model and data moments as

$$[\frac{\text{model}(k) - \text{data}(k)}{0.5 * \text{model}(k) + 0.5 * \text{data}(k)}]^2$$

We choose parameter values to minimize the sum of weighted distance for all moments. To match well the aggregate pre-reform inequality we set a weight of 5 to that moment, and a weight of 1 to all others.

4.2 Results

Table 4.1 summarizes the calibrated parameter values and the associated moments in the data and the model. In the baseline calibration, the private-sector manufacturing TFP, A_m increases at 3.5% a year, which is around the upper bound of the empirical estimates of the growth rate, e.g. Zhu (2012). The annual growth rate of the state-sector manufacturing TFP is 3.51%, which may seem large at first glance. But as mentioned earlier, the state-sector TFP represents a combination of productivity and subsidies. In addition, in the calibration, we treat employees in public administration and institution as SOE employment. The relatively large SOE employment share in 2010s under this broad definition requires a relatively large SOE TFP in the model.

[23] While there is no available data on housing price from 1995 to 2002, its evolution in the initial 7 years has however limited impact on the evolution of inequality.

[24] The data source is China Household Survey Statistical Yearbooks. The number we use is larger than Hao et al. (2020), as we include imputed rent from owner occupied housing as part of housing expenditure.

Table 4.1: Calibrated Parameter Values and Moments

Para.	Meaning	Value	Moment	Data	Model
Para. targeting moments in pre-reform urban steady state, 1995					
$A_{m,0}$	MFG prod.	1	normalization	–	–
$A_{s,0}$	SOE prod.	0.1894	SOE emp share	0.8519	0.7993
$\theta_{e,0}$	initial entry barrier	0.7758	entrep pop share	0.0267	0.0265
$\tau_{e,0}$	profit distortion	0.7391	entrep wealth share	0.0444	0.0443
σ	intertemporal EoS	2.4732	Top 10% wealth share	0.4198	0.4194
Para. targeting moments in transition dynamics, 2012					
g_m	A_m growth rate	0.0350	GDP p.c. growth rate	0.0804	0.0806
g_s	A_s growth rate	0.0351	SOE emp share	0.2053	0.1989
$\theta_{e,end}$	terminal entry barrier	0.0004	entrep pop share	0.1208	0.1084
$\bar{e}$	entrep ability	0.7059	entrep wealth share	0.3385	0.2936
π_e	E-E trans.	0.8883	entrep-entrep trans.	0.7900	0.7765
π_w	W-W trans.	0.9757	worker-worker trans.	0.9600	0.9479
η	housing share	0.2253	housing exp. share	0.2270	0.2064
λ_h	housing collaterability	0.4746	H-W ratio for entrep	0.4137	0.4370
$p_{h,0}$	initial housing price	0.0671	H-W ratio for non-entrep	0.8250	0.7817
$\underline{h}$	para. in preference	0.5474	home ownership rate	0.8443	0.8537
h_1	housing lower bound	0.3045	H-W ratio for bottom 50%	0.7821	0.8681
Para. changing values each period during transition					
$H_{s,t}$	housing supply	–	housing price	–	–
$\tau_{m,t}$	migration barrier	–	urban emp share	–	–
$A_{r,t}$	rural productivity	–	rural-urban wage gap	–	–

The pre-reform entry barrier to the private sector is 0.7758, implying a low chance of 22.42% of registration application being approved, while the "tax" on entrepreneurial profit is as high as 73.91%. The identification of these frictions comes from the fact that given the relatively high productivity of the entrepreneurs ($\bar{e}$), the high entry barrier rationalizes the low population share of entrepreneurs and the high tax rationalizes the low wealth share of entrepreneurs. It is worth noting that a profit tax does not distort the labor employment decision, therefore though entrepreneurial wealth accumulation is severely hampered by the profit tax, the size of the private sector in terms of employment is still sizeable at 20% in the calibrated model. Our model suggests that after 30 years of economic transition, the entry barrier to the private sector will be virtually eliminated.

The collaterability of housing wealth, 0.4746, is significantly smaller than that of financial wealth. The relatively low collateral value of housing in China is consistent with the em-

pirical evidence in Wu et al. (2015), who show that the collateral value of real estate in China is limited using firm level data. For the housing grid points, the smallest housing size is 0.3045. We pick the upper bound of housing as 18 in the baseline, which is about 60 times of the lower bound, and verify later that results are robust under alternative values.[25] In the 26^{th} year in the model's transition, about 5% of urban households choose to purchase the largest housing size.

Table 4.2 presents the average growth rate of capital and return to capital. Even though we do not target either of the moments at any point in the transition, the model implied values are very close to their data counterparts.

Table 4.2: Capital Growth Rate and Return to Capital in Model and Data

	Data 1996-2021	Model period 1-26
Average capital growth rate	11.01%	9.07%
Average return to capital	16.01%	18.17%

As in data, rapid capital accumulation in the model results in an increasing entrepreneurial share both in terms of population and wealth. While we only target the entrepreneurial population and wealth shares in 1995 and 2012 in the calibration, the model generates the evolution of these shares along the entire transition that resembles well the data counterparts. Similarly, the model generates the time series of the SOE employment share along the transition that follow closely the data counterpart.[26]

Finally, in term of the housing-wealth ratio, the model replicates the data feature that for the vast majority of households in the middle and lower parts of the wealth distribution, housing is the dominant form of wealth that accounts for about 80% of the household wealth. While we select the housing-to-wealth ratio of the entrepreneurs, of the workers, and of the bottom 50% in 2012 as target, the model implies reasonable housing-wealth

[25]Note in the model all housing units have the same price, so in the baseline the value of the largest housing is 60 times greater than that of the smallest.

[26]In Appendix B, we plot the entrepreneurial population and wealth share during the transition in the model and in the data in Figure B.1. We also plot the SOE employment share during the transition in the model and in the data in Figure B.2. As these figures show, the model does a good job matching data series throughout the transition.

ratio along the entire wealth distribution over the transition.[27]

Wealth Inequality Figure 4.1 plots the wealth share of top 10% households in the initial steady state as well as during the first 26 years along the transition generated from the model. Note that we explicitly targeted top 10% wealth share in the initial year, 1995, and the wealth distribution in the transition is not targeted in the calibration. The top 10% wealth share increases from slightly over 40% in period 1 to more than 60% in the 26th period, an increase that matches almost exactly that in data from 1995-2018, though the model does not capture the rise-and-then-flatten pattern around 2010, a point we will revisit in the robustness check section. While top 10% wealth share is the main metric of wealth inequality in the analysis so far, the model also captures the evolution of wealth Gini over the same period (Figure B.4 in Appendix B).

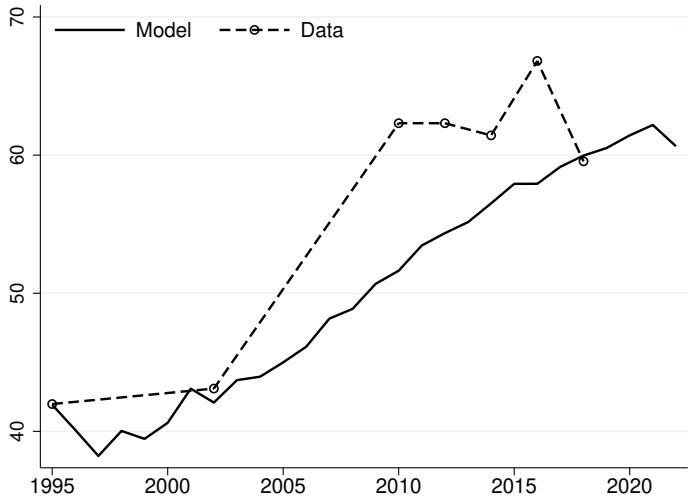


Figure 4.1: Top 10% Wealth Share During Transition (%)

[27]Figure B.3 plots the housing-wealth ratio for bottom 50%, middle 40% and top 10% urban households during the whole transition. The two points that the model does not match well is the housing-wealth ratio for bottom 50% in 2002, and for top 10% in 2018. For the former, the value in data is relatively lower due to the fact that in 2002, four years after housing reform, there are still about 16% of urban households living in government provided public houses, which does not count as household wealth, while in the model the housing market reform completes instantly.

4.3 The Role of Financial Friction

We construct a model with financial frictions to reflect the fact that reform of the financial sector in China lags much behind its economic reform. Even nowadays the Chinese lending market is still dominated by a few state-owned banks. In the baseline calibration, we take $\lambda = 1.435$ from the literature. To showcase the importance of financial friction in understanding the evolution of wealth inequality, we compare the baseline results with those in a model in which financial friction is completely removed, i.e. $\lambda = \infty$, and all other parameters remain the same as in the baseline. In particular, to single out the impact of financial frictions, in the case of $\lambda = \infty$, we still let urban population and housing price growth rate staying at their baseline level.

Figure 4.2 shows the trend of top 10% household wealth share in the two cases. In the case of $\lambda = \infty$, the same force that leads to China's economic growth actually brings about a reduction in wealth inequality.[28]

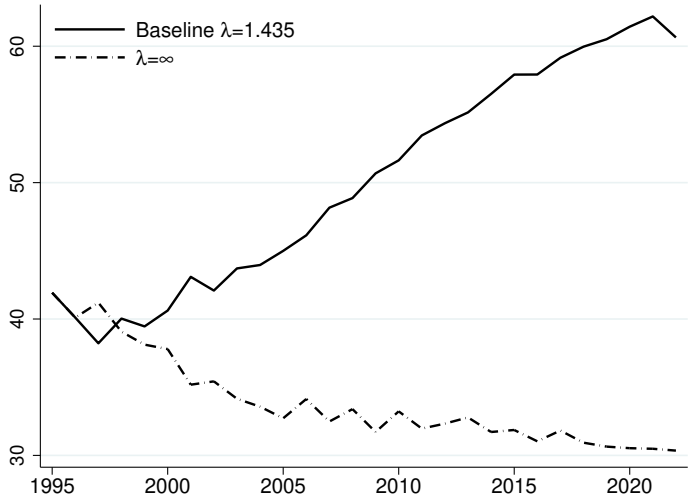


Figure 4.2: Top 10% Wealth Share During Transition (%)

Recall that wealth is the accumulation of savings, which is equal to income times saving rate. Table 4.3 reports the relevant moments in the baseline calibration and in the model with a perfect credit market. If financial friction disappears, entrepreneurs have significantly less incentive to accumulate wealth to escape the borrowing constraint. Their average saving rate reduces from 60.02% to 43.38%, which reduces entrepreneurial wealth

[28] Comparing Gini coefficient instead of top 10% wealth share produces similar patterns.

share and the overall wealth inequality. In addition, a perfect credit market allows private entrepreneurs to operate at their optimal size, which speeds up the growth rates of output as well as wage rate. In the case of $\lambda = \infty$, the average output and wage growth rates increase from 10.75% to 12.85% and from 7.97% to 13.57%, respectively. A combination of slower entrepreneurial wealth accumulation and higher wage growth leads to a greater labor income share, which also contributes to lower income and wealth inequality, as labor income is more equally distributed.

Table 4.3: Moments in Baseline Calibration *v.s.* Perfect C.M. (Credit Market)

	Baseline ($\lambda = 1.435$)	Perfect C.M. ($\lambda = \infty$)
Average growth rate, 1995-2021		
Urban output gr.	10.75%	12.85%
Wage growth rate	7.97%	13.57%
Entrep. saving rate	60.02%	43.38%
Moments in 2021		
Entrep. pop share	12.11%	12.79%
Urban labor inc. share	40.17%	63.24%
Entrep. wealth share	39.09%	23.57%
Top 10% wealth share	62.18%	30.49%

This result highlights the critical role of financial friction in driving up China's wealth inequality. Capital accumulation per se does not necessarily leads to a more unequal distribution. In the case of a perfect credit market, there is actually more capital employed in production. It is the fact that entrepreneurs need to finance these investment through their own pockets that matters for the increase of wealth inequality.

4.4 Counterfactual Exercises: Impact of Various Reforms on Wealth Inequality

The rise of China's wealth inequality occurred during its economic reform process that unleashed the country's growth potential. To assess the impact of various reform measures on the wealth inequality as well as growth, we perform the following counterfactual exercises which undo the various reforms one at a time: curbing housing market boom, shutting down rural-to-urban migration, and limiting entry to entrepreneurship. Any

one of these measures shapes the inequality and the growth trajectories simultaneously and ours is a framework where we can look at these consequences jointly.[29]

To assess the contribution of a housing market boom to rising inequality, we consider a counterfactual increase in land supply that reduces the annual housing price appreciation from the observed 10% during transition to 2%, the same return on deposits. To assess the contribution of rural-to-urban migration, we recalibrate the migration barrier such that the urbanization rate remains at the pre-reform level throughout the transition. That is, we keep migration flow at zero for all periods in transition. Finally, to assess the importance of the entry to the private sector, we counterfactually fix the entry barrier to entrepreneurship at the pre-reform level throughout the transition. Table 4.4 present the effects of these counterfactual policies on changes in wealth inequality, the urban output growth rate, and the average housing consumption.[30]

Table 4.4: Growth and Equity in Baseline and Counterfactuals

		Counterfactual		
	Baseline	Curbing housing market boom	Shutting down migration	Limiting entry to entrepreneurship
Δ Top 10% share	19.03%	26.46%	14.21%	10.33%
Urban output gr.	10.75%	10.65%	8.14%	7.23%
Avg. housing	3.49	5.15	5.44	4.71

Housing Market Boom In the first counterfactual, we reduce the annual housing prices appreciation rate from 10% in the baseline to 2% per annum to cool the housing market boom. To achieve a lower housing price growth, more supply of housing is required, which we recalibrate. Comparing to the baseline case, the required supply of housing stock in the counterfactual in the 26^{th} year in transition is 2.78 times larger. The results are in the second column of Table 4.4.

We find that curbing housing market boom actually increases wealth inequality as housing provides a vehicle for the middle- and lower-income households to accumulate wealth,

[29] In this section we still use the top 10% households' wealth share as the baseline measure of wealth inequality. All results shown in this section are robust if Gini coefficient is used instead.

[30] In Appendix B, we plot the evolution of the top 10% wealth share during the transition in baseline and in each counterfactual in Figure B.6 to Figure B.8.

especially given that the return to bank saving is relatively low. Put it differently, under a larger housing-to-wealth ratio for the relatively low wealth groups, a proportional decrease in housing price decreases their wealth share in the population. More specifically, the 19.3 percentage point increase in the top 10% wealth share from 1995 to 2021 in the baseline is exacerbated to a 26.46 percentage point in the counterfactual.

Naturally, a lower housing price allows urban households to purchase larger houses. The average housing size in the urban area increases by 48% in the counterfactual relative to the baseline. However, it also tends to reduce the GDP growth rate in urban areas, as housing acts as collateral and the value of house is lower in the counterfactual. That effect is quantitatively small as the average urban output growth rate reduces from 10.75% in the baseline to 10.65% in the counterfactual.

Rural-to-Urban Migration The urbanization rate in the baseline calibration increases 1.38 percentage points each year, from 28% in the pre-reform steady state to 83% in the 42^{th} year in transition. Here we change the migration barrier such that the urbanization rate remains at their pre-reform level, and keep migration flow at zero for all periods in transition. We fix the supply of land and housing at their baseline level, and endogenously determine the housing price series. In the baseline the migration barrier reduces from 13.35 in 1995 to -70.06 in 2021.[31] In the counterfactual, the required migration barrier in 2021 is -18.95, much larger than the baseline value.

Rural-to-urban migration is beneficial for growth. As shown in the third column of Table 4.4, shutting down migration leads to a significant drop in urban output growth rate, from a baseline level of 10.75% to 8.14%. On the other hand, migration impacts wealth inequality from several channels. One, as migrants are of relatively low wealth compared to urban incumbents, their presence tends to increase inequality. Second, inflow of migrant labor dampens the increase of wage growth, which tends to increase inequality. Third, housing demand from migrants fuels the housing price appreciation which we show in the previous counterfactual to reduce inequality. The net effect of migration during transition is to increase inequality, as shutting it down results in a reduction of the top 10% wealth share from a baseline level of 19.03% to 14.21%.

[31] See Figure B.5 in Appendix B.2 for the entire times series of migration barrier from 1995 to 2025 in the baseline model.

To see the different channels where migration affects inequality, we present additional moments in Table 4.5. As explained above, without migrant workers, the urban wage grows faster putting downward pressure on inequality (compare the baseline 7.97% wage growth rate to the 8.59% in the second column titled "Endogenous p^h" in Table 4.5). However, without the housing demand from migrants, the housing price grows much slower at 5.12% in the counterfactual which tends to widen inequality. To see this, when we further calibrate the housing supply to restore a housing price growth rate of 10% in the counterfactual without migration, the level of inequality is further lowered to 7.77% (see the third column titled "Exogenous p^h in Table 4.5). That is, in a hypothetical transition without rural-to-urban migration but a booming housing market unaffected by the lack of demand from migrants, the level of inequality would be much lower.

Table 4.5: Additional Moments in the "Shutting Down Migration" Counterfactual

		Counterfactual	
	Baseline	Endogenous p^h	Exogenous p^h
Migration per annum	1.38%	0	0
Housing price gr.	10.00%	5.12%	10.00%
Wage growth rate	7.97%	8.59%	8.60%
Δ Top 10% share	19.03%	14.21%	7.77%

Entry Barriers: Let Some People Get Rich First In the baseline calibration, the parameter that governs the entry barriers to the private sector, θ_e, reduces from 0.78 in the pre-reform steady state to almost zero in the 30^{th} year in during transition. Here we let the entry barrier remain at its pre-reform level throughout the transition. We fix the supply of land and housing and the migration barriers at their baseline level and endogenously determine the housing prices and the urbanization rate. The results are in the fourth column of Table 4.4 as well as Table 4.6.

A higher entry barrier to entrepreneurship takes a heavy toll on growth. The urban output growth rate drops from 10.75% in the baseline to 7.23% (Table 4.4) and the urban wage growth rate drops from 7.97% to 5.76% (Table 4.6). Less urban growth also implies less migration. The change in the urbanization rate over the 26-year transition is 4.81 percentage points, much smaller than the 34.15 percentage points in the baseline. Slower urban income growth, combined with less migration, implies that housing demand weakens

and housing price grows more slowly at only 4.62% per annum.

Table 4.6: Additional Moments in the Entry Barrier Counterfactual

	Baseline	Counterfactual
Housing price gr.	10.00%	4.62%
Wage growth rate	7.97%	5.76%
Δ Urbanization rate	33.67%	4.81%
Δ Entrep. pop. share	9.51%	1.30%
Δ Entrep. wealth share	34.15%	4.38%
Δ Top 10% share	19.03%	10.33%

The effect of permitting entry to entrepreneurship on wealth distribution is significant. If the entry barrier to the private sector remains as high as it is in 1995, with the rest of the economy in terms of migration barrier and the housing supply evolving as in baseline, we will have a much smaller entrepreneurial class possessing much lower wealth. The increases in the entrepreneurial population share and wealth share over the 26-year transition are only 1.30 and 4.38 percentage points, respectively, much lower than those in the baseline economy. As a result, the increase in the top 10% wealth share during transition is 10.33%, only about half of what it is in the baseline. It is for this reason that we think that the reforms that facilitated the entry to the private sector and the rise of the entrepreneurial class rings true to the famous slogan, "Let some people get rich first."

Discussion There are a few caveats we should point out in interpreting our results. While carefully addressing these issues is beyond the scope of the current paper, a discussion of them helps clarify the implicit assumptions underlying the counterfactual results in this section.

In our model, all households face a single housing price. Therefore, we cannot address heterogeneity in either the housing price or its growth across space. Fang et al. (2016) document that the housing price growth rate in first-tier cities is significantly higher than those in second- and third-tier cities. A greater housing price appreciation in larger cities may widen the wealth gap between residents in large and in small-to-medium sized cities, a plausible channel of growing inequality which our model does not capture.

Moreover, the TFP growth rates in both the state and the private sectors in our model and counterfactuals are exogenous to the changes in the environment which we consider. For example, as we vary the entry barrier to the private sector counterfactually we do not consider the possibility that private or state sector TFPs may be endogenous to competition brought by entry of private firms (Jiang et al., 2022). Similarly, as we vary the migration barrier, we do not let productivities to endogenously respond to that. One potential story is that low-skilled migrants specialize in labor-intensive sectors to allow China to quickly accumulate capital stock and gradually upgrade to capital-intensive sectors (Lin, 2012, 2015).

4.5 Sensitivity of baseline results

We conduct a series of sensitivity checks in this section and shows that our baseline results are robust to alternative modelling assumptions and externally calibrated parameter values. Table 4.7 summarizes the main results. We present the three key moments, *the top 10% wealth share*, *the housing-wealth ratio*, and *the entrepreneurial wealth share* in 2021, or the 26^{th} year in transition, in the baseline model as well as in each of the six alternative settings.

In the baseline, we take the financial friction parameter, $\lambda = 1.435$ from existing literature (Curtis, 2016). In the first sensitivity check, we assign two different values, $\lambda = 1.25$ and $\lambda = 1.65$ and simulate the model. The resulting top 10% wealth share, housing-to-wealth ratio and entrepreneurial wealth share are all within 2% variations from their baseline levels. The direction of change is also intuitive. When the financial friction that entrepreneurs face is more severe, a larger value of λ, it is harder for entrepreneurs to accumulate wealth, which naturally leads to less inequality.

In the second and third exercise, we change, respectively, the number of housing grids, from 10 in the baseline to 8 and 12, and the largest size of housing, from 18 in the baseline to 15 and 21, and simulate the model. Clearly, these changes do not affect those key moments in any significant way. This means the assumptions on the number of the housing grid and the upper bound in the baseline are adequate.

It is assumed in the baseline that migrant workers have zero entrepreneurial ability in the first period of arriving in a city. In the fourth exercise, we impose the alternative

Table 4.7: Key Moments in Baseline Calibration and Alternative Settings

	Moments in 2021 (26^{th} year in transition)		
	Top 10% wealth share	H-W ratio	Entrep. wealth share
Baseline	60.96%	57.80%	39.11%
(1). Financial friction: Baseline $\lambda = 1.435$			
$\lambda = 1.25$	61.46%	59.19%	39.43%
$\lambda = 1.65$	60.84%	56.81%	38.93%
(2). Housing grid No.: Baseline $N_h = 10$			
$N_h = 8$	60.92%	56.52%	39.37%
$N_h = 12$	59.93%	59.28%	38.93%
(3). Largest housing size: Baseline $\overline{h} = 18$			
$\overline{h} = 21$	60.73%	59.61%	39.04%
$\overline{h} = 15$	60.34%	56.30%	39.07%
(4). Migrants' entrep. ability upon arrival: Baseline $e_{Migr,0} = 0$			
$e_{Migr,0} \in \{0, \bar{e}\}$	57.08%	59.02%	39.38%
(5). Private sector TFP growth from 16th to 30th period: Baseline $g_{m,t} = 3.5\%$			
$g_{m,t} = 2.5\%, 16 \leq t \leq 30$	58.99%	59.24%	37.36%
(6). Private sector TFP growth from 31st to 40th period: Baseline $g_{m,t} = 0\%$			
$g_{m,t} = 3.5\%, 31 \leq t \leq 40$	59.59%	59.91%	39.09%

assumption that the distribution of entrepreneurial ability for first-time migrants is the same as the urban incumbents. Relative to the baseline, we now have more financially constrained entrepreneurs arriving from rural areas. This tends to increase the proportion of entrepreneurs in the population albeit less wealthy ones. The results are consistent with this interpretation.

In the last two exercises, we vary the assumptions regarding the evolution of the private sector manufacturing TFP. We let the annual manufacturing TFP growth rate from the 16^{th} to 30^{th} period reduce from 3.5% in the baseline to 2.5% to capture China's economic slowdown over the past decade or so, that is from 2011 to 2025, in the fifth exercise. Growth slow down affects entrepreneurs' wealth accumulation more than workers' and as a result the top 10% wealth share and entrepreneurial wealth share are slightly lower and the housing-to-wealth ratio is slightly higher. In the last exercise, we let the private sector TFP continue growing at their baseline level for ten more years after the 30^{th} period which corresponds to the year 2025. Alternative assumptions on the TFP growth

after the observable periods, as we show, have little quantitative effect on the moments we observe, target and care about.

5 Conclusion

In this paper, we study the evolution of wealth inequality in urban China since its market-oriented reforms in the early 1990s. Our research highlights the importance of understanding the rising wealth inequality in the context of China's growth process. Empirically, from 1995-2017, the entrepreneurial shares in population and wealth have increased significantly, and housing has been used as a major vehicle for wealth accumulation for the majority, non-entrepreneurial, households after the housing reform in the late 1990s. Motivated by these facts, We develop a heterogeneous-agent open-economy dynamic equilibrium model with endogenous migration, occupation, and durable consumption (housing) choices subject to various frictions, which capture China's institutional characteristics, to understand the evolution of wealth distribution in the reform era.

The paper highlights the importance of persistent financial market friction in generating the increasing wealth gap during the transition. In an environment with a perfect credit market, the same forces unleashed by the reforms in the housing, migration and private sectors would actually close the wealth gap. We conduct a few counterfactual exercises to evaluate the impact of specific reforms on the evolution of wealth inequality. A slower housing price growth would worsen wealth distribution as it rendered the major vehicle of accumulating wealth for the middle- and low-income households less effective. Hypothetically reversing the reform efforts that brought down the migration barrier and the entry barrier to the private sector would lead to a smaller increase in wealth inequality, at the cost of slower overall growth in urban China. In terms of magnitudes, the urbanization process contributes about 25% of the growing inequality accounting for 5 of the 19 percentage points' increase in the top 10% wealth share, while the promotion of entrepreneurship contributes about 47% of the growing inequality accounting for 9 of the 19 percentage points' increase in the top 10% wealth share during the economic transition from 1995 to 2021.

References

Aiyagari, S. Rao, "Uninsured Idiosyncratic Risk and Aggregate Saving," *The Quarterly Journal of Economics*, 1994, *109* (3), 659–684.

Allen, Franklin, Jun Qian, and Meijun Qian, "Law, Finance, and Economic Growth in China," *Journal of Financial Economics*, 2005, *77*, 57–116.

Atkeson, Andrew and Patrick J. Kehoe, "Modelling the Transition to a New Economy: Lessons from two Technological Revolution," *The American Economic Review*, 2007, *97* (1), 64–88.

Bai, Chong-En, Hsieh Chang-Tai, and Yingyi Qian, "The Return to Capital in China," *Brookings Paper on Economic Activity*, 2006, *37* (2), 61–102.

Benjamin, Dwayne, Loren Brandt, John Giles, and Sangui Wang, *Income Inequality during China's Economic Transition*, Cambridge University Press,

Buera, Francisco J. and Yongseok Shin, "Financial Frictions and the Persistence of History: A Quantitative Exploration," *Journal of Political Economy*, 2013, *121* (2), 221–272.

_ , Joseph P. Kaboski, and Yongseok Shin, "Finance and Development: A Tale of Two Sectors," *American Economic Review*, 2011, *101* (5), 1964–2002.

Cagetti, Marco and Mariacristina De Nardi, "Entrepreneurship, Frictions, and Wealth," *Journal of Political Economy*, 2006, *114* (5), 835–870.

Curtis, Chadwick C., "Economic Reforms and the Evolution of China's Total Factor Productivity," *Review of Economic Dynamics*, 2016, *21*, 225–245.

Fan, Xiaoyan, Zheng Song, and Yikai Wang, "Estimating Income Process in China," *Working paper*, 2010.

Fang, Hanming, Quanlin Gu, Wei Xiong, and Li-An Zhou, "Demystifying the Chinese Housing Boom," *NBER Macroeconomics Annual*, 2016, pp. 105–165.

Garriga, Carlos, Aaron Hedlund, Yang Tang, and Ping Wang, "Rural-Urban Migration and House Prices in China," *NBER Working Paper*, 2021.

Hao, Tongtong, Ruiqi Sun, Trevor Tombe, and XiaodongZhu, "The Effect of Migration Policy on Growth, Structural Change, and Regional Inequality in China," *Journal of Monetary Economics*, 2020, *113*, 112—134.

Hubmer, Joachim, Per Krusell, and Anthony A. Smith., "Sources of US Wealth Inequality: Past, Present, and Future," *NBER Macroeconomics Annual*, 2021, *35*, 391–455.

Imbert, Clement, Marlon Seror, Yifan Zhang, and Yanos Zylberberg, "Migrants and Firms: Evidence from China," *American Economic Review*, 2022, *112* (6), 1885–1914.

Jiang, Helu, Yu Zheng, and Lijun Zhu, "Entry Barriers and Growth: The Role of Endogenous Market Structure," *CEPR Discussion Paper DP15763*, 2022.

Kaymak, Baris and Markus Poschke, "The Evolution Wealth Inequality Over Half a Century: the Role of Taxes, Transfer, and Technology," *Journal of Monetary Economics*, 2016, *77* (C), 1–25.

Khan, Azizur Rahman and Carl Riskin, "China's Household Income and Its Distribution, 1995 and 2002," *The China Quarterly*, 2005, *182*, 356–384.

Kuhn, Moritz, Moritz Schularick, and Ulrike I. Steins, "Income and Wealth Inequality in America," *Journal of Political Economy*, 2020, *128* (1).

Li, Shi and Haiyuan Wan, "Evolution of Wealth Inequality in China," *China Economic Journal*, 2015, *8* (3), 264–287.

_ , Zhong Wei, and Sai Ding, "An Empirical Analysis of China's Wealth Inequality and Its Causes," *Economic Research Journal (in Chinese)*, 2005, *6*, 4–15.

Lin, Justin Yifu, *Demystifying the Chinese Economy*, Peking University Press, 2012.

_ , *The Quest for Prosperity: How Developing Economies Can Take Off*, Princeton University Press, 2015.

Piketty, Thomas, *Capital in the Twenty-First Century*, Belknap Press: An Imprint of Harvard University Press, 2014.

_ **and Nancy Qian**, "Income Inequality and Progressive Income Taxation in China and India, 1986-2015," *American Economic Journal: Applied Economics*, 2009, pp. 53–63.

_ , Li Yang, and Gabriel Zucman, "Capital Accumulation, Private Property, and Rising Inequality in China, 1978-2015," *American Economic Review*, 2019, *109* (7), 2469–96.

Quadrini, Vincenzo, "Entrepreneurship, Saving, and Social Mobility," *Review of Economic Dynamics*, 2000, (3), 1–40.

_ , **Qi Sun, Junjie Xia, and Ting Zeng**, "Getting Rich in China: An Empirical and Structural Investigation of Wealth Mobility," *Working Paper*, 2021.

Restuccia, Diego and Richard Rogerson, "Policy Distortions and Aggregate Productivity with Heterogeneous Establishments," *Review of Economic Dynamics*, 2008, *11*, 707–720.

Santaeulalia-Llopis, Raul and Yu Zheng, "The Price of Growth: Consumption Insurance in China 1989–2009," *American Economic Journal: Macroeconomics*, 2018, *10* (4), 1–35.

Sicular, Terry, Shi Li, Ximing Yue, and Hiroshi Sato, *Changing Trends in China's Inequality*, Oxford University Press, 2020.

Song, Jin, Taili Shi, and Ximing Yue, "2002 and 2007 CHIP Survey: Sample, Weight, and Rural, Urban, and Migrant Merged Sample," in Shi Li, Taihong Zuo, and Taili Shi, eds., *Analysis of China's Income Gap and Changes—Household Income Distribution, IV*, People's Press, 2013.

Song, Zheng, Kjetil Storesletten, and Fabrizio Zilibotti, "Growing Like China," *American Economic Review*, 2011, *101*, 196–233.

Storesletten, Kjetil, Bo Zhao, and Fabrizio Zilibotti, "Business Cycle during Structural Change: Arthur Lewis' Theory from a Neoclassical Perspective.," *NBER Working Paper*, 2019.

Tombe, Trevor and Xiaodong Zhu, "Trade, Migration, and Productivity: A Quantitative Analysis of China," *American Economic Review*, 2019, *109* (5), 1843–72.

Wu, Jing, Joseph Gyourko, and Yongheng Deng, "Real estate collateral value and investment: The case of China," *Journal of Urban Economics*, 2015, *86*, 43–53.

Zhu, Xiaodong, "Understanding China's Growth: Past, Present, and Future," *Journal of Economic Perspectives*, 2012, *26* (4), 103–124.

Appendix of "Unequal Transition: The Making of China's Wealth Gap"

Appendix A Data and Method

A.1 Inequality

The share of wealthiest 10% households in total wealth is obtained by combining micro level household survey, CHIP in 1995 and 2002 and CFPS from 2010-2018, and *Hurun*'s *rich list*, which is available from 1999 onward. Following Piketty et al. (2019), we assume wealth in household surveys are accurate until the $90th$ percentile, and scale up wealth level of wealthiest 10% households by a factor of 1.5.[32] The method proposed in Song et al. (2013) is used to generate weights for CHIP 1995 and 2002. We compare the following ways to construct the aggregate inequality indices:

- *Baseline*: Wealthiest 10% households in survey is scaled up by 1.5; Merge households in Hurun's rich list with those in household surveys, each having their original survey assigned weight adjusted for the number of Hurun households.[33]
- *Direct Merge*: Do not adjust for top wealth in household surveys. Merge households in Hurun's rich list with those in household surveys, each having their original survey assigned weight adjusted for the number of Hurun households.
- *Generalized Pareto Interpolation (GPI)*: Wealthiest 10% households in survey is scaled up by 1.5; Merge households in Hurun's rich list with those in household surveys, each having their original survey assigned weight adjusted for the number of Hurun households. Combine wealth share for different wealth brackets in the merged sample and use generalized pareto interpolation to obtain the wealth share of different wealth groups.

Table A.1 presents the estimated top 10% wealth share under the three methods. Comparing to *Direct Merge*, the *Baseline* method increases the level of inequality, but does not alter the trend over time. The baseline and *GPI* give similar estimations of inequality.

[32] We also follow Piketty et al. (2019) by using 1.3 as the adjustment factor in 1995 to reflect that the underestimation is less severe in pre-reform era as there were less wealthy households then.

[33] In particular, we divide total weights in CFPS sample by total number of households in the CFPS population, to obtain the weight for one household and assign it to each Hurun household. We then multiply the CFPS weight by (1 minus summation of Hurun weights) to maintain the same total weights unchanged.

Table A.1: Urban Wealth Inequality under Different Estimation Methods

	1995	2002	2010	2012	2018
(1) Baseline	41.98%	43.10%	62.31%	62.31%	59.55%
(2) Direct Merge	35.80%	33.66%	53.31%	53.30%	50.63%
(3) GPI	42.07%	43.12%	60.20%	60.02%	57.88%

Note: This table presents top 10% wealth share under three estimation methods: (1) which adjust for top wealth in household surveys and then merge surveys with Hurun data; (2) which do not adjust for top wealth in household surveys and directly merge surveys with Hurun data; and (3) which further apply generalized pareto interpolation to the merged sample in method (1). *Data source:* CHIP 1995, 2002; CFPS 2010,12,18; Hurun's Rich List.

Table A.2 presents the share of total wealth in Hurun's rich list in the merged sample.

Table A.2: Share of Hurun Wealth in Total Wealth

	2002	2010	2012	2018
Urban Households	0.73%	5.06%	4.08%	4.81%
Urban Entrepreneurs	9.08%	21.92%	12.07%	19.61%
No. of Hurun Households	100	1359	1024	1891

Data source: CHIP 2002; CFPS 2010,12,18; Hurun's Rich List

Adjustment for CHIP-1995 CHIP-1995 is the earliest household level data in China that contains urban wealth information. The trial urban housing reform in selected regions in 1994, which has later been extended to the whole nation in 1998, has nontrivial impact on the distribution of urban household wealth in 1995. During the reform, urban households were able to purchase from the work unit the house they lived in under the old public housing system, at a discounted price significantly lower than the market value. In CHIP-1995, there are 31.03% of urban households with self-purchased private house, as listed in Table A.3. For these households, average house purchasing expenditure is only 27.8% of their self reported market value of houses.[34] The reported housing market value for most households living in public housing in CHIP-1995 is 0 as they do not own property rights to the house. Simply using the reported housing wealth would overesti-

[34]CHIP-1995 contains information on the purchasing price for households that has purchased a private house, and where they purchased it. However, the year in which the house was purchased was not recorded. Lack of this last piece of information, we do not adjust for purchasing price for inflation. This might not cause substantial bias as China's urban housing reform started in 1994.

mate the level of urban wealth inequality.

Table A.3: Urban house ownership, 1995

	Freq.	Percent
public housing owned by work unit	3,159	45.58%
other public housing	774	11.17%
inherited old private house	298	4.30%
self-built private house	446	6.43%
self-purchased private house	2,151	31.03%
house rented from private owner	56	0.81%
other	47	0.68%
total	6,931	100%

Data source: CHIP

To obtain the pre-housing reform steady state wealth distribution, we count the purchase expenditure of private houses, instead of their estimated market value, as part of household wealth in CHIP-1995. Table A.4 presents the results of wealth inequality in 1995 under different approaches. Also shown is the urban wealth inequality calculated from CHIP in 1999, when the housing reform was finished, the majority of households purchased private houses, and we use self reported market value of housing for all households. It is reassuring that the wealth inequality level, after adjusting for housing value, in 1995, matches quite well the level in 1999.

Table A.4: Top 10% wealth share in 1995 and 1999

Year	Measure	Value
1995	private housing value = self reported market value	41.61%
1995	private housing value = purchasing expenditure	35.80%
1999	self reported housing market value	34.74%

Data source: CHIP 1995 and 1999

National Wealth Inequality By combining the adjusted household survey sample with Hurun's rich list, Piketty et al. (2019) divide household wealth equally among adult members, and use Generalized Pareto Interpolation to obtain the wealth share of top 10%

households for the whole nation.[35] For the national wealth share of top 10% households, we also scale up the top 10% household wealth by 1.5 in household surveys and then merge it with Hurun's rich list. We plot in Figure A.1 the time series of our inequality measure and that in Piketty et al. (2019). Though the observation unit is adult and the unit is household in our measures, the time series we obtained are quite similar to Piketty et al. (2019). The major difference is in 1995, as we count durable goods as part of household wealth while Piketty et al. (2019) and we adjust for housing value in 1995. The share of durable goods in total household wealth is below 5% in 2010s, so adjusting for them does not significantly change wealth inequality.

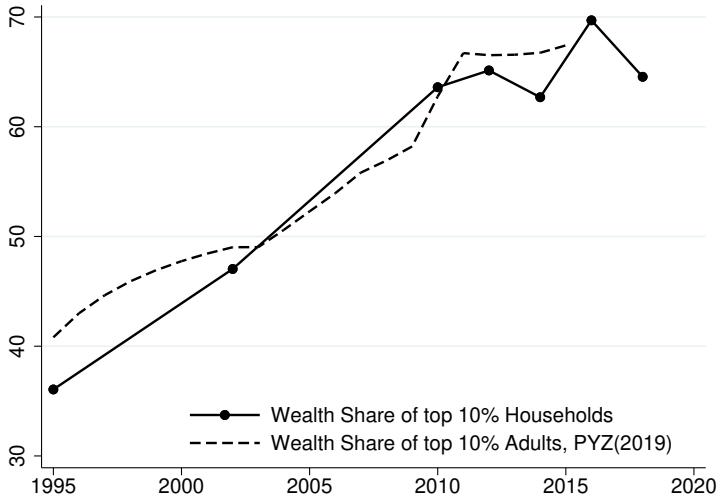


Figure A.1: Wealth Share of Top 10% Households vs Adults in China (%)

Using the national sample, we also plot the time series of top 10% wealth share for the nation, the urban and the rural.[36] Figure A.2 plots top 10% wealth share for the nation, urban and rural. The three time series follow a similar trend. From 1995-2002, inequality within rural or urban has decreased slightly, the increase of national inequality is mainly a result of enlarging rural-urban gap. From 2002 onward, the trend of top 10% wealth share in the nation comoves with that in the urban, as the majority of wealthiest 10% households in the nation reside in the urban in 2000 and 2010s, shown in Table A.5.

[35] For households in Hurun's rich list, they assume wealth is equally shared among 10 household members

[36] Note here we scale up wealth of the wealthiest 10% households by 1.5, and the resulted wealth inequality within the urban differs slightly from Figure **??** in which we focus on the urban and scale up the wealthiest 10% households by 1.5.

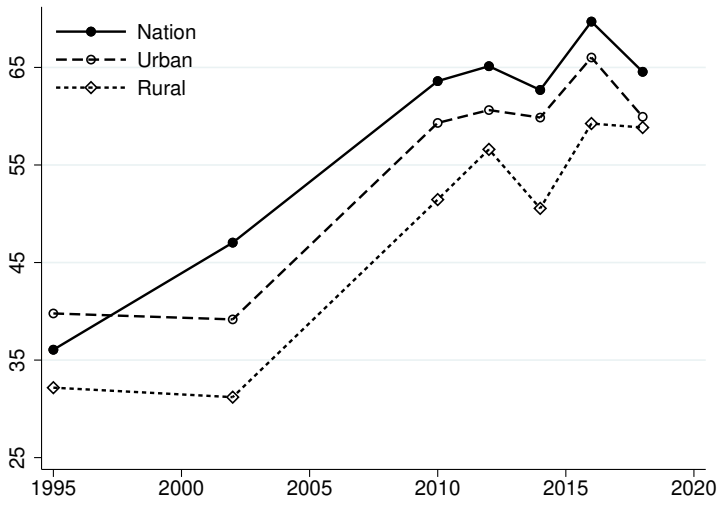


Figure A.2: Top 10% Wealth Share in China, Nation, Urban vs Rural (%)

Table A.5: Urban Proportion among Nationwide Wealthiest 10% Households

Year	1995	2002	2010	2012	2018
	30.1%	85.6%	85.6%	84.0%	89.4%

Data Source: CHIP 1995, 2002; CFPS 2010-18. This table shows the fraction of the nation's wealthiest 10% households which reside in the urban area.

Housing Table A.6 presents the distribution of home ownership in urban China from 1995-2012. Table A.7 presents the home ownership rate and housing wealth ratio for entrepreneurial households. For households from Hurun's rich list, we assume the housing-wealth ratio for them is the same as the wealthiest 1% entrepreneurs in household surveys.

Table A.6: Distribution of Home Ownership

	1995	1999	2002	2012
% own private house	41.76%	66.13%	78.89%	84.39%
% own public house	56.75%	30.38%	–	1.4%
% rent public house	–	–	16.22%	1.00%

Data source: CHIP 1995, 1999, 2002 and CFPS 2012.

Table A.7: Home Ownership Rate and Housing Wealth Ratio for Entrepreneurial Households

Year	1999	2002	2012	2018
Home-Ownership Rate	64.83%	74.84%	84.42%	84.02%
Housing-Wealth (H-W) Ratio	42.71%	55.84%	41.14%	61.83%

Data Source: CHIP 1999, 2002; CFPS 2012, 2018.

A.2 Capital stock

We follow Bai et al. (2006) to calculate capital stock in China and extend the series to 2017. The stock of capital is calculated from the inventory approach

$$K_{t+1} = (1-\delta)K_t + I_t$$

Take 1952 as the initial year. Assume that the economy is initially in an old steady state, so that $I_0 = -(1-\delta)K_0 + K_1 = -(1-\delta)K_0 + K_0\frac{I_1}{I_0}$. It follows that

$$K_0 = \frac{I_0}{\delta + \frac{I_1 - I_0}{I_0}}$$

So we can back-out the value of K_0 using data about I_0, I_1 and δ. Use the average growth rate of investment (*gross fixed capital formation*) from 1953 to 1958 to approximate $\frac{I_1-I_0}{I_0}$. For depreciation rates, take 24% for machinery and equipment, and 8% for structure. We use the inventory approach to first calculate stock for *machinery and equipment* and *structure* separately, and then add them up into an aggregate stock of capital. As in Bai et al. (2006), we adjust for GDP deflators in 1992-1995, while maintaining its overall accumulated growth, to accommodate the vast fluctuation of investment deflators in that period.

The nominal return to capital j is

$$i(t) = \frac{P_Y(t)MPK_j(t)}{P_{K_j}(t)} - \delta_j(t) + \hat{P}_{K_j}(t)$$

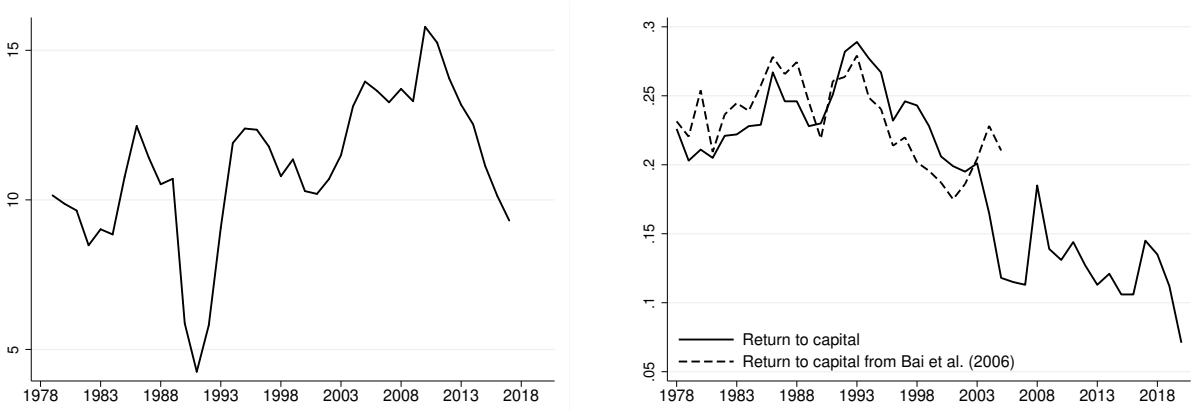
where $\hat{P}_{K_j}(t) \equiv \frac{P_{K_j}(t+1)-P_{K_j}(t)}{P_{K_j}(t)}$ is percentage change in price of capital j. Denote $\alpha(t)$ the

capital income share, the real return to capital equals to

$$r(t) = i(t) - \hat{P}_Y(t) = \alpha(t)\frac{P_Y(t)Y(t)}{P_K(t)K(t)} + \hat{P}_K(t) - \hat{P}_Y(t) - \delta(t)$$

with $P_K(t)K(t) \equiv \Sigma_j P_{K_j}(t)K_j(t)$, $\delta(t) \equiv \Sigma_j \frac{P_{K_j}(t)K_j(t)}{P_K(t)K(t)}\delta_j(t)$, and $\hat{P}_K(t) \equiv \Sigma_j \frac{P_{K_j}(t)K_j(t)}{P_K(t)K(t)}\hat{P}_{K_j}(t)$. The return to capital can thus be measured according to this formula.

Figure A.3 presents the real capital growth rate and return to capital in China from 1978 to 2017.



(a) Real Capital Growth Rate (%)

(b) Return to Capital (%)

Figure A.3: Real Capital (Annual) Growth Rate and Return to Capital in China, 1978-2017

A.3 Entrepreneurship

In CFPS, we define a household as an entrepreneurial household if they answer yes to the following question.

Question: Over the past year, Is there any family member in your household who operates individual businesses or private enterprises?

For CHIP, entrepreneur households are defined as those with at least one household member whose primary occupation is private enterprise employers or self employed (*siying qiye guzhu huo geti huzhu*).[37] Neither CFPS nor CHIP contains consistent information on employment of the firms the entrepreneurs operate. In the merged sample of

[37] In the CHIP questionnaire, private enterprise employers and self employed are classified as one single group. We have also tried to define an entrepreneur household based on occupation of the head of household in CHIP, and obtain results similar those under the baseline definition.

household surveys and Hurun's rich list, essentially all households in Hurun's list are entrepreneurs and we assume they all reside in the urban area.[38]

China Household Finance Survey (CHFS) 2011-17, supposedly the Chinese version of Survey of Consumer Finances, is another household survey that contains information on household wealth. For CHFS, we first multiply the wealthiest 10% households by 1.5 and then merge it with Hurun's rich list.[39] For entrepreneurship, CHFS includes the following question

Question: At the moment, is your family engaging in industrial or commercial production or business operation, which includes self employed, leasing, transportation, online shops, and private enterprises?

This is a broader definition of entrepreneurship. In 2015 and 2017, CHFS further asks numbers of family members and outside employment work in the family business. In the baseline, we define an entrepreneurial household as one who has family members engaging in industrial or commercial operation, i.e. answering yes to the question above, and has at least one employment, which can be either other household members or hires from outside.

Table A.8 presents the population and wealth share of entrepreneurs from 1995-2018 among urban population and the wealthiest 10%, 5% and 1%. Entrepreneurs accounts for a larger share in the top than in population. Over time, the entrepreneurial population and wealth share, among population as well as among wealthiest households, increases in 1990s and 2000s and stabilizes in 2010s. Table A.9 provides the share of entrepreneurs in population and wealth under the broader definition in CHFS 2015 and 2017, which increases the population share, but has only moderate impact on the wealth share, especially at the top.

Table A.10 presents the 2 year transition probability between entrepreneur and worker households using CHFS 2015-17 data.

[38] This is equivalent to assume that the entrepreneurial population and wealth share in the interval from the largest wealth in household surveys to the smallest wealth in Hurun's rich list is the same as those in the merged sample. Given that entrepreneurial share increases when we narrow to the top of wealth distribution, our estimates provide a lower bound for entrepreneurial wealth shares.

[39] Using the CHFS data, the top 10% wealth share in urban china is 60.28% in 2015 and 61.27% in 2017, both very close to the CFPS sample.

Table A.8: Population and Wealth Share of Entrepreneurs among Wealthiest Households

Year	1995	2002	2010	2012	2015	2017	2018
Pop. Share	2.67%	6.23%	9.45%	12.08%	13.12%	12.20%	12.81%
Wealth Share	4.44%	7.71%	23.07%	33.85%	32.53%	25.18%	24.52%
Among Wealthiest 10% Households							
Pop. Share	4.57%	8.92%	16.96%	29.20%	33.27%	24.86%	21.17%
Wealth Share	5.32%	12.07%	30.74%	45.57%	44.32%	31.90%	30.16%
Among Wealthiest 5% Households							
Pop. Share	4.99%	11.04%	19.65%	35.51%	41.98%	28.17%	19.83%
Wealth Share	5.68%	15.05%	36.06%	52.99%	51.59%	36.14%	32.75%
Among Wealthiest 1% Households							
Pop. Share	6.76%	16.94%	38.45%	61.15%	65.64%	43.27%	25.14%
Wealth Share	6.82%	25.18%	57.39%	74.86%	72.05%	54.00%	48.45%

Data Source: CHIP 1995, 2002; CFPS 2010, 2012, 2018; CHFS 2015, 2017; Hurun's Rich list

Table A.10: Entrepreneur-Worker 2 year transition probability

	Entrepreneur in 2017	Worker in 2017
Entrepreneur in 2015	63.08%	36.92%
Worker in 2015	6.38%	93.62%

Data source: CHFS, 2015-17.

Table A.9: Entrepreneurs' Population and Wealth Share in CHFS, 2015 and 2017, under broader Definition of Entrepreneurs.

Year	All	Top10% HHs	Top5% HHs	Top1% HHs
Pop Share in 2015	19.20%	38.30%	46.32%	69.03%
Wealth Share in 2015	37.62%	48.71%	55.53%	74.87%
Pop Share in 2017	18.01%	30.07%	32.80%	48.43%
Wealth Share in 2017	30.70%	36.92%	40.90%	59.10%

Note: The column for "Top10% HHs" means "among wealthiest 10% households". *Data Source:* CHFS 2015 and 2017, Hurun's rich list.

A.4 SOE employment share and urbanization rate

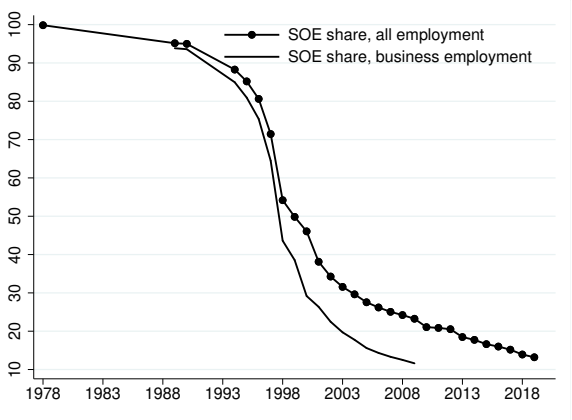


Figure A.4: SOE Share in Urban Employment (%)

Note: For all employment, SOE employment contains state owned enterprises (*qiye*), public institutions (*shiye danwei*), and public agencies and organizations (*jiguan*). For the business sector, SOE employment refers to employment in state owned enterprises. Data source: China Labor Statistical Yearbook, various years.

Appendix B Calibration and Counterfactual Exercises

In this appendix, we present some supplementary figures demonstrating the performance of the calibrated model in Section B.1 and the details of the counterfactual exercises in Section B.2.

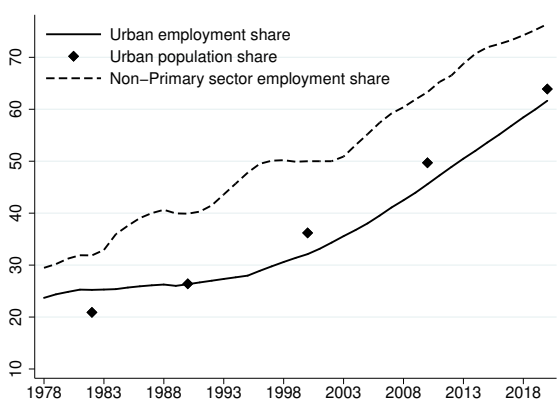
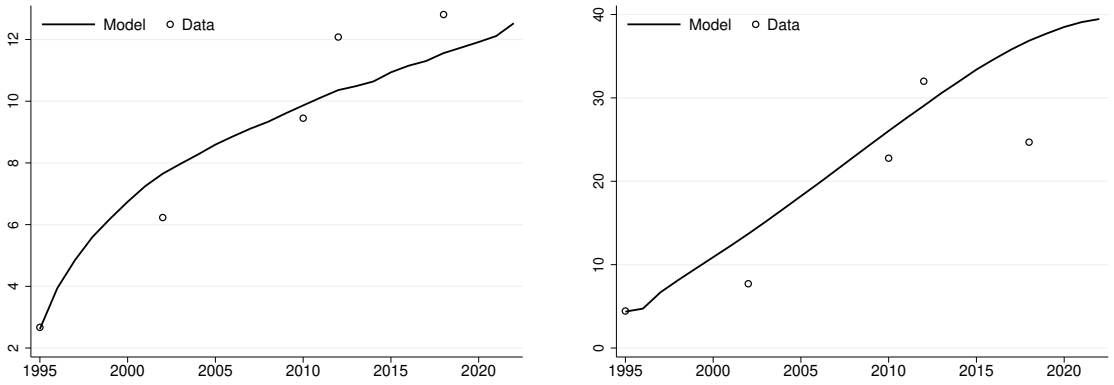


Figure A.5: Urbanization Rate and Non-Primary Sector Emp. Share in China (%)

Note: Urban and Non-Primary sector employment share is from NBS; Urban population share in 1982, 1990, 2000, 2010, and 2020 is from population census in these years.

B.1 Calibration

We plot the model simulated entrepreneurial population and wealth shares against their data counterparts throughout the transition from 1995 to 2021 in Figure B.1. The model simulated time series of SOE employment share are plotted against data in Figure B.2. In Figure B.3, we show the model generated housing-to-wealth ratios for all urban households, for the top 10% wealthiest urban households, the middle 40% and the bottom 50% alongside their data counterparts during the transition. Lastly, we plot the evolution of the urban Gini coefficient generated by the model and in the data in Figure B.4.



(a) Population Share (%)

(b) Wealth Share (%)

Figure B.1: Entrepreneurial Population and Wealth Share during Transition

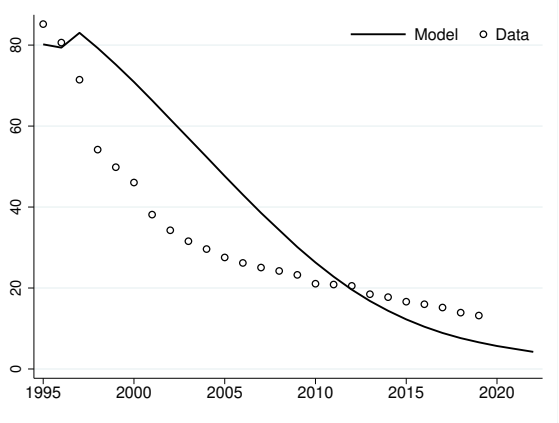


Figure B.2: SOE Employment Share During Transition in Baseline Calibration (%)

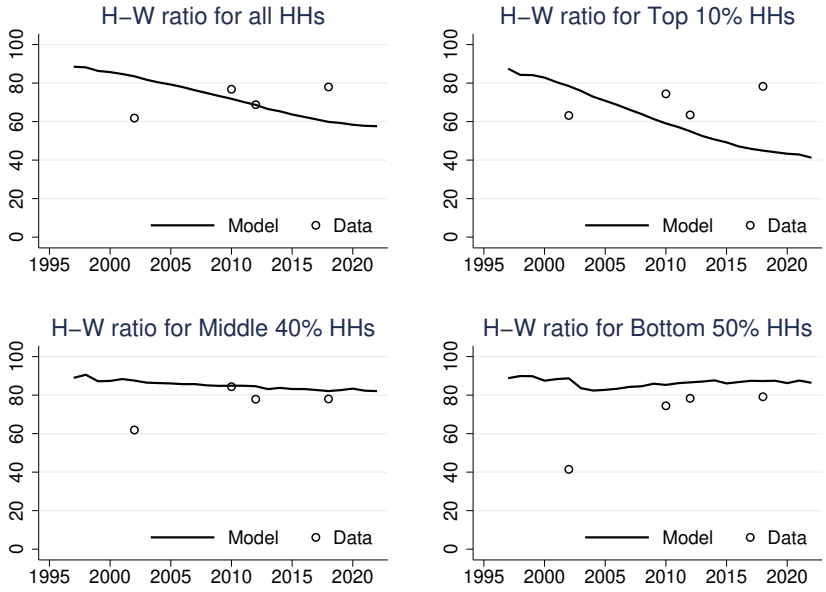


Figure B.3: Housing-Wealth Ratio During Transition in Baseline Calibration (%)

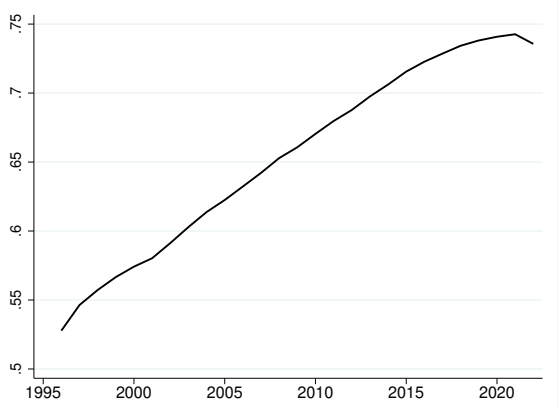


Figure B.4: Urban Gini Coefficient During Transition in Baseline Calibration (%)

B.2 Counterfactual Exercises

Figure B.5 reports the estimated migration barriers during the transition in the baseline calibration. In Figures B.6 to B.8, we plot the entire time series of the top 10% wealth share in baseline and in the counterfactuals from 1995 to 2025.

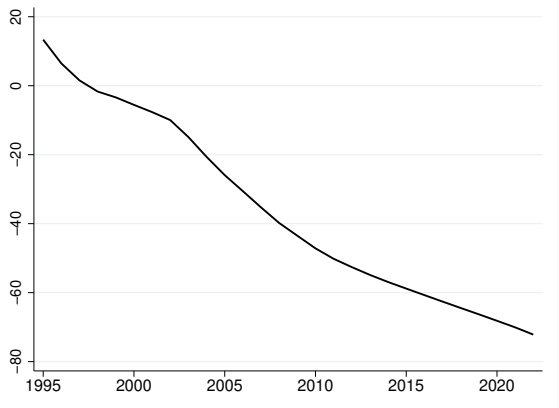


Figure B.5: Estimated Migration Barrier During Transition in Baseline Calibration (%)

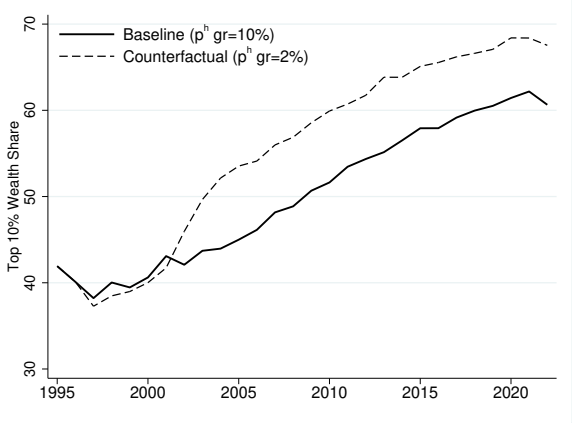


Figure B.6: Top 10% Wealth Share in Baseline and Counterfactual Cases

Note: In this figure, in the baseline case housing price grows 10% per annum; In the counterfactual exercise, it increases 2% per annum.

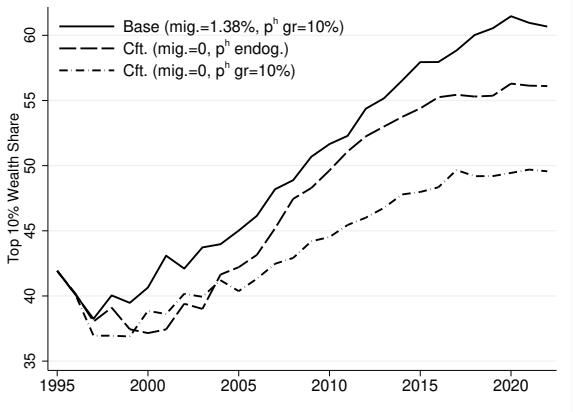


Figure B.7: Top 10% Wealth Share in Baseline and Counterfactual

Note: In this figure, the baseline urbanization rate increases 1.38% per annum; In the counterfactual exercise, it increases 0% per annum.

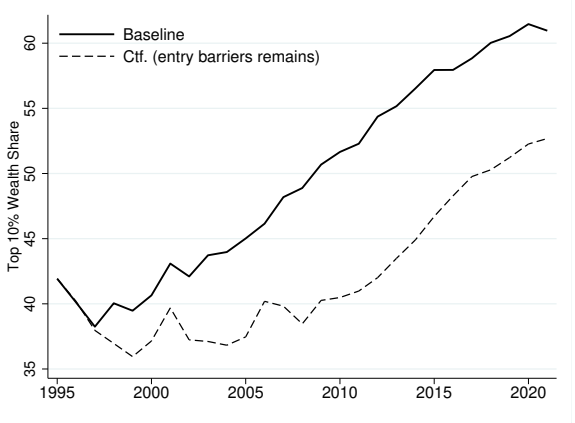


Figure B.8: Top 10% Wealth Share in Baseline and Counterfactual

Note: In this figure, the baseline entry barrier reduces from 0.78 (1995) to 0.00 (2025); In the counterfactual exercise, it remains at 0.78.