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Yangtian Jiang, Yu Zheng and Lijun Zhu

Working Paper No. 955 June 2023 ISSN 1473-0278

School of Economics and Finance

Queen Mary University of London

Unequal Transition: The Widening Wealth Gap amidst China's Rapid Growth*

Yangtian Jiang
Peking University

Yu Zheng
QMUL and CEPR

Lijun Zhu†
Peking University

June 20, 2023

Abstract

We propose a quantitative theory of wealth creation and distribution during China's transitional growth from the early 1990s, when barriers to setting up private businesses, trading housing, and migrating from rural to urban areas are struck down. In response to the changing economic environment, a small entrepreneurial class emerges and accumulates substantial wealth, whereas the majority working class, partly due to limited investment available from an underdeveloped financial sector, uses housing as the main vehicle of wealth accumulation over the course of a long-time housing boom. Our heterogeneous-agent dynamic equilibrium framework determines growth and equity jointly. We show a reasonably calibrated version of the model matches the rise in urban China's wealth inequality since 1995 almost exactly. We further quantify the relative contribution of different reform measures to the rising inequality and discuss the welfare implications taking into account possible growth-equity trade-offs.

JEL classification: E21, O11, O16, O18

Keywords: Wealth inequality, Capital accumulation, Entrepreneurship, Housing, Migration

*We gratefully acknowledge helpful comments from Michele Boldrin, Timo Boppart, Chaoran Chen, Mariacristina De Nardi, Andres Erosa, Byoungchan Lee, Justin Yifu Lin, Ping Wang, Michael Song, Yang Tang, Bernard Yeung, and Xiaodong Zhu as well as the seminar and conference participants at ABFER 9^{th} Annual Meeting, CEPR 29^{th} ESSIM, University Carlos III of Madrid, Kent, King's College London, EUI, QMUL, Brunel University London, Academia Sinica, Renmin Univeristy of China, The University of Hong Kong, and Peking University. We thank Ruixuan Zhong for providing excellent research assistance.

†Jiang: Institute of New Structural Economics, Peking University, Beijing, China. E-mail: ytjiang2019@nsd.pku.edu.cn. Zheng: School of Economics and Finance, Queen Mary University of London. Mile End Road, E1 4NS London, UK. Email: yu.zheng@qmul.ac.uk. Zhu: Institute of New Structural Economics, Peking University, Beijing, China. E-mail: lijunzhu@nsd.pku.edu.cn.

1 Introduction

Ever since Kuznets (1955), economists have been fascinated by how economic growth affects the long-run distribution of economic resources critical of ensuring living standards and maintaining social and political stability. While Kuznet focused on the experiences of three early industrializers, the US, England, and Germany, the more recent growth episode of a very different kind of economy, one whose growth coincides with fundamental structural shifts from planning to markets, seems to align with his hypothesis of rising inequality at the early stage of economic development. Since the market-oriented reforms gathered pace in urban China in the late 1980s and early 1990s, the top 10% wealth share in urban China increased from 40% in 1995, the first year for which micro-level wealth data is available, to over 60% in 2015, fast approaching the US level (Piketty et al., 2019). The primary aim of this paper is to study the mechanisms behind the staggering rise of wealth inequality in urban China during its transitional growth and disentangle the various forces behind its growth-equity trade-off. This area of research should potentially be of interest to other economies that seek to industrialize and grow while transitioning to a well-functioning market economy in an inclusive way.[1]

We propose a quantitative theory of China's economic transition that is capable of explaining the entire increase of the wealth inequality observed for its urban population since 1995. At the heart of our theory is a continuum of rational forward-looking agents with standard preferences, who make economic decisions in response to a set of transition policies that lowers the barriers to private ownership of capital, including both productive and housing capital. A small fraction of more entrepreneurial households take the opportunity to start a private business. In the presence of financial frictions, they maintain high investment rates with high rates of return on capital, which creates massive wealth accrued to this small group at the top of the wealth distribution. The overwhelming majority, the working class, who are faced with increasing wage income risks, engage in precautionary saving. But as they are precluded from investing in the lucrative private business sector due to underdeveloped financial markets, they seize the opportunity to store their wealth in houses over a decades-long housing market boom.[2] We show such

[1] The European Bank for Reconstruction and Development (EBRD) publishes an annual transition report for 37 transition economies from Central Europe to Central Asia, the Western Balkans, and the southern and eastern Mediterranean to track their progress towards open market-oriented economies. In 2016, the EBRD added inclusive growth into the set of transition qualities, by which the economies are evaluated.

[2] The stylized facts we mention here are all well-known and we present them in detail in Section 2. We also review the large literature on China's growth at the end of the introduction, which has typically studied each of the stylized facts in isolation.

a theory of the transition, properly disciplined by the main features of the transition, can generate a rise in wealth inequality that matches the data almost exactly.

Our model builds on the heterogeneous-agent model of Aiyagari (1994), which has grown into a standard macroeconomic framework for understanding income and wealth inequalities and their policy remedies for advanced economies (see De Nardi and Fella (2017) for a review). What distinguishes ours from previous work is the incorporation of fundamental structural changes in multiple sectors and the calibration of the entire transition dynamics along which growth and equity are jointly determined. 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 goods. Along the transition path, 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 manufacturing firm, be it state-owned or private, and becoming an entrepreneur in the private manufacturing sector subject to a financing constraint. The urban residents, after the establishment of the housing market, are also able to purchase housing units as a form of durable consumption good in addition to save in financial assets.

There are three time-varying frictions that are affected by reforms or policies in the model: a barrier to trade housing units, a barrier to migrate from rural to urban areas, and a barrier to enter the private manufacturing sector.[3] In addition, we also assume a constant friction, a financing constraint a la Buera et al. (2011) faced by entrepreneurs.[4] We interpret the data in 1995 as reflecting a pre-reform steady state. Subsequently, alongside the exogenous TFP growth rates in agricultural and manufacturing sectors, the housing trading restriction is removed, the migration barrier reduced, and the entry barrier to the private sector brought down gradually until the model settles down to a new steady state in the distant future. We calibrate the initial steady state as well as the transitional dynamics jointly, targeting data moments describing growth and structural changes such as urbanization rate, the size of the entrepreneurial sector, and the housing-to-wealth ratio,

[3]Relaxation of these frictions reflects China's migration policy reform, SOE reform, and urban housing reform. All reforms took place in the middle to late 1990s, as detailed in Section 2.

[4]This reflects the fact that financial sector reform lags behind reforms in other sectors of the economy. Even nowadays China's financial sector is still dominated by a few state-owned banks. Buera and Shin (2013) made the same observation that reforms in China and other Asian miracle economies have been implemented amid underdeveloped financial markets.

at two points in time: 1995, before the transition sets off, and 2012, in the middle of the transition. Though not directly targeted, the model predicts a 19 percentage point increase in the top 10% wealth share over the transition that matches the data counterpart almost perfectly.

We then use the calibrated model to decompose the drivers of the wealth inequality in China. Starting from the baseline model, we successively remove the four reform or growth measures: keeping the migration barrier as high as in the pre-reform economy, keeping the entry barrier to entrepreneurship high, shutting down TFP growth, and closing down the housing market, which brings us back to the pre-reform economy. We show their distributional consequences are vastly different. Promoting entrepreneurship disproportionately benefits the wealthiest, accounting for as much as 91% of the rise of wealth inequality. At the other extreme, the housing market helps disproportionately the lower and middle classes grow wealth and act as a mitigating force, accounting for -44% of the rise in wealth inequality. Both the migration reform and TFP growth induce inequality to a moderate degree, accounting for 33% and 20% of the rise respectively. In terms of the welfare impact of each of the four forces, taking both growth and equity into consideration, we find that the biggest driver for post-reform welfare gain is still the rather moderate TFP growth of about 3.5%. For urban residents, however, reducing the entry barrier to entrepreneurship is almost as important as TFP growth, as its positive impact on growth over-weighs the negative impact on equity.

While the decomposition exercise maintains a constant financial friction, we also investigate what would happen if the same set of reforms and the TFP growth happened in an economy with a perfect credit market. The striking result is that not only would the output growth be higher but the wealth inequality would actually decline during the transition. In other words, the growth-equity trade-off in the Chinese case emerges only in the context of an underdeveloped financial market. Had the private sector had easier access to finance, the picture would have looked much different. For other transition economies, these results potentially point to the importance of developing a well-functioning financial market alongside reforms in industrial or agricultural sectors.

Our paper is related to three strands of literature. First, it is closely related to the 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; Zhang, 2021). 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% wealth share as our main measure of wealth inequality. Our focus on wealth inequality is driven by the recognition that housing is an important store of wealth for the vast majority of Chinese households due to the longtime housing boom during the transition. Its welfare impact would be underestimated if we only looked at income. Kuhn et al. (2020) makes a similar point for the evolution of U.S. wealth inequality.

Second, our paper belongs to the group of quantitative macro models that examine various aspects of 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, Garriga et al. (2021) the impact of rural-to-urban migration on housing prices since 2000, and Quadrini et al. (2021) the impact from cross-sectional house price variation on wealth mobility in the 2010s. Our framework synthesizes all the aforementioned aspects of the transition to study the evolution of wealth inequality and to evaluate quantitatively the importance of different forces in a unified framework.

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 focuses on transition dynamics along which both growth and distributional outcomes are observed and can be calibrated to. Closer to our paper but focused on the US, Kaymak and Poschke (2016) and Hubmer et al. (2021) 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.

The rest of the 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 up the wealth gap and their growth and welfare implications. Concluding remarks follow in Section 5.

2 Institutional Background and Stylized Facts

We make use of various publicly available microdata from China from 1995, the earliest year for which household-level wealth information is available, 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, 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, mainly in rural areas, and accelerated since 1992 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 2.1 shows the wealth inequality in urban China from 1995. 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 the 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.[7] This means since early 2000s the main drivers of wealth accumulation for the national top 10% have to do with changes

[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 approaches are minor in Appendix A.1. In addition, the average size of a typical household in the top 10%, middle 40%, and bottom 50% respectively is quite stable over time.

[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 a year. An urban permanent resident does not necessarily have an urban *hukou*.

[7] See Table A.4 in Appendix. 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 the early 1990s lived in state-provided accommodation and by construction had zero housing wealth. As housing market liberalization progressed in the late 1990s, by 2000 most urban households become home owners and participate in the housing market.

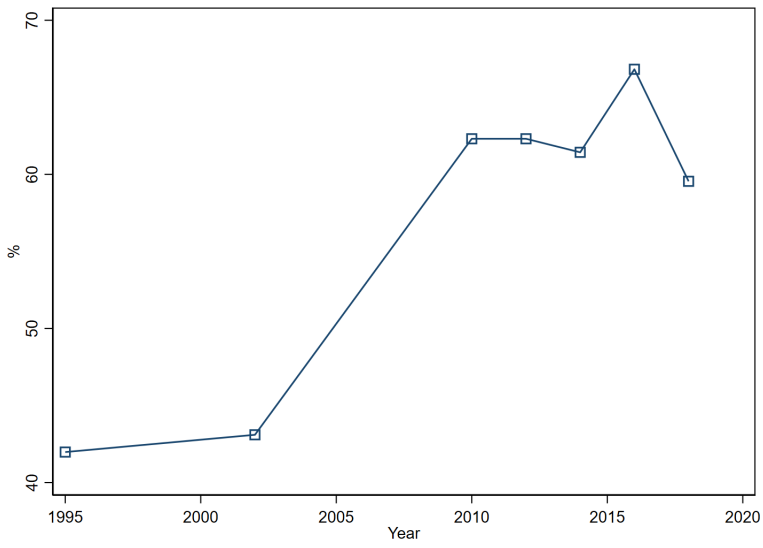


Figure 2.1: Top 10% Wealth Share in Urban China, 1995-2018

Note: This figures reports the top 10% wealth share in urban China from 1995 to 2018. Data sources are CHIP 1995, 2002; CFPS 2010-2018; and *Hurun's Rich List*.

that occur in urban areas. Second, as detailed below, almost all major economic reforms relevant to the urban sector in China were initiated in the 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 the 80s and 90s there.[8]

Capital Accumulation and Entrepreneurship Entrepreneurs, as a rising class of *nouveau riche*, emerge from the transition from an SOE-dominant planned system to a market-oriented economy. China started to reform its state-owned entreprises since the late 1990s under the slogan "Grasp the large, let go of the small"(Hsieh and Song, 2015). As a result, the size of the SOE sector shrinks from employing as much as 85% of the urban population in 1995 to 34% in 2002 and further to 13% in 2020.[9] As the SOEs retreat, the entry barriers faced by private firms are slowly lowered following the promulgation of the *Company Law* in 1994, which legitimizes private ownership of capital (Jiang et al., 2022).

Private entrepreneurs, partly due to the motive of saving out of borrowing constraints in

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

[9]See Figure A.4 in Appendix A.

an underdeveloped financial market (Song et al., 2011), contribute to the rapid capital accumulation during the transition.[10] Figure A.3 in Appendix A shows the stock of capital and its rate of return from 1978 to 2020. During that 42-year span, China's real capital stock grows at an average annual rate of 11.09% and the return remains at a high level of above 15% through 2008, and hovers between 10% and 15% in the past 10 to 15 years.[11]

A combination of rapid capital accumulation and a high rate of return brings 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 operations.[12] The share of entrepreneurs in the urban population rises from 1.07% in 1988 to 6.23% in 2002, and their wealth shares experience a similar increase.[13] The decade after 2002, however, has seen the largest increase in both the population and wealth share. Entrepreneurs' population share rises to over 16% in the urban population in 2012; together they account for more than 30% of urban wealth, after which both shares stay stable at those levels. The timing of the surge coincides with the aftermath of the big wave of SOE reform in late 1990s.

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 the wealthiest 10% of households is 4.57%, and the wealth share is slightly larger at 5.32%. Following a similar trend as before, after a significant acceleration of growth after 2002, the entrepreneurs account for close to 30% of urban population and close to 46% of urban wealth in 2012.[14]

[10] 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.

[11] As a comparison, the real capital stock has increased 2.50% per annum from 1978 to 2019 for 21 developed countries and 4.45% for 95 developing countries in the Penn World Table.

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

[13] The population share of entrepreneurs in 1988 from CHIP is consistent with that from the Urban Household Survey Statistical Yearbook 1989. There, the self-employed and private employers (*geti guzhu yu siyingzhe*) account for 1.49% of urban employment in 1988. As CHIP 1988 does not contain wealth information, we cannot calculate entrepreneurs' wealth share for that year.

[14] Table 2.1 shows a drop in entrepreneurial wealth share in 2018. It likely reflects a short-run fluctuation due to the housing price boom, which tends to benefit more the lower and middle class, rather than the start of a long-run trend. In Table A.5 in Appendix A, we confirm that the entrepreneurial population and

Table 2.1: Entrepreneurial Population and Wealth Share, Urban China

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%

Note: This table reports the population share and wealth share of entrepreneurs among the general urban population as well as the wealthiest 10% urban population for selected years. The data sources are CHIP 1988, 1995 and 2002; CFPS 2010, 2012, 2018; *Hurun's Rich List*.

Housing for Non-Entrepreneurial Households While entrepreneurs benefit from the rapid capital accumulation and growth process, the underdevelopment of financial markets limits how much non-entrepreneurial households can gain. Over the past few decades, the real interest rate on bank deposits has been consistently low at about 2% in China (Fang et al., 2016). In contrast, urban housing prices on average grow at around 10% per annum throughout the 2000s and 2010s, much higher than the deposit rate. It is partly due to limited land supply and partly due to an increasing housing demand fueled by a combination of rural-urban migration and rapidly rising urban income.[15] As a result, most non-entrepreneurial households invest a large chunk of their wealth in housing, leading to a high housing-to-wealth ratio.

China starts its housing reform in 1994, which is then rolled out to the whole country in 1998. Under the planned system, SOEs provide public housing to their employees. After the housing reform, urban households are offered their accommodations at a deeply discounted price by their state employers and are allowed to trade houses in the market. Table 2.2 shows the average homeownership rate and housing-to-wealth ratio for non-entrepreneurial households from 1999 to 2018. In 1999, the first year after the national roll-out of the housing reform, about a third of urban workers still live in public houses, and about two-thirds own their accommodations. In the 2000s and 2010s, the homeownership rate is relatively stable at around 80%.[16] The housing-to-wealth ratio is high in the

wealth shares among the wealthiest 5% and 1% of are even larger and follow a similar increasing trend.

[15] Fang et al. (2016) collects micro-level data from 120 cities from 2003 to 2013, and finds that the hedonic housing price indices grow annually at 13.1%, 10.5% and 7.9% in first-, second-, and third-tier cities.

[16] Home ownership rate here refers to the fraction of households who own a house. The high homeownership 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 a big city and own a house in a small city. If we narrow the definition to those who own the house they live in, the homeownership rate in 2012 and 2018 reduce only

sample period, reaching 82.10% in 2012. In the same year, the housing-to-wealth ratio for entrepreneurial households is 41.79%.[17]

Table 2.2: Home Ownership Rate and Housing-to-Wealth Ratio for Non-Entrepreneurial Households, Urban China

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

Note: This table reports the homeownership rates and housing-to-wealth ratios of non-entrepreneurial households in urban China for selected years. The data sources are CHIP 1999, 2002; CFPS 2012, 2018.

Urbanization The wealth accumulation process of the entrepreneurs following easier entry to the private sector and that of the workers following the housing market boom is further aided by the process of urbanization, as China relaxes the rural-to-urban migration restrictions such as the *Hukou* system (Tombe and Zhu, 2019).

As shown in Figure A.5 in Appendix A, from 1978 to the mid-1990s, the urban employment share is relatively stable at slightly above 20%. From then on, it increases steadily to over 60% in 2020. The non-primary sector employment share rises nontrivially before the 1990s, and evolves in parallel to that of the urban employment/population share over the last two to three decades, reaching 76.4% in 2020.[18] Urbanization has two implications for wealth accumulation. Firstly, a constant inflow of rural labor to the non-agricultural sector helps keep the wage rate in that sector low and maintain a relatively high return on capital as shown earlier. Secondly, as the urban population grows, the demand for housing, which needs to be purchased from the market, 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 by the three policy-induced

slightly to 81.08% and 75.80%.

[17] See Table A.7 in Appendix A. The homeownership rate and housing-to-wealth ratio in urban China are significantly higher than those in developed economies. For example, the homeownership rate in the US is about 65% and the housing-to-wealth ratio is 32.4% in 2013 (Kuhn and Rios-Rull, 2016).

[18] The rise of non-primary sector employment share and relatively stagnation of urbanization rate from 1978 to the mid-1990s is mainly due to rural industrialization—rise of the township and village enterprises—during that period.

changes in the access to entrepreneurship, the housing market, and the rural-to-urban migration respectively, together with a persistent friction in the financing condition. Next, we introduce the framework that embeds all these ingredients for quantitative assessment.

3 The Model

We construct a discrete-time open-economy dynamic equilibrium incomplete markets model to account for China's economic growth and the evolution of wealth distribution during the transition. The model builds on the heterogeneous-agent models with occupational choice under financial frictions (Cagetti and De Nardi, 2006; Buera and Shin, 2013). There are two regions: rural and urban. Although both regions produce the same nondurable final consumption good, for convenience we refer to the rural production as the agricultural sector and the urban production as the manufacturing sector.[19] The pre-reform economy is characterized by various frictions in migration, entrepreneurship, and housing market. The economic reform is modeled as reductions in those frictions as well as a gradual improvement in productivity.

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

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

where β is the discount factor, c_t is nondurable consumption which is the numeraire, and h_t is housing which is modeled as durable consumption.

Urban households are endowed with 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 contain a finite number of values and $(e, z) \in E \times Z$ evolves stochastically according to a Markov process with the transition probability from (e, z) in this period to (e', z') in the next period given by $\Pi((e', z'), (e, z))$. The stochastic process embodies the idiosyncratic labor income risk workers face and the entrepreneurial risk entrepreneurs face. At the beginning of a period, given savings and housing durable consumption (whether publicly provided or privated owned), they make occupation, nondurable consumption, and saving (and,

[19] This is equivalent to assuming two goods with fixed relative prices (as for example determined in an international market) and a homothetic preference over them.

after housing reform, next period's housing consumption) decisions. In what follows, we detail technology, market structure, frictions, and decision in the urban and rural sectors.

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 a 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 the SOE in period t, which is a combination of true productivity, subsidies, and all policy factors that give SOE an advantage over private firms. $K_{s,t}$ and $L_{s,t}$ are capital and labor inputs. α_s and γ_s are 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 the world market. The interest rate faced by firms is $r_t(1+\tau_r)$, where τ_r captures inefficiencies in the domestic banking sector. We do not distinguish the interest rate difference faced by SOEs and private firms as all SOE-related distortions/subsidies are summarized in $A_{s,t}$. Given the interest rate, depreciation rate δ, and urban wage rate, w_t, the SOE maximizes the following profit

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

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. Firm $i's$ production depends on its entrepreneur's ability, e_i, as well as the aggregate productivity in the manufacturing sector, $A_{m,t}$. Because of decreasing return to scale, the entrepreneurs earn positive profits.

Entrepreneurs, owning financial wealth b and housing wealth b^h, face the urban wage w and the rental rate of capital $r(1+\tau_r)+\delta$ and are subject to a collateral constraint. Let $\pi(e,b,b^h)$ denote the profit of an entrepreneur given by:

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

subject to the financial friction

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

where b^h is the market value of housing with size h. Housing can be used as collateral, whose collaterability might potentially differ from that of financial wealth. The parameters λ and λ_h capture the under-development of the financial market. The smaller the values of these parameters, the more severe the financial frictions.

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. Before the housing reform, she lives in state-provided housing and makes nondurable consumption and saving decisions. After the housing reform, she owns her housing and chooses nondurable consumption today and saving and housing consumption for the next 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

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

where the first branch is the value of being a worker, and the second branch is the value of being an entrepreneur. The parameter $\theta_e \in [0,1]$ denotes the entry barrier— a potential entrepreneur can only obtain the license to register a firm with probability $1-\theta_e$ (Jiang et al., 2022).

Denote the term $i^o(e,z,b,b^h), o = W, E$, the earnings of an urban household with occupa-

tion o, which is either her wage or her income from profits. That is,

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

The parameter τ_e captures (time-varying) distortions that affect entrepreneurial profit.

Before the housing reform, all urban households are provided with government-funded public housing $\bar{h}_u$, and their occupation-specific value function is[20]

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

subject to the budget constraint

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

and a no-borrowing constraint,

$$b' \geq 0.$$

Note that as the publicly provided housing has no market value, it cannot be used as collateral by an entrepreneur and the housing wealth in the earnings function is zero.

After the housing reform, urban households purchase houses in the market, and their occupation-specific value function becomes

$$V_u^o(e,z,b,h) = \max_{c,\, b',\, h' \in H} \; u(c,h') + \beta \mathbb{E}_{e',z'} V_u(e',z',b',h'), \quad o = W,E \tag{3}$$

subject to the budget constraint

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

[20] 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.

and the same no-borrowing constraint,

$$b' \geq 0.$$

Here for simplicity, we do not allow workers to borrow to purchase houses, and accordingly, in data, we calculate only the net housing wealth— the value of houses minus the mortgage. 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 significantly higher than the return on saving deposits and avoids 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 conditions which we specify when we discuss equilibrium.

Finally, there are two kinds of incomes that are not tracked in the model. The first is the SOE profit, which, we assume, is collected by the government and does not affect private budget constraint. 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 that 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 government 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 are assumed to be hand-to-mouth with zero wealth. Therefore in the pre-reform economy where migration is prohibited, rural households have no decision to make. During the transition, at the beginning of each period, rural households decide if to migrate to the city. Denote the cost of migration $\tau_{m,t}$, which is a time-varying policy variable. The

migration choice for a rural worker is

$$V_r = \mathbb{E}_{\epsilon_r,\epsilon_u}\{\max\{\overline{V}_r + \nu\epsilon_r, \quad \mathbb{E}_z V_u(0,z,0,0) - \tau_m + \nu\epsilon_u\}\} \tag{4}$$

with $\overline{V}_r$ denoting the value of a rural worker staying in the rural area and given by

$$\overline{V}_r = u(c,\overline{h}_r) + \beta V_r.$$

The shocks ϵ_r and ϵ_u are idiosyncratic preference shocks to living in rural and urban areas, and follow Type-I Extreme Value distribution $G(\epsilon) = \exp(-\exp(-\epsilon - \overline{\gamma}))$. We assume that when a rural worker arrives in the urban area, she has no entrepreneurial skill, draws her worker's ability from the stationary distribution of z, and owns neither financial wealth nor housing. It then follows that

$$V_r = \nu \log[(\exp(\overline{V}_r))^{1/\nu} + (\exp(\mathbb{E}_z V_u(0,z,0,0) - \tau_m))^{1/\nu}],$$

and the fraction of rural workers who choose to migrate to the urban area satisfies

$$\frac{(\exp(\mathbb{E}_z V_u(0,z,0,0) - \tau_m))^{1/\nu}}{(\exp(\overline{V}_r))^{1/\nu} + (\exp(\mathbb{E}_z V_u(0,z,0,0) - \tau_m))^{1/\nu}}.$$

We simulate the migration process until the urban population share reaches 83%, which is the urban population share in the United States in 2021, and shut down migration altogether thereafter.[21] In a stationary equilibrium, which we define below, there is no migration.

3.3 Recursive Competitive Equilibrium

We define a stationary recursive equilibrium for urban China, characterized by constant technologies (A_s, A_m) for the state and private manufacturing sectors respectively, and the constant policy parameters $(\tau_r, \theta_e, \tau_e)$, which represent the level of policy interventions in interest rate and entry to the private sector. Our transition starts from a pre-reform stationary recursive equilibrium and dynamically evolves towards a terminal stationary recursive equilibrium with rational expectation.

Let $\mathbf{x} = (e, z, b, h)$ be the urban household's state vector. Without loss of generality, denote

[21] Otherwise, the model would imply 100% of urban population share in the long run steady state. In Appendix B, we comment on this property of the model and discuss an alternative way of modeling migration.

$b \in [0, b_{max}] \equiv B$ 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 $\mathcal{A}$ and the typical subset be $(\mathcal{E} \times \mathcal{Z} \times \mathcal{B} \times \mathcal{H}) \equiv \mathcal{S} \in \mathcal{A}$. The space $(S, \mathcal{A})$ 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 with the housing market consists of i) interest rate r determined in the world market, wage w, and housing price p_h; ii) policy functions for nondurable consumption $c(\mathbf{x})$, occupation $o(\mathbf{x})$, savings $b'(\mathbf{x})$, and housing consumption $h'(\mathbf{x})$ for urban households; iii) value functions $V_u(\mathbf{x})$ for urban households specified in (1); iv) exogenously given urban housing supply H^s; v) and invariant probability measures $F(\mathbf{x})$ over a mass μ_u of urban households, such that

1. Given prices, urban households make the optimal occupational, nondurable consumption, housing consumption, and savings decisions, and $V_u(\mathbf{x})$ is the associated value function;

2. The representative SOE and the private entrepreneurs maximize profits;

3. The urban labor and housing markets clear:

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

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

   - In the housing market,

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

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

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

The stationary recursive competition equilibrium for the pre-reform economy without a housing market can be defined analogously. During the transition from the pre-reform steady state to the terminal steady state, the size of the urban population increases due to endogenous migration decisions made by rural households, therefore we amend the market clearing conditions in the definition above by including the rural migrants in each period and require their migration decision to be optimal. We solve the model numerically and the algorithms for the stationary equilibrium as well as the transition are found in Appendix D.

4 Quantitative Analysis

Conceptually, we view the observed 27-year empirical growth process from 1995 to 2022 as 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 migration or housing market and laden with 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 allow migration, and from then on vary policy parameters that govern various frictions as well as admit productivity growth in various sectors over the transition, until the model economy settles down in a hypothetical terminal steady state.

Along the transition dynamics, we let the productivities and the friction-related parameters change in the following way: the manufacturing productivity A_m and the SOE sector productivity A_s (which can reflect both TFP and subsidy) evolve at constant rates for 30 years and stay at the level of the 30^{th} year afterward, A_r changes non-parametrically such that the rural-urban wage gap is the same as data.[22] For entrepreneur-related frictions, we assume that the profit distortion τ_e reduces to 0 immediately in the post-reform era, and the entry barrier parameter, θ_e, declines gradually from a pre-reform level to a level

[22]How TFP changes after the 30^{th} period affects the terminal steady state. It, however, has a negligible effect on the transition over the initial 30 years, which is the focus of our paper. We provide robustness checks under different productivity growth assumptions after the 30^{th} year in Section 4.3. Garriga et al. (2021) and Storesletten et al. (2019) also find that how parameters change after the T^{th} year has limited impact on the transition from the 1^{st} to the T^{th} year.

in the 30th year, which we endogenously calibrate.[23] To reflect the fact that the reforms over entry barriers for private firms are concentrated in the late 1990s and early 2000s, we assume that θ_e^2 decreases linearly in the post-reform era so that a substantial portion of reduction occurs in the early 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 policies. 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 amid the transition. With the entire calibrated transition in hand, we then perform a series of counterfactual exercises by shutting down different forces to isolate their respective impact on the evolution of China's wealth inequality over the past decades.

4.1 Calibration

One period in the model corresponds to one year in the data. The periodic utility function is specified as

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

With a positive value for $\underline{h}$, households can choose not to purchase a house.

Externally Calibrated Parameters We set the discount factor as $\beta = 0.92$. The world interest rate, which is also the interest rate on deposits, is $r = 2\%$, and we set $\tau_r = 1.5$ so that the interest rate on firms' loans is 5%. The collaterability of financial wealth is set to $\lambda = 1.435$ following Curtis (2016). Parameters in the production functions, 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 much macroeconomic research (Atkeson and Kehoe, 2007; Restuccia and Rogerson, 2008). Physical capital depreciates at the rate $\delta = 0.10$, and housing depreciates at the rate $\delta_h = 0.03$.

[23] The assumption of setting τ_e to 0 during the transition is mainly 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.

We assume the processes for workers' ability and for entrepreneurial ability are independent. The logarithm of a worker's ability follows an AR(1) process. We set the persistence parameter to 0.9127, following Fan et al. (2010) and Garriga et al. (2021), and calibrate the variance parameter to the variance of log wage in the CFPS 2010-12, as the wage inequality plateaued after 2012 in the data. To account for the fact that wage inequality was institutionally suppressed in the pre-reform era in the simplest manner, we assume a wedge, $1 - \tau_w$, on the two largest states such that the variance of abilities matches the variance of wage in CHIP 1995, which results in a τ_w of 0.25. We then let this wedge decrease smoothly to 0 during the first 17 periods in transition to generate a gradual increase in wage inequality over time that is consistent with that in the data.[24] For the value of ν, which governs the elasticity of migration, we set $\nu = 3$, which is in line with values estimated in the literature (Caliendo et al., 2019).

Internally Calibrated Parameters The productivity of the private manufacturing sector in the pre-reform steady state is normalized to 1. We calibrate the private manufacturing TFP growth rate g_m such that the model-generated GDP per capita grows at an average rate of 8% during 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, its growth rate g_s is calibrated to target SOE employment share in 2012. In both the pre-reform steady state and the transition, rural productivity is such that the model-produced time series on the rural-urban wage gap matches the data counterpart.[25]

Entrepreneurial ability is assumed to take two values, 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 over two consecutive periods. The transition probabilities π_w and π_e in the entrepreneurial ability transition matrix are calibrated to match entrepreneur-to-entrepreneur and work-to-worker transition probabilities observed from CFPS 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

[24] Wage in the model is endogenous and depends on the supply and demand for labor. The occupational choices in principle affect both the supply and demand side of the labor market and hence the wage dispersion. However we verify that the wage dispersion in the baseline model calibrated in this way stays close to the wage dispersion in the data. Moreover, we also find that movements in wealth inequality are relatively insensitive to assumptions on the ability process.

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

of entry barrier in the 30^{th} year, $\theta_{e,end}$, and entrepreneurial ability, $\bar{e}$. They 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 set a large enough h_N and verify that a sufficiently small proportion of households purchase that size. We pick $N = 9$ and choose housing grid points such that $(h_{n+1})^{1/3} - (h_n)^{1/3}$ is a constant.[26] 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 calibrate these parameters to target the homeownership rate, housing-to-wealth ratio for working and entrepreneurial households, and housing-to-wealth ratio for the bottom 50% in the household wealth distribution in CFPS 2012. 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 to 2013. The average annual growth rate of 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 afterward.[27]

There are two remaining preference parameters, housing's share η, and intertemporal elasticity of substitution σ. We choose η to target the housing share in total household expenditure from the China Household Survey Statistical Yearbooks, 22.7%.[28] The intertemporal elasticity of substitution affects households' saving motive, and we choose it such that the top 10% households' wealth share in the pre-reform steady state matches that in 1995.

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

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

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.

[26] We present robustness checks against setting the housing grid points in Section 4.3.

[27] While there is no available data on housing prices from 1995 to 2002, its evolution in the initial 7 years has limited impact on the evolution of inequality. The results are available upon request.

[28] We take the average of the housing expenditure shares in the Yearbooks over the 2014-2018 period. This number is larger than Hao et al. (2020), as the measure in the statistical yearbook includes imputed rent from owner-occupied housing in the housing expenditure, which is what we want.

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 institutions as SOE employment. The relatively large SOE employment share in the 2010s under this broad definition requires a relatively large SOE TFP growth in the model.

The pre-reform entry barrier to the private sector, $\theta_{e,0}$, is 0.7758, implying a low chance of 22.42% of registration application being approved, while the "tax" on entrepreneurial profit, $\tau_{e,0}$, 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 in the pre-reform economy. 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 pre-reform steady state. Our calibration suggests that after 30 years of economic transition, the entry barrier to the private sector, θ_e, is virtually brought down to zero.

The collaterability of housing wealth, λ_h, is 0.4746, significantly lower than that of financial wealth. This is consistent with the empirical evidence in Wu et al. (2015), which shows that the collateral value of real estate in China is limited using firm-level data. For the housing grid points, the smallest positive housing size is 0.3045 and the largest is 18. In the 27^{th} period in the model corresponding to the year 2022, about 5% of urban households choose to purchase the largest housing size.

Though we only target some key variables in the initial year, 1995, and in one single year during the transition, 2012, the calibrated model's prediction of the evolution of these variables over the entire transition fits well with the data counterparts. Figure 4.1 (a) and (b) show the evolution of the model-predicted entrepreneurs' population share and wealth share against the data and the model does a good job matching the entire rise over

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	0.8016
$\theta_{e,0}$	initial entry barrier	0.7758	entrep pop share	0.0267	0.0262
$\tau_{e,0}$	profit distortion	0.7391	entrep wealth share	0.0444	0.0437
σ	intertemporal EoS	2.4732	Top 10% wealth share	0.4198	0.4193
Para. targeting moments in transition dynamics, 2012					
g_m	A_m growth rate	0.0350	GDP p.c. growth rate	0.0804	0.0782
g_s	A_s growth rate	0.0351	SOE emp share	0.2053	0.1901
$\theta_{e,end}$	terminal entry barrier	0.0004	entrep pop share	0.1208	0.1024
$\bar{e}$	entrep ability	0.7059	entrep wealth share	0.3385	0.3217
π_e	E-E trans.	0.8883	entrep-entrep trans.	0.7900	0.7530
π_w	W-W trans.	0.9757	worker-worker trans.	0.9600	0.9594
η	housing share	0.2253	housing exp. share	0.2270	0.1999
λ_h	housing collaterability	0.4746	H-W ratio for entrep	0.4137	0.4110
$p_{h,0}$	initial housing price	0.0671	H-W ratio for non-entrep	0.8250	0.7485
$\underline{h}$	para. in preference	0.5474	homeownership rate	0.8443	0.8526
h_1	housing lower bound	0.3045	H-W ratio for bottom 50%	0.7821	0.8820
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	–	–

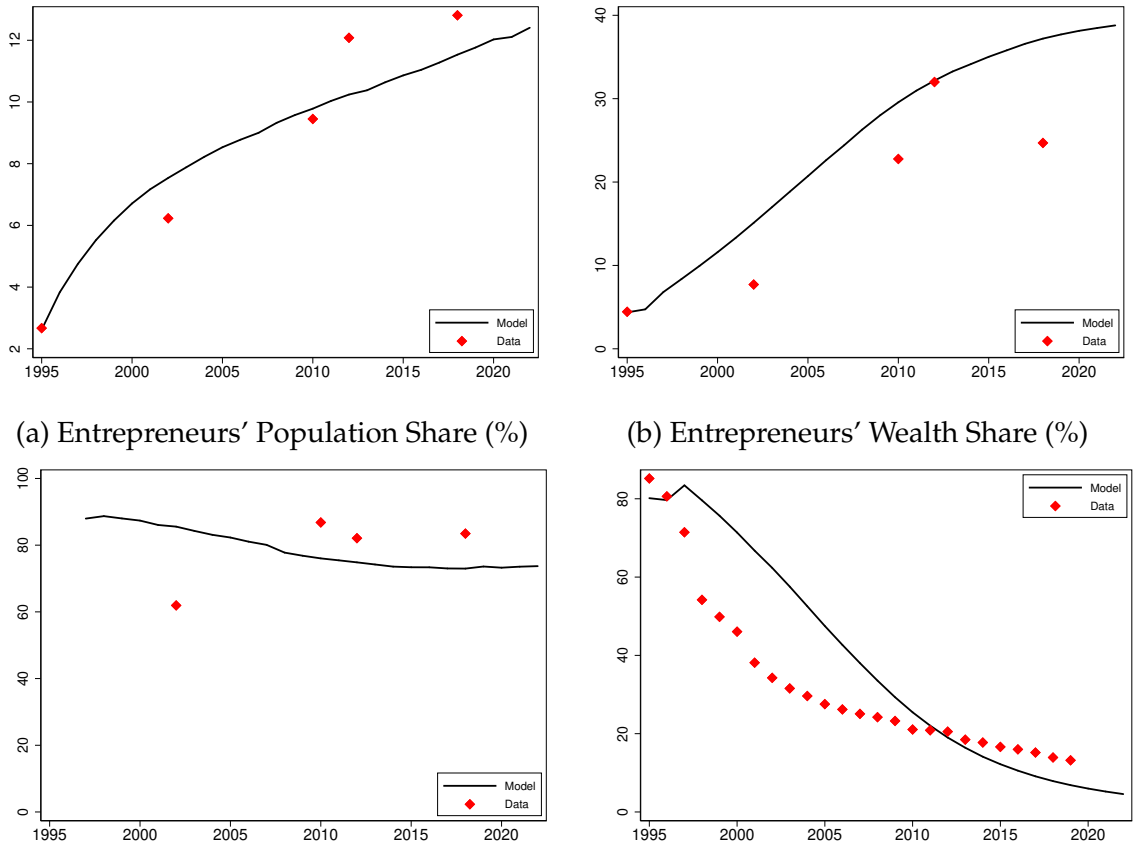
Note: This table reports the model parameters and the associated data moments in the baseline calibration. The bottom panel of the table lists the parameters which change from period to period to target the entire times series of the corresponding data moments. As the parameters and moments are all vectors of dimension 27 as we have 27 years of observed data, for brevity we do not present them explicitly in the table.

the period.[29] The model also replicates a relatively stable and large housing-to-wealth ratio for the working class (Figure 4.1 (c)) as well as realistic time series of the SOE employment share along the transition (Figure 4.1 (d)).[30]

More importantly, the model generates an overall increase in wealth inequality that is very similar to that in the data, even though we have only explicitly targeted the top 10%

[29] As mentioned in Section 2, the entrepreneurial wealth share in 2018 in the data, which the model overpredicts, likely reflects a temporary fluctuation rather than a long run trend.

[30] In Appendix C.1, we further report the housing-to-wealth ratio for the bottom 50%, middle 40% and top 10% urban households during the whole transition (Figure C.1) and discuss how the model performs relative to those untargeted moments.



(a) Entrepreneurs' Population Share (%)

(b) Entrepreneurs' Wealth Share (%)

(c) Workers' Housing Wealth Share (%)

(d) SOE Employment Share (%)

Figure 4.1: Targeted Key Variables during Transition, Model vs. Data

Note: This figure shows the evolution of entrepreneurs' population share (Panel (a)), entrepreneurs' wealth shares (Panel (b), workers' housing wealth share (Panel (c)), and the SOE's employment share (Panel (d)) in urban China from 1995 to 2022 in the model and in the data.

wealth share in the initial year, and the wealth distribution during the transition is not targeted at all (Figure 4.2). In our model, the top 10% wealth share increases from slightly over 40% in 1995 to more than 60% in 2022. While the top 10% wealth share is the main metric of wealth inequality in the analysis so far, the model also captures well the evolution of wealth Gini over the same period (Figure C.2 in Appendix C.1).

To generate such wealth concentration at the top, which are disproportionately populated by entrepreneurs, the entrepreneurs in our model achieve a combination of high saving rates and persistently high rates of return for capital. In the model, the aggregate capital grows at 9% annually, whereas the annual rate of return on capital stands at a high level of 21%. The data counterparts of these numbers are 11% and 16%. As financial exclusion

precludes workers from investing in the private sector, the return on their savings is much more limited and their main vehicle for storing wealth is housing.

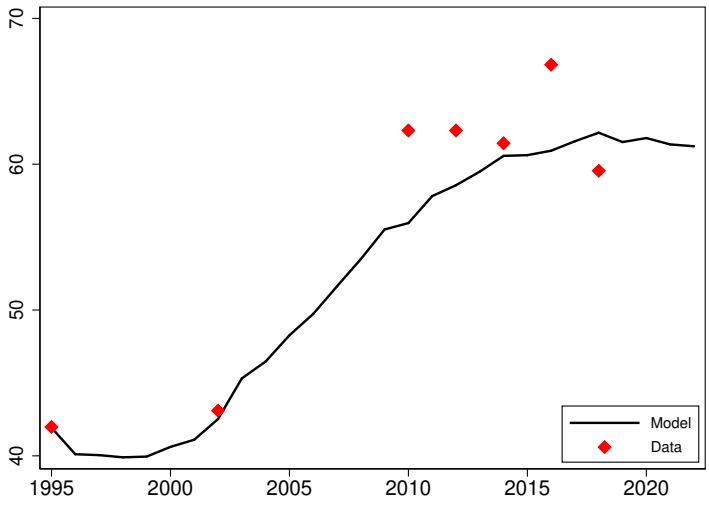


Figure 4.2: Top 10% Wealth Share during Transition, Model vs. Data

Note: This figures reports the top 10% wealth share in urban China from 1995 to 2022 in the model and in the data.

In sum, our baseline model, which is disciplined by realistic processes of urbanization, wage risk, and housing market boom and delivers reasonable compositions of household wealth, can account for almost the entire rise of wealth inequality over the economic transition in urban China since 1995.

4.3 Sensitivity of Baseline Results

We conduct a series of sensitivity checks to make sure the baseline results are robust to alternative modeling assumptions and externally calibrated parameter values. More specifically, we have considered: 1) varying the collaterability of financial wealth around the baseline value of 1.435 from 1.25 to 1.65; 2) varying the number of housing grids around the baseline number of 10 from 8 to 12; 3) varying the value of the largest house size around the baseline size of 18 from 15 to 21; 4) giving the rural households who choose to migrate the same draw in entrepreneurial abilities as the urban incumbents; 5) reducing the private manufacturing TFP growth rate from the 17^{th} to the 30^{th} period corresponding to 2011 to 2025 from the baseline value of 3.5% to 2.5%; 6) letting the private manufacturing TFP continue to grow after the 30^{th} period for ten more years. In all these

alternative scenarios, we examine how the top 10% wealth share, the housing-to-wealth ratio, and the entrepreneurs' wealth share in 2022 or the 27^{th} period in the model are affected. The results are presented in Appendix C.2, which we summarize here.

We find that those three key moments are all within 2% variations from their baseline levels in scenarios 1)-3), so our results are robust to varying assumptions on collaterability and the setup of housing grids. In scenario 4), where we allow migrants to have better entrepreneurial ability, 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, but the quantitative magnitudes are relatively small. For example, it reduces the top 10% wealth share by 2.88 percentage points, a 4.7% decrease. We find the baseline assumption more plausible.

The last two scenarios concern the sensitivity of the private manufacturing TFP growth rates. Scenario 5) is meant to capture China's economic slowdown over the past decade or so following the global financial crisis. Growth slowdown 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. All changes are within 2 percentage points. Finally, when we allow the TFP growth to continue for ten more years beyond 2025 in scenario 6), we observe little effects on those key moments in 2022, which we can observe and care about.

4.4 Counterfactual Exercises

4.4.1 Decomposing Forces Behind the Increasing 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 wealth inequality, we employ the calibrated model to decompose the increase in wealth inequality along several different contributing forces. Relative to the pre-reform economy, the transition is driven by four broad categories of reform and growth measures: (i) facilitating rural-to-urban migration; (ii) reducing entry barriers for private firms and the entrepreneurial profit distortion; (iii) enjoying TFP growth in the urban state and private sectors and the rural sector (and removing the wage compression among urban workers); and (iv) establishing a housing market. Starting from the baseline model, we shut down one force after another, and in each step, we simulate the time series of the

top 10% wealth share and the urban total output along the transition and calculate the welfare for an average urban and an average national resident over this period. Once all four channels are shut down, we arrive at the pre-reform steady state. This process gives us a decomposition of the difference of inequality, growth, and welfare of the baseline transition relative to the pre-reform steady state into their individual components due to each of the four forces.

The decomposition of the wealth inequality is visualized in Figure 4.3.[31] In the baseline model, wealth inequality increases from 41.93% in 1995 (the pre-reform steady state) to 61.23% in 2022, which is a rise of 19.30 percentage points (the black line with squares). Shutting down migration reduces the magnitude of the increase to 12.96 percentage points, or accounting for 32.85% of the rise in wealth inequality (the blue line with x). In addition, keeping the entry barrier to the private sector and the profit tax at the pre-reform levels brings the inequality further down to below the pre-reform level (the red line with circles), which accounts for 91.03% of the rise in inequality. Eliminating TFP growth brings the inequality further down to the orange line with "+" and accounts for 19.90% of the rise of the inequality. Finally, removing the housing market exacerbates inequality, bringing it up to the level of the pre-reform economy (the horizontal dash line) and accounting for -43.78% of the rise of wealth inequality. With the exception of the establishment of the housing market that tends to reduce inequality as it benefits mainly the relatively poor, all other forces contribute positively to the rise of urban wealth inequality, through very different ways.

To see how these forces impact the entire wealth distribution, we report in Table 4.2 the average wealth level of the residents in the low, middle, and top segments of the urban wealth distribution in 2022 in the baseline and the counterfactuals, with the wealth level for the bottom 50% in the baseline normalized to 1. With the exception of removing migration, removing all other reform and growth measures results in lower wealth in absolute terms for all urban residents over the transition relative to not removing them, suggesting all segments of the urban population benefit from those measures. However, the benefits are not necessarily equally distributed. Take the last two rows. Relative to the pre-reform steady state, the housing reform benefits predominantly the bottom 50% and middle 40% of the population, hence presenting itself as an equalizing force. The benefit of TFP growth is widely shared and skewed only slightly to the top, with the av-

[31] Figure C.3 in Appendix C.3 shows the decomposition results for the Gini coefficient, which resembles that for the top 10% wealth share in Figure 4.3.

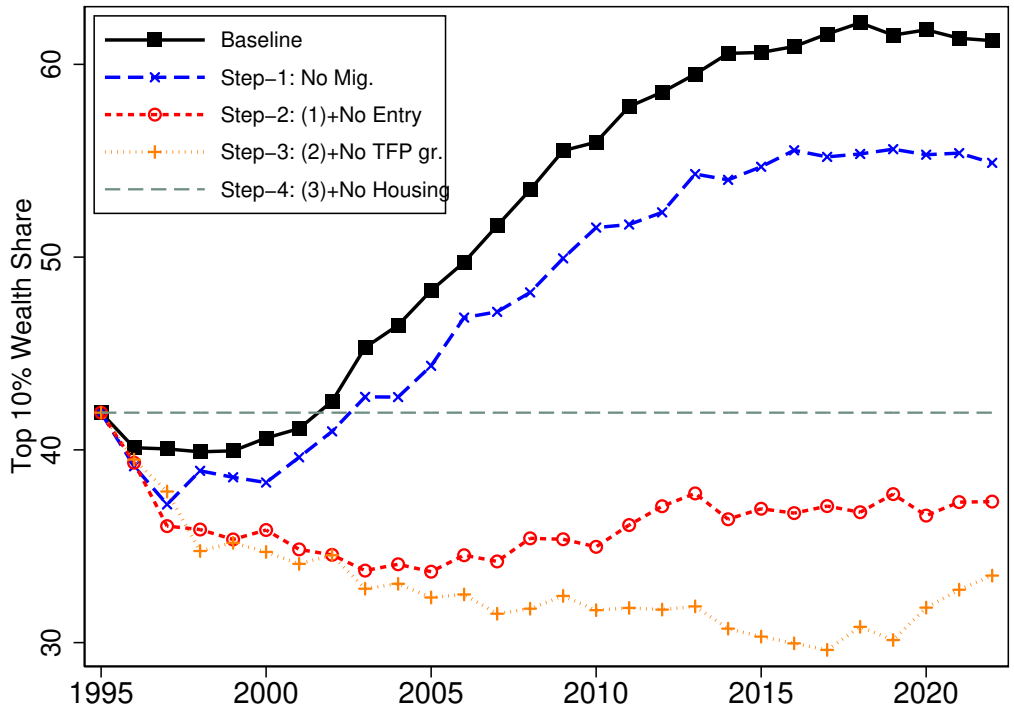


Figure 4.3: Decomposition Results

Note: This figure shows the counterfactual exercises in which we decompose the increase in wealth inequality by gradually shutting down reform measures.

erage wealth of the bottom 50%, middle 40%, and top 10% increasing by a factor of 2.6, 3.7 and 4.2 respectively by the end of the transition relative to where TFP growth is absent (i.e. compare the third to the fourth row). In contrast, the reduction in the entry barriers to private entrepreneurship produces a much more skewed wealth distribution (i.e. the second and third rows). While the bottom and middle sections of the wealth distribution see their wealth increase by a factor less than 3, the top 10% experience much faster wealth accumulation so that by 2022 their wealth is increased almost 6 fold, compared to the scenario where the entry barriers remain high. Finally, the reduction of migration barriers leads to a dramatic expansion of the urban population from 27.97% to 64.38%. As migrants arrive with zero wealth and no entrepreneurial ability, they almost certainly occupy the lowest segments of the urban wealth distribution, and as a result, the bottom 50% of the expanded urban population and even the middle 40% consist predominantly of migrants and have lower wealth in absolute terms than their counterparts of the urban incumbents who have always lived in urban areas. Similarly, the threshold for making the top 10% is lowered due to the population expansion leading to a lower average. In

relative terms, allowing migration lowers the average wealth at the top less than at the bottom, confirming that it still contributes positively to the rising wealth inequality.

Table 4.2: Average Wealth along the Wealth Distribution in 2022 in Baseline and Counterfactuals

	Bottom 50%	Middle 40%	Top 10%	Urban Pop.
Baseline (Mig.+Hous.+TFP gr.+Entry)	1.00	9.53	64.95	64.38%
+No Mig. (Hous.+TFP gr.+Entry)	4.45	25.06	141.69	27.97%
+No Entry (Hous.+TFP gr.)	1.70	8.56	24.78	27.97%
+No TFP gr. (Hous. only)	0.64	2.28	5.84	27.97%
+No Hous. (Pre-reform)	0.12	0.61	3.71	27.97%

Note: This table reports the average wealth by wealth partitions for the baseline and each of the counterfactuals. The average wealth of the bottom 50% in the baseline is normalized to 1.

Not only do these reform and growth measures impact wealth distribution differently, they also have different growth implications and our framework allows us to examine growth, inequality, and the resulting welfare consequence jointly. This is reported in Table 4.3. In computing welfare, we employ a utilitarian social welfare function, assigning equal weights to households to compute the welfare of an average urban or an average national resident. We then calculate a nondurable consumption equivalent variation (CEV) that compares the welfare in each scenario relative to that in the pre-reform steady state. That is, if the CEV of a scenario is x, then the welfare in that scenario is equal to the welfare when the typical household's nondurable consumption is multiplied by $1 + x$ in the pre-reform economy.

As our previous analysis shows, the reduction of entry barriers to entrepreneurship accounts for the vast majority of the rising wealth inequality since 1995, with migration and TFP growth contributing a moderate degree and the housing reform counteracting the trend. In terms of their contribution to urban output growth, the TFP growth is by far the strongest contributor, though migration brings about higher urban output through more than doubling the urban working population. Overall in terms of welfare, TFP growth clearly accounts for the largest share of the welfare improvement for urban residents during the transition from the pre-reform steady state, at 69.80%. A strong propeller of growth combined with relatively mild consequences on inequality allows it to spread the gains in a relatively equitable way and therefore produces the biggest welfare gain, among the four channels. The second most important source for welfare gain is the reduction of entry barriers to private entrepreneurship, which accounts for 55.52% of

welfare improvements in urban areas. This welfare gain hinges on the fact that an expanding private sector in the model benefits everyone even though it benefits the rich a lot more than the poor. To an average urban resident, it presents itself as a massive opportunity for upside potential with no downside risk. The negative welfare effect from migration for the urban population is clearly driven by the expansion of the urban population to include poorer migrants, as we discussed before. But as migration is endogenous at the national level it is not surprising that it is welfare-improving. In sum, regardless of whether we focus on the urban areas only or the entire nation, the contributors to welfare improvement during the economic transition in descending order, taking into account the implications on equity, are TFP growth, the reforms to strike down entry barriers to private entrepreneurship, the establishment of a housing market, and the reforms to facilitate rural-to-urban migration.[32]

Table 4.3: Growth, Equity, and Welfare in Baseline and Counterfactuals

	Baseline	Counterfactual			
		Step 1 No Mig. (Hous.+TFP gr.+Entry)	Step 2 (1)+No Entry (Hous.+TFP gr.)	Step 3 (2)+No TFP gr. (Hous. only)	Step 4 (3)+No Hous. (Pre-reform)
Δ Top 10% share	19.30 pp	12.96 pp	-4.61 pp	-8.45 pp	0.00 pp
Contribution		*32.85%*	*91.04%*	*19.90%*	*-43.78%*
Urban output gr.	9.92 pp	7.12 pp	6.29 pp	-0.12 pp	0.00 pp
Contribution		*28.23%*	*8.37%*	*64.62%*	*-1.21%*
Relative to the pre-reform steady state					
Urban CEV	62.97%	90.04%	55.08%	11.13%	0.00%
Contribution		*-42.99%*	*55.52%*	*69.80%*	*17.68%*
National CEV	62.29%	61.86%	56.34%	1.85%	0.00%
Contribution		*0.69%*	*8.86%*	*87.48%*	*2.97%*

Note: This table reports the increase in the top 10% wealth share and the urban output growth rate in the baseline and in each of the four counterfactual exercises in the upper panel in percentage points (pp), and the CEV of an urban resident and the CEV of a national resident relative to the pre-reform steady state in the baseline and in each of the four counterfactual exercises in the lower panel. The contribution of each channel in accounting for the rise in inequality, the output growth, and the welfare gain in the baseline is reported in italics under the relevant row. For example, the contribution of migration in generating wealth inequality is $(19.30pp - 12.96pp)/19.30pp = 32.85\%$ and the contribution of private entry is $(12.96pp - (-4.61)pp)/19.30pp = 91.04\%$.

[32]Note that the results and interpretations in this section hinge on the particular order in which we shut down the channels. We argue that this is the order that is the most sensible when thinking about the relative contributions of the individual channels, but we also present the results following different orderings in Appendix C.3.

4.4.2 Discussions

We discuss briefly the mechanism behind each of the four forces in shaping the growth and equity trajectory during the transition which we report in the last section. More details can be found in Appendix C.3.

Rural-Urban Migration. The urban population share in the baseline calibration increases from 28% in the pre-reform steady state to 83% in the terminal steady state. When we shut down migration, the urban population share stays at the initial level and we let housing prices endogenously clear the housing market, given the series of land and housing supply in the baseline model. Allowing rural-to-urban migration obviously promotes urban growth as it makes labor a more abundant factor. However, its impact on inequality works through multiple countervailing channels. One, as migrants are the wealth-poor, their presence mechanically increases urban inequality. Second, the inflow of migrant labor dampens wage growth, which tends to increase inequality. Third, the housing demand from migrants fuels the housing price appreciation, which then provides a higher return on savings to the working class and tends to reduce inequality.[33] The net effect on inequality is positive, as we show in Table 4.3, as shutting it down results in a reduction of the rise in the top 10% wealth share from a baseline level of 19.30 percentage points to 12.96 percentage points.

Entry to Entrepreneurship: Let Some People Get Rich First. In Step 2, we further fix the entry barrier to the private sector θ_e and the profit tax τ_e at the pre-reform levels. A higher entry barrier to entrepreneurship takes a toll on growth, as it limits the number of people who can set up a firm to enjoy the TFP growth in the private manufacturing sector.[34] Moreover, its effect on wealth distribution is significant. With the entry barrier fixed at the pre-reform level, entrepreneurs account for a smaller share of the population and wealth at the end of the transition, and more urban residents work for the state sector, which drives the wage growth. As a result, the top 10% wealth share during transition actually declines by 4.61 percentage points. 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 ring true to the famous slogan, "Let some people get rich first." Entry barrier reform worsens inequality but generates growth. On balance, the positive growth effect domi-

[33] Table C.2 in Appendix C.3 contains these relevant moments in the counterfactual simulations.

[34] As we vary the entry barrier to the private sector counterfactually we do not consider the possibility that private or state sector productivities may be endogenous to the competition brought by the entry of private firms (Jiang et al., 2022). Taking that into account should lead to a greater estimation of this entry barrier's impact on growth.

nates and it contributes to a higher urban and national welfare.

TFP growth. In Step 3, we additionally shut down TFP growth (for the private, the SOE, and the rural sectors), and let the wage depression faced by workers stay at its pre-reform level. This substantially reduces the growth rate—urban output growth in the initial 27 years in transition is virtually eliminated by Step 3. In our model, the exogenous TFP growth rate explains almost two-thirds of the growth, with the remaining one-third accounted for by migration and entry barrier reforms. On the other hand, the impact of TFP growth on distribution is relatively small, as productivity growth benefits all individuals without strong bias towards certain groups.

Housing Reform. In Step 4, we further close the housing market so that each urban resident consumes housing freely available from the government and this brings us to the pre-reform steady state. This last step increases wealth inequality, as we remove an important vehicle for middle- and lower-income households to accumulate wealth, especially given that the return to bank savings is so low. Put differently, under a larger housing-to-wealth ratio for the relatively low-wealth groups, a proportional increase in housing price increases their wealth share in the population, and therefore a booming housing market reduces inequality.[35] More specifically, housing marketization leads to an 8.45 percentage point decrease in the top 10% wealth share from 1995 to 2022.

4.5 The Role of Financial Frictions

Our model features persistent financial frictions to reflect the fact that reform of the financial sector in China lags much behind its reform efforts in other sectors. In the baseline calibration, we take $\lambda = 1.435$. 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 credit constraint is completely removed during the transition, i.e. $\lambda = \infty$, and all other parameters remain the same as in the baseline. We find that the same growth and reform process placed in a perfect credit market will actually deliver lower wealth inequality by the end of the transition.

[35] 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 that our model does not capture.

Since wealth is the accumulation of savings, which is equal to income times saving rate, we consider how a perfect credit market affects the saving rate and income for entrepreneurs and workers to understand this result. With a perfect credit market, entrepreneurs have significantly less incentive to accumulate wealth to escape the borrowing constraint. Their average saving rate reduces significantly from over 60% in the baseline to around 45%. At the same time, a perfect credit market allows entrepreneurs to operate at their optimal size, which speeds up the growth rates of output as well as the wage rate workers receive. Under a perfect credit market, the average output and wage growth rates increase from 9.98% in the baseline to close to 13% and from 7.97% in the baseline to over 11%, respectively. These factors combined lead to a more equal distribution of wealth.[36]

This result highlights the critical role of financial friction in enabling China's tremendous rise of wealth inequality and the resulting growth-equity trade-off. Capital accumulation per se does not necessarily lead 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 investments through their own pockets that drives the increase in wealth inequality.

5 Conclusion

In this paper, we study the evolution of wealth inequality in the growth process of a transition economy, China. Reforms that liberalize the private business sector, establish the housing market, and integrate rural and urban labor markets generate simultaneously growth and inequality. Our theory of the transition, once properly calibrated, predicts movements in the wealth inequality that match the data almost exactly. The advantage of our quantitative framework, which jointly determines growth and equity, is that we can delineate how each reform measure contributes to the changes in growth, equity and ultimately welfare during the transition. We show the reduction of the entry barriers to private business contributes the most to the rising wealth inequality, though it is also an important source of welfare gain for urban residents during the transition. At the same time, a booming housing market provides a vehicle of wealth accumulation for the working class who lacks access to better investment opportunities due to financial repression and mitigates the rise of inequality. Throughout the transition in China, financial markets remain underdeveloped and private business are severely credit constrained. We show

[36]Table C.3 in Appendix C.4 reports the relevant moments in the baseline calibration and in the model with a perfect credit market.

it has crucial implications on the observed growth-equity trade-off in China. If the same set of reform measures took place in an economy with perfect credit market, we would achieve both higher growth and lower inequality by the end of the transition.

When Kuznets wrote the seminal paper in 1955, he speculates on the internal mechanisms of the growth process of the early industrialized economies that would act as an equalizing or disequalizing force on the nation's income distribution. The growth process of a transition economy certainly differs from that of a mature market economy where the basic institutions of capitalism are in place. However, the basic tenet of economic theory that rational agents respond to incentives when making economic decisions still applies. We undertake the task of modelling the changing economic environment which alters the incentives the Chinese households face and show indeed such a theory can account for both the observed growth and rising inequality during the transition. Although our theory is tailored to the Chinese experience and cannot be blindly generalized to other economic contexts, there are a few broad lessons we learn from the study which could perhaps be useful to others wanting to transition to a market-oriented economy. First, a well-functioning financial market with wide access and participation could help distribute the gain from economic growth more equally. Second, while reducing market frictions and addressing structural issues are important for transition, TFP growth may still present itself as the best way to produce inclusive growth. Lastly, as transition policies are typically a basket of policies affecting multiple sectors, it opens the room for policy coordination. In the Chinese example, liberalizing housing market and the subsequent housing market boom help mitigating the growing inequality. In another country, it could be reforming another sector. A multi-sector macroeconomic framework like the one we propose can therefore be the appropriate tool not only to evaluate past policies but also to design future ones.

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.

Caliendo, Lorenzo, Maximiliano Dvorkin, and Fernando Parro, "Trade and Labor Market Dynamics: General Equilibrium Analysis of the China Trade Shock," *Econometrica*, 2019, *87* (3), 741–835.

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.

Hsieh, Chang-Tai and Zheng Michael Song, "Grasp the Large, Let Go of the Small: The Transformation of the State Sector in China," *Brookings Papers on Economic Activity*, 2015, pp. 295–346.

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

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 and Jose-Victor Rios-Rull, "2013 Update on the U.S. Earnings, Income, and Wealth Distributional Facts: A View from Macroeconomics," *Federal Reserve Bank of Minneapolis Quarterly Review*, 2016, *37* (1).

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

Kuznets, Simon, "Economic Growth and Income Inequality," *The American Economic Review*, 1955, *45* (1).

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

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

Nardi, Mariacristina De and Giulio Fella, "Saving and Wealth Inequality," *Review of Economic Dynamics*, 2017, *26*, 280–300.

Piketty, Thomas 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.

Zhang, Junsen, "A Survey on Income Inequality in China," *Journal of Economic Literature*, 2021, *59* (4), 1191–1239.

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

Appendix of "Unequal Transition: The Widening Wealth Gap amidst China's Rapid Growth"

Appendix A Data and Method

A.1 Wealth Inequality

The share of the wealthiest 10% households in total wealth is obtained by combining micro-level household surveys, CHIP 1995 and 2002, CFPS 2010-2018, and *Hurun's Rich List*, which is available from 1999 onward.[37] Following Piketty et al. (2019), we assume wealth in household surveys are accurate until the 90*th* percentile, and scale up the wealth level of the wealthiest 10% households by a factor of 1.5.[38] Wealth contains financial wealth (e.g. stocks and deposits), non-financial wealth (e.g. housing and land), and durable goods (e.g. cars and furniture).[39]

CHIP 1995 is the earliest household-level data in China that contains urban wealth information. The trial of urban housing reform in selected regions in 1994, which has later been extended to the whole nation in 1998, has a 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 houses. For these households, the average house purchasing expenditure is only 27.8% of their self-reported market value of houses.[40] On the other hand, 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. As a result, simply using the reported housing wealth would overestimate the level of

[37] The method proposed in Song et al. (2013) is used to generate weights for CHIP 1995 and 2002.

[38] 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 the pre-reform era as there were fewer and less wealthy households then.

[39] We differ from Piketty et al. (2019) in that we include durable goods as part of wealth. The reason for our choice is that, excluding durable goods would produce an unreasonably high level of wealth inequality for urban China in 1995, when most households living in government-provided housing owned zero housing wealth and durable goods accounts for a nontrivial fraction of household wealth. For later years, adding durable has limited impact on measures of wealth inequality, as discussed below.

[40] CHIP 1995 contains information on the purchasing price for households that had purchased a house, and where they purchased it from. However, the year in which the house was purchased is not recorded. In the absence of this last piece of information, we do not adjust the purchasing price for inflation. This might not cause substantial bias as China's urban housing reform started only in 1994, so the purchase could not happen too far back in history.

urban wealth inequality.

To obtain the pre-housing reform steady-state wealth distribution, we use the purchase expenditure of private houses, instead of their estimated market value, as part of household wealth in CHIP 1995. Table A.1 presents the results of wealth inequality in 1995 under different approaches. Also shown is the urban wealth inequality calculated from CHIP 1999, when the housing reform was completed and the majority of households had purchased private houses. There we use the 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.1: Top 10% Wealth Share in 1995 and 1999, without Top Adjustment

Year	Measure of Private Housing Value	Top 10% Wealth Share
1995	Self-reported housing market value	41.61%
1995	Purchasing expenditure	35.80%
1999	Self-reported housing market value	34.74%

Note: This table lists the top 10% wealth share in CHIP 1995 under different measures of private housing value, together with the top 10% wealth share in CHIP 1999 when the housing reform was completed and most households are homeowners. The top 10% wealth has not been scaled up in this table.

To calculate wealth inequality in 2002 and later years, we scale up the wealth level of the wealthiest 10% households in the surveys by 1.5, merge the households in *Hurun's Rich List* with those in the household surveys, each having their original survey assigned weight adjusted for the number of *Hurun* households.[41] Table A.2 presents the share of total wealth in *Hurun's Rich List* in the merged sample. The resulting time series of the top 10% wealth share for urban China from 1995 are plotted in Figure 2.1 of the paper.

We compare the *baseline* method described above, i.e. scaling up the wealth level of the wealthiest 10% households in household surveys by 1.5 and then merging the households in *Hurun's Rich List* with those in the household surveys, with the following two alternative methods to construct the aggregate inequality indices:

- *Direct Merge*: Do not adjust the top wealth in the household surveys. Merge the

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

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

Note: This table shows the share of wealth from *Hurun's Rich List* out of the total wealth among urban households and among urban entrepreneurs. The data sources are CHIP 2002; CFPS 2010,12,18; and *Hurun's Rich List*.

households in *Hurun's Rich List* with those in the household surveys, each having their original survey assigned weight adjusted for the number of *Hurun* households.

- *Generalized Pareto Interpolation (GPI)*: The wealthiest 10% households in the surveys are scaled up by 1.5; Merge the households in *Hurun's Rich List* with those in the household surveys, each having their original survey assigned weight adjusted for the number of *Hurun* households. Combine the 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.3 presents the estimated top 10% wealth share under the three methods. Compared to *Direct Merge*, the *Baseline* method increases the level of inequality but does not alter the trend over time. The *Baseline* and the *GPI* give similar estimates of inequality.

Table A.3: 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 the top 10% wealth share under three estimation methods: (1) which adjusts the top wealth in the household surveys before merging with *Hurun* data; (2) which does not adjust the top wealth in the household surveys before merging with *Hurun* data; and (3) which further applies generalized Pareto interpolation to the merged sample in method (1). The data sources are CHIP 1995, 2002; CFPS 2010,12,18; and *Hurun's Rich List*.

National Wealth Inequality There are two main differences between our measure of inequality and the one constructed by Piketty et al. (2019). Firstly, we document inequality

across households, whereas they focus on inequality across individuals. By combining the adjusted household survey samples with *Hurun's Rich List*, Piketty et al. (2019) divide household wealth equally among the adult members of the household, and use Generalized Pareto Interpolation to obtain the wealth share of the top 10% adults for the whole nation.[42] In our case, to compute the national wealth share of the top 10% households, we scale up the top 10% households' wealth by 1.5 in the household surveys and then merge it with *Hurun's Rich List*. Secondly, our wealth measure includes durable consumption goods, whereas theirs does not. We plot in Figure A.1 the time series of our household-level inequality measure together with that in Piketty et al. (2019). Though the unit of observation differs, the two time series are quite similar for most parts of the sample period. The biggest difference is in 1995, where counting durable goods and housing consumption makes a difference and tends to reduce inequality. Later in the sample period, the share of durable goods in total household wealth drops to below 5% in the 2010s, so adjusting for them does not significantly change wealth inequality.

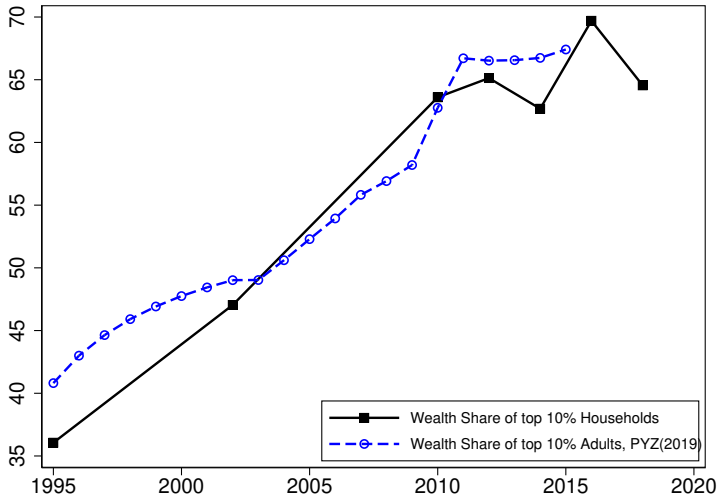


Figure A.1: Wealth Share of Top 10% Households vs Adults in China (%)

Note: This figure compares the top 10% wealth share in our paper with the measure constructed according to Piketty et al. (2019).

Using the national sample, we also plot the time series of the top 10% wealth share for the nation, and the urban and the rural separately. Figure A.2 plots the top 10% wealth share for the nation, urban and rural. The three time series follow a similar trend. From 1995

[42]For households in *Hurun's Rich List*, they assume wealth is equally shared among 10 household members.

to 2002, inequality within rural or urban areas has decreased slightly, the increase in national inequality is mainly a result of the enlarging rural-urban gap. From 2002 onward, the trend of the top 10% wealth share in the nation comoves with that in the urban areas, as the majority of the wealthiest 10% households in the nation reside in the urban areas in the 2000s and 2010s, shown in Table A.4.

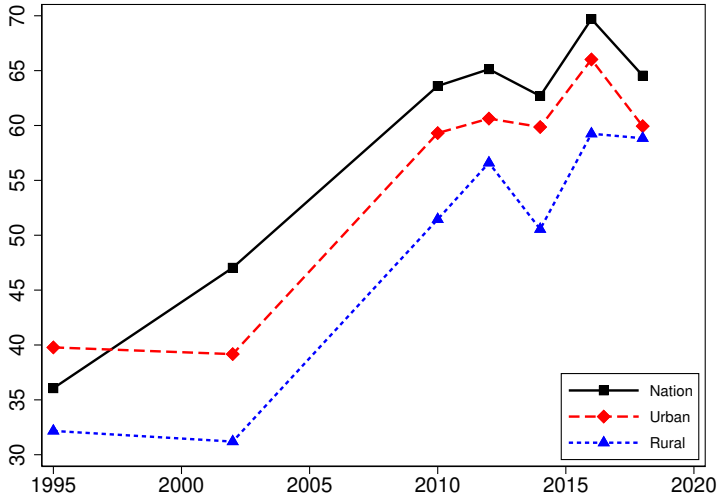


Figure A.2: Top 10% Wealth Share in China, Nation, Urban vs Rural (%)

Note: This figure shows the evolution of the top 10% wealth share nationwide, in the urban areas and in the rural areas separately. The data sources are CHIP 1995 and 2002, and CFPS 2010-18.

Table A.4: Urban Share of the Nationwide Wealthiest 10% Households

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

Note: This table shows the fraction of the nation's wealthiest 10% households which reside in the urban area. The data sources are CHIP 1995 and 2002, and CFPS 2010-18.

A.2 Capital Stock and Return

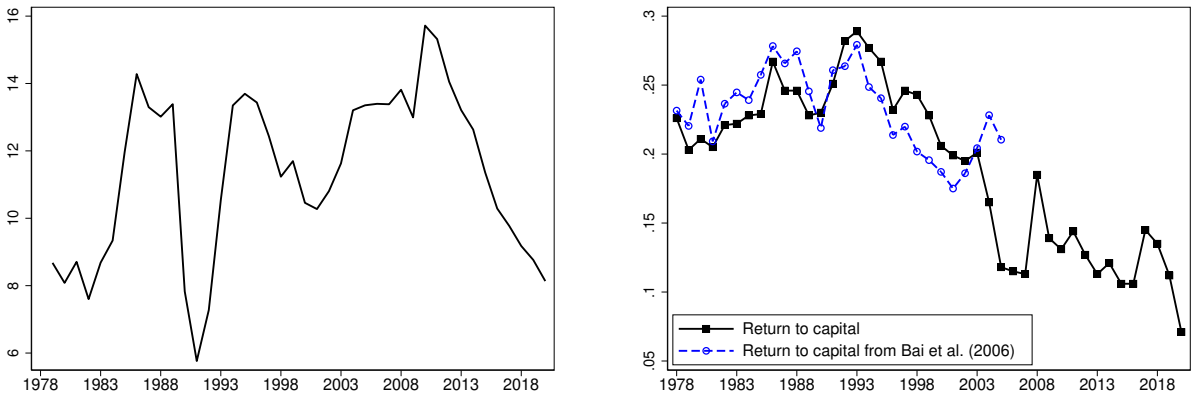
We follow Bai et al. (2006) to calculate capital stock in China and extend the series to 2020. The stock of capital is calculated following the perpetual inventory method, i.e. $K_{t+1} = (1-\delta)K_t + I_t$. Take 1952 as the initial year. Assume that the economy is initially in an old steady state so that $I_0 = -(1-\delta)K_0 + K_1 = -(1-\delta)K_0 + K_0\frac{I_1}{I_0}$. It follows

that $K_0 = \frac{I_0}{\delta+(I_1-I_0)/I_0}$. We 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 first calculate the stock for *machinery and equipment* and for *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 $P_Y(t), P_{K_j}(t)$ and $\delta_j(t)$ are price of final goods, price of capital j and depreciation rate, and $\hat{P}_{K_j}(t) \equiv \frac{P_{K_j}(t+1)-P_{K_j}(t)}{P_{K_j}(t)}$ is the 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 2020.



(a) Real Capital Growth Rate (%)

(b) Return to Capital (%)

Figure A.3: Real Capital (Annual) Growth Rate and Return to Capital in China, 1978-2020

Note: This figure shows the growth rate of the real capital stock in Panel (a) and the return to capital constructed following Bai et al. (2006) in Panel (b).

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?

In CHIP, entrepreneurial 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*).[43] Neither CFPS nor CHIP contains consistent information on the employment of the firms the entrepreneurs operate. In the merged sample of the household surveys and *Hurun's Rich List*, essentially all households in *Hurun's Rich List* are entrepreneurs and we assume they all reside in the urban area.[44]

China Household Finance Survey (CHFS) 2011-17, supposedly the Chinese version of the 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*.[45] To identify entrepreneurship, we rely on the following question in CHFS:

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?

In addition, in 2015 and 2017, CHFS further asks for the number of family members and outside employees working in the family business. We adopt a baseline definition of entrepreneurship as one that has family members engaging in industrial or commercial operation, i.e. answering yes to the question above and has at least one employee, which can be either other household members or hires from outside. Table A.5 presents the entrepreneurs' population and wealth shares among the urban population as well as among

[43] 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 the occupation of the head of household in CHIP and obtain results similar to those under the baseline definition.

[44] This is equivalent to assuming 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 whole 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.

[45] 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.

the wealthiest 10%, 5%, and 1% constructed from CFPS 2012 and 2018, and CHFS 2015 and 2017. The results from the two datasets are quite consistent.

For CHFS, we also present facts according to a broader definition of entrepreneurship which requires only a yes answer to the aforementioned question, for the sake of transparency. Table A.6 provides the population and wealth shares under the broader definition in CHFS 2015 and 2017. Under this broader definition, unsurprisingly the entrepreneurs' population and wealth shares are higher, but still in the same ballpark.

Table A.5: Entrepreneurs' Population and Wealth Share in Urban Population and at the Top Wealth Segments, in CFPS *v.s.* CHFS

Year	2012-CFPS	2015-CHFS	2017-CHFS	2018-CFPS
Pop. Share	12.08%	13.12%	12.20%	12.81%
Wealth Share	33.85%	32.53%	25.18%	24.52%
Among Wealthiest 10% Households				
Pop. Share	29.20%	33.27%	24.86%	21.17%
Wealth Share	45.57%	44.32%	31.90%	30.16%
Among Wealthiest 5% Households				
Pop. Share	35.51%	41.98%	28.17%	19.83%
Wealth Share	52.99%	51.59%	36.14%	32.75%
Among Wealthiest 1% Households				
Pop. Share	61.15%	65.64%	43.27%	25.14%
Wealth Share	74.86%	72.05%	54.00%	48.45%

Note: The table reports the entrepreneurs' population and wealth shares among the urban population, the wealthiest 10%, 5%, and 1% urban households. The data sources are CFPS 2012 and 2018, CHFS 2015 and 2017, and *Hurun's Rich List*.

Housing for Entrepreneurial Households Table A.7 presents the homeownership rate and the housing wealth ratio for entrepreneurial households. For households from *Hurun's Rich List*, we assume the housing-to-wealth ratio for them is the same as the wealthiest 1% entrepreneurs in household surveys.

Table A.6: Entrepreneurs' Population and Wealth Share in CHFS, 2015 and 2017, under a Broader Definition of Entrepreneurship

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 table reports the entrepreneurs' population and wealth shares among the urban population, the wealthiest 10%, 5%, and 1% urban households under a broader definition of entrepreneurship in CHFS. The data sources are CHFS 2015 and 2017, and *Hurun's Rich List*.

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

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%

Note: This table shows the homeownership rate and the average housing-to-wealth ratio in urban China. The data sources are CHIP 1999 and 2002, and CFPS 2012 and 2018.

A.4 SOE Employment Share and Urbanization

Figure A.4 plots the evolution of two definitions of the SOE shares. The first SOE share measures the size of the state sector more broadly, which is the share of all employees working in state-owned enterprises (*qiye*), public institutions (*shiye danwei*), and public agencies and organizations (*jiguan*) out of total urban employment. This is the one used in the main paper. The second SOE share measures the share of employment in state-owned enterprises among all urban enterprises.

Figure A.5 plots the evolution of several measures of urbanization rate in China: the urban employment share, the urban population share, as well as the non-primary sector employment share. The urban and non-primary sector employment shares are from the NBS and the urban population shares are from the 1982, 1990, 2000, 2010, and 2020 Population Census. All three shares increase over the economic transition at similar rates.

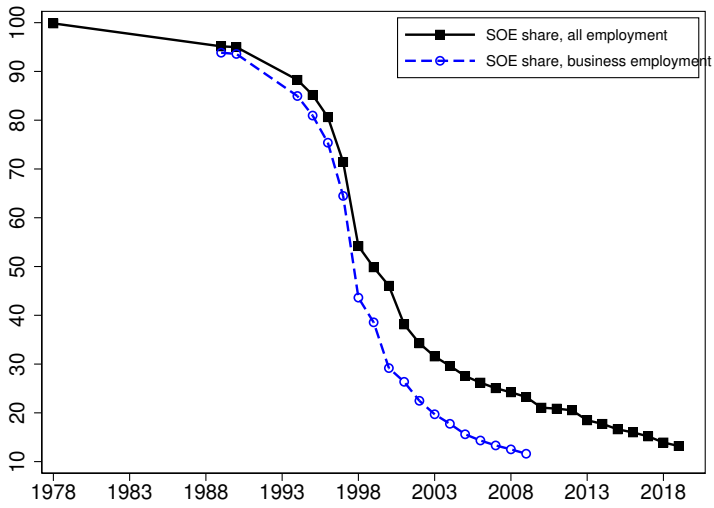


Figure A.4: SOE Share in Urban Employment (%)

Note: This figure shows the evolution of two measures of SOE shares. The data sources are *China Labor Statistical Yearbooks*, various years.

Appendix B Model

An alternative way of modeling migration In the baseline model, we assume that idiosyncratic shocks on preferences for living in the rural or urban areas are drawn independently each period. Under this assumption, as migration is modeled as only a one-way movement from rural to urban areas but not vice versa, the urban population in the long run steady state will be 100% if we do not shut down migration.

An alternative way of modeling migration is to assume that the idiosyncratic component is fixed for an individual (Garriga et al., 2021). In particular, assume 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. Under this alternative assumption, the migration choice for a rural worker with type 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 $V_u(0, z, 0, \bar{h}_u)$ denotes the value of migrating to the city, and $\overline{V}_r(\epsilon)$ the value of staying in the village and given by

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

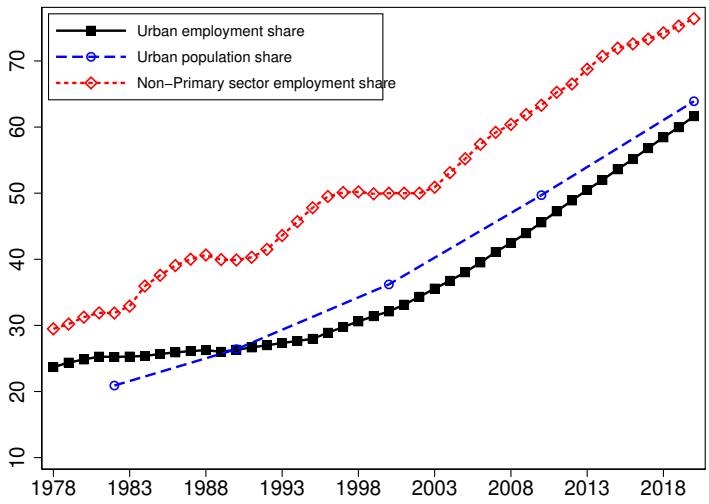


Figure A.5: Urbanization Rate and Non-Primary Sector Employment Share in China (%)

Note: This figure shows the evolution of the urban employment share, the urban population share and the non-primary sector employment share. The data sources of the employment shares are the NBS and of the population shares are the Population Census.

The optimal migration 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

$$\bar{\epsilon} = [V_u(0, z, 0, \bar{h}_u) - \overline{V}_r(\epsilon) - \tau_m]/\xi. \tag{5}$$

The advantage of this way of modeling is that the steady state features a positive rural population share and the urbanization rate in the steady states and transitional dynamics is defined in a consistent manner. However, in the counterfactual exercise, the cutoff value is very sensitive to parameter changes, which produces a very irregular urbanization rate consisting of lumps and spikes. We, therefore, opt not to model migration this way.

Appendix C Calibration and Counterfactual Exercises

In this appendix, we present some supplementary figures demonstrating the performance of the calibrated model in Appendix C.1, the results of the sensitivity checks of the baseline calibration in Appendix C.2, and the details of the counterfactual exercises in Appendix C.3.

C.1 Calibration

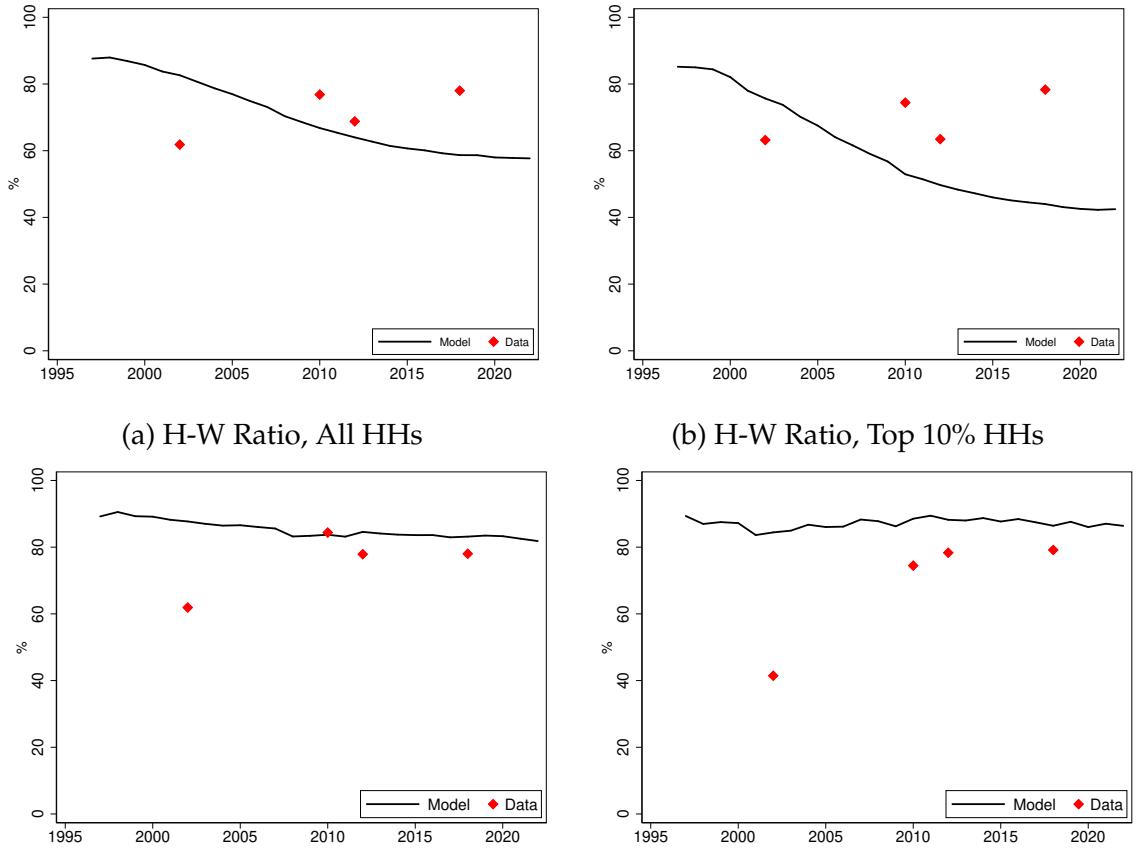
In Figure C.1, we show the model-generated housing-to-wealth ratios for all urban households, for the top 10% wealthiest urban households, the middle 40%, and the bottom 50% alongside their data counterparts during the transition. The model generates housing-to-wealth ratios for various segments of the wealth distribution that match data reasonably well. It replicates well the key feature in the data that for the majority of households who are in the middle and lower parts of the wealth distribution, housing accounts for around 80% of their wealth.

The two points that the model does not match well are the housing-to-wealth ratio for bottom 50% in 2002, and for top 10% in 2018. For the former, the value in data is relatively low due to the fact that in 2002, four years after the national roll-out of the housing market, 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. For the latter, the model over-predicts the decline in housing-to-wealth ratio for the entrepreneurs during transition relative to the data and hence predicts a lower housing-to-wealth ratio of the top 10% in 2018. This could possibly be due to the fact that some wealthy entrepreneurs in reality treats housing as a way of storing wealth which is less risky than investing in physical capital. It could also be that in reality the ability dispersion among entrepreneurs is much greater, so for highly able entrepreneurs, it takes longer to save out of the credit constraint using housing as a form of collateral.

Figure C.2 plots the evolution of the urban Gini coefficient generated by the model and in the data. The model replicates the rise in Wealth Gini in the data equally well.

C.2 Sensitivity of Baseline Results

Table C.1 presents the three key moments, *the top 10% wealth share*, *the housing-to-wealth ratio*, and *the entrepreneurial wealth share* in 2021, or the 26^{th} year in transition, in the baseline model as well as under six alternative modeling assumptions and externally calibrated parameter values. The results and summarized and discussed in Section 4.3.



(a) H-W Ratio, All HHs

(b) H-W Ratio, Top 10% HHs

(c) H-W Ratio, Middle 40% HHs

(d) H-W Ratio, Bottom 50% HHs

Figure C.1: Housing-to-Wealth Ratios, Baseline and Data (%)

Note: This figure reports the housing-to-wealth ratios for different segments of the wealth distribution during the economic transition in the baseline model and in the data.

C.3 Counterfactual Exercises

Figure C.3 repeats the decomposition exercise as presented in Figure 4.3 but for the wealth Gini coefficient instead of the top 10% wealth share. The results using wealth Gini as the inequality measure are qualitatively and quantitatively similar to our baseline results using top 10% wealth share as the inequality measure.

Table C.2 sheds additional light on how each force works to impact growth and equity in the decomposition exercise by providing additional model moments along the transition. We discuss here in more detail the mechanisms behind Step 1 (rural-urban migration) and Step 2 (entry barriers) in the following.

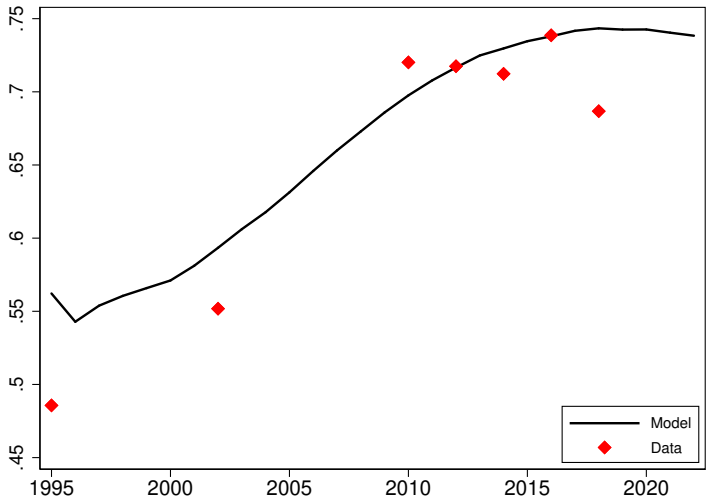


Figure C.2: Wealth Gini Coefficient, Baseline and Data

Note: This figure reports the wealth Gini coefficient as an alternative measure of wealth inequality during the economic transition in the baseline model and in the data.

Rural-Urban Migration Rural-to-urban migration is beneficial for growth. As shown in the third column of Table 4.3, shutting down migration leads to a significant drop in urban output growth rate, from a baseline level of 9.92% to 7.12%. Migration increases the labor supply in the urban sector, resulting in slower wage growth (comparing 7.95% wage growth in the baseline with 8.44% in Step 1 in Table C.2). This benefits the entrepreneurs and leads to a larger entrepreneurial sector. In the baseline, by 2022 the mass of entrepreneurs is 8%, which is the product of the urban population share, 64.38%, and the entrepreneurs' share in the urban population, 12.41%. This is almost twice as big as that in 2022 in the counterfactual without migration, which is 4.15% (i.e. urban population share 27.97% times entrepreneurs' urban population share 14.15%). Note that in the last two rows of Table C.2, it may appear that the growth of the entrepreneurial sector is slower in the baseline than in the counterfactual without migration. But this is entirely due to the fact that in the baseline, rural-to-urban migration results in significant expansion of the urban population from 27.97% to 64.38% and the migrants initially have no entrepreneurial ability so are in expectation worse entrepreneurs than an urban incumbent. Therefore by 2022 the share of entrepreneurs in the urban population is actually smaller in the baseline.

At the same time, migration impacts wealth inequality via several channels. One, as migrants are of relatively low wealth compared to urban incumbents, their presence tends to

Table C.1: Key Moments in Baseline Calibration and Alternative Settings

	Moments in 2022 (27^{th} year in transition)		
	Top 10% wealth share	H-W ratio	Entrep. wealth share
Baseline	61.23%	57.71%	38.79%
(1). Financial friction: Baseline $\lambda = 1.435$			
$\lambda = 1.25$	62.48%	57.84%	39.23%
$\lambda = 1.65$	60.10%	57.70%	38.30%
(2). Housing grid No.: Baseline $N_h = 10$			
$N_h = 8$	62.11%	55.65%	39.39%
$N_h = 12$	60.93%	58.72%	38.70%
(3). Largest housing size: Baseline $\overline{h} = 18$			
$\overline{h} = 15$	60.40%	56.41%	38.65%
$\overline{h} = 21$	61.75%	58.61%	39.04%
(4). Migrants' entrep. ability upon arrival: Baseline $e_{Migr,0} = 0$			
$e_{Migr,0} \in \{0, \bar{e}\}$	58.35%	59.19%	38.77%
(5). Private sector TFP growth from 17th to 30th period: Baseline $g_{m,t} = 3.5\%$			
$g_{m,t} = 2.5\%, 17 \leq t \leq 30$	59.41%	59.80%	36.88%
(6). Private sector TFP growth from 31st to 40th period: Baseline $g_{m,t} = 0\%$			
$g_{m,t} = 3.5\%, 31 \leq t \leq 40$	61.68%	58.43%	39.41%

Note: This table reports the key moments from the calibration under alternative assumptions for sensitivity checks.

increase urban inequality mechanically. Second, the inflow of migrant labor dampens the increase of wage growth as we explain above, which tends to increase inequality. Third, housing demand from migrants fuels the housing price appreciation which tends to reduce inequality. The housing price grows 10% per year in the baseline with migration, whereas in the counterfactual without migration it grows only at an annual rate 5.35% (the third row in Table C.2). 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 19.30 percentage points to 12.96 percentage points.[46]

[46]There are a couple of caveats for interpreting this counterfactual exercise. First, though we fix the times series of land supply in the counterfactual to be the same as that in the baseline, but in reality it is likely to be endogenous to the migration process. We tried simultaneously shutting down migration and varying the land supply such that housing prices grow at the baseline speed, and obtained an even smaller increase in wealth inequality which is intuitive. Second, we assume that productivity does not endogenously respond to migration, and therefore do not capture the forces whereby low-skilled migrants specialize in labor-intensive sectors to allow China to quickly accumulate capital and gradually upgrade the capital-intensive sectors (Lin, 2012).

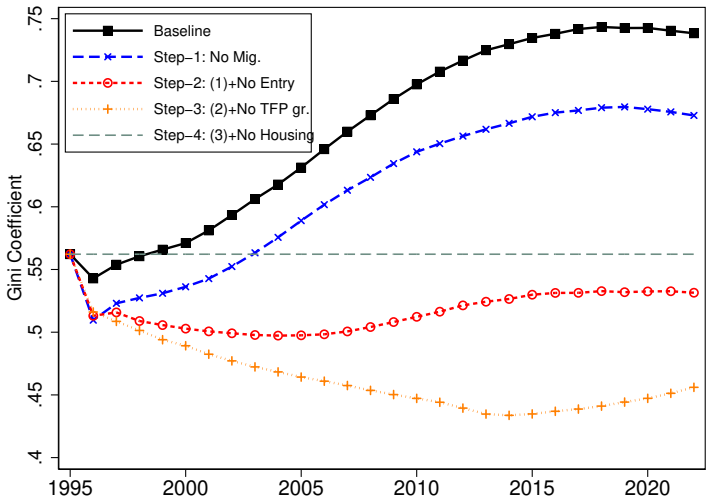


Figure C.3: Decomposition Results for Gini Coefficient

Note: This figure reports the decomposition of the evolution of the wealth Gini coefficient along the economic transition, shutting down various aspects of the economic reforms.

In terms of welfare, the result that migration reduces urban welfare may seem puzzling at first glance (Table 4.3). However, this is largely due to the fact that migration brings a large number of migrants to urban areas, who are poorer than the urban incumbents. This mechanically lowers the average welfare of an urban resident which now includes the migrants in the baseline. Moreover, in the counterfactual we allow the land supply to increase at the same rate as that in the baseline but catered to a much smaller urban population. Therefore, the average housing size for an urban resident in the counterfactual is larger than that in the baseline, which tends also to increase the average urban welfare in the counterfactual relative to the baseline. For the whole nation, the average welfare or equivalently the aggregate welfare, is lower in the counterfactual as there is a greater proportion of the population living in the poorer rural areas.

Entry Barriers: Let Some People Get Rich First In Step 2, we further shut down entry barrier reform in addition to Step 1. 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 transition. Further, the entrepreneurial profit distortion, 0.74, is immediately removed in the transition. Here we let the entry barrier (and profit distortion) remain at its pre-reform level throughout the transition. We fix the supply of land and housing at their baseline level and endogenously determine the housing prices.

Table C.2: Additional Moments in Baseline and Counterfactuals

	Baseline	Counterfactual			
		Step 1 No mig.	Step 2 (1)+No Entry	Step 3 (3)+No TFP gr.	Step 4 (4)+No Hous.
Migration per annum	1.38%	0.00%	0.00%	0.00%	0.00%
Wage gr.	7.95%	8.44%	5.56%	-0.08%	0.00%
Hous. price gr.	10.00%	5.35%	1.46%	-4.14%	—
Δ Entrep. pop share	9.79%	12.23%	-1.30%	-0.22%	0.00%
Δ Entrep. wealth share	34.42%	35.54%	-2.58%	-0.89%	0.00%

Note: This table provides additional moments for the four consecutive counterfactual exercises. Moments are averaged for the first 27 years in transition. The last two rows denote the change from the pre-steady state to the 27th year in transition.

A higher entry barrier to entrepreneurship takes a toll on growth: The urban output growth rate drops from 7.12% in Step 1 to 6.29% in Step 2 (Table 4.3). In Table C.2, we further report that the urban wage growth rate slows down from 8.44% in Step 1 to 5.56% in Step 2, which implies a weaker housing demand and slower housing price growth at only 1.46% per annum.

The effect of the expansion of the entrepreneurial sector on wealth distribution is significant. If the entry barrier to the private sector remains as high as it is in 1995, we will have a much smaller entrepreneurial class possessing much lower wealth. In the Step 2 counterfactual where we keep migration and entry barrier to entrepreneurship both high, the entrepreneurial population share and wealth share actually decline over the 27-year transition by 1.30 and 2.58 percentage points respectively (Table C.2). This is a huge contrast to Step 1 counterfactual where we only shut down migration. As a result, the top 10% wealth share during transition actually declines by 4.61 percentage points over the transition (Table 4.3). Entry barrier reform worsens inequality but generates growth. On balance, the positive growth effect dominates and it contributes to a higher urban and national welfare.

Order of Counterfactual Exercises We have experimented with different orders to decompose the increase in wealth inequality. We first argue the sensible sequence is "no migration" - "no entry" - "no TFP". Then we evaluated whether to put "no housing" first or last.

We argue that closing migration, closing entry to the private sector, and removing TFP

growth (i.e. Steps 1-3 in the main paper) constitute a sensible order of decomposition. Suppose we switch the order of Step 1 and Step 2, that is, closing first the entry barrier reform with the migration barrier lowered as in the baseline and migration flow endogenously determined, and then closing the migration. In this case, the contribution of migration to rising inequality is much smaller, for intuitive reasons. As we close first the entry to the private sector, we essentially reduce the attractiveness of being in the urban area and this results in small migration numbers to start with. When we further close down migration entirely, the effect is small. We think it makes more economic sense to close migration before closing entry to the private sector, as the magnitude of the effect of the latter does not critically depend on the former. Regarding Step 2 (closing entry to the private sector) and Step 3 (removing TFP growth), changing the order of the two has only a negligible impact on their respective contributions to the increase in wealth inequality.

The next question is whether to shut down the housing reform last, as in the paper, or shut it down first. Closing the housing market first, while keeping all other reforms and TFP growth as in baseline, leads to an increase in the top 10% wealth share over the transition to reach more than 75%.[47] The subsequent closing down of migration and of entry to the private sector both reduce inequality and their relative contributions are similar in magnitude as in the paper. Removing TFP growth in the final step eliminates the increase in wealth gap over transition and the combined effect on inequality from removing TFP growth and closing the housing market is of similar magnitude compared to that in the paper. Note that the signs of the contributions are all consistent with our decomposition results in the paper. The only difference here is that the housing reform and the TFP will have much larger off-setting contributions. In the paper, we report the relatively conservative effects. But more importantly, we prefer the baseline result to this alternative as housing is an—or even the most—important vehicle of wealth accumulation for the vast majority of urban residents, evaluating the impact of other reforms with this vehicle available appears a more natural choice.

C.4 The Role of Financial Frictions

We compare the baseline results with those in a model in which financial friction is completely removed during the transition, i.e. $\lambda = \infty$, and all other parameters remain the same as in the baseline. We perform two exercises, in the first exogenous case, we still let

[47] When we shut down the housing market first, we assume migrants are provided the urban public housing from the time they arrive in the city.

urban population and housing price growth rate stay at their baseline level, and in the second, we let both be endogenously determined. Figure C.4 shows the trend of the top 10% wealth share in the two cases. In the exogenous case of $\lambda = \infty$, the same force that leads to China's economic growth actually brings about a reduction in wealth inequality. In the endogenous case, essentially all rural labor finds it optimal to migrate immediately after the reform, so the urbanization rate reaches the 83% upper bound in the first period in transition. That leads to an immediate jump in wealth inequality. Along the transition, inequality decreases over time and eventually settles at a level also lower than the pre-reform level. In other words, in either case of $\lambda = \infty$, the wealth inequality declines to a level in 2022 that is lower than in 1995. Table C.3 contains relevant moments in the baseline model and counterfactual exercises.

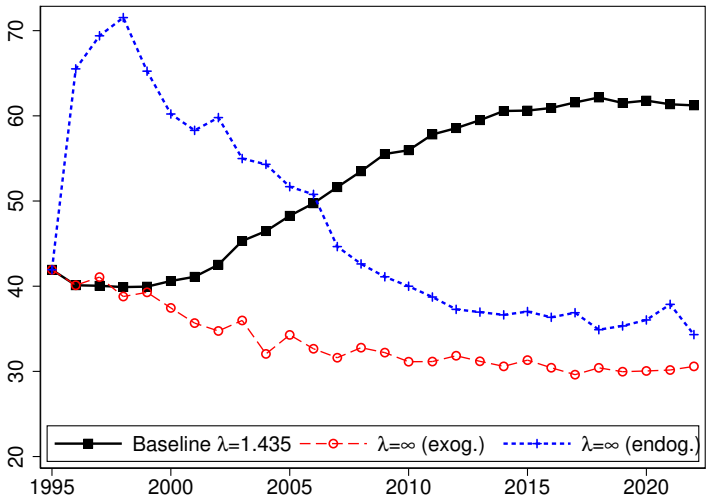


Figure C.4: Top 10% Wealth Share During Transition (%), with and without Financial Friction

Note: This figure shows the evolution of the top 10% wealth share during the economic transition in the baseline and in the counterfactuals of a perfect credit market. The red line with circle denotes the counterfactual of a perfect credit market where we fix the urban population share and housing price growth rate at the baseline levels. The blue line with cross denotes the counterfactual of a perfect credit market where we allow migration and housing purchases to be endogenous.

Table C.3: Moments in Baseline Calibration *v.s.* Counterfactuals of a Perfect Credit Market

	Baseline ($\lambda = 1.435$)	Perfect C.M.($\lambda = \infty$) Exog. p^h & mig.	Perfect C.M.($\lambda = \infty$) Endog. p^h & mig.
1995-2022 Average			
Urban output gr.	9.92%	12.90%	12.94%
Wage growth rate	7.95%	11.33%	11.54%
Entrep. saving rate	60.44%	45.33%	47.06%
Moments in 2022			
Entrep. pop share	12.41%	13.23%	15.66%
Entrep. wealth share	38.79%	23.15%	24.15%
Top 10% wealth share	61.23%	30.59%	34.32%

Note: This table reports additional moments in the baseline model and the counterfactuals with a perfect credit market.

Appendix D Numerical Algorithm

D.1 Computing the Stationary Equilibrium

We solve for the stationary equilibrium as follows.

1. Guess the housing price in the invariant distribution, p_h^i (bisection).
2. Guess the wage rate in the invariant distribution, $w^{i,j}$ (bisection).
3. Given the guesses on the housing price and wage rate, solve the individuals' optimization problem using value function iteration to obtain policy functions.
4. Given the optimal decision rule, compute the transition matrix, and we iterate forward on the distribution of states using these policy functions to obtain the stationary distribution.
5. Then we solve for the aggregate supply and the aggregate demand of labor in the stationary equilibrium. Check the labor market clearing condition in the stationary equilibrium. Let μ_u be the urban population share.

$$L_s + \mu_u \int I\{o(\mathbf{x}) = e\} l(\mathbf{x}) dF(\mathbf{x}) = \mu_u \int I\{o(\mathbf{x}) = w\} dF(\mathbf{x}).$$

   If there is excess labor demand choose a new wage $w^{i,j+1}$ that is greater than $w^{i,j}$ If there is excess labor supply, choose a new wage $w^{i,j+1}$ that is smaller than $w^{i,j}$.
6. Repeat Steps 2-5 until the labor market clears in the stationary equilibrium.

7. Calculate the demand of housing H_d and check the housing market clearing condition in the stationary equilibrium, given the aggregate supply of housing H_s.

$$H_s = \mu_u \int h'(\mathbf{x}) dF(\mathbf{x}).$$

If there is excess housing demand, choose a new housing price p_h^{i+1} that is greater than p_h^i. If there is excess housing supply, choose a new housing price p_h^{i+1} that is smaller than p_h^i.

8. Repeat Steps 1-7 until the housing market clears in the stationary equilibrium.

D.2 Computing the Transition Dynamics

To compute the entire transition dynamics, we have to iterate on the wage rate sequences and housing price sequences. Taking both sequences as given, we solve for the individuals' optimization problem, and then check whether labor and housing markets clear for all periods. We start by fixing a T, the period by which the economy must have reached a steady state. We choose T to be 100 years, and numerically verify that increasing T to 200 has virtually no effect on the results.

1. Guess the housing price sequence $\{p_{h,t}^i\}_{t=0}^T$.
2. Guess the wage rate sequence $\{w_t^{i,j}\}_{t=0}^T$.
3. Compute the value function of the stationary equilibrium and let $V_T(\mathbf{x}_t) = V(\mathbf{x}_t)$.
4. By backward induction, taking the wage sequence $\{w_t^{i,j}\}_{t=0}^T$ and the housing price sequence $\{p_{h,t}^i\}_{t=0}^T$ as given, compute the value function $V_t(\mathbf{x}_t)$ for $t = T-1, ..., 0$.
5. Given the optimal decision rule, calculate transition of distribution function $F_t(\mathbf{x}_t)$
6. Then we solve for the aggregate supply of labor in the transition dynamics. First, given rural and urban value functions, we calculate the probability of rural-to-urban migration m_t for rural households. Second, check the labor market clearing condition in the transition dynamics. Construct a sequence $\{\bar{w}_t^{i,j+1}\}_{t=0}^T$ that clears the labor market for each period.

$$\begin{aligned} &L_{s,t} + (\mu_{u,t} + (1-\mu_{u,t})m_t) \left(\int I\{o_t(\mathbf{x}_t) = e\} l_t(\mathbf{x}_t) dF_t(\mathbf{x}_t) \right) \\ &= (\mu_{u,t} + (1-\mu_{u,t})m_t) \left(\int I\{o_t(\mathbf{x}_t) = w\} dF_t(\mathbf{x}_t) \right) \end{aligned}$$

Update the wage rate sequence: $w_t^{i,j+1} = \eta_l w_t^{i,j} + (1 - \eta_l)\bar{w}_t^{i,j}$

7. Repeat Steps 2–6 until the wage rate sequence converges.

8. Check the housing market clearing condition on the transition. Construct a sequence $\{\bar{p}_{h,t}^i\}_{t=0}^T$ that clears the housing market for each period.

$$H_{s,t} = (\mu_{u,t} + (1 - \mu_{u,t})m_t) \int h_t'(\mathbf{x}_t) dF_t(\mathbf{x}_t).$$

Update the housing price sequence: $p_{h,t}^{i,j+1} = \eta_h p_{h,t}^{i,j} + (1 - \eta_h)\bar{p}_{h,t}^{i,j}$

9. Repeat Steps 1–8 until the housing price sequence also converges.

School of Economics and Finance

This working paper has been produced by
the School of Economics and Finance at
Queen Mary University of London

School of Economics and Finance
Queen Mary University of London
Mile End Road
London E1 4NS
Tel: +44 (0)20 7882 7356
Fax: +44 (0)20 8983 3580
Web: www.econ.qmul.ac.uk/research/workingpapers/