Redefining China's Real Estate Market: Land Sale, Local Government, and Policy Transformation*

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Abstract

This study examines the economic consequences of China's "Three-Red-Lines" policy. Following the policy's implementation in late 2020, real estate developers exceeding policy thresholds experienced a sharp decline in debt financing, land acquisitions, and financial performance, and are more likely to default on bonds. The negative impact on financial performance and the increase in default probability are significantly more pronounced for privately-owned developers than for state-owned developers crossing the same number of red lines. This policy curbed debt-fueled expansion but substantially reduced land sales revenue of local government. Local governments adapted by relying more heavily on the subsidiary companies (Sub-LGFVs) of their local government financing vehicles for land acquisitions. Using satellite night light data, we find slower development on lands acquired by Sub-LGFVs. Collectively, we document the policy's disruptive and transformative effects on China's land and housing markets.

Keywords: Three-Red-Lines, Credit Crunch, Real Estate, Land Sales, LGFVs, China

JEL Classification: G30, G31, G32, R10, R30

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1. Introduction

As the world's second-largest economy, the remarkable growth of the real estate sector has significantly contributed to China's rapid economic expansion, accounting for over 25% of aggregate demand (Rogoff and Yang (2024a)), while also introducing considerable leverage and notable risks (Glaeser, Huang, Ma, and Shleifer (2017)). The recent turmoil in China's real estate market, epitomized by the high-profile debt default and restructuring of major property developers like Evergrande, has plunged the sector into a deep crisis. This upheaval has had far-reaching consequences for financial stability and local government financing, given the critical reliance on revenue from land sales to service mounting debts (e.g., Ru (2018); Huang, Pagano, and Panizza (2020)).[1]

This paper examines the economic consequences of China's "Three-Red-Lines" policy, fully implemented on January 1, 2021, to enforce deleveraging in the real estate sector by imposing strict thresholds on asset-liability, net debt, and cash-to-short-term debt ratios. Real estate firms that exceeded these thresholds encountered tiered restrictions on interest-bearing liabilities, leading to significant reductions in land acquisitions and a decline in financial performance. Notably, privately-owned developers experienced more pronounced declines in financial performance and a higher likelihood of bond defaults compared to their state-owned counterparts. This policy not only curbed the debt-fueled expansion of real estate developers but also impacted local governments' land sales revenue after 2020. In response, local governments increasingly utilized subsidiaries of local government financial vehicles (Sub-LGFVs) to purchase land, aiming to offset the decline in land sales revenue.[2] Taken together, these findings reveal the profound and multifaceted influence of the policy on China's real estate sector.

Specifically, we obtain information on real estate firms and land transaction data to examine the impact of the "Three-Red-Lines" policy. We collected financial information for 162 public real estate firms, with 80 listed on the A-share market and 82 on the H-share market, from WIND. Land transaction data for those real estate firms primarily comes from China Real Estate Information Corp (CRIC) information service, a major digital platform for China's real estate

[1] This progress is shadowed by growing apprehensions regarding financial stability, primarily due to the expansive off-balance-sheet debts accrued through local government financing vehicles (LGFVs), as highlighted by research from Chen, He, and Liu (2020) and Gao, Ru, and Tang (2022).

[2] Local Government Financing Vehicles (LGFVs), are special-purpose entities created by local governments in China to raise funds for infrastructure and public welfare projects. These entities serve as a crucial tool for local governments to bypass restrictions on direct borrowing and finance urban development initiatives.

sector that offers comprehensive coverage and accurately attributes land acquisitions by subsidiaries to their parent firms. To enhance robustness, we cross-referenced this dataset with Land China. Additionally, primary land transactions spanning 2013–2023 were obtained from the Ministry of Land and Resources (e.g., Chen and Kung (2019)). Local Government Financing Vehicles (LGFVs) and their subsidiaries (Sub-LGFVs) were identified using WIND and the Industrial and Commercial Enterprises Information System, resulting in a dataset of 3,419 unique LGFVs and 41,401 Sub-LGFVs.[3] These data provide a robust foundation for analyzing shifts in real estate firm behaviors and local government financing dynamics.

Based on these data, we assess the economic consequences of the "Three-Red-Lines" policy on real estate companies using difference-in-differences (DiD) design with ordered discrete treatments. The treatment variable represents the number of red lines crossed by each firm, as determined by their financial position in 2019. First, we find that firms crossing one more red line experienced a 10.8% decline in interest-bearing debt and reduced the land purchase value by 26%. This policy also leads to a deteriorating financial performance of line-crossing firms. In particular, we find that violating one more red line reduces developers' sales by 6.4%, ROE by 8.2 percentage points, and increases the probability of default by 10.8 percentage points after the policy' implementation in 2021. Furthermore, we do not find significant pre-policy differences, suggesting the parallel trend assumption holds. Besides the direct policy impact, we also examined the heterogeneous effects across state-owned and privately-owned real estate developers. Following the "Three-Red-Lines" policy, privately-owned developers experienced substantial financial distress. Compared to state-owned developers with the same number of red lines crossed, privately-owned developers experience a 12.3% decrease in sales, 9.6 percentage points in ROE, and a striking 15.8 percentage points increase in default probability. This stark disparity suggests that the policy disproportionately impacted privately-owned entities, potentially altering the real estate sector's competitive landscape.

Second, we find that real estate firms tend to continue operating in cities where they have existing business, with 63% of land purchases occurring in cities where firms had previously bought land in the past three years. This purchase inertia led us to create a city-level intensity measure to capture each city's exposure to the "Three-Red-Lines" policy, defined as the

[3] The methodology for identifying LGFVs' subsidiaries through ownership network examination is detailed in Section 3.3.

percentage of land values sold to line-crossing real estate firms from 2017 to 2019. We find that one standard deviation increase in the city's intensity measure leads to a 1.8% decline in housing prices after the implementation of the "Three-Red-Lines" policy.

Third, we observe a modest increase in LGFV land purchases to compensate for the sharp decline in demand from real estate firms post-policy, with Sub-LGFVs playing an increasingly prominent role by significantly boosting their acquisitions from 2021 onward. Sub-LGFVs include firms wholly owned by LGFVs or formed through joint ventures where LGFVs maintain majority ownership. The total value of lands purchased by Non-LGFV holders drop from RMB 6,582 billion in 2020 to RMB 4,092 billion in 2022, while the total value of lands purchased by Sub-LGFVs increase from RMB 440 billion in 2020 to RMB 797 billion in 2022, offsetting 14.3% of Non-LGFV holders' reduction. LGFVs have shifted their strategies to stabilize local land markets, with Sub-LGFVs becoming critical in local government borrowing and land transactions.

To understand the consequences of the shift to LGFVs, we analyze satellite-based night light data as proxies for land value and utilization, comparing levels at the time of purchase and two years post-purchase across different buyers. Our findings show that lands acquired by LGFVs and Sub-LGFVs post-2021 experience slower development (7.3% slower by LGFVs and 3.3% slower by Sub-LGFVs) than those purchased by Non-LGFV entities. This slower development suggests that LGFVs and Sub-LGFVs focus on stabilizing local land markets rather than promoting real estate growth. Notably, this trend is consistent across cities with varying policy intensities, highlighting a significant shift in local government strategies. These findings reflect profound behavioral changes in public real estate firms and an increasing reliance on Sub-LGFVs to address the challenges imposed by the "Three-Red-Lines" policy.

This study contributes to the academic discourse on China's economic conditions in three key ways. First, it deepens the understanding of China real estate sector's recent downturn, which was primarily influenced by the Three-Red-Lines policy. While much of the existing literature focuses on the sector's prolonged boom and its economic implications (e.g., Glaeser, Huang, Ma, and Shleifer (2017); Han, Han, and Zhu (2018); Rogoff and Yang (2021); Liu and Xiong (2020); He et al. (2022); He et al.(2025))[4], there is limited evidence on the challenges arising from regulatory interventions like the Three-Red-Lines policy (Chen, Du, and Ma, 2024). Our findings fill a gap in the literature by documenting how the policy's strict financial constraints significantly reduced

[4] Cai, Henderson, and Zhang (2013) and Chen and Kung (2019) investigate corruption in China's land market.

land purchases by real estate firms, providing evidence of a likely first-order cause of China's economic downturn.

Second, this study examines the interconnectedness between the real estate sector and local government financing, with a specific focus on the evolving role of LGFVs and their subsidiaries (Sub-LGFVs). While prior studies extensively explore LGFVs as traditional conduits for local government financing (e.g., Ru (2018); Huang, Pagano, and Panizza (2020); Chen, He, and Liu (2020); Gao, Ru, and Tang (2022); Ambrose, Deng, and Wu (2015); Zhang and Barnett (2014)), our findings reveal the rising importance of Sub-LGFVs in this financial ecosystem. From 2021, Sub-LGFVs have surpassed LGFVs as the primary acquirers of land, playing a key role in local governments' fiscal strategies to address the challenges posed by the three-red-lines policy and the real estate downturn. However, this shift to Sub-LGFVs may be inefficient, as evidenced by satellite night light data showing slower development on lands they acquire. This transition underscores both the increasing reliance on Sub-LGFVs and the potential economic inefficiencies of this adaptation to regulatory pressures.

In particular, our findings align with Chang, Wang, and Xiong (2023), who document how Chinese cities during the COVID-19 pandemic (2020–2022) experienced rising residential land and property prices despite falling transaction volumes. This divergence is attributed to local governments' active management of land and housing prices, with cities more dependent on land sales and land-collateralized debt seeing greater price increases. LGFVs also secured more land at higher prices, illustrating the significant influence of local governments on real estate markets. By integrating these perspectives, our study enhances the understanding of the evolving relationship between real estate markets and public financing in China's decelerating economy.

Third, our study contributes to both the nascent literature on real estate developers and the broader research on credit supply and housing markets. Existing studies have primarily examined developers' speculative behavior and financing strategies (Nathanson and Zwick (2018); Gu (2024); Van Straelen (2024)) or focused on mortgage credit conditions and their impact on housing cycles from the demand side (Favara and Imbs (2015); Mian, Sufi, and Verner (2017); Di Maggio and Kermani (2017); Justiniano, Primiceri, and Tambalotti (2019); Han, Lutz, Sand, and Stacey (2021); Mian and Sufi (2021, 2022); Adelino, Schoar, and Severino (2025)). Our paper extends this literature by examining the broader impacts of a credit crunch on real estate developers,

specifically through the lens of credit supply to developers and its effects on the supply side of the housing market.[5]

The remainder of this paper is organized as follows. Section 2 describes the background of the Chinese land market, the local government financial mechanisms, and the Three-Red Lines policy. Section 3 presents the data and summary statistics. Section 4 provides the empirical results. Section 5 concludes.

2. Institutional Background

2.1. Land and Real Estate Market in China

In 1949, when the People's Republic of China was established, the concept of private land ownership does not exist as all land is constitutionally owned by the state. For many years since then, the exchange of land was essentially banned. This situation changed with a crucial constitutional reform in 1988, which made land transactions possible, marking a significant shift towards the privatization of housing. Notably, these transactions allow the rights to use the land for a specific period rather than transferring full ownership.

The Chinese government applies rigorous zoning laws to assign distinct parcels of land for specific uses: lands for industrial use are designated for projects related to manufacturing, those for residential purposes are allocated for dwellings, and commercial lands are set aside for business ventures. Under current legislation, leases for industrial lands are capped at 30 years, commercial lands at 40 years, and residential lands can go up to 70 years. The Ministry of Land and Resources at the national level oversees the enforcement of these regulations.

Moreover, local governments adopt a nuanced approach towards the sale of land. Industrial lands are often offered at discounted rates to attract businesses, especially major ones, to set up in local areas. By contrast, lands for residential and commercial development are sold at premium prices, serving as a financial backbone for regional growth and infrastructure projects. For example, He et al. (2022) have investigated the tactical reasons and outcomes of such local governmental strategies.

The government imposes a strict limit on the total area of land available for residential and commercial use each year, dividing this quota among different areas. Local authorities are

[5] For seminal works on the supply side of the housing market, see Glaeser, Gyourko, and Saiz (2008); Saiz (2010); Baum-Snow and Han (2024).

responsible for the sale of land within these limits. The land market is regulated to ensure transparency and equity, mandating that sales of commercial and residential land parcels proceed through formal market mechanisms like tenders, auctions, and public listings. Despite a smaller volume of secondary market transactions, municipal governments dominate as the main suppliers of land, significantly influencing land prices through supply adjustments. The entry barriers to the primary land market are comparatively low, attracting a multitude of businesses to the real estate sector and fostering competition. The entity offering the highest bid receives the rights to use the land. Comprehensive studies of the Chinese land market have been examined by Chen and Kung (2019) and Gyourko et al. (2022).

The real estate sector has been a significant contributor to China's GDP, especially in recent years. Rogoff and Yang (2021) show that investments in real estate directly contributed to 10% of GDP, and the sector accounted for over 15% of urban employment. The valuation of Chinese housing market is double that of the US housing market in recent years (Xie and Bird, 2020; Rogoff and Yang, 2024a). Figure 1 presents the time trend of volume of land sales in terms of area and value. We observe a significant increase in the total values of land sold in the primary market for private residential lands and commercial lands, rising from less than RMB 100 million in 2007 to nearly RMB 800 million in 2021.

The real estate sector holds particular importance because land sales become a crucial source of funding for local governments, enabling them to finance infrastructure projects and stimulate economic growth. By 2019, proceeds from land transactions had become a cornerstone of fiscal revenue in numerous localities, constituting more than half of their total income in certain areas, as highlighted in Gyourko et al. (2022).

Throughout the years, real estate developers, especially private ones, strategically employed leverage tools to pursue aggressive expansion. They adopted a development model that involved acquiring land using high leverage and generating substantial sales revenue by capitalizing on rising housing prices. While this expansion strategy rapidly increased sales revenue and company size, it also introduced extensive leverage and significant operational risks to the real estate industry. According to Mao (2021), outstanding loans in the real estate sector reached as much as RMB 47.8 trillion by the first quarter of 2020.

2.2. Local Government Financing Mechanisms

In China, the real estate sector and local government financing are deeply interconnected. A surge in real estate investment stimulates higher demand for land, which elevates land prices and boosts transaction activity. As all land is state-owned, proceeds from these sales become a critical revenue source for local governments (Zhou, 2006; Mo, 2018; Zhang et al., 2018). Research indicates that land sales constitute a substantial share of municipal income—approximately 30% in tier 1 cities and over 40% in tier 2 and tier 3 cities (Rogoff and Yang, 2024b). This dependency underscores the pivotal role of China's real estate market in shaping local fiscal health.

The need for financing by local governments may date back to the "Tax Sharing Reform" in 1994. In the Chinese fiscal landscape, the distribution of local tax income is a collaborative affair between the central and local governments. Before 1994, a large chunk of this revenue flowed directly to the local governments. The introduction of the "Tax Sharing Reform" in 1994 marked a significant realignment, rerouting a greater share of these funds to the central government. This shift was designed to equalize financial resources across various regions, especially targeting those lagging in economic development. As a result, the proportion of tax revenue retained by local governments was reduced from 80% to around 50%, with their fiscal duties marginally lessened, pushing them toward seeking new sources of income. One primary avenue for raising funds by local governments has involved the acquisition of land from rural and urban residents and the sale of land to developers and businesses.

In this background, the LGFVs started to appear since 1994, and were set up as a workaround to prohibitions against deficit spending and borrowing by local governments from the banking sector or financial markets. There were restrictions on LGFVs in conducting their financial operations initially. However, the landscape changed with the 2008 global financial crisis and the subsequent fiscal stimulus, broadening the scope for LGFVs to engage in extensive borrowing and bond issuance activities. This has led to LGFVs being considered as a form of off-the-books debt for local governments. The unique governance and economic framework of China propels local officials to prioritize economic growth, viewing it as the key to career advancement. This has resulted in a heavy involvement of LGFVs in the real estate market, leveraging land sales and usage as a significant revenue stream. The practice has continued to expand, especially in the aftermath of the 4 trillion stimulus plans, underscoring the crucial role these financing vehicles play in local economic strategy.

Several studies have examined LGFVs extensively (e.g., Bai, Hsieh, and Song, 2016; Chen, He, and Liu, 2020; Gao, Ru, and Tang, 2021). However, there is a paucity of research on the roles and effects on the subsidiary companies of those LGFVs. Indeed, by tracking the equity investments of LGFVs, we are able to identify many firms that are held by LGFVs. Some of the subsidiaries are wholly owned by LGFVs while some are jointly held with other entities such as private firms.

2.3. Three-Red-Lines Policy

As discussed in Section 2.1, the real estate sector has accumulated substantial debts, with heavy speculation in the housing market driven by the belief in continuously rising prices. In 2017, President Xi introduced the popular slogan "Housing for living, not for speculation", aiming to tighten the real estate market. To further address the growing risks, Chinese authorities later introduced the "Three-Red-Lines" policy. This policy was unveiled on August 20, 2020, at a symposium for key real estate enterprises, convened by the People's Bank of China (PBoC) and the Ministry of Housing and Urban-Rural Development, the state construction regulator. The symposium was attended by 12 major real estate developers, including Country Garden, Evergrande, Vanke, and Sunac.

The "Three-Red-Lines" policy establishes thresholds on three key financial metrics for property developers: (1) Asset-liability ratio (excluding advance receipts)$\leqslant$70%; (2) Net debt ratio $\leqslant$100%; (3) Cash to short-term debt ratio$\geqslant$1.0. Firms that cross one, two, and three of these thresholds are categorized into "yellow", "orange", and "red" tier, respectively, with tiered restrictions on the growth of their interest-bearing liabilities. Companies fully compliant with these thresholds are permitted to increase their debt by a maximum of 15 percent annually. However, any violation of the three red lines would reduce the allowed debt growth, decreasing by 5% for each violation, to a minimum of no further borrowing permitted ("red tier").

This policy marks a significant shift in China's regulatory approach towards real estate companies' debt management. For the first time, clear and specific standards for property developers' borrowing have been established, effectively closing loopholes that companies previously exploited. The policy's comprehensive scope extends beyond credit bonds to include trust products, asset management products, and overseas financing. Complementing the "Three-

Red-Lines," the "Two-Red-Lines" policy for bank lending was introduced in late 2020, setting upper limits on the proportion of real estate loans and personal housing loans in banks' portfolios.[6]

Aligning with President Xi's vision of housing as a basic necessity rather than a speculative asset, the slogan and the policy are well-intentioned to promote housing affordability and maintain financial stability in the real estate sector (UBS (2021); Xiong (2023)). They underscore Beijing's commitment to incentivize developers to improve their financial health, reduce leverage, and maintain adequate liquidity, thereby deleveraging the real estate industry and mitigating financial risks.[7] However, these policies have profoundly impacted the Chinese real estate industry, affecting companies' financing and sales capabilities, land acquisition by developers, and local government land sale revenues. The resulting financial strain has unintendedly led to numerous defaults among real estate companies, leaving many homebuyers with unfinished housing projects.[8]

3. Data and Summary Statistics

In this section, we describe the four sets of data used in this paper and present their summary statistics: (1) transaction-level data on land purchases in the primary land market; (2) public real estate firms' financial information; (3) list on Local Government Financial Vehicles and their subsidiaries; (4) satellite-measured night light data.

3.1. Land Transaction Data

We obtain the transaction-level land data for the commercial and private residential lands on the primary land market from the CRIC information system (http://www.cricchina.com/). We

[6] At the end of 2020, the People's Bank of China (PBoC) and the China Banking and Insurance Regulatory Commission (CBIRC) jointly issued the "Notice on Establishing a Management System for Concentration of Real Estate Loans in Banking Financial Institutions" . In the Notice, PBoC and CBRIC set the requirements for the proportion of real estate loan balance to the balance of all RMB loans (i.e., real estate loan ratio) and the proportion of personal housing loan balance to the balance of all RMB loans (i.e., personal housing loan ratio). This regulation categorizes banks into five tiers with different caps: large state-owned banks are limited to 40% for real estate loans and 32.5% for personal housing loans; medium-sized banks to 27.5% and 20% respectively; small banks and non-county rural financial institutions to 22.5% and 17.5%; county-level rural financial institutions to 17.5% and 12.5%; and village banks to 12.5% and 7.5%. See the detailed Notice here.

[7] Another motivation behind this policy is Beijing's desire to redirect capital from less productive sectors, such as real estate, towards more productive industries, particularly high-end manufacturing. This shift aims to upgrade China's value chain. Figure A1 in the Online Appendix demonstrates a significant increase in loans to manufacturing firms following the implementation of the "Three-Red-Lines" policy. See also the discussion among investment professionals here.

[8] See, for example, this news article on unfinished housing projects. Chen et al. (2024) examined the causes of unfinished projects before the three-red-lines policy.

cross-checked the validity of the CRIC data with the data from the China Land Market website (www.landmarket.com), maintained by the Ministry of Land and Resources (Chen and Kung, 2019), and confirmed the coverage and accuracy of the data obtained from CRIC. This dataset covers 694,443 transactions between 2013 and 2023, offering a detailed view of land market dynamics over the period. We exclude land parcels acquired by individuals rather than firms. After this filtering, our final dataset comprises 426,704 land parcels. We mainly rely on the CRIC land data because CRIC accurately attributes land acquisitions by subsidiaries to their parent firms, making it easier for us to link land parcels to the public real estate firms. To acquire several land characteristics (e.g., detailed address, land quality, and land life) that are not provided in the CRIC dataset, we obtain the information from the China Land Market website by matching these two datasets by holder name, land city location, land price, and land area. We can match 75% of the CRIC land data to the data from the China Land Market website. For each land transaction, we have detailed characteristics including land parcel size (in hectares), detailed address, plot ratio, land quality, and land use type, alongside the transaction value and buyer's identity. Leveraging the Gaode Map API, we identify each parcel's geographical coordinates from its detailed address.

Figure 1 displays the trends in total land area and total land value of private housing and business lands in the primary land market from 2013 to 2023. The figure shows that land transaction value arrived at a low point in 2015, and started to recover and increase rapidly thereafter before reaching the top in 2020 and experiencing another significant decrease in 2022 and 2023.

[Insert Figure 1 about here]

3.2. Public Real Estate Firms

We obtained the financial information of 162 public real estate firms listed in China, with 80 firms listed on the A-share market, and 82 firms listed on the H-share market. Table 1 shows the summary statistics of the firm-year level data for 162 public real estate firms from 2017 to 2023. The sample firms have an average *Debt-to-assets ratio* of 0.66 and an average *Debt-to-equity ratio* of 1.02. The *Cash-to-short term debt ratio* has a mean of 4.59 and a median of 1.13, suggesting that most firms have small cash reserves relative to short-term debt. *Number of lines crossed* is a count variable that equals the number of red lines the firm has crossed at the end of 2019. On average, firms violated 1.24 red lines. *Post* is a dummy variable that equals one for years on and

after 2021, and zero otherwise. *Number of lines crossed*×*Post* is an interaction term between *Number of lines crossed* and *Post*.

[Insert Table 1 about here]

3.3. Local Government Financial Vehicles and Their Subsidiaries

We obtain the list of Local Government Financial Vehicles (LGFVs) from WIND, including 3,419 unique firms. We then proceed to trace the equity investments of these LGFVs using the Industrial and Commercial Enterprises Information System, which enables us to identify their subsidiaries: those wholly owned by LGFVs and those formed through joint ventures between LGFVs and other firms with LGFVs owing over 50% ownership. Subsequently, we merge our LGFVs and subsidiary list with the transaction-level land data based on the purchaser's identity (i.e., firm name). Out of all land parcels for commercial and residential use, LGFVs directly acquired 4.8% of the land purchases. Furthermore, subsidiaries LGFVs (Sub-LGFVs) account for an additional 5.4% of the land purchases.

3.4. Night Light Data

While we possess data on the value of land transactions at their respective transaction dates, tracking the evolution of land value over time remains challenging. To address this issue, we leverage the "NPP-VIIRS-like" night lights dataset with a 500-meter resolution, spanning from 2000 to 2023, provided by the National Earth System Science Data Center, National Science & Technology Infrastructure of China (http://www.geodata.cn). This dataset, measured through satellites, allows us to infer economic activity (Campante and Yanagizawa-Drott, 2018) and hence, indirectly, land value. By merging this nighttime illumination data with our land transaction records, based on geographical coordinates, we can not only assess the light levels at the time of each transaction but also examine the variations in illumination before and after these transactions. This approach offers a novel proxy for understanding land value dynamics over time. Notably, Figure 2 reveals a robust positive correlation between the land price per square meter of land and the level of nighttime illumination one year before the sale, suggesting that light is a valid proxy for land price.

[Insert Figure 2 about here]

4. Empirical Analyses and Results

4.1. The Impact of "Three-Red-Lines" Policy on Real Estate Firms

To examine the impact of the "Three-Red-Lines" policy on real estate firms, we first classify the 162 public real estate firms into two groups: firms that did not violate any red lines (green) and firms that violated at least one red line (red).[9] We classify firms into two groups based on their financial information in 2019. Panel A of Figure 3 illustrates the trend of interest-bearing debt over time for these two groups of firms. Before 2020, both groups of firms increased their interest-bearing debt steadily, with the red line showing a sharp increasing speed, suggesting that line-crossing firms were more aggressive in accumulating debt before the policy. After 2020, firms that did not violate any red lines continue to increase their debt at a slower growth rate. However, the red line shows a notable decrease in interest-bearing debt from 2021, indicating that line-crossing firms' borrowing capacity has been limited from 2021. Panel B shows the average Return on Equity (ROE) for two groups of firms. A notable decline in ROE is observed for both groups of firms after 2020, with a much sharper decline for firms that crossed any of the three red lines. Panel C depicts the average probability of default over the years. Real estate developers that violated any of the three red lines are significantly more likely to default on bonds after 2020 compared to those that did not. Panel D shows the land acquisition behavior over the years. Firms that crossed any of the three red lines dramatically reduced their land acquisitions since 2021, indicating the policy's impact on limiting these firms' ability to acquire new land. By contrast, firms that met all requirements maintained a relatively stable pace of land purchases after 2021, although their land acquisitions were still negatively affected in 2022.

[Insert Figure 3 about here]

After exploring the unconditional patterns, we analyze the impact of the "Three-Red-Lines" Policy using a difference-in-differences design with ordered discrete treatments, i.e., number of lines crossed by the real estate developers. We use firms' financial information in 2019 to determine the number of lines they crossed, as the "Three-Red-Lines" policy was first officially proposed in a symposium held for key real estate companies by the Ministry of Housing and Urban-Rural Development and the People's Bank of China on August 20, 2020. We thus do not

[9] In Table A1 of the Online Appendix, we find that firms violating the policy are typically larger, operating in more cities, and have more aggressive land purchasing behavior. They are also less likely to be state-owned enterprises.

use the financial data of the year 2020 to avoid the effects of potential pre-reactions to the policy before the effective date. The regression specification is as follows:

$$Depvar_{i,t} = \beta_0 + \beta_1 Number\ of\ lines\ crossed_i \times Post_t + Controls + Firm\ FEs + Year\ FEs + \varepsilon_{i,t}$$

$$Depvar_{i,t} = \beta_0 + \sum_{\substack{t=2017 \\ t\neq 2019}}^{t=2023} \beta_t Number\ of\ lines\ crossed_i \times I(t) + Controls + Firm\ FEs + Year\ FEs + \varepsilon_{i,t},$$

where, *i* denotes firm, and *t* denotes year. *Number of lines crossed* is a count variable that equals the number of red lines the firm crossed at the end of 2019. *Post* is a dummy variable that equals one for years on and after 2021, and zero otherwise. *Controls* represent the firm-year level controls of firm size. We include the firm fixed effects to capture the time-invariant firm-level characteristics and year fixed effects to account for the unobserved time-varying factors. Standard errors are clustered at the firm level.

Panel A of Table 2 shows the main DiD regression results. In column (1), the coefficient of the interaction term *Number of lines crossed*×*Post* is significantly negative (β_1 = –0.108, *t-statistics* = –2.57), indicating a significant reduction in the interest-bearing debt in firms violating more red lines compared to firms violating less or no red lines. The coefficient indicates that, violating one more red line leads to a 10.8% reduction in firms' interest-bearing debt after the implementation of the three-red-lines policy. Column (2) shows the effects on developers' land purchasing behaviors. We find that treated firms' land acquisition value decline significantly after 2021. In terms of the economic magnitude, compared with the mean values, real estate developers that crossed one more line reduced the land purchase value by 26% (–3.003 / 11.547). Columns (3)–(5) examine the impacts on firms' sales, financial performance, and credit default probability. The results show that, crossing one more red line leads to a 6.4% reduction in sales, a 8.2 percentage points reduction in return on equity (*ROE*), and a 10.8 percentage points increase in credit default probability. Overall, the results are consistent with the findings in Figure 3.

Panel B of Table 2 shows the dynamic impacts of the "Three-Red-Lines" policy on real estate firms. The sample period is from 2017 to 2023, and the benchmark year is the year 2019. Panel B shows that, except for the interest-bearing debt in column (1), most coefficients are insignificantly different from zero for periods before 2020, suggesting that there are no significant pre-trends. Column (1) shows that, relative to the base year in 2019, firms crossing one more red lines reduced

their interest-bearing debt by 6.5% in 2020, 11.2% in 2021 and by 11.3% in 2022, but the difference between the two groups of firms becomes insignificant in 2023.[10] The results in column (2) show that the post-treatment negative effects of the Three-Red-Lines policy on treated firms' land acquisition starts right after the implementation year 2021, with a significant drop in land acquisition value lasting to the last year of our sample. Column (3) shows that crossing one more red line reduce firms' sales by 8.2% in 2021 and 9.0% in 2022, but the effect on sales become insignificant in 2023. Column (4) shows that line-crossing firms' *ROE* also decreases significantly, with crossing one more red line resulting in a reduction of ROE by 1.4 percentage points, 7.3 percentage points, 10.4 percentage points, and 7.1 percentage points in 2020, 2021, 2022, and 2023, respectively. We find in column (5) that line-crossing firms' credit default probability increased by 5.9 percentage points, 13.6 percentage points, and 15.2 percentage points in the subsequent three years after the policy implementation. Overall, the Three-Red-Lines policy has an immediate and strong negative impact on line-crossing developers. Both financial performance and new land purchases of those line-crossing firms have been significantly affected by the policy implementation.

[Insert Table 2 about here]

Next, we examine the heterogeneous impact of the Three-Red-Lines policy across different types of firms. In our real estate firm sample, 39.1% of the real estate firms are state-owned enterprises. In Figure 4, we plot the trends in debt financing, financial performance, probability of default, and land acquisition behaviors for state-owned developers (green) and privately-owned developers (red). We define firm types based on their ownership type in 2019. The figure reveals a stark divergence in trajectories between privately-owned and state-owned developers following the implementation of the "Three-Red-Lines" policy. Privately-owned developers experienced a pronounced decline across multiple financial indicators, including a sharp drop in interest-bearing debt, deteriorating financial performance, a dramatic spike in default probability, and a steeper decline in acquired land values. By contrast, state-owned developers maintained relatively stable financial positions, with steady debt levels, consistent performance, and negligible default risk. This differential impact suggests that the "Three-Red-Lines" may have disproportionately affected

[10] This is not surprising because, in early 2023, China began softening its approach to the three-red-lines in an effort to increase market confidence due to the devastating effects on the real estate sector and China's economic conditions.

privately-owned developers, potentially constraining their access to credit, eroding their financial stability, and increasing their vulnerability to market pressures.

[Insert Figure 4 about here]

We next conduct a formal regression analysis on the heterogeneous effects of the "Three-Red-Lines" policy on real estate developers with different ownership types. In Table 3, we include the triple interaction between *Non-SOE*, *Number of lines crossed*, and *Post* to examine the heterogeneous impacts. The results demonstrate that after 2021, while line-crossing privately-owned developers show similar reductions in debt financing and new land purchase as their state-owned counterparts, line-crossing privately-owned developers exhibited a larger drop in sales and financial performance. They are also more likely to default on bonds. In particular, we find that violating one more red line reduce privately-owned developers' sales by 12.3%, ROE by 9.6 percentage points, and increased the probability of default by 15.8 percentage points. Taken together, the results in Table 3 suggest a similar effect of the "Three-Red-Lines" policy on debt financing and land acquisition behavior of line-crossing firms, but a divergence in sales and financial performance between state-owned and privately-owned developers after 2021, highlighting the policy's unintended uneven effects on the real estate sector.[11]

[Insert Table 3 about here]

4.2. The Impact of Three-Red-Lines Policy on the Land Market

Real estate firms tend to continue operating in cities with existing businesses. Our data shows that, on average, 63% of the land acquired by real estate firms is purchased in cities where the firms have previously acquired land within the past three years. This purchase inertia motivates us to create a city-level intensity measure to capture the exposure of each city to the three-red-lines policy using land data before the shock (from 2017 to 2019). Specifically, the city-level three-red-lines policy intensity measure (*Intensity*) is defined as the percentage of land value sold to line-crossing real estate firms in each city from 2017 to 2019. A higher intensity means that the city is more affected by the "Three-Red-Lines" policy. Our sample consists of 287 cities from 2017 to 2023. Table 4 shows the summary statistics of our city-year level data. Compared to Non-LGFV

[11] In a related study, Fang et al. (2022) document a resurgence of SOEs in the real estate sector following the 2012 anti-corruption campaign, albeit through different mechanisms than those observed in our analysis of the three-red-lines policy in 2021.

buyers, both LGFVs and Sub-LGFVs acquired less land on average. Specifically, the ratio of LGFV land value to Non-LGFV land value is 6.5%, while the ratio of Sub-LGFV land value to Non-LGFV land value is 9.0%.

[Insert Table 4 about here]

Figure A2 in the Online Appendix shows the frequency distribution and percentage distribution of our city-level intensity measure. The distribution is left-skewed, with most cities having low intensity, and only 5 cities having intensity values over 0.5. For example, 54 cities (21% of cities in our sample) have an intensity of 0, indicating that these cities are unaffected by the "Three-Red-Lines" policy. We also examine the difference between cities with higher and lower than median city-level intensity in Table A3. The results show that cities with higher *Intensity* tend to be larger in both population and GDP, which suggests that larger cities are more likely to be affected by the "Three-Red-Lines" policy. The cities with higher *Intensity* also exhibit stronger GDP growth rates and lower budget deficit ratios, suggesting they have generally healthier financial situations.

To examine the impact of three-red-lines intensity on city-level housing prices. We compare the housing price changes before and after 2021 for cities with different levels of intensity. The results in Table 5 show that the coefficient of the interaction term *Intensity*×*Post* (coefficient = –0.124, *t-statistics* = –2.16) is significantly negative, indicating that one standard deviation increase in *Intensity* leads to a 1.8% (–0.124×0.147) reduction in the average housing price. Overall, cities with greater exposure to the Three-Red-Lines policy saw a larger decline in average housing prices in 2022 and 2023, compared to cities with lower exposure.

[Insert Table 5 about here]

We further investigate different landholders' reactions to the policy by examining the land transactions of three types of landholders: LGFVs, Sub-LGFVs, and real estate firms. Figure 5 illustrates that, before 2020, real estate firms consistently acquired more land parcels than the combined total purchased by LGFVs and Sub-LGFVs each year. However, this pattern reversed in 2021, as land purchases by real estate firms declined sharply from 2021 to 2023. By contrast, Sub-LGFVs show an increasing trend in land acquisitions, while LGFVs maintain a much more stable pace of land purchases. Specifically, the total value of land purchased by Non-LGFV holders dropped from RMB 6,582 billion in 2020 to RMB 4,092 billion in 2022, while the total value of

lands purchased by Sub-LGFVs increased from RMB 440 billion in 2020 to RMB 797 billion in 2022, offsetting 14.3% of Non-LGFV holders' reduction.

[Insert Figure 5 about here]

To formally examine this relationship, we investigate the impact of the Three-Red-Lines policy on the land purchasing behavior of different types of holders using regression at the city-year level and report the results in Table 6. In column (1) of Table 6, we find that the coefficient of *Intensity*×*Post* is significantly negative (coefficient = –0.578, *t-statistics* = –2.46), indicating that a one standard deviation increase in *Intensity* leads to a 8.5% (–0.578×0.147) decrease total land value.

In columns (2) and (3), we investigate the impacts on the land purchasing of LGFVs and Sub-LGFVs, separately. We find that land purchasing of both types of LGFV firms increases after the policy takes effect, however, only the increase in Sub-LGFVs' land purchasing is statistically significant. In terms of the economic magnitude, a one standard deviation increase in *Intensity* leads to a 26.0% (1.772×0.147) increase in land value purchased by LGFVs and a 23.5% (1.599×0.147) increase in land value acquired by Sub-LGFVs. The average city-level total land value bought by all types of firms in 2019 is RMB 22.515 billion, a 8.5% decrease in total land value corresponds to RMB 1.91 billion. The average land value of LGFV and Sub-LGFVs are RMB 0.892 billion and RMB 1.090 billion, respectively. An 26.0% increase in LGFVs land value and 23.5% increase in Sub-LGFVs land value represents an increase in land value of RMB 0.23 billion and RMB 0.26 billion, respectively. Apart from the increase in LGFVs and Sub-LGFVs land values, Non-LGFV's land value thus decrease by RMB 2.40 billion (1.91 + 0.23 + 0.26), and the increase in LGFVs and Sub-LGFVs land values thus offset 20.4% ((0.23 + 0.26) / 2.40) of the reduction of Non-LGFVs. In columns (4) and (5), the dependent variables are the ratio of LGFVs land value to Non-LGFVs land value, and the ratio of Sub-LGFVs land value to Non-LGFVs land value, respectively. The findings in columns (4) and (5) are largely similar. Panel B of Table 6 shows the dynamic impact on land purchases. Overall, there are no significant pre-trends for periods before 2021, and the total land value begins to decrease from 2022 in cities more affected by the policy. For LGFV firms, we find in columns (2) and (4) that LGFVs do not respond statistically significantly to the policy, however, Sub-LGFVs significantly increase land purchasing from 2022.

[Insert Table 6 about here]

Taken together, our analysis documents a sharp decline in land purchases by public real estate firms in China following the Three-Red-Lines policy. However, Sub-LGFVs have become increasingly prominent in local government land acquisitions, playing a stabilizing role in the land market. Our findings reveal significant shifts in the behavior of public real estate firms and LGFVs, particularly through their subsidiaries (Sub-LGFVs). This provides a fresh perspective to the discourse on China's financial and economic governance.

4.3. The Evolution of Land Night Light

To delve deeper into the motivations behind local governments' reliance on LGFVs and Sub-LGFVs, we investigate the changes in land value, as indicated by variations in night light level, before and after the land transaction year across all types of buyers. Nightlight level, captured through satellite imagery, serves as a proxy to assess the value and utilization of the land before and after its purchase.

To assess the economic activity and development on the purchased lands, we measure the satellite nightlight level for each land parcel at the purchase year, and two years following the purchase. In particular, *Light at t*+2 measures the land light two years after purchase, and *LightChange (t*+2*)-(t)* measures the change in land light from year *t* to year *t*+2. We then compare the night light development on land purchased by different types of buyers before and after the Three-Red-Lines policy. Results are tabulated in Table 7. Column (1) shows that the coefficients on both interaction terms (*LGFV*×*Post* and *Sub-LGFV*×*Post*) are negative and significant. Compared with the average *Light at t*+2 of 16.702, the results indicate that LGFVs develop purchased lands 7.3% (–1.232 / 16.702) slower, and Sub-LGFVs develop purchased lands 3.3% (–0.558 / 16.702) slower than Non-LGFV firms. Column (2) uses the light change as the dependent variable and finds similar results. The pattern implies that, relative to land acquired by Non-LGFVs, the parcels purchased by LGFVs and Sub-LGFVs seem to experience slower development (or land value decrease) after 2021. Such findings suggest that the primary motivation behind LGFVs' and Sub-LGFVs' land acquisitions post-2021 is not to engage in real estate development but rather to provide support to the local land market.

[Insert Table 7 about here]

5. Conclusion

This paper examines the economic consequences of China's "Three-Red-Lines" policy, focusing on its transformative impact on real estate firms, local government financing, and the primary land market. Our analysis reveals that the policy's strict financial constraints significantly curtailed land purchases and financial leverage among real estate firms, a likely first-order cause of China's recent economic downturn. This reduction was largely offset by a strategic shift in land purchases by LGFVs and, more prominently, Sub-LGFVs, which have become pivotal in local government borrowing and land acquisitions. Moreover, land acquired by Sub-LGFVs post-2021 experience slower development compared to those acquired by Non-LGFV entities. This slower development underscores that Sub-LGFVs' primary objective is market stabilization rather than immediate real estate growth, reflecting the broader economic challenges imposed by the policy and their role in mitigating fiscal and market disruptions.

In summary, our study fills a critical gap in the literature by documenting the far-reaching consequences of the Three-Red-Lines policy, including the transformation of real estate firms' behavior and the growing importance of Sub-LGFVs in the land market. This nuanced understanding provides valuable insights for policymakers, market participants, and scholars, offering a comprehensive perspective on the interconnected dynamics of real estate, land markets, and local government financing in China's evolving economic landscape.

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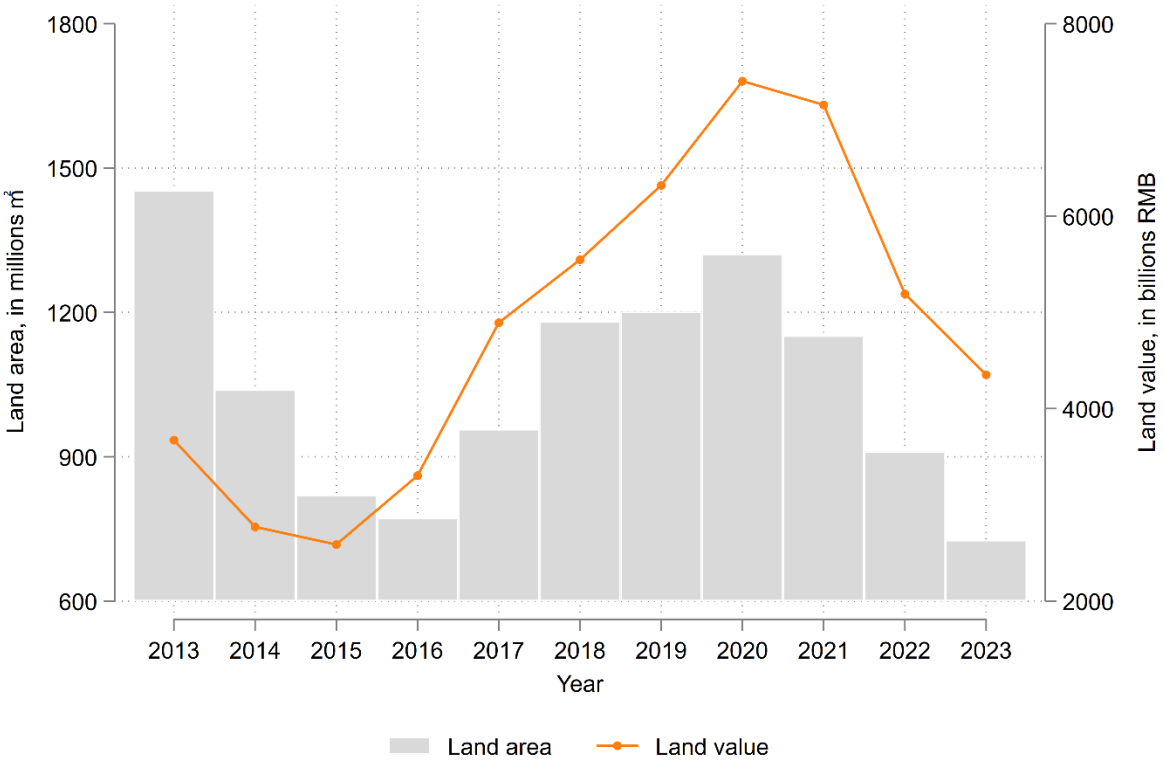
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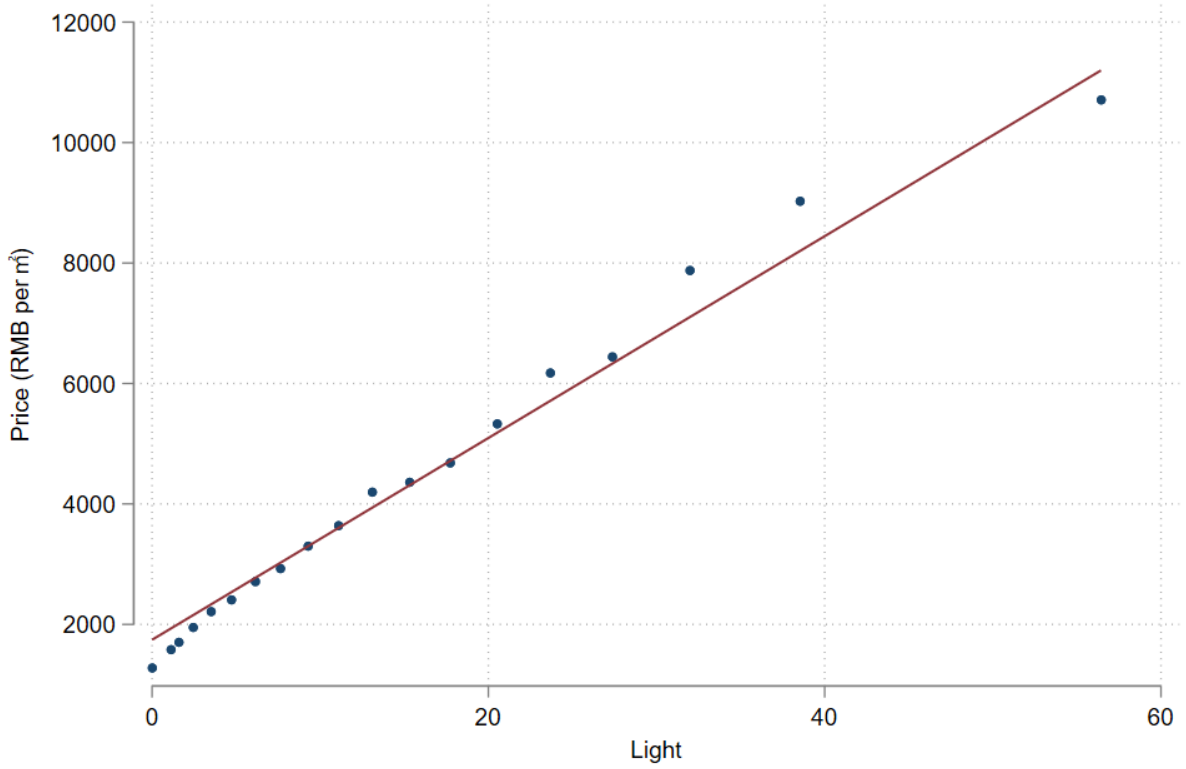
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Figure 1 Private Housing and Business Land Transactions



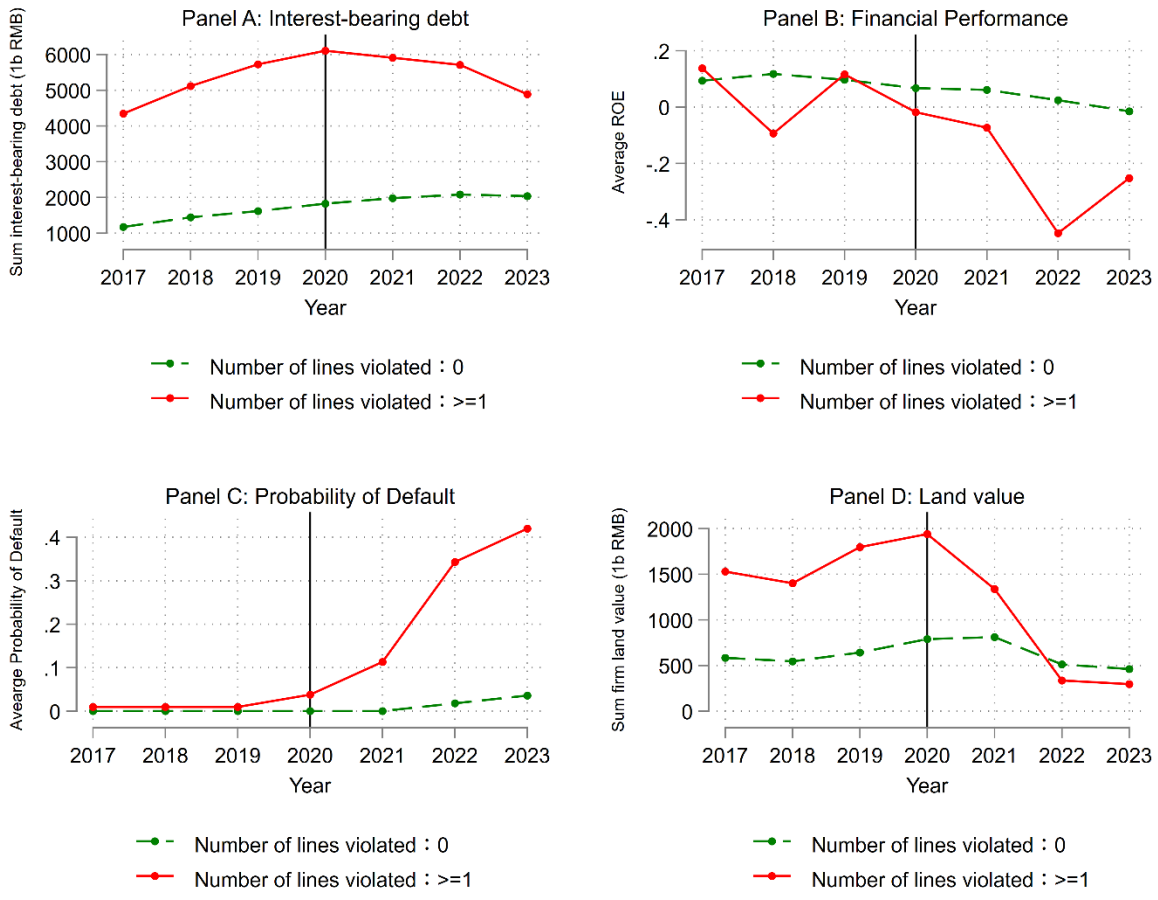
This figure shows the land area in millions of square meters and the land value in billions of RMB of all private housing and business land transactions in the primary land market from 2013 to 2023. The left vertical line shows the land area in millions of square meters, and the right vertical line shows the land value in billions of RMB.

Figure 2 Land Night Light and Land Price



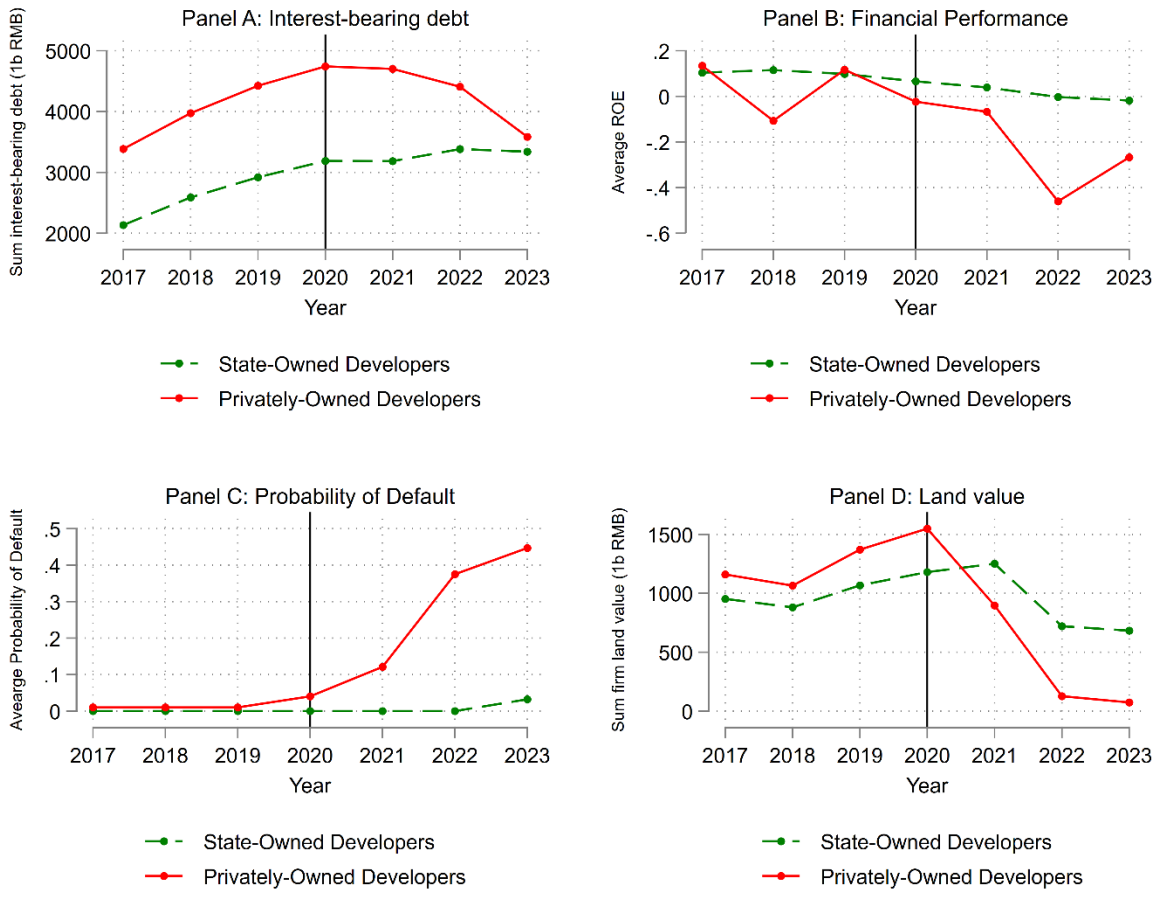
This figure shows the binned scatterplots of land night light and land price. The vertical axis represents the land price, and the horizontal axis represents the land light one year before the land purchase.

Figure 3 The Impact of Three-Red-Lines Policy on Real Estate Developers



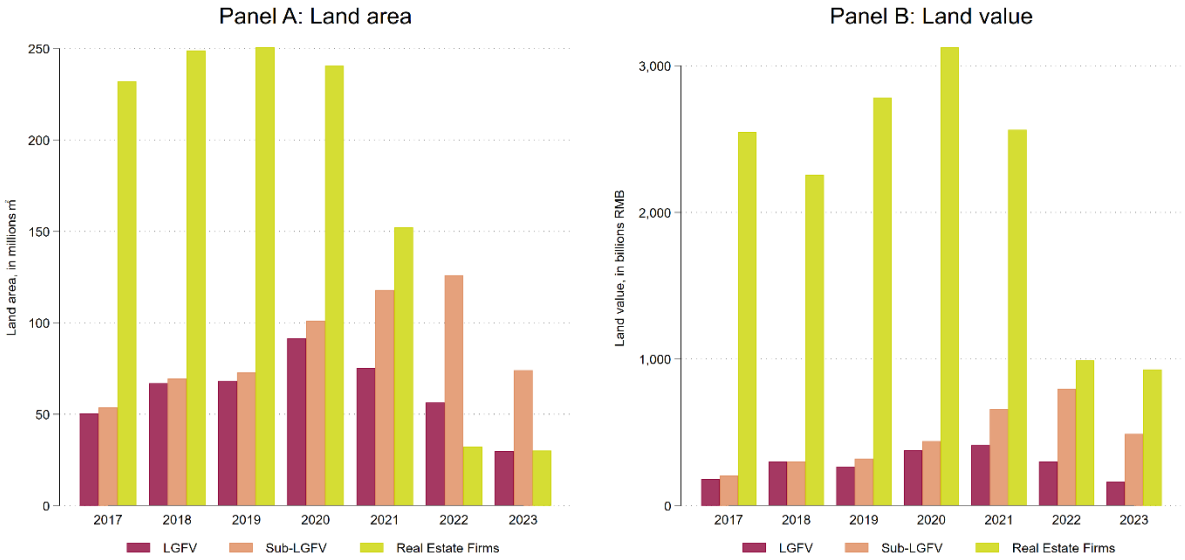
This figure shows the effects of the three-red-lines policy on real estate developers. The green dashed line represents firms that did not cross any "red" lines (i.e., asset-liability ratio, net debt ratio, and cash to short-term debt ratio), while the red solid line represent firms that crossed at least one "red" line. We classify the firms into two groups based on their financial information in 2019. Panels A, B, C and D show aggregate interest-bearing debt (in billion RMB), average ROE, average probability of default, and aggregate land acquisition value (in billion RMB) for these two groups of firms, respectively.

Figure 4 The Heterogeneous Impacts of Three-Red-Lines Policy by Firm Types



This figure shows the heterogeneous effects of the three-red-lines policy on real estate developers with different ownership types. The green dashed line represents privately-owned listed developers, while the red solid line represents state-owned listed developers. We categorize firms according to their ownership type as of 2019. Panels A, B, C and D show aggregate interest-bearing debt (in billion RMB), average ROE, average probability of default, and aggregate land acquisition value (in billion RMB) for these two groups of firms, respectively.

Figure 5 Land Purchases of LGFVs, Sub-LGFVs, and Real Estate Firms



This figure shows land transactions of three types of land holders: LGFV, Sub-LGFV, and Real Estate Firms. LGFV is local government financing vehicle, Sub-LGFV is the subsidiary firm of LGFVs, with a LGFV ownershiop ratio higher than 50%. Real Estate Firms are the 162 publicly listed real estate firms.

Table 1: Summary Statistics of Real Estate Firms

This table shows the summary statistics of firm-year level data. The sample consists of 162 public real estate firms from 2017 to 2023. *Number of lines crossed* is a count variable that equals the number of red lines a firm crossed at the end of 2019. *Post* is a dummy variable that equals one for years on and after 2021, and zero otherwise. *Non-SOE* is a dummy variable that equals one if a firm is a privately-owned enterprise at the end of 2019, and zero otherwise. *Size* is the natural logarithm of firm total assets. *Debt-to-assets ratio* is the ratio of total debt excluding advance payments from customers to total assets excluding advance payments. *Debt-to-equity ratio* is interest-bearing debt minus cash and cash equivalents, divided by total equity. *Cash-to-short term debt ratio* is the sum of cash, cash equivalents and financial assets held for trading, divided by current liabilities. *Ln(Interest-bearing debt)* is the natural logarithm of the interest-bearing debt. *ROE* is net profit scaled by the average total equity in this year and last year. *Default* is a dummy variable that equals one if a firm has experienced a credit default in a year or in previous years, and zero otherwise. *Firm land sites* is the total number of land sites bought by the firm in each year. *Firm land value (1b RMB)* is the total land value in billions of RMB of all lands bought by the firm in each year. *Firm land area (10k m^2)* is the total land area in 10 thousand square meters bought by the firm in each year. All continuous variables are winsorized at the 1st and 99th percentile.

Variables	N	Mean	Std Dev	P5	Median	P95
Number of lines crossed	1,124	1.241	1.159	0.000	1.000	3.000
Post	1,124	0.423	0.494	0.000	0.000	1.000
Non-SOE	1,124	0.609	0.488	0.000	1.000	1.000
Size	1,124	24.764	1.619	21.869	24.843	27.209
Debt-to-assets ratio	1,112	0.662	0.199	0.260	0.716	0.908
Debt-to-equity ratio	1,112	1.022	1.467	-0.344	0.695	3.596
Cash-to-short term debt ratio	1,085	4.594	16.726	0.061	1.133	12.014
In(Interest-bearing debt)	1,096	23.462	1.982	20.074	23.770	25.984
Ln(Sales)	1,111	22.990	1.719	20.054	23.056	25.725
ROE	1,101	0.029	0.203	-0.406	0.063	0.242
Default	1,124	0.088	0.284	0.000	0.000	1.000
Firm land sites	1,124	16.864	36.616	0.000	2.000	85.000
Firm land value (1b RMB)	1,124	11.547	24.169	0.000	1.554	60.629
Firm land area (10k m^2)	1,124	83.128	194.204	0.000	9.631	407.967

Table 2: The Impact of Three-Red-Lines Policy on Real Estate Firms

This table reports the OLS regression results on the impact of the three-red-lines policy on real estate firms. The sample period is from 2017 to 2023. Panel A shows the post-treatment effects of the three-red-lines policy. Panel B shows the dynamic effects of the policy. *Year2017* is a dummy variable that equals one for the year of 2017, and zero otherwise. *Number of lines crossed×Year2017* is the interaction term between *Number of lines crossed* and *Year2017*. Other year dummies and interaction terms are defined similarly. The definition of other variables can be found in the legend of Table 1. Standard errors are clustered at the firm level, and t-statistics are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Post-treatment effects

Variables	(1) *In(Interest-bearing debt)*	(2) *Firm land value (1b RMB)*	(3) *Ln(Sales)*	(4) *ROE*	(5) *Default*
Number of lines crossed×Post	-0.108**	-3.003***	-0.064*	-0.082***	0.108***
	(-2.57)	(-2.78)	(-1.93)	(-5.94)	(5.24)
Size	0.680***	0.059	0.746***	0.009	0.040
	(6.27)	(0.05)	(8.29)	(0.49)	(1.16)
Observations	1,096	1,124	1,111	1,101	1,124
Adjusted R^2	0.935	0.772	0.953	0.464	0.431
Firm FEs	YES	YES	YES	YES	YES
Year FEs	YES	YES	YES	YES	YES
Cluster	Firm	Firm	Firm	Firm	Firm

Panel B: Dynamic effects

Variables	(1) *In(Interest-bearing debt)*	(2) *Firm land value (1b RMB)*	(3) *Ln(Sales)*	(4) *ROE*	(5) *Default*
Number of lines crossed×Year2017	0.031	-0.373	-0.025	0.014	0.006
	(0.86)	(-0.30)	(-0.89)	(1.29)	(1.27)
Number of lines crossed×Year2018	0.032	-1.131	-0.030	-0.004	0.002
	(0.67)	(-1.48)	(-0.97)	(-0.33)	(1.24)
Number of lines crossed×Year2020	-0.065***	-0.628	-0.017	-0.014*	0.018
	(-3.32)	(-0.77)	(-0.57)	(-1.66)	(1.61)
Number of lines crossed×Year2021	-0.112***	-2.964***	-0.082**	-0.073***	0.059***
	(-4.12)	(-2.92)	(-2.33)	(-4.38)	(2.97)
Number of lines crossed×Year2022	-0.113**	-4.050***	-0.090**	-0.104***	0.136***
	(-2.42)	(-2.76)	(-2.10)	(-5.30)	(4.99)
Number of lines crossed×Year2023	-0.102	-3.629**	-0.074	-0.071***	0.152***
	(-1.61)	(-2.47)	(-1.53)	(-2.94)	(5.35)
Size	0.695***	0.022	0.744***	0.014	0.046
	(6.21)	(0.02)	(8.09)	(0.76)	(1.26)
Observations	1,096	1,124	1,111	1,101	1,124
Adjusted R^2	0.935	0.772	0.953	0.467	0.442
Firm FEs	YES	YES	YES	YES	YES
Year FEs	YES	YES	YES	YES	YES
Cluster	Firm	Firm	Firm	Firm	Firm

Table 3: Differential Effects of the Three Red Lines Policy Across Firm Types

This table reports the OLS regression results on the heterogeneous impact of the three-red-lines policy on real estate firms. The sample period is from 2017 to 2023. *Non-SOE×Number of lines crossed×Post* is the interaction term between *Non-SOE*, *Number of lines crossed*, and *Post*. The definition of other variables can be found in the legend of Table 1. Standard errors are clustered at the firm level, and t-statistics are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Variables	(1) *In(Interest-bearing debt)*	(2) *Firm land value (1b RMB)*	(3) *Ln(Sales)*	(4) *ROE*	(5) *Default*
Non-SOE×Number of lines crossed×Post	0.065	-2.153	-0.123**	-0.096***	0.158***
	(0.83)	(-1.05)	(-2.06)	(-4.65)	(5.60)
Number of lines crossed×Post	-0.136***	-1.458	0.015	-0.023**	0.004
	(-3.11)	(-1.02)	(0.37)	(-2.02)	(0.49)
Non-SOE×Post	-0.360**	-4.306	-0.093	-0.043	0.081**
	(-2.13)	(-1.50)	(-0.87)	(-1.65)	(2.13)
Size	0.656***	-0.228	0.737***	0.006	0.046
	(6.50)	(-0.21)	(8.49)	(0.29)	(1.42)
Observations	1,096	1,124	1,111	1,101	1,124
Adjusted R^2	0.936	0.778	0.955	0.522	0.519
Firm FEs	YES	YES	YES	YES	YES
Year FEs	YES	YES	YES	YES	YES
Cluster	Firm	Firm	Firm	Firm	Firm

Table 4: Summary Statistics City-Year Level Data

This table shows the summary statistics of city-year level data. The sample consists of 287 cities from 2017 to 2023. *Intensity* is the percentage of land values that are sold to line-crossing real estate firms during 2017 and 2019 in each city. *Post* is a dummy variable that equals one for years on and after 2021, and zero otherwise. *Ln(City population)* is the natural logarithm of the population in the city in each year. *Ln(Housing price)* is the natural logarithm of the housing price index in the city in each year. *AllHolder value (1b RMB)* is the total value of all business and private housing lands sold in the city in each year in billions of RMB. *LGFV value (1b RMB)* is the value of all business and private housing lands sold to LGFV firms in the city in each year in billions of RMB. *Sub-LGFV value (1b RMB)* is the value of all business and private housing lands sold to Sub-LGFV firms in the city in each year in billions of RMB. *LGFV value / Non-LGFV value* is the ratio of the total value of all business and private housing lands sold to LGFV firms to the total value of all business and private housing lands sold to Non-LGFV holders. *Sub-LGFV value / Non-LGFV value* is the ratio of the total value of all business and private housing lands sold to Sub-LGFV firms to the total value of all business and private housing lands sold to Non-LGFV holders. All continuous variables are winsorized at the 1st and 99th percentile.

Variables	N	Mean	Std Dev	P5	Median	P95
Intensity	1,861	0.187	0.147	0.000	0.158	0.455
Post	1,861	0.447	0.497	0.000	0.000	1.000
Ln(City population)	1,861	5.904	0.691	4.711	5.952	6.923
Ln(Housing price)	1,854	8.917	0.502	8.278	8.818	9.929
AllHolder value (1b RMB)	1,861	19.791	33.898	0.324	7.082	99.975
LGFV value (1b RMB)	1,861	0.916	1.990	0.000	0.021	5.273
Sub-LGFV value (1b RMB)	1,861	1.470	3.155	0.000	0.178	8.279
LGFV value / Non-LGFV value	1,861	0.065	0.142	0.000	0.004	0.307
Sub-LGFV value / Non-LGFV value	1,861	0.090	0.150	0.000	0.026	0.407

Table 5: The Impact of Three-Red-Lines Policy on Housing Prices

This table reports the OLS regression results on the impact of the three-red-lines policy on city-level housing prices. The sample period is from 2017 to 2023. The table shows the post-treatment effects of the three-red-lines policy. *Intensity*×*Post* is the interaction term between *Treat* and *Post* . *Ln(Housing price)* is the natural logarithm of the housing price index in the city in each year. The definition of other variables can be found in the legend of Table 4. Standard errors are clustered at the city level, and t-statistics are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Variables	*Ln(Housing price)*
Intensity×*Post*	-0.124**
	(-2.16)
Ln(City population)	0.008
	(0.07)
Observations	1,818
Adjusted R^2	0.979
City FEs	YES
Province×Year FEs	YES
Cluster	City

Table 6: The Impact of Three-Red-Lines Policy on LGFV Land Purchases

This table reports the OLS regression results on the impact of the three-red-lines policy on city-level land purchases. The sample period is from 2017 to 2023. *Ln(AllHolder value)* is the natural logarithm of *AllHolder value*. *Ln(LGFV value)* is the natural logarithm of *LGFV value*. *Ln(Sub-LGFV value)* is the natural logarithm of *Sub-LGFV value*. *Intensity*×*Post* is the interaction term between *Treat* and *Post*. The definition of other variables can be found in the legend of Table 4. Standard errors are clustered at the city level, and t-statistics are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Variables	(1) *Ln(AllHolder value)*	(2) *Ln(LGFV value)*	(3) *Ln(Sub-LGFV value)*	(4) *LGFV value / Non-LGFV value*	(5) *Sub-LGFV value / Non-LGFV value*
Intensity×*Post*	-0.578**	1.772*	1.599**	0.086**	0.207***
	(-2.46)	(1.93)	(2.35)	(2.14)	(3.67)
Ln(City population)	0.918***	-0.362	-0.394	-0.066	-0.200***
	(2.64)	(-0.16)	(-0.42)	(-1.51)	(-2.61)
Observations	1,861	995	1,243	1,861	1,861
Adjusted R^2	0.913	0.548	0.595	0.298	0.416
City FEs	YES	YES	YES	YES	YES
Year FEs	YES	YES	YES	YES	YES
Cluster	City	City	City	City	City

Table 7: Land light

This table reports the OLS regression results at the land level. The dependent variables are the land light at *t*+2, in which time *t* is the land purchasing year, and time *t+2* is two years after the land purchasing year. *LGFV* (*Sub-LGFV*) is a dummy variable that equals one if the landholder is a LGFV firm (Sub-LGFV firm), and zero otherwise. *Post* is a dummy variable that equals one for years on and after 2021, and zero otherwise. *LGFV*×*Post* (*Sub-LGFV*×*Post*) is the term between *LGFV* (*Sub-LGFV*) and *Post*. *Lagged light* is the land light one year before the land purchasing year. *Ln(Price)* is the natural logarithm of the land price per square meter at purchase. *Ln(Area)* is the natural logarithm of the area of the land. *Ln(Max plot ratio)* is the natural logarithm of the maximum plot ratio of the land. *Ln(Land life)* is the natural logarithm of the year limit of the land use right. *Land quality* is the quality measure of the land, which is 19 minus the initial quality range to facilitate interpretation. *Land quality* ranges from 1 (worst quality) to 18 (best quality). Standard errors are clustered at the city level, and t-statistics are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)
Variables	*Light at t+2*	*LightChange (t+2)-(t)*
LGFV×Post	-1.232***	-1.120***
	(-2.97)	(-3.11)
Sub-LGFV×Post	-0.558*	-0.366
	(-1.75)	(-1.21)
LGFV	0.327	0.115
	(1.40)	(0.65)
Sub-LGFV	0.104	0.237
	(0.55)	(1.58)
Lagged light	0.903***	-0.055***
	(93.14)	(-8.02)
Ln(Price)	0.958***	0.532***
	(14.82)	(12.25)
Ln(Area)	0.176***	0.086***
	(6.01)	(3.75)
Ln(Max plot ratio)	0.387***	0.209***
	(4.02)	(2.80)
Ln(Land life)	-0.624***	-0.239*
	(-3.72)	(-1.67)
Land quality	0.017	0.012
	(0.93)	(0.90)
Ln(City population)	1.507	-2.164
	(0.68)	(-1.03)
Observations	103,047	103,047
Adjusted R^2	0.811	0.069
YearMonth FEs	YES	YES
City FEs	YES	YES
Sector FEs	YES	YES
Cluster	City	City

Online Appendix for

Redefining China's Real Estate Market: Land, Local Government Financing, and Policy Transformations

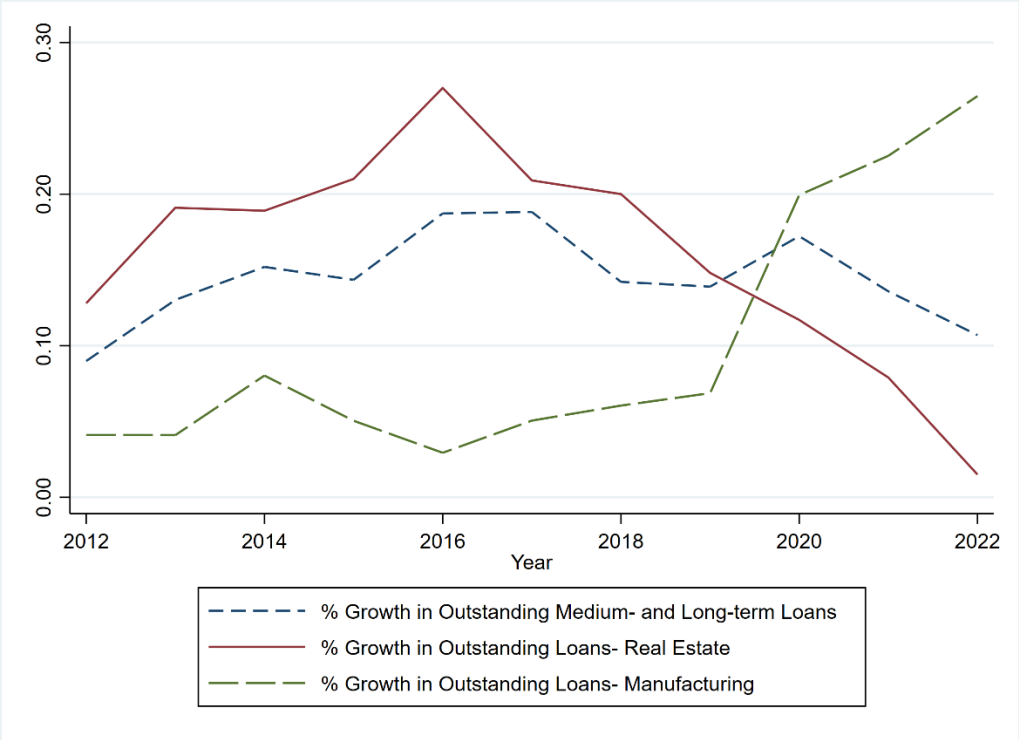
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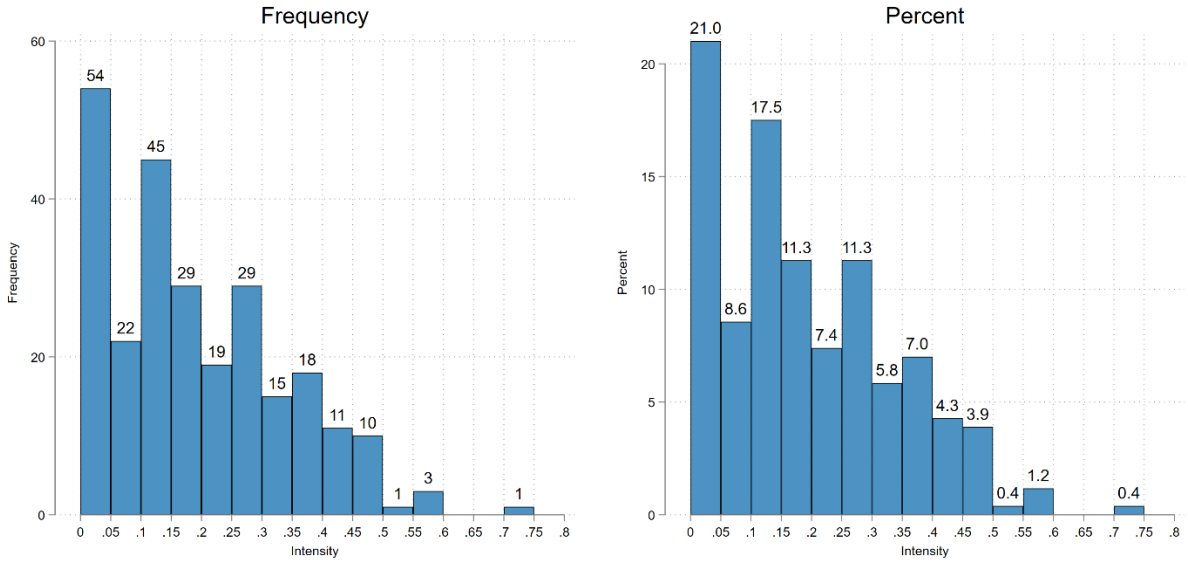
Kunru Zou

Figure A1 Year-on-Year RMB Loan Growth: Total, Manufacturing, and Real Estate Sectors



This graph illustrates the percentage growth in outstanding RMB loans in China from 2012 to 2022. The short-dashed blue line represents the year-over-year growth in overall outstanding medium- and long-term loans. The solid red line indicates the year-over-year growth in outstanding loans to the real estate sector. The long-dashed green line shows the year-over-year growth in outstanding loans to the manufacturing sector.

Figure A2 The Distribution of City-Level Three-Red-Lines Policy Intensity



This figure shows the frequency distribution (left) and percentage distribution (right) of the city-level three-red-lines intensity.

Table A1: Summary Statistics of Treat and Control Firms

This table shows the summary statistics of real estate firms crossing at least one red line and real estate firms violating no red lines in 2019. *SOE* is a dummy variable that equals one if a firm is a state-owned enterprise, and zero otherwise. *Total assets* is firms' total assets in billions of RMB in 2019. *Number of cities* is the number of cities the firm bought land parcels during 2017 and 2019. *Land sites* is the number of land parcels the firm bought during 2017 and 2019. *Land area (10k m^2)* is the sum of land areas in 10 thousand square meters of all lands the firm bought during 2017 and 2019. *Land value (1b RMB)* is the sum of land values in billions of RMB of all lands the firm bought during 2017 and 2019. *Land price (10k RMB)* is the mean of land prices per square meter in 10 thousand RMB of all lands the firm bought during 2017 and 2019.

	Cross at least 1 line		Cross 0 line		Difference	
	Count	Mean	Count	Mean	T-value	P-value
SOE	106	0.34	56	0.48	-1.74	0.08
Total assets (1b RMB)	106	202.44	56	131.60	1.54	0.13
Number of cities	106	22.76	56	8.84	3.36***	0.00***
Land sites	106	104.46	56	39.09	2.52*	0.01*
Land area (10k m^2)	106	524.74	56	186.33	2.46*	0.02*
Land value (1b RMB)	106	46.77	56	31.71	1.16	0.25
Land price (10k RMB)	98	1.86	43	2.63	-1.99*	0.05*

Table A2: Summary Statistics of Firms Crossing Different Number of Red Lines

This table compares the summary statistics of firms crossing different number of red lines in 2019. Firms are further classified into state-owned firms and private-owned firms.

	Non-SOE				SOE			
Number of red lines crossed	*Number of firms*	*Mean Debt-to-assets ratio*	*Mean Debt-to-equity ratio*	*Mean Cash-to-short term debt ratio*	*Number of firms*	*Mean Debt-to-assets ratio*	*Mean Debt-to-equity ratio*	*Mean Cash-to-short term debt ratio*
3	25	0.81	2.36	0.51	13	0.77	2.17	0.59
2	13	0.76	1.14	0.94	8	0.75	1.57	1.30
1	32	0.65	0.57	1.40	15	0.68	0.66	1.24
0	29	0.42	0.12	28.51	27	0.54	0.23	41.07

Table A3: Summary Statistics of Cities with Higher or Lower Three-red-lines Intensity

This table compares the summary statistics of cities with different levels of city-level three-red-lines policy intensity. In particular, cities are classified into two groups, according to the median value of the city-level *Intensity*. *City population* is the city population in units of 10 thousand. *City GDP* is the Gross Domestic Product in 100 million RMB. *City GDP growth* is the city's GDP growth rate. *City budget deficit ratio* is the budget expenditure minus budget income divided by budget income.

	Intensity>=Median		Intensity<Median		Difference	
	Count	Mean	Count	Mean	T-value	P-value
City population	127	528.51	126	387.91	4.06***	0.00***
City GDP	129	4797.59	128	1852.48	6.04***	0.00***
City GDP growth	120	0.08	117	0.04	2.70**	0.01**
City budget deficit ratio	129	1.59	128	3.02	-5.81***	0.00***