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—introduced in 2021 to cap real estate developers' leverage by imposing strict thresholds on debt ratios and liquidity. Developers breaching these thresholds experienced sharp declines in financing, land acquisitions, and financial performance. Privately owned developers (POE) are hit harder than state-owned firms (SOE), with larger drops in sales and higher default risk. Using granular project-level data, we show that the policy reduces developer sales primarily by curtailing new-project supply: breached developers launch fewer projects. On the demand side, homebuyers reallocate purchases from privately owned developers to SOEs, further widening the POE–SOE gap. The policy also reduced local governments' land-transfer revenues, increased reliance on local government financing vehicles (LGFVs) for land purchases, and these LGFV-acquired parcels exhibit very low subsequent development rates.

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

JEL Classification: G30, G31, G38, R10, R30

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1. Introduction

In recent years, China's real estate sector has entered a period of severe distress: real-estate bond defaults totaled RMB 31.1 billion over 2017–2020, but jumped to RMB 111.7 billion over 2021–2023 (Figure 1). Meanwhile, land sales collapsed: land sold fell by 45% from its 2020 peak to 2023, and land-transfer revenues declined by roughly 41% over the same period (Figure 2). This joint pattern—widespread developer credit events together with a collapse in land sales—evokes the abrupt turning point observed during the U.S. housing bust of the late 2000s, when disruptions in housing finance rapidly propagated to broader financial conditions and real activity (Mian and Sufi, 2014).

A central difference, however, lies in the proximate trigger—and in which side of the market the credit shock hit. In the United States, the boom and bust were, at least in part, driven by the expansion and subsequent contraction of mortgage credit (Adelino, Schoar, and Severino, 2025): the deterioration of subprime lending, together with securitization and banking turmoil, ultimately froze mortgage funding and triggered a rapid downturn in the housing market and the broader real estate sector (Keys et al., 2010; Gorton and Metrick, 2012). In China, by contrast, the tightening operated primarily on the supply side of developer finance: an important institutional backdrop is the policy-driven push to deleverage property developers and restrict their access to financing beginning in 2021—most notably the introduction of the "Three Red Lines" (Xiong, 2023).

This paper examines the economic consequences of China's "Three-Red Lines" (TRL) policy, implemented on January 1, 2021. The TRL introduced balance-sheet-based thresholds—on the asset–liability ratio, net debt ratio, and the cash-to-short-term-debt ratio—and imposed tiered limits on developers' access to interest-bearing debt when one or more thresholds were breached. We find that constrained developers sharply reduced land acquisitions and experienced weaker financial performance, with effects particularly pronounced among privately owned developers, who also saw greater drop in sales and larger increases in default risk relative to state-owned counterparts. We further show that the policy induces a demand reallocation from privately owned developers to SOEs, which helps explain the widening POE–SOE gap in sales and default risk.

Beyond developer balance sheets, the TRL reshaped the land market and local public finance: beginning in 2021, local government land-sale revenues weakened, and local governments increasingly relied on subsidiaries of local government financing vehicles (Sub-LGFVs) to purchase land to offset the revenue shortfall. [2] Yet fewer than 18% of (Sub-)LGFV-acquired parcels are subsequently developed, suggesting that these purchases primarily warehoused land and shifted fiscal risk off budget, exacerbating local governments' hidden debt burdens. Taken together, our results highlight the far-reaching and multifaceted effects of the TRL policy across both real-estate and fiscal dimensions of China's economy.

To analyze these dynamics, we compile detailed financial and transaction data for real estate firms and land acquisitions. We collect financial information for 160 public real estate firms, with 80 listed on the A-share market and 80 on the Hong Kong stock market, from WIND. Land transaction data for those real estate firms primarily come from China Real Estate Information Corp (CRIC) information system, a major digital platform for China's real estate sector that offers comprehensive coverage and accurately attributes land acquisitions by subsidiaries to their parent firms. We further extract the housing projects sales data from China Real Estate Index System (CREIS) database which provide detailed sales information at the housing project-quarter level. Local Government Financing Vehicles (LGFVs) and their subsidiaries (Sub-LGFVs) are identified using WIND and the Industrial and Commercial Enterprises Information System, resulting in a database of 3,419 LGFVs and 41,401 Sub-LGFVs.[3] Together, these data offer a comprehensive basis for analyzing how the TRL policy reshape both housing market and land sale market.

Based on these data, we assess the economic consequences of the TRL policy on real estate companies using difference-in-differences (DID) design with ordered discrete treatments. The treatment variable represents the number of red lines breached by each firm, as determined by their financial position in 2019. First, we find that firms crossing one additional red line experience a

[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.

[3] The methodology for identifying LGFVs' subsidiaries through ownership network examination is detailed in Section 3.4.

10.6% decline in interest-bearing debt and reduce the land purchase value by 27%. 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 6.6%, ROE by 8.3 percentage points, and increases the probability of default by 10.7 percentage points after the policy's implementation in 2021. The absence of significant pre-trends supports the validity of our identification strategy. Importantly, these effects are not uniform. Following the TRL policy, privately-owned developers experience significantly greater financial distress than state-owned peers with comparable violations, suffering a 12.8% decrease in sales, a 9.9 percentage points drop in ROE, and a striking 15.9 percentage points increase in default probability. This disparity suggests that the policy disproportionately impacts privately-owned developers, potentially altering the real estate sector's competitive landscape.

Using project–quarter sales data from CREIS, we reconfirm that the TRL policy leads to sizable declines in housing sales among listed developers: each additional red-line violation is associated with roughly 12–17% lower sales volume and value, along with a modest decline in average prices. These effects are highly heterogeneous by ownership: relative to SOEs with comparable TRL exposure, private developers experience substantially larger reductions in units sold, sales area, and sales value, indicating a stronger policy impact on private firms.

We then decompose the sales effects into supply- and demand-side channels. On the supply side, more exposed firms contract new supply sharply after TRL: crossing one additional red line is linked to about a 25% decline in the number of projects brought to market, and roughly 34–35% declines in newly supplied units and construction area. This supply retrenchment is significantly stronger for private developers, consistent with tighter financing constraints translating into a larger pullback in launching new projects.

On the demand side, within-project estimates suggest little average change in demand conditional on a given project being on the market. Comparing the same project before versus after the policy and netting out common local shocks, the average effects on within-project sales and prices are economically small and statistically indistinguishable from zero. However, we uncover

a sharp ownership split: within-project sales decline for private developers as TRL exposure increases, while SOE projects see higher sales with greater exposure, consistent with a reallocation of demand away from private developers' projects and toward SOE-developed projects.

Taken together, the TRL policy generates both a pronounced supply contraction and a demand reallocation across developer types. Private developers cut back new supply more aggressively and simultaneously lose demand to SOE projects, whereas SOEs are relatively insulated and may even gain market share on the demand margin. These two forces jointly help explain the widening POE–SOE gap in sales outcomes and financial distress after the policy.

Lastly, we study how the TRL policy spills over from developers to local public finance, given that land sales are a key revenue source for local governments. Developers also display strong purchase inertia—about 63% of land acquisitions occur in cities where they operated in the previous three years—suggesting that a city's exposure to TRL depends importantly on its pre-policy reliance on more constrained developers. Motivated by this persistence, we construct a city-level treatment intensity measure, defined as the share of pre-policy land value (2017–2019) sold to red-line–crossing developers, and use it to trace policy spillovers to local land markets and government-linked buyers.

We find that more exposed cities experience a sharp contraction in land market activity and fiscal revenue: a one-standard-deviation increase in intensity reduces total land transaction value by 8.9%. At the same time, land purchases by government financing vehicles rise after the policy—by 25.4% for LGFVs and 23.1% for Sub-LGFVs per one-standard-deviation higher intensity—partially offsetting the decline in non-LGFV purchases. Consistent with this substitution at an aggregate level, from 2020 to 2022 land purchases by non-LGFV entities fell from RMB 6.582 trillion to RMB 4.092 trillion, while Sub-LGFV purchases increased from RMB 440 billion to RMB 797 billion, offsetting roughly 14.3% of the decline.

Importantly, these land acquisitions by (Sub-)LGFVs are far less likely to translate into housing supply. Over 2017–2023, listed developers develop about 85% of acquired land, whereas LGFVs and Sub-LGFVs develop only 18% and 17%, with development rates trending downward.

This pattern suggests that some local governments may be using LGFVs to support land-sale revenues without subsequent development, potentially obscuring weaker fundamentals while increasing contingent fiscal burdens and heightening implicit debt risks.

This study contributes to the literature on China's economic conditions in three main ways. First, it deepens the understanding of China real estate sector's recent downturn, which was primarily influenced by the TRL 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); Liu and Xiong (2020); Chen et al. (2024); Rogoff and Yang (2024); He et al.(2025b))[4], few studies evaluate the impact of deleveraging reforms such as the TRL 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 land purchases by real estate firms, providing evidence of a likely first-order cause of China's economic downturn.

Second, this study examines how the TRL policy reshapes the relationship between the real estate sector and local government financing, with a particular focus on the evolving role of local government financial vehicles (LGFVs) and their subsidiaries (Sub-LGFVs). While prior studies have highlighted the use of LGFVs as traditional financing tools (e.g., Ru (2018); Huang, Pagano, and Panizza (2020); Chen, He, and Liu (2020); Gao, Ru, and Tang (2021); Ambrose, Deng, and Wu (2015); Zhang and Barnett (2014)). Chang, Wang, and Xiong (2025) document how local governments managed land and housing prices amid declining transactions during COVID-19, our findings link these dynamics more directly to the consequences of the TRL policy. As financially constrained developers withdrew from the land market, Sub-LGFVs emerged as key buyers to sustain local land revenues. Together, these findings underscore a fundamental transformation in China's real estate landscape—where fiscal stabilization increasingly relies on public-sector entities, deepening the entanglement between real estate markets and local government finance.

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

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

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 (2022); Adelino, Schoar, and Severino (2025)). Our paper highlights the supply side effects of a credit crunch on real estate developers—showing how developer financing constraints shape land acquisitions, housing supply, and broader market dynamics.[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 TRL policy. Section 3 presents the data and summary statistics. Section 4 provides the empirical results. Section 5 concludes.

2. Institutional Background

2.1 Land, Housing, and Public Finance in China

Real estate plays a macroeconomically central role in China. Rogoff and Yang (2021) estimate that real-estate-related activities account for nearly 30% of GDP when including both direct construction and extensive upstream and downstream linkages. Institutionally, China's urban land market operates through the transfer of long-term land-use rights, while ultimate ownership of urban land remains with the state. Local governments act as the primary—and effectively monopolistic—suppliers of new urban construction land in the primary market. Most residential and commercial parcels are allocated through standardized competitive mechanisms (collectively known as zhao-pai-gua), including auction, bidding, and listing formats, in which the highest bidder acquires the use rights for a fixed term (Chen and Kung, 2019). Beyond revenue generation, land is also managed as a policy instrument: zoning restrictions and differentiated pricing across uses are used to pursue multiple objectives (He et al, 2025a). Figure 3 summarizes the institutional chain and financial flows linking local governments, LGFVs, developers, and the housing market.

[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).

Land-transfer revenues are the cornerstone of local public finance, a dependency rooted in the 1994 Tax-Sharing Reform. This reform recentralized tax revenues while leaving local governments with disproportionate expenditure responsibilities. To bridge this fiscal gap, local authorities turned to quasi-fiscal funding sources, most notably land-based finance. In 2020, gross land-transfer revenues reached RMB 10.01 trillion, a figure equivalent to 84% of local governments' general budgetary revenue (Gyourko et al., 2022). Land-transfer revenues are accounted for under the "Government Fund Budget." They are closely linked to local fiscal capacity and are widely used to finance infrastructure spending and industrial subsidies.

A distinctive institutional feature is the separation between primary land development and real estate development. Primary development—consisting of land requisition, resettlement, and the provision of basic site infrastructure (Figure 3, Paths 1 and 2)—is typically delegated to Local Government Financing Vehicles (LGFVs). Once the land is made construction-ready, land-use rights are transferred to developers through zhao-pai-gua. This chain creates a tight financial nexus: the solvency of LGFVs depends on the market value of the land they prepare, while developers' demand for land is sensitive to the availability of credit.

LGFVs function as the off-budget financing arm of local governments. Initially established to circumvent formal prohibitions on municipal borrowing, these corporatized entities raise funds via bank credit and bond issuance (e.g., Bai, Hsieh, and Song, 2016; Chen, He, and Liu, 2020; Gao, Ru, and Tang, 2021). Their borrowing capacity is typically supported by land assets injected by local governments and, in many cases, implicit government guarantees. Importantly, most LGFVs operate under a policy mandate to provide public goods rather than maximizing commercial profit; they generally lack the specialized organizational capabilities, branding, and sales networks required for large-scale housing development.

Developers' financing models are characterized by high leverage and a "high-turnover" strategy that relies heavily on the continuous rollover of debt and customer deposits from pre-sales**.** By the end of 2020, the sector's average asset-liability ratio stood at 80.7%, with total liabilities

reaching RMB 85.7 trillion. This high degree of financial fragility makes the sector acutely vulnerable to liquidity shocks and regulatory tightening in developer financing.

2.2 "Three-Red-Lines" (TRL) 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 TRL 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 TRL 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 (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 may have profoundly impacted the Chinese real estate industry. This paper studies how the resulting credit tightening for developers maps into outcomes for developers, homebuyers, and local governments' land finance.

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 acquisition in the primary land market; (2) financial information of publicly listed real estate firms; (3) project-quarter-level housing sales data; and (4) a list of Local Government Financial Vehicles (LGFVs) and their subsidiaries.

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 (www.cricchina.com/). We primarily rely on CRIC because developers often acquire land through project subsidiaries; CRIC

[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.

systematically maps such subsidiary-level acquisitions to their ultimate parent firms, allowing us to accurately link land parcels to publicly listed real estate developers. 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. Moreover, CRIC also records buyer's (i.e., developer) equity share in each land acquisition. We cross-checked the coverage of the CRIC data with the data from Land China (www.landchina.com), maintained by the Ministry of Land and Resources (Chen and Kung, 2019). We found that, from 2013 to 2023, CRIC covers around 90% of the land sites, 90% of the land area, and nearly 100% of the land value covered by Land China. See Table A1 in the Online Appendix for a detailed comparison.

Figure 2 displays the trends in total land area and total land value of private housing and business lands in the primary land market from 2017 to 2023. The figure shows that land transactions reaching the top in 2020 and experienced a significant decrease in 2022 and 2023.

[Insert Figure 2 about here]

3.2. Public Real Estate Firms

Our sample comprises real estate companies listed on the A-share and Hong Kong stock exchanges, with data sourced from Wind. The initial sample included 108 A-share and 272 Hong Kong-listed firms. We excluded four dual-listed companies to avoid double-counting. To ensure the firms are actively engaged in development, we further filtered the sample by matching them with land acquisition records in the CRIC database. This step is essential because some firms classified as "real estate"—such as "515J Holding" (000560.SZ) and "Emperor International Holdings" (0163.HK)—primarily focus on property management, brokerage, or operations limited to the Hong Kong market, while others function as REITs. By requiring a match with CRIC records, we successfully isolated 160 firms (80 A-share and 80 Hong Kong-listed) that participate in real

estate development in mainland China. Besides the financial statement, we also collected the initial default date for both domestic and overseas bonds of real estate enterprises from Inno Dealing.[8]

Panel A of Table 1 shows the summary statistics of the firm-year level data for 160 public real estate firms from 2017 to 2023. The sample firms have an average *Liability-to-asset ratio* of 0.66 and an average *Debt-to-equity ratio* of 1.01. The *Cash-to-short term debt ratio* has a mean of 4.62 and a median of 1.13, suggesting that most firms have small cash reserves relative to short-term debt. *LinesCrossed* is a count variable that equals the number of red lines the firm has crossed at the end of 2019. On average, firms violated 1.23 red lines. *Post* is a dummy variable that equals one for years on and after 2021, and zero otherwise.

[Insert Table 1 about here]

3.3. Project Level Housing Sales Data

We obtain the housing projects sales data from China Real Estate Index System (CREIS) database (http://chinaindexholdings.com). For each housing project, CREIS provides the names of the real estate firms that developed the project and the project's quarterly sales information (e.g., the number of sales units, sales area, sales value, and the average selling price per square meter).[9] Since many real estate projects may be jointly developed by two or more real estate developers, the CREIS database also records each developer's equity share in each project. Based on this, we calculated the equity-adjusted sales area and sales amount for each developer in each project. We merge our public real estate firm list with the CREIS housing sales data based on the firm name, and we find sales information for 145 public real estate firms from 2017 to 2023. Panel B of Table 1 shows the summary statistics of the project-quarter level data for 15,614 housing projects from

[8] https://www.innodealing.com/aboutus.html

[9] Sales data in financial reports may be affected by changes in accounting standards, particularly the new Chinese Accounting Standards for Business Enterprises 14 (CAS 14), issued by the Ministry of Finance. These standards were adopted by overseas listed companies starting in 2018 and by domestic listed companies in 2020, potentially impacting reported sales revenue during our sample period. However, project-level housing sales data from property online contracting in CREIS remain unaffected by these changes, allowing us to avoid their impact on revenue recognition in our empirical analysis.

2017 to 2023. On average, each housing project sells 86 units per quarter, with an average selling price of 19,334 RMB.

In addition to quarterly sales, CREIS project-level opening (for-sale) information, which includes each project's total number of units, total construction area, and opening date. We use these opening records to construct firm-quarter measures of new project openings, including (i) the number of projects (*# of Projects*) opened for sale by each firm in each quarter, (ii) the total number of units (*# of Units*) opened for sale by firm-quarter, and (iii) the total construction area (*Construction area*) opened for sale by firm-quarter. Panel C of Table 1 presents summary statistics for these firm-quarter opening variables.

3.4. 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, LGFVs' subsidiaries (Sub-LGFVs) account for an additional 5.4% of the land purchases. Panel D of Table 1 shows the summary statistics of our city-year level data. On average, both LGFVs and Sub-LGFVs acquired less land than non-LGFV entities. The ratio of LGFV land value to Non-LGFV land value is 6.5%, while that of Sub-LGFV to Non-LGFV is 9.0%.

4. Empirical Analyses and Results

4.1. The Impact of TRL Policy on Real Estate Firms

To examine the impact of the TRL policy on real estate firms, we first classify the 160 public real estate firms into two groups based on their financial positions in 2019: firms that did not breach any of the red lines ("green") and firms that violated at least one ("red").[10] Panel A of Figure 4 illustrates the trend of interest-bearing debt over time for these two groups of firms. Before 2020, both groups increased their interest-bearing debt steadily, with the red line growing at a faster rate, indicating more aggressive borrowing behavior among line-crossing firms. After 2020, non-violating firms continued expanding debt at a slower pace, while line-crossing firms experienced a significant decline in the levels of interest-bearing debt, consistent with the policy's debt constraints.

Panel B shows the average return on equity (ROE) for two groups of firms over time. A substantial decline in ROE is observed for both groups of firms after 2020, with a steeper decline among firms that violated the red lines. Panel C depicts the average probability of default over the years. Real estate developers that violated the 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, revealing that firms with policy violations drastically reduced their land purchases 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 acquisition after 2021, although their activity also declined modestly in 2022.

[Insert Figure 4 about here]

After exploring the unconditional patterns, we then move to a formal analysis using a difference-in-differences framework with ordered discrete treatments. We measure treatment intensity by the number of red lines crossed by each real estate developer based on its 2019 financial statements, which provide a clean pre-policy baseline. The TRL policy was first officially

[10] In Table A2 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 in the pre-TRL period. Among firms that violated at least one red line, 34% are state-owned enterprises (SOEs), whereas 48% of firms that did not breach any red lines are SOEs. In Table A3 of the Online Appendix, we compare the Liability-to-asset ratio, Debt-to-equity ratio, Cash-to-short-term debt ratio among firms crossing different numbers of "red" lines across different ownership types.

communicated to key developers on August 20, 2020; consequently, financial data from 2020 onward may already incorporate anticipatory responses—such as deleveraging, liquidity adjustments, and other balance-sheet management—undertaken in expectation of the forthcoming regulation. Defining treatment intensity using 2020+ financials would therefore contaminate the pre-treatment classification and risk introducing post-announcement bias into our estimates. The regression specifications are as follows:

$$Y_{it} = \beta\,(LinesCrossed_i \times Post_t) + \boldsymbol{X_{it}'\gamma} + \alpha_i + \delta_t + \varepsilon_{it} \quad (1)$$

$$Y_{it} = \Sigma_{\tau=2018}^{2023}\,\beta_\tau\,(LinesCrossed_i \times \mathbf{1}\{t=\tau\}) + \boldsymbol{X_{it}'\gamma} + \alpha_i + \delta_t + \varepsilon_{it} \quad (2)$$

where *i* denotes firm, and *t* denotes year. *LinesCrossed* is a count variable that equals the number of red lines the firm crossed as of 2019. *Post* is a dummy variable that equals one for years from 2021 and later, and zero otherwise. X_{it} denotes a vector of the firm-year level control variables. All specifications include firm fixed effects, which absorb time-invariant firm characteristics, and year fixed effects, which capture common shocks and other time-varying factors shared across firms. Standard errors are clustered at the firm level. In the dynamic specification, we omit 2017 as the reference year; thus, each β_τ is interpreted relative to 2017.

Panel A of Table 2 presents the main DID regression results. In column (1), the coefficient of the interaction term *LinesCrossed* × *Post* is significantly negative (β = –0.106*, t-statistics* = –2.51), indicating a significant reduction in the interest-bearing debt for firms violating more red lines compared to firms violating fewer or no red lines. The coefficient indicates that violating one additional red line leads to a 10.6% reduction in firms' interest-bearing debt after the implementation of the TRL policy. Column (2) reports the effects on developers' land purchasing behaviors. We find that treated firms' land acquisition value declines significantly after the TRL policy. 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 27% (–3.055 / 11.439). We do not log-transform firm land value because it is zero for roughly 300 of the 1,113 firm-year observations (i.e., no land acquisitions). As a robustness check, we re-estimate the model using a log specification and obtain qualitatively similar results. 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 6.6% reduction in sales, an 8.3 percentage point reduction in *ROE*, and a 10.7 percentage point increase in credit default probability. Overall, these results align with the descriptive patterns in Figure 4.

Panel B of Table 2 shows the dynamic impacts of the TRL policy on real estate firms for the 2017-2023 period, with 2017 as the baseline year. The coefficients for 2018 and 2019 are all insignificantly different from zero. In 2020, we begin to observe moderate declines in interest-bearing debt and ROE, likely due to the fact that the Chinese government announced the TRL policy in August 2020 with 12 major real estate developers, and firms began to adjust their financial strategies preemptively in anticipation of the upcoming restrictions. However, the magnitudes of the drop (i.e., –0.099 and –0.030 in Columns (1) and (4)) are only about half the size of the declines observed in the subsequent years. Consistent with the parallel-trends assumption, the pre-policy coefficients (2018–2020) are jointly insignificant for the other outcomes, and we cannot reject the null of no pre-trends based on the corresponding F-tests (p-values are large).

More specifically, column (1) shows that, relative to the base year of 2017, firms crossing one more red line reduced their interest-bearing debt by 9.9% in 2020, 14.0% in 2021, 14.4% in 2022, and 13.2% in 2023. The results in column (2) show that the post-treatment negative effects of the TRL policy on treated firms' land acquisition start right after the implementation year 2021, with the decline in land acquisition value becoming statistically significant in 2022 and 2023. Results in column (3) show that crossing one more red line reduces firms' sales by 6.0% in 2021, by 6.7% in 2022, and by 5.2% in 2023, though the effects are statistically insignificant. Column (4) shows that line-crossing firms' *ROE* also decreases significantly, with crossing one more red line resulting in a reduction of *ROE* by 3.0 percentage points, 9.0 percentage points, 11.8 percentage points, and 8.6 percentage points in 2020, 2021, 2022, and 2023, respectively. We find in column (5) that line-crossing firms' credit default probability increased by 5.1 percentage points, 13.0 percentage points, and 14.7 percentage points in the subsequent three years after the policy

implementation. Overall, the TRL policy has an immediate and strong negative impact on line-crossing developers. Both financial performance and land acquisitions 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 TRL policy across different types of firms. In our real estate firm sample, 61% (39%) of the real estate firms are privately-owned enterprises (state-owned enterprises). In Figure 5, we plot the trends in debt financing, financial performance, probability of default, and land acquisition behaviors for state-owned breached developers (red dashed lines) and privately-owned breached developers (red solid lines). We define firm types based on their ownership type in 2019. The figure reveals a striking divergence in trajectories between privately-owned and state-owned line-crossing developers following the implementation of the TRL policy. Privately-owned breached developers experienced a more 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 breached developers maintained relatively stable financial positions, with steady debt levels, relatively better performance, and negligible default risk. This differential impact suggests that the TRL may have disproportionately affected privately-owned developers, potentially constraining their access to credit, eroding their financial stability, and increasing their vulnerability to market pressures.

[Insert Figure 5 about here]

In Figure 6, we plot trends in debt financing, financial performance, probability of default, and land acquisition behavior for state-owned compliant developers (green dashed lines) and privately owned compliant developers (green solid lines). Across Panels A–D, outcomes for both groups evolve smoothly through the introduction of the TRL in 2020. These patterns suggest that compliant firms were largely insulated from the policy and that the salient effects of the TRL are concentrated among line-crossing developers.

[Insert Figure 6 about here]

We next conduct a formal regression analysis on the heterogeneous effects of the TRL policy on real estate developers across different ownership types. In Table 3, we include the triple interaction between *Private*, *LinesCrossed*, and *Post* to examine the heterogeneous impacts. In column (1), the coefficients on *LinesCrossed* × *Post* and *Private* × *Post* are significantly negative, while the coefficient on the triple interaction term is insignificant. This means that, compared to SOES, interest-bearing debt for private enterprises significantly decreased. After accounting for the overall trend of declining interest-bearing debt for private enterprises relative to state-owned enterprises, there was no significant difference between private enterprises and state-owned enterprises crossing the same number of "red" lines. In columns (3) – (5), we observe that violating one more red line reduces privately-owned developers' sales by 12.8%, *ROE* by 9.9 percentage points, and increases the probability of default by 15.9 percentage points. Taken together, the results in Table 3 suggest a similar effect of the TRL 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 TRL Policy on Housing Sales

In this section, we leverage granular project-quarter level housing sales data to examine the impact of TRL on housing sales. Specifically, we aggregate the project-quarter data to the firm-quarter level to estimate the overall effect of TRL on the housing sales volume and sales prices for public real estate firms.

We begin with the aggregate analysis by constructing four key firm-quarter level outcome variables. *Ln(Sales units)* is the natural logarithm of the total number of housing units sold by a

[11] In a related study, Fang and Zhang (2025) 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.

firm in a given quarter. Similarly, *Ln(Sales area (1k m^2))* is the natural logarithm of the total equity-adjusted sales area (in thousands of square meters), while *Ln(Sales value (1m RMB))* is the natural logarithm of the equity-adjusted sales value (millions of RMB) in the quarter. Finally, *Ln(Sales price (RMB/m^2))* represents the natural logarithm of the average sales price per square meter of housing units sold by the firm in a quarter.

Panel A of Table 4 presents the overall post-treatment effects. The TRL policy leads to significant declines in housing sales among public real estate firms. Specifically, each additional red-line violation is linked to a 12.4% decline in the number of units sold, a 12.8% decrease in sales area, a 17.1% decline in sales value, and a 4.3% drop in average housing prices during the post-TRL period.

[Insert Table 4 about here]

We further examine the heterogeneous effects of TRL policy on housing sales across different types of real estate firms. Specifically, we include a triple interaction term between *Private*, *LinesCrossed*, and *Post*, to assess whether privately owned developers are more affected by TRL violations. Panel B of Table 4 presents the regression results. Columns (1)-(3) show that line-crossing private developers experience significantly larger reductions in sales units, sales area, and sales value compared to their state-owned counterparts. In terms of economic magnitude, compared with state-owned developers violating the same number of red lines, privately-owned developers sold 16.9% fewer units, 21.0% less housing area, and 21.8% less sales value, indicating a stronger policy impact on private firms. Column (4) reveals that the sales price drop is similar among state-owned and private developers, suggesting that the larger decline in sales value is not driven by steeper price cuts but instead stems from lower sales volume (units and area). Overall, the firm-quarter level results reinforce our earlier findings from firm-year level financial data: TRL violations lead to significant sales and financial deterioration, with disproportionately stronger effects on privately-owned developers.

4.3. The Impact of TRL Policy on the Housing Supply and Demand

To investigate whether the decline in housing sales is mainly driven by a contraction in housing project supply or weaker homebuyer demand, we conduct two sets of tests.

First, we measure developers' housing projects supply using the opening (for-sale) of new housing projects. The CREIS database provides each project's sales opening data, number of units opened and total construction area. We aggregate these project-level measures to the firm-quarter level and test how the TRL policy affects the supply of newly opened projects.

Panel A of Table 5 shows the average treatment effects of the TRL policy on the supply of housing by public real estate firms. Across specifications, more exposed firms contract supply in a pronounced and statistically significant manner. In column (1), the coefficient on *LinesCrossed* × *Post* implies that crossing one additional red line is associated with a 25.5% (*exp*(–0.295) – 1) decline in the number of projects opened for sale in the post-policy period. Columns (2) and (3) show comparable contractions in scale: units and construction area fall by 35.1% (*exp*(–0.432) – 1) and 33.8% (*exp*(–0.412) – 1) , respectively. Taken together, these results indicate that the TRL policy materially curtailed developers' capacity (or willingness) to initiate new housing supply.

Panel B of Table 5 examines heterogeneity by ownership by augmenting the baseline specification with the triple interaction *Private* × *LinesCrossed* × *Post*. The estimates indicate that privately owned developers contract supply significantly more than state-owned developers following the TRL policy, conditional on the extent of TRL violations. The triple-interaction coefficients are negative and statistically significant across all three measures of new supply, implying larger post-policy declines for private firms in the number of projects, units, and construction area. Overall, the evidence reinforces the view that the TRL policy's tightening effects are borne disproportionately by private developers.

[Insert Table 5 about here]

Having shown that the TRL policy leads breached developers to open fewer and smaller new projects, we next ask whether the policy also depresses housing demand for projects that remain on the market. To isolate demand-side changes from supply-side adjustments operating through the extensive margin, we exploit within-project variation in sales outcomes over time. Specifically,

we estimate project-quarter regressions with project fixed effects, so identification comes from changes in sales for the same project before versus after the policy, holding constant all time-invariant project characteristics. This design isolates demand on the intensive margin by testing whether sales for the same project decline after the TRL policy, conditional on the project remaining on the market.

Panel A of Table 6 reports project-quarter regressions that exploit within-project variation by including project fixed effects, while absorbing time-varying local demand conditions with city-quarter fixed effects. The city-quarter fixed effects are particularly important in our setting because, during the sample period, many cities adjusted housing-market policies (e.g., easing purchase restrictions) that could directly affect demand. By comparing projects within the same city and quarter, we effectively net out the influence of these concurrent local policy shifts. Across all four outcomes—log sales units, log sales area, log sales value, and log price—the coefficient on *LinesCrossed*×*Post* is economically small and statistically indistinguishable from zero, suggesting a limited average demand-side response conditional on a given project being on the market.

Panel B of Table 6 explores heterogeneity by ownership by adding the triple interaction *Private*×*LinesCrossed*×*Post*. The estimates reveal a sharp divergence across developer types. The triple-interaction estimates are negative and statistically significant for log sales units, log sales area, and log sales value, indicating that greater TRL exposure leads to larger post-policy declines in within-project sales for private developers relative to SOEs. At the same time, the coefficient on *LinesCrossed*×*Post* is positive and significant for the baseline group (state-owned developers), implying that SOE projects experience higher sales in the post-policy period as exposure increases. Taken together, the opposing signs are consistent with a reallocation of demand away from private developers' projects and toward SOE-developed projects after the TRL policy.

[Insert Table 6 about here]

In sum, the TRL policy's direct effect operates primarily through the supply side. More exposed developers open fewer new projects and bring fewer units and less construction area to market, pointing to the extensive margin as the dominant channel behind the decline in housing

sales. At the same time, the policy generates meaningful heterogeneity across firms, with both supply- and demand-side forces at work. On the supply side, private developers contract new-project supply more sharply; on the demand side, sales within continuing projects shift away from private developers and toward SOEs, consistent with demand reallocation from POEs to SOEs. Taken together, the TRL policy appears to have constrained developers' expansion while simultaneously reshaping competitive dynamics in favor of state-owned firms.

4.4. The Impact of TRL Policy on Land Market

Real estate firms tend to maintain operations in cities where they have an existing presence. Our data shows that, on average, 63% of the land acquired by real estate firms is located in cities where the same firms have purchased land within the past three years. This purchasing inertia motivates the construction of a city-level intensity measure to capture the exposure of each city to the TRL policy using land transaction data from the pre-policy period (2017–2019). Specifically, the city-level TRL policy intensity measure (*Intensity*) is defined as the share of total land transaction value sold to red-line-violating firms from 2017 to 2019. A higher *Intensity* reflects greater local exposure to the TRL policy. Our sample includes 287 cities from 2017 to 2023.

Figure A2 in the Online Appendix shows that the distribution of the *Intensity* measure is left-skewed—most cities have low exposure, with only 4 cities above 0.5. Notably, 54 cities (21%) have an *Intensity* of zero, indicating no exposure to TRL-violating developers. A comparison of cities above and below the median *Intensity* (Table A3) reveals that high-intensity cities tend to be larger (by population and GDP) and financially healthier, as indicated by higher GDP growth and lower budget deficits. This suggests that more developed cities were more exposed to the TRL policy.

We investigate different landholders' reactions to the policy by examining the land transactions of three types of landholders: LGFVs, Sub-LGFVs, and other real estate firms. Figure 7 illustrates that before 2020, real estate firms consistently acquired more land parcels than the combined total purchased by LGFVs and Sub-LGFVs. However, this pattern reversed in 2021. Land acquisitions by real estate firms declined sharply from 2021 to 2023, while Sub-LGFVs

increased their purchases, and LGFVs maintained relatively stable levels. For instance, the total value of land purchased by Non-LGFV holders fell from RMB 6.582 trillion in 2020 to RMB 4.092 trillion in 2022. By contrast, Sub-LGFVs' purchase rose from RMB 440 billion to RMB 797 billion, offsetting 14.3% of Non-LGFV holders' decline.

[Insert Figure 7 about here]

To formally examine this relationship, we perform city-year panel regressions and report the results in Table 7. In column (1), we find that the coefficient of *Intensity* × *Post* is significantly negative (coefficient = –0.616, *t-statistics* = –2.53), indicating that a one standard deviation increase in *Intensity* leads to an 8.9% (–0.616 × 0.144) decrease in total land transaction value—equivalent to RMB 2.00 billion, based on the 2019 average city-level total land value bought by all types of firms of RMB 22.52 billion.

Columns (2) and (3) analyze the effects on LGFVs and Sub-LGFVs, respectively. We find that land purchases by both types of LGFV firms increase after the policy takes effect. In terms of the economic magnitude, a one standard deviation increase in *Intensity* leads to a 25.4% (1.765 × 0.144) increase in land value purchased by LGFVs and a 23.1% (1.601 × 0.144) increase in land value acquired by Sub-LGFVs. The average land value of LGFVs and Sub-LGFVs are RMB 0.892 billion and RMB 1.090 billion, respectively. An 25.4% increase in LGFVs land value and 23.1% increase in Sub-LGFVs land value represents an increase in land value of RMB 0.23 billion and RMB 0.25 billion, respectively. Apart from the increase in LGFVs and Sub-LGFVs land values, Non-LGFV's land value decreases by RMB 2.48 billion (2.00 + 0.23 + 0.25), and the increase in LGFVs and Sub-LGFVs land values thus offset 19.4% ((0.23 + 0.25) / 2.48) of the reduction of Non-LGFVs.

Columns (4) and (5) further confirm this substitution pattern. 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. These findings are consistent with the previous findings that LGFVs and Sub-LGFVs both purchase more lands after 2021 compared with Non-LGFVs, with Sub-LGFVs increasing more significantly in terms of coefficient and significance level.

[Insert Table 7 about here]

Increased land purchasing by LGFVs and sub-LGFVs may have profound fiscal consequences, given that their development trajectories may deviate significantly from those of listed developers. To investigate this, we utilize housing project-level opening (for-sale) data from the CREIS, identifying 35,529 projects with sufficient information for land-to-project matching. We link each parcel to a project based on developer identity, location, and a plausible timeline where the project launch follows the land acquisition. Parcels without a corresponding match are classified as undeveloped, whereas matched parcels are defined as developed.

Between 2017 and 2023, publicly listed real estate firms demonstrate a substantially higher land development rate of approximately 85%, whereas LGFVs and Sub-LGFVs show much lower rates of 18% and 17%, respectively. Moreover, the development rates of LGFVs and Sub-LGFVs display a declining trend over this period. These results highlight a clear divergence in land acquisition purposes: while real estate firms primarily purchase land to convert it into saleable housing projects, LGFVs and Sub-LGFVs exhibit a significantly lower propensity to develop the land they acquire.

[Insert Figure 8 about here]

Taken together, the TRL policy led to a sharp contraction in land acquisitions by real estate firms. However, Sub-LGFVs have stepped in to absorb part of this shortfall, playing a stabilizing role in the land market. Our findings reveal substantial shifts in land purchasing behavior post-policy, particularly among LGFVs and their subsidiaries, offering new insights into China's evolving financial and economic governance.

5. Conclusion

This paper examines the economic consequences of China's TRL 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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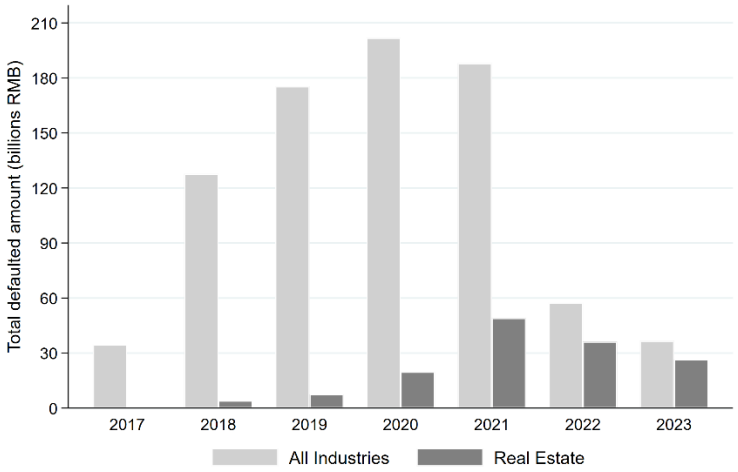
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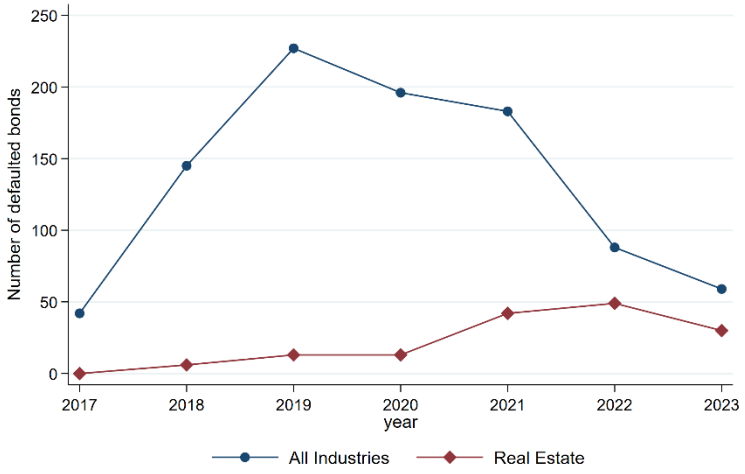
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Figure 1 Annual Defaults in China's Corporate Bond Market

Panel A: Total Defaulted Amount

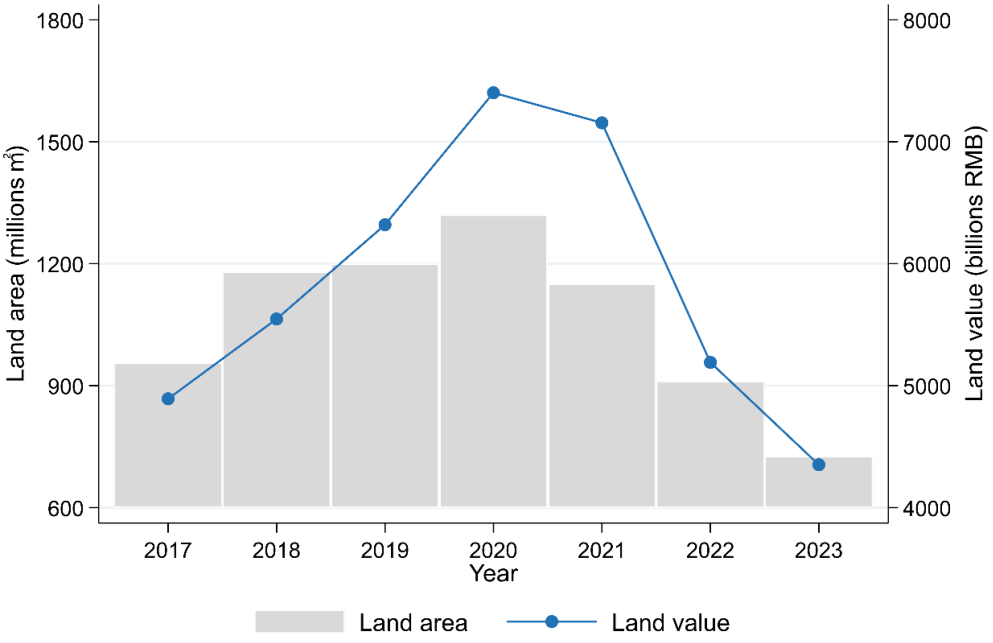


Panel B: Number of Defaulted Bonds



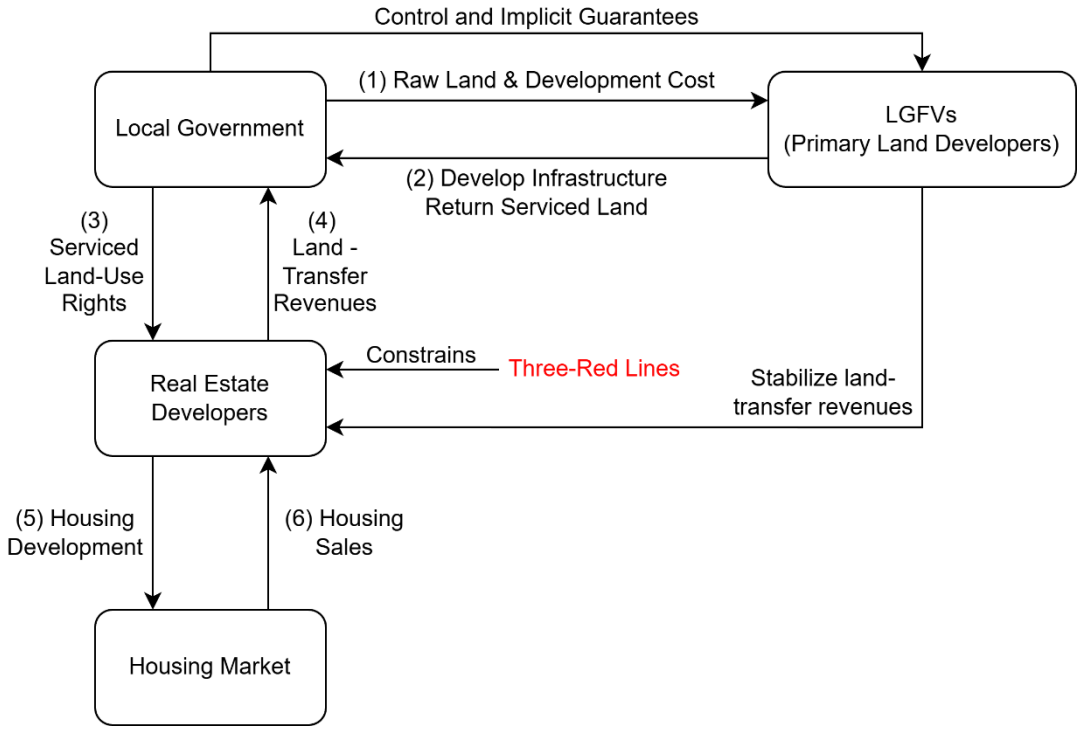
This figure summarizes default activity in China's corporate bond market from 2017 to 2023, for the overall market and for the real estate sector. Panel A reports the total defaulted amount, measured as the bond's outstanding balance on the default date (billions of RMB). Panel B reports the number of defaulted bonds. We excludes default events classified as principal/interest extensions, technical defaults, and cross defaults. We also deduplicate bonds with identical bond codes across trading venues to avoid double counting the same bond that may trade in both the exchange and interbank markets.

Figure 2 Private Residential and Commercial Land Transactions



The figure reports annual transactions of private residential and commercial land in the primary land market from 2017 to 2023. Bars show the total land area transacted (millions of m²; left axis), and the line shows the total transaction value (billions of RMB; right axis).

Figure 3 Land–Housing Market Structure: Local Governments, LGFVs, and Developers



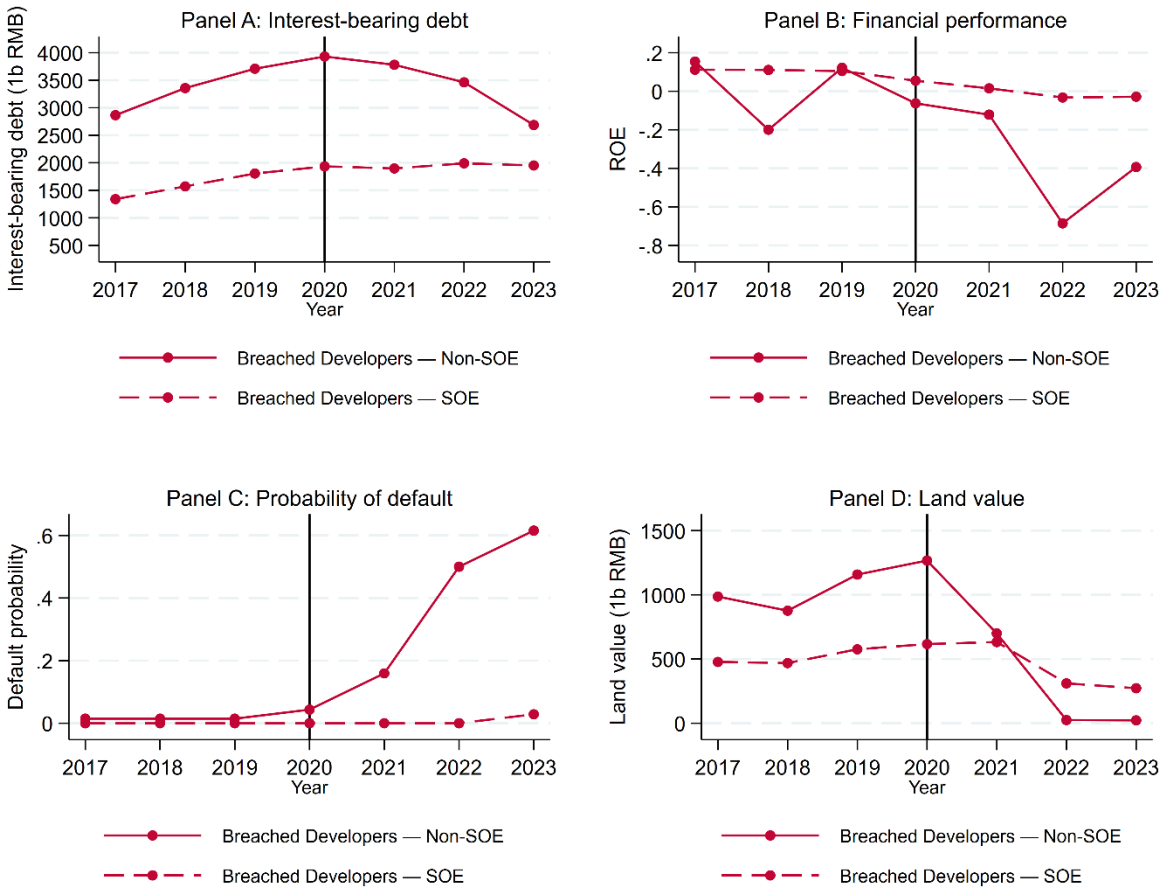
The figure summarizes the institutional relationships between local governments, LGFVs (primary land developers), and real estate developers, and illustrates how the Three-Red-Lines policy constrains real estate developers and affects land-transfer revenues.

Figure 4 The Impact of Three-Red-Lines on Real Estate Developers



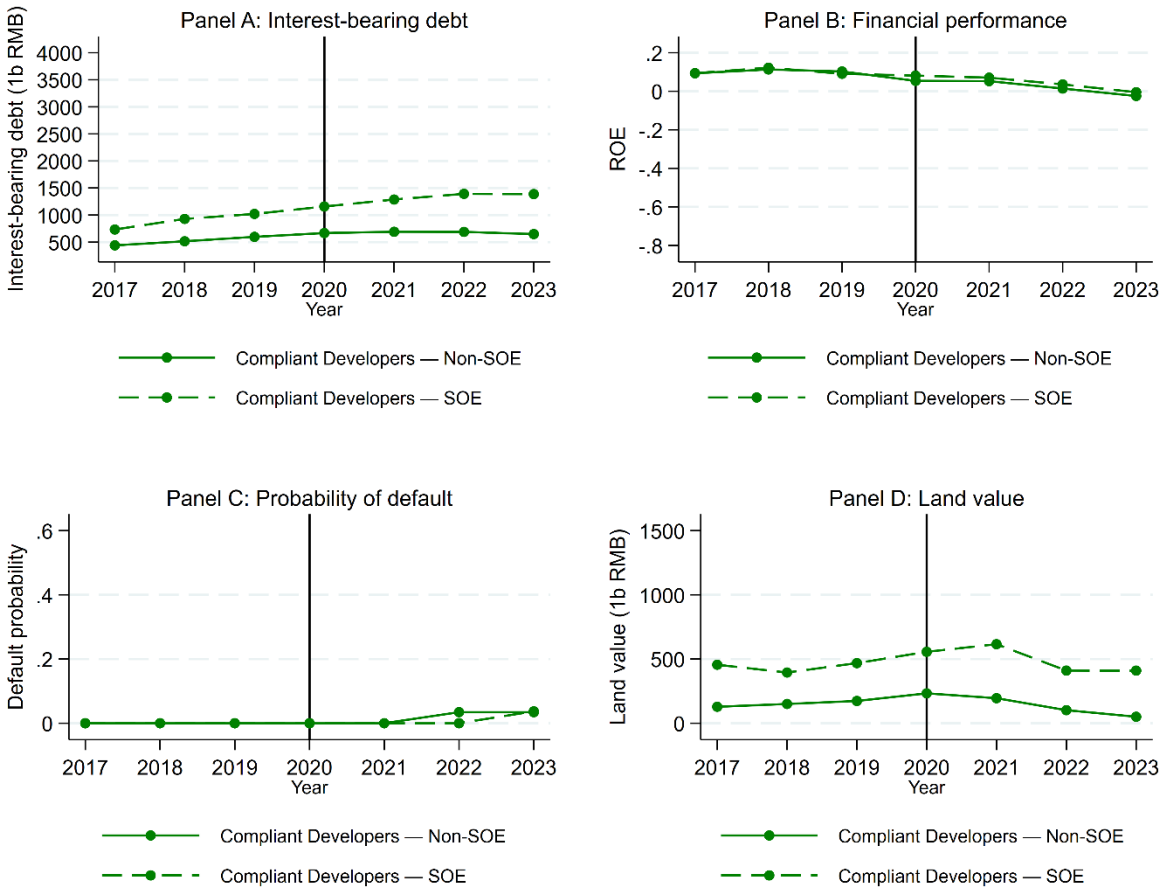
This figure shows the effects of the TRL policy on real estate developers. The green dashed line represents developers that did not cross any "red" lines (i.e., asset-liability ratio, net debt ratio, and cash to short-term debt ratio), while the red solid line represents developers that crossed at least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

Figure 5 Breached Developers: SOEs vs non-SOEs



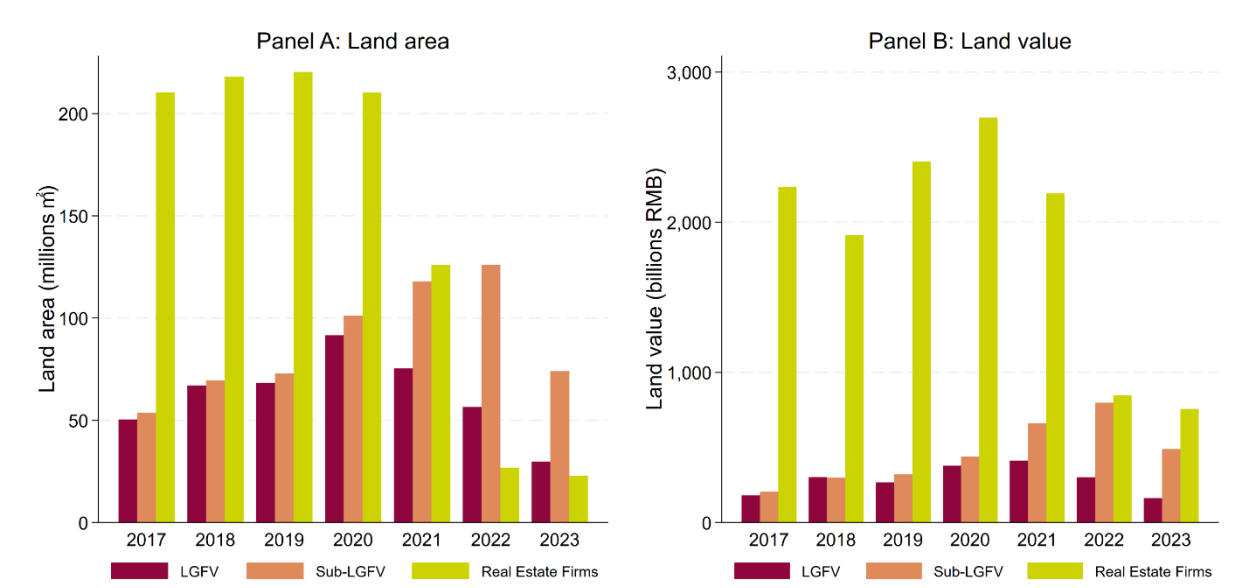
This figure compares state-owned enterprises (SOEs) and non–state-owned enterprises (non-SOEs) within the subsample of developers that breached at least one TRL threshold in 2019. The red solid line represents privately-owned listed developers, while the red dashed line represents state-owned listed developers. Panels A, B, C, and D show aggregate interest-bearing debt (billions of RMB), average ROE, average default probability, and aggregate land acquisition value (billions of RMB) for these two groups of firms, respectively.

Figure 6 Compliant Developers: SOEs vs non-SOEs



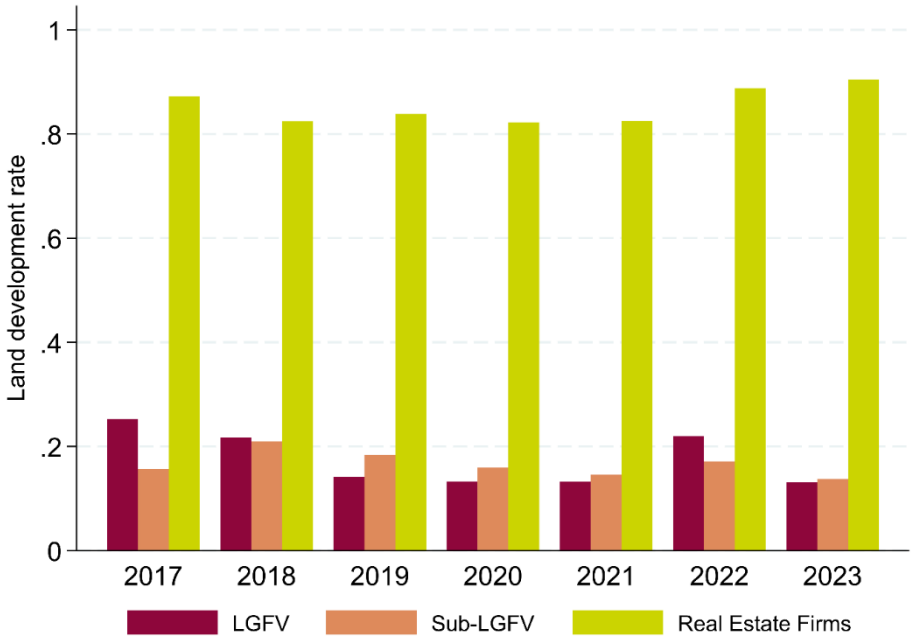
This figure compares state-owned enterprises (SOEs) and non–state-owned enterprises (non-SOEs) within the subsample of developers that did not breach any TRL thresholds in 2019. The green solid line represents privately-owned listed developers, while the green dashed line represents state-owned listed developers. Panels A, B, C, and D show aggregate interest-bearing debt (billions of RMB), average ROE, average default probability, and aggregate land acquisition value (billions of RMB) for these two groups of firms, respectively.

Figure 7 Land Purchases of LGFVs, Sub-LGFVs, and Real Estate Firms



This figure shows the land transactions in the primary land market of three categories of landholders: LGFVs (local government financing vehicles), Sub-LGFVs (subsidiaries of LGFVs with ownership stakes exceeding 50%), and Real Estate Firms (160 publicly listed companies).

Figure 8 Land Development Rate of LGFVs, Sub-LGFVs, and Real Estate Firms



This figure shows the land development rates for parcels acquired by three categories of landholders: LGFVs (local government financing vehicles), Sub-LGFVs (subsidiaries of LGFVs with ownership stakes exceeding 50%), and Real Estate Firms (160 publicly listed companies). Land development is defined as the conversion of purchased residential land into housing projects subsequently opened for sale. Data on projects opened for sale are sourced from the CREIS database, which records the first project opening date, the landholder, the project developer, and the project beneficiary for each development. Land transaction data in the primary market are obtained from the CRIC information system.

Table 1: Summary Statistics

This table reports the summary statistics for different sets of data used in our analysis. Panel A reports the summary statistics for the firm-year level data consisting of 160 public real estate firms from 2017 to 2023. *LinesCrossed* 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. *Private* is a dummy variable that equals one if a firm is a privately-owned enterprise, and zero otherwise. *Size* is the natural logarithm of a firm's total assets. *Liability-to-asset ratio* is the ratio of total liability 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. *Ln(Sales)* is the natural logarithm of sales revenue. *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 previous years, and zero otherwise. *Firm land value (1b RMB)* is the total land value in billions of RMB of all lands bought by the firm in each year. Panel B shows the summary statistics of the project-quarter level housing sales data from the China Real Estate Index System (CREIS) database. This consists of 15,614 housing projects of 145 public real estate firms from 2017 to 2023. *Sales units* is the number of housing units sold in each quarter. *Sales area (1k m^2)* is the equity-adjusted sales area in thousands of square meters sold in each quarter. *Sales value (1m RMB)* is the equity-adjusted sales value in millions of RMB sold in each quarter. *Sales price (RMB/m^2)* is the average selling price per square meter of housing units sold in each quarter. Panel C shows the summary statistics of the firm-quarter level new housing project opening data of public real estate firms from 2017 to 2023. *# of Projects* is the number of new housing projects opened for sale. *# of Units* is the total number of units of the new housing projects opened for sale. *Construction area (10k m^2)* is the total construction area of the new housing projects opened for sale. Panel D shows the summary statistics of the city-year level land purchasing data 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. *Ln(City population)* is the natural logarithm of the population in the city in each year. *Total land value (1b RMB)* measures, for each city-year, the total transaction value (in billions of RMB) of business and private residential land sold. *LGFV value (1b RMB)* and *Sub-LGFV value (1b RMB)* are the corresponding land values purchased by LGFV firms and Sub-LGFV firms, respectively. *LGFV value/Non-LGFV value* and *Sub-LGFV value/Non-LGFV* value capture the relative importance of these buyers by taking the ratio of land value purchased by LGFVs (or Sub-LGFVs) to land value purchased by non-LGFV buyers in the same city-year. All continuous variables are winsorized at the 1st and 99th percentiles.

Panel A: Firm-year level financial information

Variables	N	Mean	Std Dev	P5	Median	P95
LinesCrossed	1,113	1.228	1.156	0.000	1.000	3.000
Post	1,113	0.425	0.495	0.000	0.000	1.000
Private	1,113	0.610	0.488	0.000	1.000	1.000
Size	1,113	24.753	1.611	21.869	24.835	27.217
Liability-to-asset ratio	1,103	0.660	0.199	0.260	0.714	0.908
Debt-to-equity ratio	1,103	1.008	1.458	-0.344	0.691	3.485
Cash-to-short term debt ratio	1,076	4.620	16.793	0.060	1.133	12.152
Ln(Interest-bearing debt)	1,087	23.445	1.977	20.074	23.753	25.979
Ln(Sales)	1,103	22.991	1.715	20.054	23.056	25.725
ROE	1,092	0.029	0.203	-0.406	0.063	0.243
Default	1,113	0.084	0.278	0.000	0.000	1.000
Firm land value (1b RMB)	1,113	11.439	24.230	0.000	1.397	61.243

Panel B: Project-quarter level sales data

Variables	N	Mean	Std Dev	P5	Median	P95
Sales units	181,708	86.058	145.915	1.000	34.000	340.000
Sales area (1k m^2)	181,708	7.345	13.743	0.087	2.602	29.947
Sales value (1m RMB)	181,708	121.532	260.164	1.112	40.278	492.790
Sales price (RMB/m^2)	181,689	19334.160	16023.888	6255.712	14475.888	47912.805

Panel C: Firm-quarter level new project opening data

Variables	N	Mean	Std Dev	P5	Median	P95
# of Projects	3,892	4.123	10.388	0.000	1.000	20.000
# of Units	3,892	4806.096	22976.539	0.000	183.510	20417.550
Construction area (10k m^2)	3,892	107.968	787.914	0.000	3.415	417.563

Panel D: City-year level macro data

Variables	N	Mean	Std Dev	P5	Median	P95
Intensity	1,861	0.183	0.144	0.000	0.155	0.438
Ln(City population)	1,861	5.904	0.691	4.711	5.952	6.923
Total land 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 2: The Impact of Three-Red-Lines Policy on Real Estate Firms

This table reports the OLS regression results on the impact of the TRL policy on real estate firms. The sample period is from 2017 to 2023. Panel A shows the overall treatment effects of the TRL policy. Panel B shows the dynamic effects of the policy. *Ln(Interest-bearing debt)* is the natural logarithm of the interest-bearing debt. *Firm land value (1b RMB)* is the total land value in billions of RMB of all lands bought by the firm in each year. *Ln(Sales)* is the natural logarithm of sales revenue. *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 previous years, and zero otherwise. *LinesCrossed* 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. *Size* is the natural logarithm of a firm's total assets. *Year2018* is a dummy variable that equals one for the year of 2018, and zero otherwise. Other year dummies are defined similarly. 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. Pre-trends F-test (p-value) reports p-values from an F-test that the pre-policy interaction coefficients are jointly equal to zero (baseline year: 2017).

Panel A: Overall effects

Variables	(1) *Ln(Interest-bearing debt)*	(2) *Firm land value (1b RMB)*	(3) *Ln(Sales)*	(4) *ROE*	(5) *Default*
LinesCrossed × *Post*	-0.106**	-3.055***	-0.066**	-0.083***	0.107***
	(-2.51)	(-2.81)	(-1.99)	(-6.03)	(5.14)
Size	0.681***	0.007	0.737***	0.002	0.020
	(5.94)	(0.01)	(8.18)	(0.09)	(0.69)
Observations	1,087	1,113	1,103	1,092	1,113
Adjusted R^2	0.935	0.775	0.954	0.467	0.426
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) *Ln(Interest-bearing debt)*	(2) *Firm land value (1b RMB)*	(3) *Ln(Sales)*	(4) *ROE*	(5) *Default*
LinesCrossed × *Year2018*	0.002	-0.794	-0.003	-0.017	-0.002
	(0.05)	(-0.83)	(-0.11)	(-1.50)	(-0.86)
LinesCrossed × *Year2019*	-0.032	0.396	0.027	-0.014	-0.003
	(-0.89)	(0.31)	(0.97)	(-1.20)	(-0.89)
LinesCrossed × *Year2020*	-0.099***	-0.219	0.001	-0.030**	0.008
	(-2.78)	(-0.19)	(0.01)	(-2.12)	(0.80)
LinesCrossed × *Year2021*	-0.140***	-2.581	-0.060	-0.090***	0.051**
	(-3.42)	(-1.63)	(-1.54)	(-5.20)	(2.47)
LinesCrossed × *Year2022*	-0.144***	-3.787**	-0.067	-0.118***	0.130***
	(-2.82)	(-2.53)	(-1.41)	(-6.00)	(4.63)
LinesCrossed × *Year2023*	-0.132**	-3.296**	-0.052	-0.086***	0.147***
	(-1.98)	(-2.26)	(-1.11)	(-4.29)	(5.10)
Size	0.694***	-0.042	0.735***	0.006	0.026
	(5.92)	(-0.03)	(7.99)	(0.37)	(0.84)
Observations	1,087	1,113	1,103	1,092	1,113
Adjusted R^2	0.935	0.774	0.954	0.470	0.438
Firm FEs	YES	YES	YES	YES	YES
Year FEs	YES	YES	YES	YES	YES
Cluster	Firm	Firm	Firm	Firm	Firm
Pre-trends F-test (p-value)	0.002	0.319	0.619	0.164	0.363

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 TRL policy on real estate firms. The sample period is from 2017 to 2023. *Ln(Interest-bearing debt)* is the natural logarithm of the interest-bearing debt. *Firm land value (1b RMB)* is the total land value in billions of RMB of all lands bought by the firm in each year. *Ln(Sales)* is the natural logarithm of sales revenue. *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 previous years, and zero otherwise. *LinesCrossed* 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. *Size* is the natural logarithm of a firm's total assets. *Private* is a dummy variable that equals one if a firm is a privately-owned enterprise, and zero otherwise. 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) *Ln(Interest-bearing debt)*	(2) *Firm land value (1b RMB)*	(3) *Ln(Sales)*	(4) *ROE*	(5) *Default*
Private × *LinesCrossed* × *Post*	0.069	-2.413	-0.128**	-0.099***	0.159***
	(0.86)	(-1.16)	(-2.14)	(-4.82)	(5.59)
LinesCrossed × *Post*	-0.136***	-1.380	0.015	-0.024**	0.003
	(-3.11)	(-0.96)	(0.37)	(-2.02)	(0.41)
Private × *Post*	-0.369**	-3.807	-0.077	-0.039	0.070*
	(-2.19)	(-1.34)	(-0.74)	(-1.52)	(1.88)
Size	0.652***	-0.379	0.726***	-0.004	0.032
	(6.15)	(-0.35)	(8.39)	(-0.22)	(1.05)
Observations	1,087	1,113	1,103	1,092	1,113
Adjusted R^2	0.936	0.780	0.955	0.526	0.514
Firm FEs	YES	YES	YES	YES	YES
Year FEs	YES	YES	YES	YES	YES
Cluster	Firm	Firm	Firm	Firm	Firm

Table 4: The Impact of Three-Red-Lines Policy on Housing Sales

This table reports the OLS regression results on the impact of the TRL policy on housing sales of public real estate firms covered by the CREIS Database. The data is at the firm-quarter level. The sample period is from 2017 to 2023. *Ln(Sales units)* is the natural logarithm of the number of units sold by each firm in each quarter. *Ln(Sales area (1k m^2))* is the natural logarithm of the total area sold by each firm in each quarter. *Ln(Sales value (1m RMB))* is the natural logarithm of the total land value sold by each firm in quarter. *Ln(Sales price (RMB/m^2))* is the natural logarithm of the average sales price across all units sold by each firm in each quarter. *LinesCrossed* 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. *Size* is the natural logarithm of a firm's total assets. *Private* is a dummy variable that equals one if a firm is a privately-owned enterprise, and zero otherwise. 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) *Ln(Sales units)*	(2) *Ln(Sales area (1k m^2))*	(3) *Ln(Sales value (1m RMB))*	(4) *Ln(Sales price (RMB/m^2))*
LinesCrossed × *Post*	-0.124**	-0.128**	-0.171***	-0.043**
	(-2.27)	(-2.53)	(-3.20)	(-2.36)
Size	0.623***	0.560***	0.639***	0.079**
	(3.06)	(3.00)	(3.13)	(2.12)
Observations	3,883	3,883	3,883	3,883
Adjusted R^2	0.857	0.859	0.843	0.733
Firm FEs	YES	YES	YES	YES
Year-Quarter FEs	YES	YES	YES	YES
Cluster	Firm	Firm	Firm	Firm

Panel B: Differential effects across firm types

Variables	(1) *Ln(Sales units)*	(2) *Ln(Sales area (1k m^2))*	(3) *Ln(Sales value (1m RMB))*	(4) *Ln(Sales price (RMB/m^2))*
Private × *LinesCrossed* × *Post*	-0.169*	-0.210**	-0.218**	-0.008
	(-1.71)	(-2.34)	(-2.37)	(-0.20)
LinesCrossed × *Post*	0.007	0.023	-0.008	-0.031
	(0.09)	(0.34)	(-0.11)	(-0.94)
Private × *Post*	-0.367*	-0.233	-0.364*	-0.131*
	(-1.80)	(-1.27)	(-1.90)	(-1.78)
Size	0.604***	0.550***	0.620***	0.071**
	(3.19)	(3.14)	(3.30)	(2.13)
Observations	3,883	3,883	3,883	3,883
Adjusted R^2	0.862	0.863	0.849	0.737
Firm FEs	YES	YES	YES	YES
Year-Quarter FEs	YES	YES	YES	YES
Cluster	Firm	Firm	Firm	Firm

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

This table reports the Poisson regression results on the impact of the TRL policy on the introduction of new housing projects of public real estate firms covered by the CREIS Database. The data is at the firm-quarter level. The sample period is from 2017 to 2023. *# of Projects* is the number of new housing projects introduced by each firm in each quarter. *# of Units* is the total number of units of the new housing projects introduced by each firm in each quarter. *Construction area (10k m^2)* is the total construction area of the new housing projects introduced by each firm in each quarter. *LinesCrossed* 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. *Size* is the natural logarithm of a firm's total assets. *Private* is a dummy variable that equals one if a firm is a privately-owned enterprise, and zero otherwise. Standard errors are clustered at the firm level, and *z*-statistics are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Post-treatment effects

Variables	(1) *# of Projects*	(2) *# of Units*	(3) *Construction area (10k m^2)*
LinesCrossed × Post	-0.295***	-0.432***	-0.412***
	(-4.29)	(-4.59)	(-2.99)
Size	0.314*	0.492*	-0.268
	(1.73)	(1.87)	(-0.82)
Observations	3,864	3,864	3,864
Pseudo R^2	0.753	0.861	0.790
Firm Fes	YES	YES	YES
Year-Quarter FEs	YES	YES	YES
Cluster	Firm	Firm	Firm

Panel B: Differential effects across firm types

Variables	(1) *# of Projects*	(2) *# of Units*	(3) *Construction area (10k m^2)*
Private × LinesCrossed × Post	-0.241**	-0.407***	-0.488***
	(-2.02)	(-3.22)	(-3.12)
LinesCrossed × Post	-0.108	-0.133	-0.097
	(-1.19)	(-1.45)	(-1.15)
Private × Post	-0.363**	-0.234**	0.055
	(-2.36)	(-2.23)	(0.24)
Size	0.360**	0.468**	-0.350
	(2.18)	(2.17)	(-0.92)
Observations	3,864	3,864	3,864
Pseudo R^2	0.759	0.867	0.795
Firm FEs	YES	YES	YES
Year-Quarter FEs	YES	YES	YES
Cluster	Firm	Firm	Firm

Table 6: The Impact of Three-Red-Lines Policy on Housing Demand

This table reports the OLS regression results on the impact of the TRL policy on housing sales of public real estate firms covered by the CREIS Database. The data is at the project-quarter level. The sample period is from 2017 to 2023. *Ln(Sales units)* is the natural logarithm of the number of units sold by each project in each quarter. *Ln(Sales area (1k m^2))* is the natural logarithm of the total area sold by each project in each quarter. *Ln(Sales value (1m RMB))* is the natural logarithm of the total land value sold by each project in each quarter. *Ln(Sales price (RMB/m^2))* is the natural logarithm of the average sales price across all units sold by each project in each quarter. *LinesCrossed* 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. *Size* is the natural logarithm of a firm's total assets. *Private* is a dummy variable that equals one if a firm is a privately-owned enterprise, and zero otherwise. 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) *Ln(Sales units)*	(2) *Ln(Sales area (1k m^2))*	(3) *Ln(Sales value (1m RMB))*	(4) *Ln(Sales price (RMB/m^2))*
LinesCrossed × *Post*	0.002	0.003	0.002	-0.000
	(0.05)	(0.10)	(0.06)	(-0.16)
Size	-0.366***	-0.343***	-0.357***	-0.012
	(-3.60)	(-3.36)	(-3.37)	(-1.31)
Observations	181,708	181,709	181,377	181,377
Adjusted R^2	0.497	0.527	0.539	0.953
Project FEs	YES	YES	YES	YES
City-Quarter FEs	YES	YES	YES	YES
Cluster	Firm	Firm	Firm	Firm

Panel B: Differential effects across firm types

Variables	(1) *Ln(Sales units)*	(2) *Ln(Sales area (1k m^2))*	(3) *Ln(Sales value (1m RMB))*	(4) *Ln(Sales price (RMB/m^2))*
Private × *LinesCrossed* × *Post*	-0.135***	-0.130***	-0.128***	0.000
	(-2.76)	(-2.76)	(-2.63)	(0.00)
LinesCrossed × *Post*	0.088***	0.088***	0.086***	0.001
	(3.22)	(3.24)	(3.01)	(0.33)
Private × *Post*	-0.014	-0.027	-0.045	-0.014
	(-0.12)	(-0.25)	(-0.40)	(-1.45)
Size	-0.389***	-0.367***	-0.382***	-0.013
	(-4.06)	(-3.84)	(-3.90)	(-1.59)
Observations	181,708	181,709	181,377	181,377
Adjusted R^2	0.497	0.528	0.540	0.953
Project FEs	YES	YES	YES	YES
City-Quarter FEs	YES	YES	YES	YES
Cluster	Firm	Firm	Firm	Firm

Table 7: The Impact of Three-Red-Lines Policy on LGFV Land Purchases

This table reports the OLS regression results on the impact of the TRL policy on city-level land purchases. The sample period is from 2017 to 2023. *Ln(Total land value)* is the natural logarithm of the total transaction value of business and private residential land sold in a given city-year. *Ln(LGFV value)* and *Ln(Sub-LGFV value)* are defined analogously, using the land value purchased by LGFVs and by LGFVs' subsidiaries, respectively. *LGFV value/Non-LGFV value* and *Sub-LGFV value/Non-LGFV value* measure the relative importance of these buyers by taking the ratio of land value purchased by LGFVs (or their subsidiaries) to land value purchased by non-LGFV firms in the same city-year. *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. 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(Total land 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*	-0.616**	1.765*	1.601**	0.087**	0.211***
	(-2.53)	(1.90)	(2.26)	(2.12)	(3.62)
Ln(City population)	0.922***	-0.305	-0.353	-0.065	-0.197**
	(2.64)	(-0.14)	(-0.38)	(-1.47)	(-2.57)
Observations	1,861	995	1,243	1,861	1,861
Adjusted R^2	0.913	0.547	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

Online Appendix for

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

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Section A: 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.

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 A4 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.

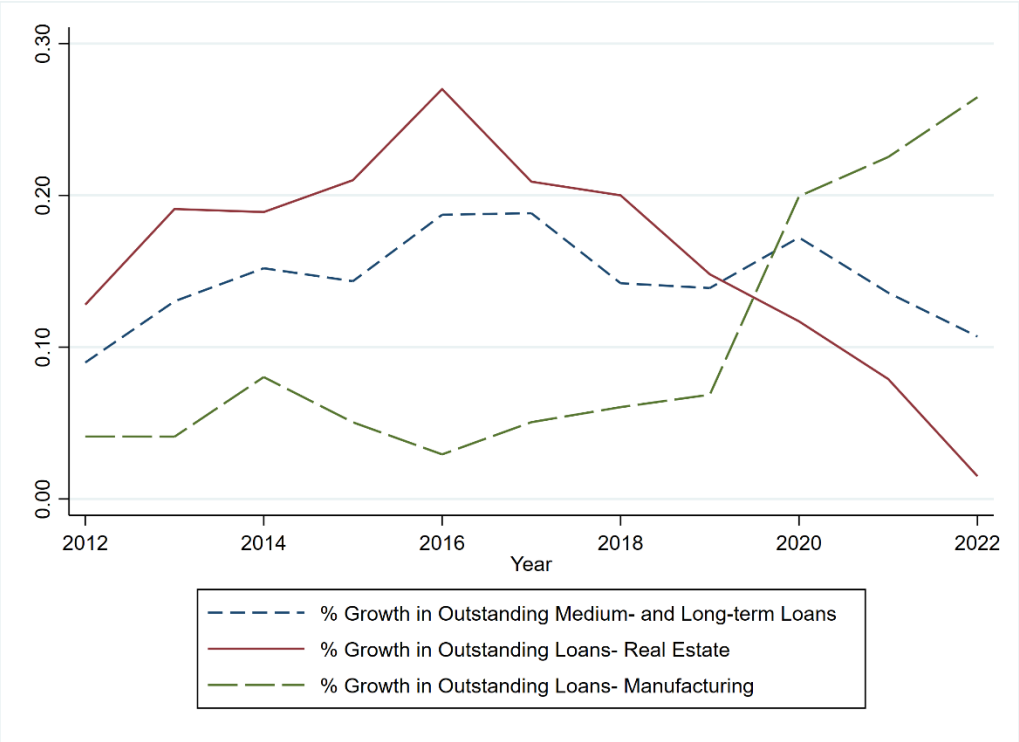
To assess the economic activity and development on the purchased lands, we measure the satellite nightlight level for each land parcel at the purchase year, and two years following the purchase. In particular, *Light at t*+2 measures the land light two years after purchase, and *LightChange (t*+2*)-(t)* 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 A5. 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 16.356, the results indicate that LGFVs develop purchased lands 7.5% (–1.233 / 16.356) slower, and Sub-LGFVs develop purchased lands 3.4% (–0.558 / 16.356) 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.

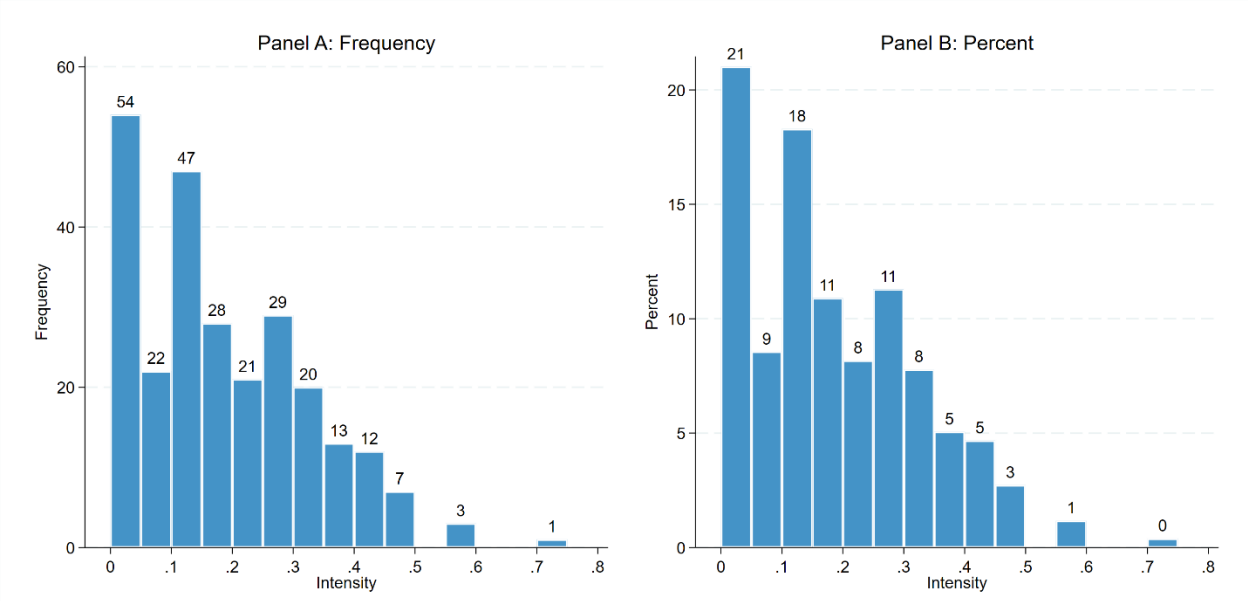
[Insert Table A5 about here]

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



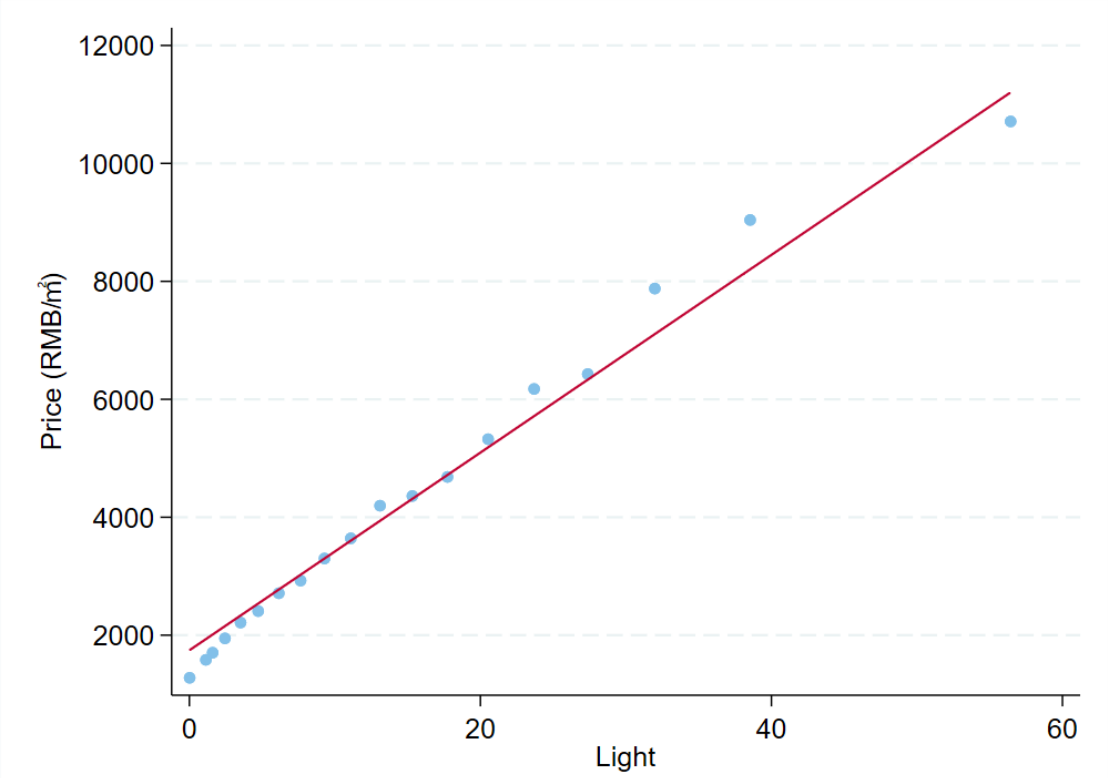
This graph illustrates the percentage growth in outstanding RMB loans in China from 2012 to 2022. The short-dashed blue line represents the year-over-year growth in overall outstanding medium- and long-term loans. The solid red line indicates the year-over-year growth in outstanding loans to the real 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 (Panel A) and percentage distribution (Panel B) of the city-level Three-Red-Lines policy intensity.

Figure A3 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.

Table A1: Comparing Coverage by CRIC and Land China

This table compares the aggregate coverage of land transactions recorded by China Real Estate Information Corporation (CRIC) and Land China (landchina.com). Land China, the official land management and market information platform under China's Ministry of Natural Resources, is responsible for publishing nationwide land supply plans, land use rights transfers, and transaction results. CRIC is a leading provider of real estate information and analysis. For this comparison, only land parcels acquired by firms (excluding individual acquisitions) are included, and the sample is restricted to transactions involving land designated for commercial/residential, commercial/office, and residential use.

	Number of land sites			Land area (in 10k m^2)			Land value (in 10k RMB)		
Year	Land China	CRIC	Coverage	Land China	CRIC	Coverage	Land China	CRIC	Coverage
2013	56,832	46,976	83%	166,077	142,733	86%	380,656,480	362,558,016	95%
2014	45,153	38,852	86%	123,571	102,355	83%	293,758,752	273,943,712	93%
2015	36,639	31,506	86%	97,370	80,590	83%	265,523,392	255,781,584	96%
2016	33,847	29,971	89%	89,229	76,287	85%	311,789,600	328,380,480	105%
2017	34,411	34,563	100%	97,117	94,496	97%	438,838,112	486,636,320	111%
2018	41,693	39,726	95%	126,769	116,610	92%	544,808,832	551,591,488	101%
2019	44,023	38,054	86%	130,120	118,767	91%	625,916,608	628,685,056	100%
2020	48,300	41,579	86%	143,434	131,207	91%	745,398,912	738,198,656	99%
2021	42,561	39,664	93%	120,292	113,634	94%	699,714,624	711,241,024	102%
2022	35,837	34,242	96%	93,199	88,389	95%	514,499,424	514,375,712	100%
2023	29,954	28,435	95%	74,051	70,779	96%	422,068,096	428,447,744	102%

Table A2: 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.

	Violate at least 1 line		Violate 0 line		Difference	
	Count	Mean	Count	Mean	T-value	P-value
SOE	104	0.34	56	0.48	-1.78*	0.08*
Total assets (1b RMB)	104	200.38	56	131.60	1.48	0.14
Number of cities	104	22.35	56	8.84	3.23***	0.00***
Land sites	104	103.98	56	39.09	2.46**	0.01**
Land area (10k m^2)	104	523.45	56	186.33	2.41**	0.02**
Land value (1b RMB)	104	45.90	56	31.71	1.09	0.28
Land price (10k RMB)	95	1.86	43	2.63	-1.97*	0.05*

Table A3: Summary Statistics of Firms Crossing Different Numbers of Red Lines

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

	Private				SOE			
Number of red lines crossed	*Number of firms*	*Mean Liability-to-asset ratio*	*Mean Debt-to-equity ratio*	*Mean Cash-to-short term debt ratio*	*Number of firms*	*Mean Liability-to-asset ratio*	*Mean Debt-to-equity ratio*	*Mean Cash-to-short term debt ratio*
3	24	0.80	2.25	0.53	13	0.77	2.17	0.59
2	13	0.76	1.14	0.94	7	0.76	1.56	1.34
1	32	0.65	0.58	1.36	15	0.68	0.66	1.24
0	29	0.42	0.12	28.51	27	0.54	0.23	41.07

Table A4: 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	126	529.75	127	387.78	4.10***	0.00***
City GDP	128	4830.13	129	1843.02	6.11***	0.00***
City GDP growth	119	0.08	118	0.04	2.80***	0.01***
City budget deficit ratio	128	1.56	129	3.04	-6.05***	0.00***

Table A5: The Evolution of Land Night 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. *Light at t*+2 is 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. *LGFV* (*Sub-LGFV*) is a dummy variable that equals one if the landholder is an 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*	-1.233***	-1.117***
	(-2.98)	(-3.11)
Sub-LGFV × *Post*	-0.558*	-0.364
	(-1.75)	(-1.21)
LGFV	0.328	0.115
	(1.41)	(0.65)
Sub-LGFV	0.103	0.235
	(0.54)	(1.57)
Lagged light	0.903***	-0.055***
	(93.13)	(-8.02)
Ln(Price) (RMB/m^2)	0.957***	0.533***
	(14.81)	(12.27)
Ln(Area) (10k m^2)	0.176***	0.086***
	(5.98)	(3.75)
Ln(Max plot ratio)	0.387***	0.208***
	(4.02)	(2.80)
Ln(Land life)	-0.623***	-0.238*
	(-3.72)	(-1.66)
Land quality	0.017	0.012
	(0.93)	(0.89)
Ln(City population)	1.496	-2.166
	(0.67)	(-1.03)
Observations	103,058	103,058
Adjusted R^2	0.811	0.069
Month FEs	YES	YES
City FEs	YES	YES
Sector FEs	YES	YES
Cluster	City	City