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ABSTRACT

This paper provides the first theory and evidence on the role of presale policies in the residential housing market. We start with constructing a novel dataset of unfinished projects, presale policies, and land auction outcomes across 270 major cities in China. We then identify 2,330 unfinished residential projects from 2010 to 2017 on a citizen complaint website run by the central government. We find that both presale criterion and postsale supervision of construction costs relate to a lower probability of unfinished projects. But only presale criterion relates negatively to the pace of new housing development, measured by developers' multitasking and land auction outcomes. A back-of-the-envelope calculation suggests that the average bundle of presale policies is inferior to the Pareto frontier in our sampled cities. Tightening the regulation on postsale supervision by 2 standard deviations may lead to a 58% reduction in the occurrence of unfinished projects, while keeping the pace of new housing development unchanged. Eliminating unfinished projects would entail a drastic increase in both presale criterion and postsale supervision, with slower housing development.

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1 Introduction

It is not uncommon to sell new residential properties before construction is completed, this practice is called "presale." According to the US Census Bureau, 675,000 new single-family houses were sold in August 2023, of which 113,000 had not started and 298,000 were under construction at the time of sale.[1] This implies a presale rate close to 61%. Similarly, around 40% of residential units are sold by presale in the United Kingdom and over 70% in Hong Kong.[2]

While presale is prevalent around the world, it is remarkably high in China: over 90% of residential units were sold through presale during the 2010s.[3] In the meantime, the growth of residential housing is astonishing in China – the average living space per urban resident surged from 7.1 m^2 in 1990 to 41.8 m^2 in 2020, accompanied by a more than tenfold increase in average housing prices.[4] The real estate sector contributes to 12.9% of China's GDP, much higher than that of the US, UK and Hong Kong.[5] However, China has also witnessed a surge in unfinished projects, impacting millions of families and posing risks to system-wide financial and social stability. In January 2023, New York Times reports that "infuriated homebuyers in over 100 cities rose up in a rare act of collective rebellion last year, refusing to repay loans on unfinished properties."[6]

What role does presale play in the rapid growth of housing development and the painful surge of unfinished projects? To answer this question, we compile a unique dataset that delineates the presale policies in 270 Chinese cities between 2010 and 2017. These cities account for 96.3% of the population and 99.1% of the GDP in China. After

[1]Source: https://www.census.gov/construction/nrs/pdf/newressales.pdf

[2]UK: https://www.thetimes.co.uk/article/collapse-in-demand-for-off-plan-homes-hits-housebuilding-x6w3k89q8 (The Times); Hong Kong: Li and Chau (2019).

[3]Source: BJ News, retrieved on September 15, 2023.

[4]Source: http://www.news.cn/politics/2022-08/10/c_1128902945.htm, retrieved on December 2, 2023.

[5]World Bank "China Economic Report", June 22, 2022, available at https://thedocs.worldbank.org/en/doc/90cc1e4ce917be77d779609ef2dd8614-0070012022/original/CEU-June-2022-CN.pdf, retrieved on October 21, 2023.

[6]New York Times "They Poured Their Savings Into Homes That Were Never Built", January 24, 2023, available at https://www.nytimes.com/interactive/2023/01/24/world/asia/china-unfinished-apartments.html, retrieved on October 4, 2023.

consulting with engineering experts, we categorize a total of 792 government documents recorded by the China Law Database[7] into two numerical variables as a summary of presale policies. One is "presale criterion", which denotes the minimum percentage of construction progress that developers must achieve before initiating presale. By definition, presale criterion is between 0 and 1. In China, the central government prohibits any presale until the construction reaches at least 25% completion, thus we observe presale criterion from 0.25 to 0.8 in our data. In comparison, presale in the US can occur even before construction commences, implying a presale criterion as low as 0. However, presale in China allows the developer to collect *full* sales revenue from buyers at the time of presale, while presale in the US and other countries may allow the buyer to pay in phases and condition the payment on project progress. The other presale policy variable, "postsale supervision", describes how stringent the government supervises the construction progress after presale. We use the value of 1 to represent the highest supervision standard (akin to the city government withholding 100% of the predicted construction costs postsale in an escrow account until the project is complete on time) and value 0 for the lowest (akin to the government returning all funds in the escrow account to the developer even if the project remains unfinished at the scheduled completion time). Unlike the US and other countries, China has weak laws to protect and compensate buyers upon unfinished construction, and if buyers borrow mortgage, they are obligated to make monthly payment to the lender bank even if the developer fails to deliver their home as scheduled. This implies that presale criterion and postsale supervision are the most important, if not the only, guardrails for individual buyers in China.

We then develop a simple conceptual framework to highlight a crucial tradeoff associated with presale policies. On the one hand, presale enables developers to secure sales proceeds prior to project completion, effectively enhancing their cash flow and alleviating financial constraints. Depending on the extent to which the sales revenue exceeds the remaining construction costs, presale may even allow developers to initiate new projects before completing the ongoing ones, thereby promoting a rapid growth in the real estate sector. This finding represents a significant extension of the prior research (Chan,

[7]This database (www.pkulaw.net) is maintained by the Legal Information Center of Peking University.

Wang, and Yang, 2012; Edelstein, Liu, and Wu, 2012). On the other hand, presale carries potential risks for homebuyers if developers fail to fulfill their construction obligations within the initially specified timeframe. Inadequate postsale supervision may incentivize developers to divert construction funds for other purposes, leading to unfinished projects.

Our model predicts that both tightening the presale criterion and strengthening postsale supervision will reduce the probability of unfinished projects. A stricter presale criterion reduces the developer's benefits to halt construction, while a tighter supervision increases the costs associated with abandoning projects. These effects are predicted to increase with the cost of the focal project. However, the two policy levers have distinct influences on the pace of urban development. A more lenient presale criterion encourages developers to undertake multiple projects simultaneously and enables them to generate higher profits. Apparently, the more revenue a developer can obtain from presale of the current project (relative to its construction cost), the greater influence of presale criterion on their ability to pursue other projects concurrently. In contrast, postsale supervision has no impact on the probability of initiating a new project in parallel since supervision only affects how much funds the developer can retrieve from the government's escrow account after completing the current project.

To test these predictions, we construct a novel dataset of unfinished residential projects based on comments posted on the Local Leaders' Message Board (LLMB). The LLMB, administered by China's central government, serves as a platform for citizens to express their grievances and concerns. Local officials are obligated to promptly address these messages, making it a common avenue to lodge complaints regarding various issues, including unfinished residential projects. By analyzing individual messages on the LLMB, we identify a total of 2,330 unfinished residential projects through 7,478 related complaints from 2010 to 2017 (based on project starting year).[8] The dataset we assemble includes pertinent details such as project name, commencement year, and geographical location of each unfinished project. On average, they correspond to 0.8% of all land parcels sold for residential housing development per city-year.

[8]Most unfinished projects receive multiple complaints in the LLMB.

To the best of our knowledge, our study represents the first systematic collection of unfinished projects and city-year panels on presale policies in China, and the first attempt to establish a theoretical and empirical linkage between these two aspects. In addition, we measure developers' multitasking behavior from land sales data, which is widely used in previous research (Cai, Henderson, and Zhang, 2013; Chen and Kung, 2019). The developers' multitasking behavior is measured by how many residential construction projects they are concurrently working on. Land auction data also enables us to associate presale policies with land auction prices and the rates of auction failures, thereby inferring the role of presale in the land sale revenue of local governments.

Our primary empirical method utilizes a generalized Difference-in-Differences (DiD) approach with city fixed effects, year fixed effects, and observable city and mayor attributes. By incorporating city and year fixed effects, we account for potential variations in citizens' tendency to report unfinished projects on the LLMB across different cities, as well as account for common trends in reporting, construction speed, financing costs, and land supply at the national level.

A potential concern is that mayors who revise presale policies might also take unobserved actions to mitigate the occurance of unfinished projects, such as modifying land auction rules or influencing developers' capacity to undertake multiple projects concurrently,. To address this concern, we adopt a donut DiD approach as in Baltrunaite, Giorgiantonio, Mocetti, and Orlando (2021), akin to donut RD estimators in Barreca, Guldi, Lindo, and Waddell (2011). Specifically, we exclude the city-year observations throughout the entire term of those mayors that have made policy revisions any time in their tenure. The underlying identification assumption is that the current mayor's incentives to revise resale policies are not correlated with the unobserved incentives or actions of their predecessor or successor, once we have controlled for city fixed effects, year fixed effects, and observable city and mayor attributes.

To further alleviate the concern, we conduct a comprehensive search for other city-wide policies in the China Law Database that aim to mitigate the occurance of unfinished projects. Results are robust to controlling for these additional policies, and we found no significant relationship between these additional policies and the two presale policies

under investigation. Moreover, we performed an additional robustness check in the form of an event study, comparing cities that have implemented stricter presale policies (above a specific threshold) with cities that have maintained more lenient presale policies. We find no significant differences between these two groups of cities in the pre-treatment period, confirming the parallel trend assumption. These findings further confirm that the effects of presale policies are distinct from unobservable factors that could potentially confound our key results.

Our analysis yields two key findings. First, stricter postsale supervision relates to a significantly lower likelihood of unfinished projects, while the coefficient of presale criterion is also negative but weaker in statistical significance. These findings align with our theoretical framework, though the theory does not explicitly speak to the relative effectiveness of the two policy levers in addressing unfinished projects. Consistent with our theory's predictions, the role of postsale supervision is more pronounced for projects in cities with stricter requirements for earthquake resistance in urban buildings (which significantly increases construction costs). Second, our theoretical prediction suggests that a more lenient presale criterion allows developers to undertake a greater number of concurrent projects; this leniency also relates to higher auction success rates and greater land auction revenue for the local government. As expected, these estimates are stronger in cities where the expected presale revenue net of land costs is higher. Moreover, we find little correlation between postsale supervision and these two auction outcomes, again consistent with the theory.

To facilitate a straightforward comparison across various sets of presale policies, we conduct a back-of-the-envelope analysis by constructing an efficient frontier with minimizing the occurance of unfinished builidings and maximizing the amount of new developments as the objective. This analysis demonstrates that the status quo lies within the interior of the Pareto frontier. Keeping the existing presale criterion and increasing postsale supervision by 2 standard deviation (from 0.22 to 0.8) yields a 58% reduction in unfinished projects, while keeping the pace of new housing development unchanged. To eliminating the occurance of unfinished projects to zero, we would need to strengthen the presale criterion to 0.7 and postsale supervision to 0.8, resulting in a 5% slowdown

in new housing development through less developer multitasking. The strengthened standards are close to the presale policy bundle prevailing in the US and Hong Kong, if presale criterion reflects the time when a developer can access the full presale revenue of the new house rather than the time that the developer can start to collect any money from the buyer.

Our study contributes to the growing literature on presale practices in the residential housing market. Despite its widespread adoption in major economies worldwide, there has been a limited focus on conducting comprehensive assessments of the associated costs and benefits. Most previous research approached presale from a theoretical standpoint (Buttimer, Clark, and Ott, 2008; Chan, Wang, and Yang, 2012; Edelstein, Liu, and Wu, 2012; Lai, Wang, and Zhou, 2004). However, these studies typically examine presale as a single-period problem, overlooking the fact that presale enables developers to secure sales proceeds at an early stage and jump on opportunities to engage in concurrent development projects. This could eventually accelerate the pace of urban development, as we have witnessed in China. Empirical evidence on presale of residential housing predominantly focuses on Hong Kong, especially on the determinants of presale timing, price discounts (Gan, Hu, Shi, and Zhang, 2023; Li, Bao, and Chau, 2023), presale contract rescission (Gan, Hu, and Wan, 2022). This paper aims to fill this research gap, by conducting a comprehensive economic study that evaluates presale policies in mainland China, both theoretically and empirically.

In doing so, our paper represents the first attempt to systematically collect and quantify data on unfinished projects and presale policies in China.[9] Despite the presence of unfinished projects since the 2000s, which coincides with the implementation and amendments of presale policies in China and has received considerable media coverage, presale of residential housing has garnered limited attention in academic research.[10] As

[9]Some recent policy reports, such as the YiJu-Research (2022), attempt to measure the extent of unfinished buildings in China. However, their estimates are primarily based on a limited sample of recent unfinished projects (around 300). They extrapolate data for the entire market assuming that 10-20% of the total area developed by real estate companies with any unfinished projects would remain unfinished. Additionally, the scope of these reports does not extend to unfinished projects from earlier years, nor can they ascertain the start year of these unfinished projects.

[10]See a Reuters report at https://www.reuters.com/markets/asia/china-home-buyers-occupy-their-rotting-unfinished-properties-2022-09-26/ and a New York Times article at https://www

real estate accounts for 12.9% of China's GDP and presale applies to 90% of residential units sold in China, these datasets and our findings shed light on this under-explored aspect of the Chinese real estate market and lay the foundation for future research in this area.

Moreover, this paper also relates to a rich body of literature on optimal policy design in the housing market (Agarwal, Chau, Hu, and Wan, 2021; Agarwal, Hu, and Lee, 2023; Berger, Turner, and Zwick, 2020; Lee, Ferdowsian, and Yap, 2023). While the literature focuses on the design of tax and housing assitance programs, we emphasize the importance of presale policies. More specifically, not only do we evaluate the adverse impacts of presale policies in terms of unfinished projects, we but also explore the potential benefits of presale policies in fostering rapid urban development. A narrower focus on the costs associated with presale policies may overlook local governments' incentives in implementing such policies, potentially leading to a misguided optimal policy design. By considering both the benefits and costs of presale policies, we demonstrate the potential of Pareto improvement for most cities.

The rest of the paper is organized as follows: Section 2 discusses the background of the presale policy in China. Section 3 presents a conceptual framework for analyzing the presale policy. Section 4 describes the data utilized in our empirical analysis. Section 5 outlines our empirical strategies, followed by the empirical results in Section 6. Section 7 delves into optimal policy design, drawing on both the model and the empirical results. Finally, Section 8 concludes the paper.

2 Institutional Background

2.1 Presale in the residential housing market

Presale, also known as off-plan sales or pre-construction sales, refers to the practice of selling residential properties by property developers before the construction is completed. This approach enables developers to secure funding early in the development

.nytimes.com/interactive/2023/01/24/world/asia/china-unfinished-apartments.html.

process and assess the market demand for their projects. Presale is a widely adopted practice in the real estate industry in many major economies around the world. For instance, 61% of new single-family houses were sold through presale in the US in August 2023. Similarly, presale constitutes approximately 70% of home sales in Hong Kong and 40% in the United Kingdom.

The concept of presale emerged in the Chinese real estate market in the late 1980s and early 1990s. In 1994, the Ministry of Construction issued "The Urban Commercial Housing Pre-sale Management Measures", officially permitting presale in mainland China's housing market. Since then, presale has become a dominant practice, with over 90% of the houses being sold through presale during the 2010s.[11] This widespread adoption of presale underscores its instrumental role in fostering substantial growth of the real estate sector in China.

In practice, housing presale encompasses a *bundle* of policies, which comprises presale criterion, postsale supervision, and legal protections available to presale buyers. First, presale criterion establishes the minimum construction progress required before a presale can take place. In mainland China, the central government mandates that all buildings must be at least 25% completed for presale. Local governments have the discretion to set higher standards. As shown in Section 4, the national average presale criterion in mainland China is 33%. Similarly, in Hong Kong, the presale process is regulated by the Lands Department. Developers can commence presale no earlier than 20 months before the estimated completion time, and all foundation works must be completed. Additionally, the developer must obtain consent from the Building Authority to begin construction on the main structure. Together, these regulations in Hong Kong correspond to approximately 30% of a project's construction progress. In contrast, in the US, there are no strict federal-level regulations on presale criteria; in 2022, around 30% of residential projects were even sold before construction began.[12]

Second, postsale supervision describes how stringent the government supervises the

[11]The remaining 10% of the houses that are not presold are typically government-subsidized affordable houses.

[12]Source: https://www.census.gov/construction/nrs/pdf/newressales.pdf

construction progress after presale. There were no national regulations in China governing this policy during our sample period from 2010 to 2017. In 2010, 78% of the cities in our sample did not have any postsale supervision. This number decreased to 36% in 2017. In cities with the strictest postsale supervision in mainland China, developers are obligated to deposit more than 110% of the expected remaining construction costs into a bank account overseen by a third-party monitoring system. The fund will be released based on construction progress, and less than 60% of the funds will be released after the completion of the building's main structure. In contrast, postsale supervision in the US and Hong Kong is more stringent. Unlike in mainland China, where buyers must pay the full housing price at the time of presale, buyers in the US and Hong Kong typically make progressive payments based on construction milestones. Developers are required to establish a separate sales proceeds account for each development project, subject to strict regulations. As discussed in Section 4, the national average of postsale supervision in our sample period is around 0.22. By our definition, this number would be close to 1 (the highest possible level) in the US and Hong Kong.

The legal system in Mainland China is still under development, leading to inadequate protection for homebuyers in the event of unfinished projects. Homebuyers are still obligated to pay for the entire mortgage amount, even if a project turns out to be unfinished. Homebuyers of unfinished properties primarily rely on local governments to address these issues. This reliance incentivizes citizens to report unfinished projects through platforms like the Local Leaders' Message Board, as bringing the problem to the attention of local leaders such as mayors or city secretaries is often the only viable means of resolving these matters.

In contrast, homebuyers in Hong Kong and other regions such as Australia can resort to a relatively more robust legal protection system when faced with unfinished presold properties. For instance, Hong Kong's Consumer Protection Ordinance and Residential Properties Ordinance provide avenues for homebuyers to seek monetary compensation for losses due to a developer's failure to fulfill their obligations. Homebuyers have the option to cancel the contract if the developer fails to deliver the unit within the agreed-upon timeframe. In Australia, if a developer becomes insolvent, dies, or disappears, the

Domestic Building Warranty Insurance (DBI) protects the consumers from financial loss caused by a builder's incomplete or unsatisfactory work.[13]

Figure 1 summarizes the presale process in China. Before the presale begins, a developer must purchase land and cover a portion of the construction cost to ensure that housing projects meet the minimum requirements set by the government. These requirements can be measured by either the share of the total construction costs or the visible progress of the construction. The specific stipulations are outlined in local laws or government administrative regulations, which local officials have the authority to modify. Most developers face credit constraints at this stage, as they often rely on bank loans to finance the land acquisition and initial construction costs.

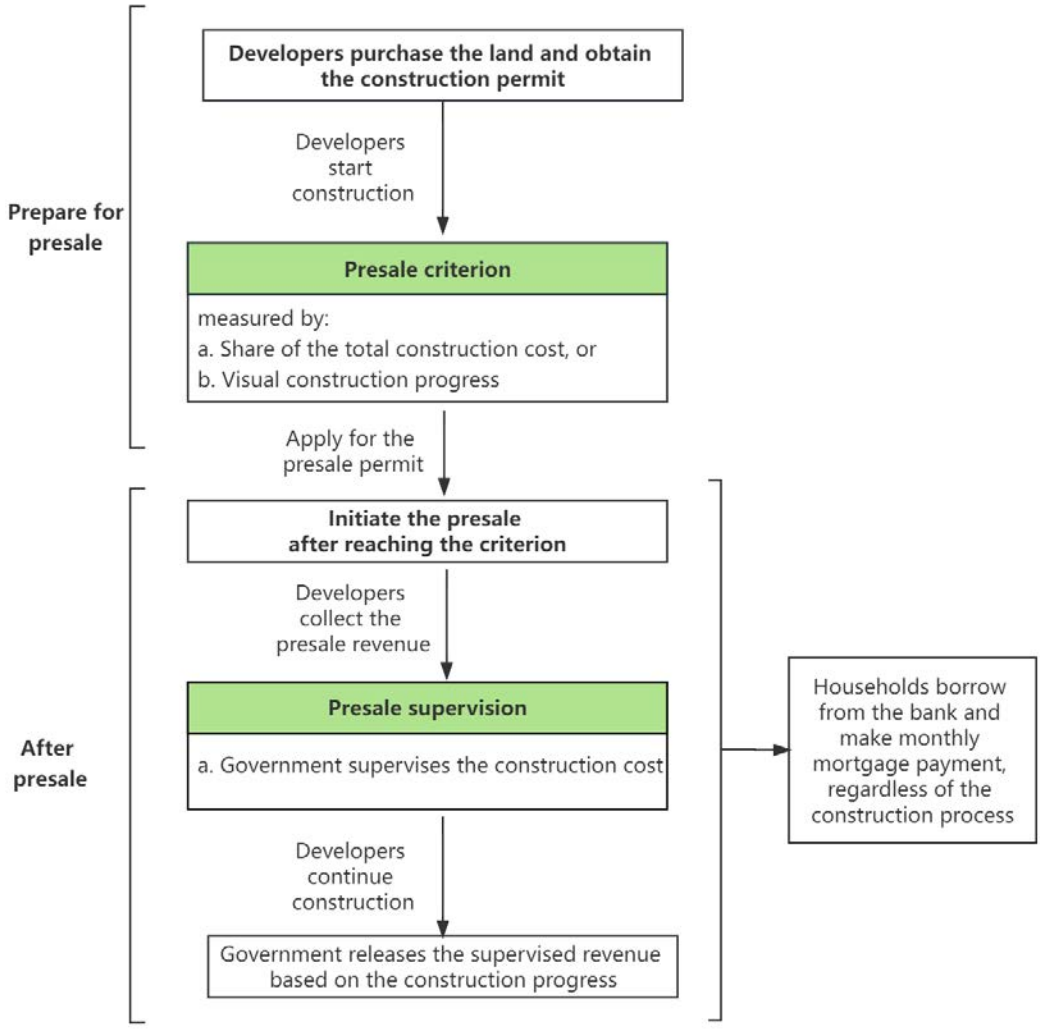
Once the minimum construction progress requirements are met, developers can initiate presales and begin collecting revenue from them. Typically, all units in a building eligible for presale are offered simultaneously and often sell out quickly. Therefore, we assume that developers receive all presale revenues at the time of the presale. This stage also marks the onset of government supervision; in some cities developers are required to deposit the remaining construction funds into a supervised account. However, as detailed in Section 4, there is considerable variation in the degree of supervision, both across cities and over time. Remarkably, some cities do not mandate developers to deposit any of the remaining construction funds into supervised accounts. Once presale begins, house buyers facing cash flow constraints borrow from the bank to finance their purchases.

2.2 Presale as a financial leverage and a risk-sharing tool

The most prominent feature of presale is that it serves as a financial leverage, shortening the borrowing cycle for developers and enabling them to work on multiple projects concurrently. It also functions as a risk-sharing tool that transfers risks from the developer to buyers.

[13]Source: ABC News on 2023/09/28, available at https://www.abc.net.au/news/2023-09-28/builders-collapsing-state-breakdown-of-legal-rights/102878514.

Figure 1: Presale system in mainland China



Given the high financial costs and profitability of the real estate market in China, developers have heavily relied on their ability to swiftly move cash across different projects to maximize fund efficiency. As illustrated in Figure 1, developers often resort to bank loans or utilize their cash holdings to purchase land and finance the initial stage of construction to reach the presale milestone. Upon collecting presale revenue, they can then reallocate their funds to initiate another project. Consequently, a lower presale criterion can enhance financial leverage and expedite this process.

However, a surge in unfinished apartments has drawn unprecedented attention to

the presale model in China's housing market. For example, a news report on Quartz (2022/08/08) was titled "Pre-selling homes in China was a developer's dream, now it's 'only a matter of time before it explodes'."[14] Another article on New York Times (2023/01/24) was titled "They Poured Their Savings Into Homes That Were Never Built."[15] The Ministry of Housing and Urban-Rural Development was startled to find that funds from presales had been misappropriated, leaving many pre-sold residential projects unfinished.[16]

Under the Chinese presale model, presale serves as a risk-sharing tool that shifts risk from the developers to homebuyers. Due to the relatively lenient regulations concerning presale criteria and postsale supervision, along with insufficient protection for homebuyers in the event of unfinished projects, households bear all the risks associated with housing construction progress after presale, including making monthly mortgage payments to their lender even if developers fail to deliver their homes as scheduled.

3 Presale Model

3.1 Setup

Consider a model in which the developers maximize their payoff for a given presale criterion and supervision extent. We aim to capture two key features of the presale system in the real estate market. First, without proper supervision, presale can lead to unfinished projects. Second, the presale system can encourage developers to work on multiple projects at the same time and increase the pace of residential housing development. For ease of exposition, we only consider the scenario where there is *one* representative developer with *two* potential projects to develop in this model (Chan, Wang, and Yang, 2012; Edelstein, Liu, and Wu, 2012). Results are robust when we extend the model to multiple

[14] Available at https://qz.com/china-pre-selling-homes-1849383480.

[15] Available at https://www.nytimes.com/interactive/2023/01/24/world/asia/china-unfinished-apartments.html, retrieved on October 4, 2023.

[16] Source: https://www.gov.cn/zhengce/zhengceku/2021-03/26/content_5596070.htm, retrieved on December 3, 2023

developers and more projects.

Project 1's total expected construction costs are represented by c. On average, c accounts for 40 to 50% of the housing price in China (National Bureau of Statistics, 2014).[17] The duration required to complete Project 1 is normalized to 1. The presale criterion posits that presale can begin at time $t = \alpha$, measured as a percentage of the construction process that needs to be completed before presale commencement. This construction milestone requries the developer to pay construction costs $c_1 = \alpha c$ upfront.

Once the construction milestone is achieved, presale starts and the developer can obtain presale revenue up to R.[18] During our sample period, all units in a building eligible for presale are offered simultaneously and often sell out quickly. Therefore, we ignore the possibility that the risk of unfinished buildings may change over time and buyers may have strategic incentives to wait for others to buy first. Meanwhile, the developer is required to deposit the remaining construction costs $(c - \alpha c)$ in a third-party escrow account for supervision purposes. If Project 1 remains unfinished at the end of its planned duration, the developer can only receive a fraction of the supervised amount back from the government (i.e., $(1 - s) \cdot (c - \alpha c)$) at time 1. The parameter s measures the intensity of *postsale supervision*, with $s = 0$ akin to no supervision whereby no fund in the escrow account would be held back from the developer if the project is not completed as scheduled, and $s = 1$ akin to full supervision where the entire amount for finishing the remaining construction needs to be held in the escrow account until project completion.

While Project 1 is ongoing, Project 2 can arrive at any time $t \in (0, 1)$ with equal likelihood. The expected profit from Project 2 is denoted as $\pi_2 > 0$. To initiate Project 2, the developer's cash flow needs to exceed a threshold denoted as M, as the developer

[17] https://data.stats.gov.cn/files/html/quickSearch/pc/pctz74.html

[18] To highlight the effect of presale policies on developer incentives, we abstract away from the endogenous formation of R as a function of presale policies. Note that the developers' decision of whether to abandon the project is made after the realization of R. Presale revenue cancels out, and will not affect the developers' choice of whether to abandon or not. This assumption is also reasonable from the individual developer's perspective because on average we observe 169 active developers in each city-year. In the empirical analysis, we use the new house price of each city as of 2010 (the beginning of our data period) to test the theoretical predictions about R, and always include city fixed effects. This circumvents the endogeneity of R in each data period after 2010.

needs to have sufficient financial resources or cash flow available to undertake Project 2.

In short, the model highlights two key aspects of presale policies: presale criterion α and postsale suprevision s. Presale criterion α determines the point at which presales can commence. Lower α allows for earlier presale, which in turn increases the developer's cash flow by $R - (c - \alpha c)$, and the likelihood of the developer being able to initiate Project 2. Postsale supervision s is essentially a bond to counter the developer's strategic incentive to abandon Project 1 after presale. Under tighter supervision (higher s), the developer faces a high penalty for misbehavior, and thereby has less incentive to abandon the project. Put another way, the two policy levers play distinct roles in regulating developer behaviors: presale criterion impacts the developer's cash flow and liquidity constraints, while postsale supervision deters moral hazard.

Like all principal-agent problems, the principal is unable to write a complete contract as the agent holds private information or faces uncertainty unknown to the principal. In our model, we assume that after $t = 0$, the developer observes two shocks privately. The first shock, ξ_1, affects the actual construction costs needed for Project 1 before fulfilling the presale criterion. This shock might represent land conditions that determine whether the land is construction-ready or the developer needs to stabilize the land before development begins. The second shock, ξ_2, signifies a developer-specific cost tied to abandoning Project 1. It can be interpreted as a variation to the typical ethical, legal, or reputation costs of deserting an ongoing project (τ). For ease of exposition, we assume $\xi_1 \sim \text{Uniform}(-\sigma_1, +\sigma_1)$, and $\xi_2 \sim \text{Uniform}(-\sigma_2, +\sigma_2)$.

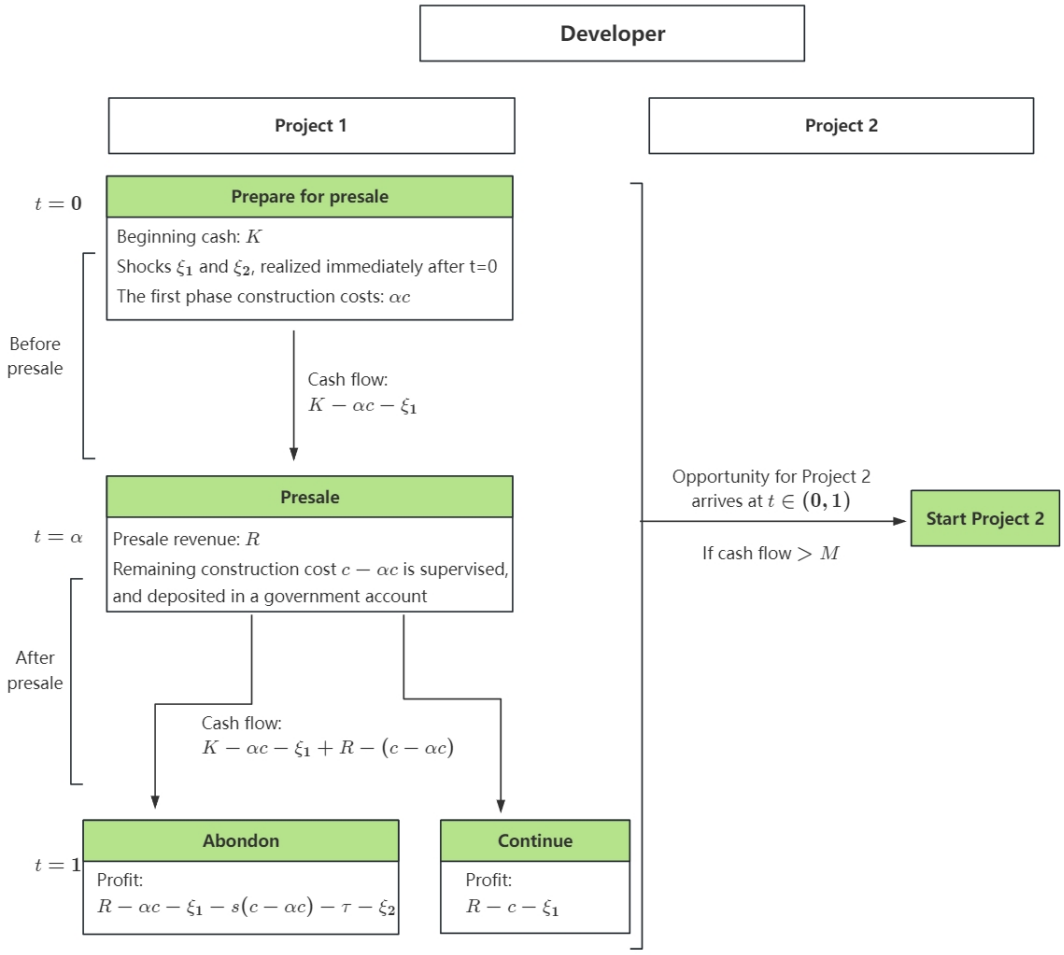
As shown in Figure 2, the timing of the model is as follows:

Stage 1: ($t = 0$) A representative developer initiates project 1 with cash K in hand.

Stage 2: ($t = \epsilon$) Two shocks, ξ_1 and ξ_2, are realized immediately after $t = 0$. These shocks are private information to the developer.

Stage 3: ($0 < t < 1$) The new project 2 can arrive at any time with equal probability during $0 < t < 1$. The developer must decide whether to take Project 2 at the time of its arrival, however, initiating project 2 requires having at least cash M in hand.

Figure 2: Presale Timeline



Stage 4: ($0 < t < \alpha$) Before satisfying the presale criterion, the developer is required to cover the realized presale construction costs $\alpha c + \xi_1$. With initial cash K, the developer's cash flow by time α can be expressed as $K - \alpha c - \xi_1$.

Stage 5: ($t = \alpha$) The presale takes place, the developer receives presale revenue R.

Stage 6: ($t = \alpha + \epsilon$) The developer decides whether or not to abandon project 1, trading off the benefits from abandoning the project ($(1 - s)(c - \alpha c)$) and the reputation, ethical, and legal costs of abandoning ($\tau + \xi_2$).

Stage 7: ($t = 1$) All outcomes related to project 1 are realized and revealed.

The developer faces two decisions: (1) whether to initiate Project 2 when the oppor-

tunity arises, and (2) whether to abandon Project 1 after realizing the cost shock ξ_2 is realized to maximize her profit.

For ease of exposition, we abstract away from discounting cash values over time, following prior studies (Chan, Wang, and Yang, 2012; Edelstein, Liu, and Wu, 2012). Adding a reasonable discount rate to the model is unlikely to alter the trade-offs highlighted in the model but doing so makes our model less tractable.

Before solving the model, we impose two assumptions to avoid edge cases:

Assumption 1 (Sufficient presale revenue): We assume presale revenue is strictly greater than the total expected construction costs, i.e., $R > c$. This assumption guarantees that the developer's cash flow after presale is always greater than before presale.

Assumption 2 (Moderate initial cash): We assume that the developers' initial cash in hand K is not always enough for them to initial Project 2 when it arrives before the presale of Project 1, i.e., $K - M - \alpha c < \sigma_1$.

3.2 Analysis

To solve the model, we begin with the developer's decision on whether to initiate Project 2. When Project 2 arrives prior to presale ($t \in (0, \alpha)$), the developer will always choose to invest in Project 2 as long as her cash flow surpasses M. This is because investing in Project 2 before presale generates positive profits (immediately). It will not impact her decision of whether to abandon Project 1 after presale, nor will it influence her profit from Project 1. When Project 2 arrives after presale ($t \in (\alpha, 1)$)[19], there are four potential outcomes, depending on the values of ξ_1 and ξ_2:

Outcome 1: *Abandon project 1 and ignore project 2.* In this scenario, we need the net payoff from abandoning project 1 to be greater than the net payoff from continuing construction, and the cash flow postsale to be smaller than M. Thus, ξ_1 and ξ_2 satisfy $R - \alpha c - \xi_1 - s(c - \alpha c) - \tau - \xi_2 > R - c - \xi_1$ and $R + K - c - \xi_1 <$

[19]Note that based on our assumption about the arrival of Project 2, Project 2 will definitely arrive during $t \in (\alpha, 1)$ if it doesn't occur before the presale.

M. The conditional probability that outcome 1 occurs after presale is:

$$Pr_1 = \left(\frac{1}{2} - \frac{R+K-c-M}{2\sigma_1}\right)\left(\frac{1}{2} - \frac{\tau-(1-s)(c-\alpha c)}{2\sigma_2}\right).$$

Outcome 2: *Abandon project 1 and start project 2.* In this scenario, ξ_1 and ξ_2 satisfy: $R-\alpha c-\xi_1-s(c-\alpha c)-\tau-\xi_2 > R-c-\xi_1$ and $R+K-c-\xi_1 > M$. Therefore, the conditional probability that outcome 2 occurs after presale is:

$$Pr_2 = \left(\frac{R+K-c-M}{2\sigma_1} + \frac{1}{2}\right)\left(\frac{1}{2} - \frac{\tau-(1-s)(c-\alpha c)}{2\sigma_2}\right).$$

Outcome 3: *Continue project 1 and ignore project 2.* In this scenario, ξ_1 and ξ_2 satisfy: $R-\alpha c-\xi_1-s(c-\alpha c)-\tau-\xi_2 < R-c-\xi_1$ and $R+K-c-\xi_1 < M$. Therefore, the conditional probability that outcome 2 occurs after presale is:

$$Pr_3 = \left(\frac{R+K-\alpha c-M}{2\sigma_1} + \frac{1}{2}\right)\left(\frac{1}{2} - \frac{\tau-(1-s)(c-\alpha c)}{2\sigma_2}\right).$$

Outcome 4: *Continue project 1 and start project 2.* In this scenario, ξ_1 and ξ_2 satisfy: $R-\alpha c-\xi_1-s(c-\alpha c)-\tau < R-c-\xi_1-\xi_2$ and $R+K-c-\xi_1-\xi_2 > M$. The conditional probability that outcome 4 occurs after presale is[20]:

$$Pr_4 = 1 - Pr_1 - Pr_2 - Pr_3.$$

After calculating the conditional probability of all four potential outcomes, we can determine the two key outcomes:

The probability that the developer starts project 2 is:

$$Pr_{new} = \underbrace{\left(\frac{K-\alpha c-M}{2\sigma_1} + \frac{1}{2}\right)\cdot\alpha}_{\text{Project 2 arrives before the presale}} + \underbrace{(Pr_2+Pr_4)(1-\alpha)\cdot}_{\text{Project 2 arrives after the presale}} \tag{1}$$

The probability that project 1 becomes unfinished is:

$$Pr_{uf} = \frac{1}{2} - \frac{\tau-(1-s)(c-\alpha c)}{2\sigma_2} \tag{2}$$

[20]Note that when $\frac{1}{2} \geq \frac{R+K-c-M}{2\sigma_1}$, $Pr_1 = 0$, and when $\frac{1}{2} \geq \frac{\tau-(1-s)(c-\alpha c)}{2\sigma_2}$, $Pr_2 = 0$.

3.3 Comparative statics

After defining the two key outcomes, we conduct comparative static analyses to determine the impact of presale criterion α and postsale supervision s on them.

Prediction 1: Strengthening postsale supervision s and presale criterion α can reduce the probability of unfinished project 1. Formally, $\frac{\partial Pr_{uf}}{\partial s} < 0$, $\frac{\partial Pr_{uf}}{\partial \alpha} < 0$.

This prediction is derived directly from equation (2). Intuitively, a higher value of supervision s increases the loss of the developer if Project 1 remains unfinished, while a higher presale criterion α implies less gain from abandoning project 1.

Prediction 2: Strengthening presale criterion α reduces the developers' multitasking behavior, while the postsale supervision s has no impact on multitasking. Formally, $\frac{\partial Pr_{new}}{\partial \alpha} < 0$, $\frac{\partial Pr_{new}}{\partial s} = 0$.

This prediction is derived from equation (1). Intuitively, setting a higher presale criterion α prevents the developer from securing presale revenue R early on. Consequently, if the opportunity to initiate Project 2 arrives early, the developer is less likely to start Project 2 due to cash flow constraints. The zero impact of postsale supervision s comes from the assumption that the total amount under supervision $c - \alpha c$ won't be given back to the seller (even if she abandons the project) until the end of the game. In the real world where government supervision is lax, it is possible for the developer to receive a portion of the supervised amount before the end of the game. This situation can create a negative effect of s on Pr_{new}. However, we anticipate this impact to be less significant than that of α, as in the real data the presale revenue R substantially exceeds any supervised amount the developer might receive during construction.

Based on Predictions 1 and 2, we can show that both presale criterion α and postsale supervision s have a negative effect on the developer's expected profits. We expect the the negative effect of α to be more pronounced than that of s, because in addition to influencing the option of abandoning Project 1, an effect shared by α and s, α also

reduces the probability of initiating Project 2, as suggested by Prediction 2.[21]

3.4 Heterogenity

Next, we explore the heterogenous effects of presale criterion α and postsale supervision s. Our objective is to understand how variations in the total expected construction costs (c) and in the presale revenue (R) affect the impact of α and s on the probability of unfinished projects and the developer's multitasking behavior. We focus on the heterogeneity of c and R because they exhibit significant variations across cities and can be measured empirically. We obtain the following results:

Prediction 3: Total expected construction costs c amplifies the effect of presale criterion α and postsale supervision s on reducing unfinished projects. The presale revenue R has no such heterogenous effect. Formally, $\frac{\partial Pr_{uf}}{\partial s\ \partial c} < 0$, $\frac{\partial Pr_{uf}}{\partial \alpha\ \partial c} < 0$, and, $\frac{\partial Pr_{uf}}{\partial s\ \partial R} = 0$, $\frac{\partial Pr_{uf}}{\partial \alpha\ \partial R} = 0$.

The first two derivatives come directly from equation (2). Intuitively, higher construction costs result in a higher supervised amount postsale. Hence, it can enhance the role that α and s play in reducing unfinished projects. Since the presale revenue R is realized before the decision of whether to abandon Project 1 and R goes to the developer either way, it cannot heterogeneously affect the impact of α and s on the abandoning decision.

Prediction 4: An increase in presale revenue R amplifies the negative impact of presale criterion α on multitasking. An increase in the total expected construction costs c works in an opposite direction. Formally, $\frac{\partial Pr_{new}}{\partial R\ \partial \alpha} \leq 0$, and, $\frac{\partial Pr_{new}}{\partial c\ \partial \alpha} \geq 0$.

The first result is derived from Equation (1). As shown in Equation (1), the probability of starting Project 2 is influenced by (a) the probability that the developer can initiate Project 2 if it arrives before the presale, denoted by $\frac{c(K-\alpha c-M)}{2\sigma_1} - \frac{1}{2}$, and (b) the probability

[21] Formally, the developer's expected profit from Project 1 and Project 2 can be written as:

$$\begin{aligned}\Pi = (1-\alpha)\{&Pr_1 \cdot (R - \alpha c - s(c-\alpha c) - \tau + a_2) + Pr_2 \cdot ((R - \alpha c - s(c-\alpha c) - \tau + a_2) + \pi_2) \\ &+ Pr_3 \cdot (R - c) + Pr_4 \cdot (R - c + \pi_2)\} + \\ \alpha &\left\{ (\frac{K - \alpha c - M}{2\sigma_1} + \frac{1}{2})\pi_2 + (Pr_1 + Pr_2)(R - \alpha c - s(c-\alpha c) - \tau + a_2) + (Pr_3 + Pr_4)(R - c) \right\}\end{aligned}$$

where π_2 denotes the expected profit from Project 2, $a_2 = \frac{\sigma_2 - ((1-s)(c-\alpha c) - \tau)}{2}$ denotes the strategic gain that the developer could obtain by choosing to abandon Project 1 based on his private observation of ξ_2.

that the developer can initiate Project 2 if it arrives after the presale, denoted by $Pr_2 + Pr_4$. Intuitively, a higher R can alleviate the developer's credit constraints *after* the presale. Consequently, a high enough R makes the second probability higher than the first one, resulting in a more negative role α plays in Pr_{new}. Note that when R becomes large enough, such that $R + K - C - M \geq \sigma_1$, the equality holds. This is because a sufficiently high R guarantees the developer will have enough funds to cover the fixed cost M to initiate Project 2 when it arrives after presale.

The heterogeneous impact of construction costs c arises for a similar reason. A *lower* c effectively plays a similar role as a *higher* R, as both variables relax the credit constraint when Project 2 arises after presale. The only difference is that, since part of c is paid by the developer before presale to meet the presale criterion, the size of the derivative $\frac{\partial Pr_{new}}{\partial c \, \partial \alpha}$ is smaller than $\frac{\partial Pr_{new}}{\partial R \, \partial \alpha}$. When $R + K - C - M \geq \sigma_1$, the equality holds.

The proof of all four theoretical predictions is presented in Appendix A.

4 Data and Measures

We compile multiple data sources for our empirical analysis, including presale policy documents, incidents of unfinished housing project, as well as land transaction and housing development records. This section describes each dataset and the key measures. Summary statistics of the relevant variables are presented in Table 1.

4.1 Presale policy documents

In China, prefecture-level governments possess the authority to modify local presale policies through amendments to local laws and administrative regulations. On presale criteria, the central government stipulates that all buildings must reach a minimum completion level of 25% before presale. However, local governments have the flexibility to set higher presale criteria beyond this minimum threshold. In comparision, no specific nationwide regulations govern the extent of postsale supervision.

We collect all local laws and administrative regulations pertaining to presale criteria

and postsale supervision from the China Law Database (www.pkulaw.net) maintained by the Legal Information Center of Peking University. To obtain information at the prefecture level, we manually searched for policy documents using keywords *presale*, *permit*, *revenue*, *supervision*, and *housing* (or synonyms such as *real estate* and *property*). Our extensive search identified 792 policy documents from 270 cities, in effect between 2010 and 2017. These 270 cities, including four direct-administered municipalities (Zhi Xia Shi) and almost all prefecture-level cities in China,[22] account for 96.3% of the population and 99.1% of the GDP in China. To the best of our knowledge, this represents the first comprehensive compilation of presale policy documents in China.

Presale criteria in China typically take two forms: as a percentage of the total construction costs invested before the presale, or based on visual construction progress. Figure A1 displays an example of the policy document regarding the presale criterion. After consulting with construction experts, we translate key milestones of construction progress into a percentage scale between 0 and 100%: finishing the foundation is equivalent to 30% of completion; finishing the main structure is equivalent to 65% of completion; finishing the exterior walls is equivalent to 80% of the completion. If the policy document requires completion of a specified percentage of the building's main structure, then the presale criterion becomes $a\% \cdot (65 - 30)\% + 30\%$. For instance, if the document states that developers can start presale after completing 50% of the building's main structure, then the presale criterion is $50\% \cdot (65 - 30)\% + 30\% = 0.48$.

Table 1 Panel (a) shows that over half of the cities adhere to the national minimum requirement of 25% for presale criterion. Notably, for cities at the 9th decile, mainly located along the eastern coast of China (see Panel (a) of Figure 3), presale criterion is more than doubled to 58%.

As shown in Figure A2, postsale supervision is constructed based on four variables. First, we construct a dummy that equals 1 if the supervised amount exceeds 110% of the remaining construction costs (s_{cost}). Second, we create another dummy that equals 1 if the release of the supervised amount is based on real-time construction progress

[22]Due to data limitations, we are unable to include cities in Tibet and ethnic minority autonomous prefectures.

($s_{progress}$), and 0 otherwise. If $s_{progress} = 1$, we then collect a third variable, the percentage of the supervised amount ($S_{mainstructure}$) that the developer could retrieve from the escrow account upon completion of the building's main structure. Lastly, we create a dummy that equals 1 if the supervised construction costs are deposited in a third-party independent bank account (s_{third}). After consulting with construction experts, we define postsale supervision (s) as a weighted average of the above four variables, namely $s = 0.25 \cdot S_{cost} + 0.2 \cdot S_{progress} + 0.35 \cdot (1 - \frac{S_{mainstructure} - 0.5}{0.5}) + 0.2 \cdot S_{third}$. Results are robustness if we use alternative weighting as described in Appendix E.2.

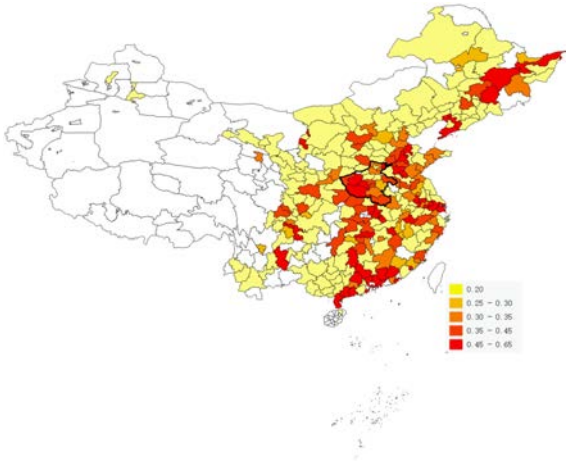
Figure A4 plots how the average presale criterion and postsale supervision change year by year from 2010 to 2017. Both of them are tightened over time, especially postsale supervision. Out of the 270 cities in our sample, 56 experienced one adjustment in their presale criterion between 2010 and 2017, another 2 experienced multiple changes. Regarding postsale supervision, 112 cities experienced one adjustment during 2010-2017, another 7 cities experienced multiple adjustments. As depicted in Table 1, the standard deviation of postsale supervision is 1.4 times higher than that of the presale criterion.

Table 1: Summary statistics

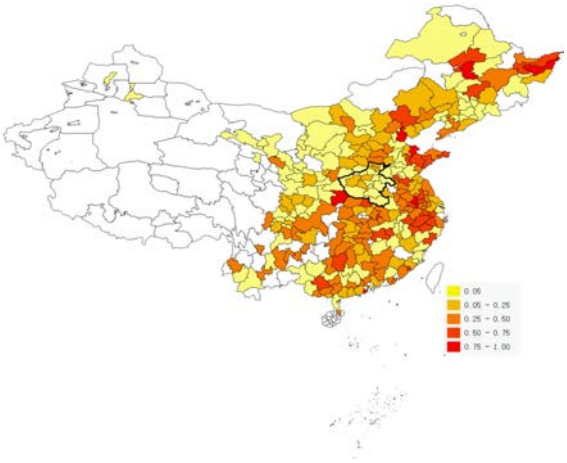
Variable	Mean	Std.Dev.	Minimum	Q1	Median	Q3	Maximum
Panel (a). Presale policies (2,144 obs. by city-year, 270 cities)							
Presale criterion (α)	.33	.12	.25	.25	.25	.38	.80
Postsale supervision (s)	.22	.29	0	0	0	.45	1
Panel (b). Unfinished residential development projects (2,144 obs. by city-year, 270 cities)							
Probability of unfinished projects (%)	.80	1.72	0	0	0	.88	23.88
Panel (c). Multitasking developers (364,248 obs. by developer-city-year, 270 cities)							
# of projects	1.75	1.42	0	1	1	2	9
Panel (d). Land auction records (144,948 obs. by land parcel up for auction, 270 cities)							
Auction success	.68	.47	0	0	1	1	1
Aution deal price (RMB/m^2)	4802.7	6950.16	43.93	286.23	1701	6021	25996

Notes: (1) The data in Panel (c) is constructed at the developer-by-year level. (2) Prices in current RMB.

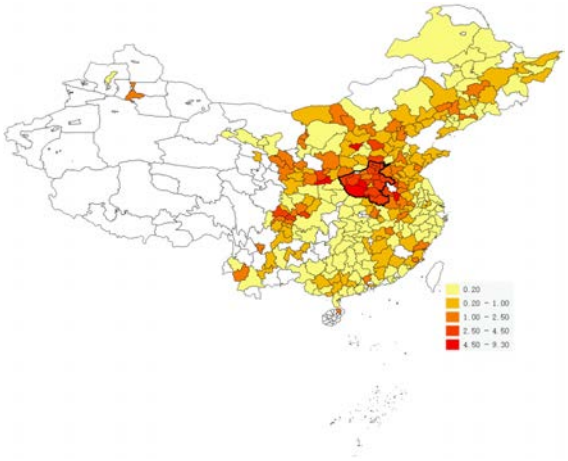
Figure 3: Presale policies and geographical distribution of unfinished projects



(a) Presale criterion



(b) Postsale supervision



(c) Probability of unfinished projects

Notes: This figure displays the spatial variations in presale criterion, postsale supervision, and the probability of unfinished projects (0-100%) from 2010 to 2017. We calculate the average of these variables for each city. Cities for which data is not available are displayed in shadow. These missing cities only account for around 4% of the population and 1% GDP in China. The region encircled by a dark boundary at the center of each map represents Henan Province.

4.2 Unfinished Residential Projects

We collect data on unfinished residential projects from the Local Leaders' Message Board (LLMB) maintained by the main state media People's Daily (www.liuyan.people.com.cn). Since 2006, the LLMB has been serving as a platform for citizens to communicate their

difficulties and complaints to local government officials. It is mandatory for local leaders to respond promptly to citizen messages, resulting in a high response rate around 90%. Both citizen messages and leadership replies are publicly accessible. In China, it is important to make leaders aware of these problems in order to solve them. Citizens have the option to send messages through their personal computers or the dedicated mobile app, and the service is provided free of charge. Given the cost-effectiveness of utilizing the LLMB, citizens often send messages to local leaders when they encounter problems that significantly impact their own interests, such as unfinished construction projects. The dataset we have compiled comprises over 3 million messages from 2010 to 2021. These messages cover a wide range of topics, including housing, education, healthcare, corruption, and employment.

Figure A3 displays an example message posted on the LLMB. Note that response is not equivalent to solving the problem. One of the most common responses we observe on the LLMB is the government's promise to look into the problem. In this sense, LLMB messages indicate problems at the time of message posting, but do not reveal whether, how and when the problems might be solved afterwards.

To identify unfinished residential development projects from the LLMB, we searched for messages that contain keywords such as $unfinished$ and $buildings$ (or synonyms such as $housing$ and $property$). This process yielded 7,478 complaint messages. To extract more specific details about unfinished projects, we manually collected property names and project starting years from the LLMB messages sent by citizens, the corresponding replies from the leaders, and related news online.[23] After removing duplicate complaints related to the same unfinished projects and excluding irrelevant messages, we successfully identify 2,330 unfinished projects across 270 cities that began construction between 2010 and 2017. We do not include unfinished projects that commenced in or after 2018 because completing a residential project typically takes 3 years. Consequently, by 2021, we lack sufficient information to ascertain whether a project starting in 2018 was indeed unfinished or not. By focusing on projects initiated before 2018, we ensure a more

[23]In most cases, the starting year of the development projects can be found within the messages and replies on the platform. However, for projects where this date is not explicitly stated, we utilized search engines to ascertain this information.

accurate assessment of the unfinished residential developments.

We acknowledge potential under-reporting of unfinished buildings on the LLMB, despite the relatively low cost of communication and high response rate. In all econometric specifications, we include city and year fixed effects to control for geographic and temporal differences in under-reporting. Additionally, we assess the extent of underreporting by comparing the aggregate number of unfinished buildings from our dataset to the numbers reported in the media and government reports. In cities where we have counts of unfinished projects from other sources, the unfinished projects we identified account for more than 60% of the total.[24] In a robustness check, we exclude the 10% cities that were most lenient in their 2010 presale policies, to address the concern that citizens in the most lenient cities may have a different tendancy to report unfinished buildings as compared to other cities. Results remain robust, as shown in Appendix Table A5.

To compute the probability of unfinished projects by city-year, we divide the total number of unfinished projects that *started* in a city-year by the city's annual number of residential land transactions in that year. This measure is imperfect because we cannot observe the total number of residential projects starting in each city-year. However, based on the project start date agreed upon by the government and the developer, almost all projects are required to begin within several weeks after the land transaction. Additionally, presale should incentivize developers to initiate each project as soon as they acquire the land. As detailed in Appendix E.3, our results are robust if we use the absolute number of unfinished projects rather than the probability of unfinished projects as the dependent variable.

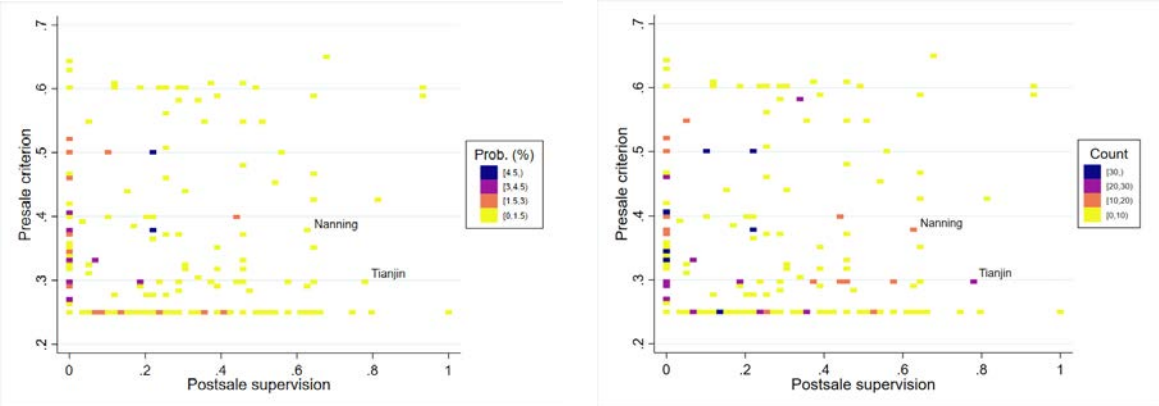
Figure 3 Panel (c) visualizes the spatial distribution of the probability of unfinished projects. For ease of exposition, we aggregate our city-by-year panel data into average per city. Consistent with anecdotes from media coverage, the share of unfinished projects is extraordinarily high in Henan Province (marked by a black circle in the map). By

[24]For instance, according to China News Weekly, Zhengzhou had 106 unfinished projects by 2022, but we successfully identified 72 of those projects that began between 2010 and 2017. Data source: Henan Government, retrieved on October 21, 2023. Similarly, in Kunming, local officials in 2021 stated that there were 93 unfinished projects, yet we identified 56 of these in our dataset. Data source: Yunnan Net, retrieved on October 21, 2023.

visually comparing the probability of unfinished projects with the stringency of presale policies across cities (Panels a and b), we observe that cities with less stringent presale policies, particularly in terms of postsale supervision, tend to have a higher likelihood of unfinished projects. This suggests a negative correlation between the stringency of presale policies and the prevalence of unfinished projects across the cities in our sample.

Figure 4 uses heatmaps to illustrate the relationship between presale criterion α (on the x-axis) and postsale supervision s (on the y-axis) with respect to unfinished projects (in color). In Panel (a), darker colors denote a higher probability of unfinished projects. For comparison, Panel (b) uses the absolute number of unfinished projects as the outcome variable. We observe that both the probability of unfinished projects and the total number of unfinished projects are the highest in the lower-left region, where both presale criterion and postsale supervision are at their lowest. This aligns with our theoretical predictions. Our main regression analyses will use the probability of unfinished projects (rather than their absolute count) as the outcome variable, because the number of unfinished projects may appear high merely due to a greater number of land sold in that city, as exemplified by Tianjin and Nanning in Panel (b).

Figure 4: Presale policies and unfinished projects



(a) Probability of unfinished projects

(b) # of unfinished projects

Notes: The heatmaps visualize the initial relationship among the average of presale criterion, postsale supervision, and the total count/probability of unfinished projects from 2010 to 2017.

As shown in the last graph of Figure A4, the average probability of unfinished

projects (across all 270 cities) first increased from 2010 to 2014 and then zigzagged afterwards. According to our theory, this pattern could be related to the tightening of presale criterion and postsale supervision over time.

4.3 Land data

To measure the likelihood of developers working on multiple projects simultaneously and to evaluate the associated outcomes in the land market, we compile a dataset of land sales in China, which is sourced from a data vendor, China Stock Market and Accounting Research (CSMAR).[25] In this paper, we focus on the transaction of residential land. Apart from transaction type, this dataset also contains information regarding the land sale, such as auction date, reserve price, deal price, area, developer of the land, as well as the agreed project start date and completion date in the land contract.

To construct the number of projects a developer is concurrently working on, we use the start and completion dates agreed upon by the government and the developer in the land contract. This augments the land data to a land-year panel.[26] In addition, based on developer information in the land transaction data, we reshape the land data to a developer-city-year panel where each observation denotes the number of projects a developer d is working on simultaneously in city j and year t.[27] Note that we define a developer by its company name and city. Identifying every developer across cities is challenging, as they may use different company names in different cities. As detailed below, our results remain robust if we exclude the top 50 developers, who often work on projects in multiple cities.

Other land auction outcomes can further enrich our analysis on multitasking devel-

[25]The dataset used in this study includes information on land transactions in China's primary land market after the implementation of the 2007 Land Management Law. The Law mandates local governments to report all land sales within their jurisdictions on www.landchina.com, ensuring the availability of comprehensive land transaction records.

[26]For instance, if developer d works on only one project from 2011 to 2014 and starts working on another project in 2017, then the number of projects developer d works on is labeled as 1 for the years 2011 to 2014 and 2017, and labeled as 0 for 2015 and 2016.

[27]If the developer of the land starts working on another project in 2017, then the number of projects the developer worked on in 2015 and 2016 is labeled as 0.

opers. For example, land auction price reflects bidders' willingness to pay, which is likely related to how early they expect presale and what profits to expect from constructing and potentially abandoning the project. Additionally, our land data includes failed auctions. With the average auction failure rate around 32%, this data enables us to measure land auction success rate and link it to presale policies.

The summary statistics for multitasking developers and land auction outcomes are reported in Panels (c) and (d) of Table 1. On average, each developer has 1.75 ongoing projects in a city-year. For the 68% of auctions that succeed in land sale, the average deal price is 4,802 RMB per square meter.

5 Empirical Strategies

5.1 Empirical specification

To associate presale policies with key outcomes, we use a generalized DiD (two-way fixed effects) approach. In particular, we compare the change in outcomes of interest between cities that experienced a presale policy modification and those that did not. The baseline regression is estimated using the following specification:

$$Y_{(i,)j,t} = \beta_1 \alpha_{j,t} + \beta_2 s_{j,t} + \gamma X_{(i,)j,t} + \theta_j + v_t + \epsilon_{(i,)j,t} \tag{3}$$

where j denotes city, t denotes year, and i denotes the observation level more detailed than city j and time t if applicable. $Y_{i,j,t}$ represents the outcome variables, which includes the probability of a project being unfinished (at the city-year level), land auction success rate (at the land parcel level), land auction price (at the land parcel level), and the number of projects a developer works on simultaneously (at the developer-city-year level). $\alpha_{j,t}$ denotes the presale criterion in city j and year t. $s_{j,t}$ is the extent of postsale supervision in city j and year t. θ_j denotes city fixed effects that absorb all time-invariant city-level characteristics. v_t denotes year fixed effects, which captures common shocks in year t. These fixed effects are crucial for our identification strategy, as they absorb the local institutional and economic conditions that may simultaneously influence both presale

policies and our outcome variables of interest. $X_{j,t}$ denotes a comprehensive list of time-variant socioeconomic characteristics in city j and year t, including the city's GDP growth rate, share of population with internet access, the mayor's attributes (age, gender, and education attainment), and the city's other observable regulations on unfinished projects (more details below). When the observation level is at the land level, $X_{i,j,t}$ also includes land parcel attributes such as the auction reserve price. $\epsilon_{(i,)j,t}$ is the error term. Standard errors are clustered by city. The key parameters of interest are β_1 and β_2.

5.2 Identification and interpretation

One potential concern in our Difference-in-Differences (DiD) analysis is that mayors who have incentives to modify presale policies $\alpha_{j,t}$ and $s_{j,t}$ may also undertake other unobservable actions to reduce the occurrence of unfinished projects during their tenures. These unobservable actions — for example negotiating with relevant stakeholders behind the scenes or allocating ad hoc resources to address specific unfinished projects — can potentially confound the estimated impact of presale policies on the prevalence of unfinished projects. To address this concern, we employ a "donut DiD" specification:

$$Y_{i,j,t\neq m} = \beta_1 \alpha_{j,t\neq m} + \beta_2 s_{j,t\neq m} + \gamma' X_{j,t\neq m} + \theta_j + v_{t\neq m} + \epsilon_{j,t\neq m} \tag{4}$$

where the subscript $t \neq m$ indicates that we exclude those city-year observations if the mayor changed any presale policies during his term.

Note that changes in the presale policies occurred only once or twice in almost all cities in our sample period. By excluding the city-year observations that are most susceptible to endogeneity concerns, we still retain a sufficient number of observations for statistical inference. The same approach was employed in Baltrunaite et al. (2021).

To further alleviate the concerns that the change in presale policies may be correlated with other policies aimed at reducing unfinished projects, we searched for all laws and local government regulations containing the word *unfinished* in the China Law Database and defined a new dummy equal to 1 if such regulations exist in the focal city-year. As reported in Appendix C, we find that neither presale criterion nor the postsale supervision is correlated with this new dummy. Still, we include it as an additional control in

all regressions.

As a robustness check, we further employ an event study approach to examine the parallel-trend assumption and assess dynamic treatment effects over time. In particular, we define a treatment dummy on presale criterion equal to 1 if the presale criterion in the focal city-year is strictly above the national minimum (25%) and another treatment dummy on postsale supervision equal to 1 if the postsale supervision is strictly above 0.5, which implies at least two of the four supervision indicators are met. As detailed in Appendix E.1, the event study results confirm parallel pretreatment trends between the cities that have either treatment dummy turned on over time and other cities that remain lenient in the presale policies. This alleviates the concern that cities changing presale policies might face more severe issues with unfinished buildings or offer different support of multitasking developers in other unobserved ways.

One may argue that presale policies, even if exogenous to the current mayor, may interact with other government regulations or industry policies prevailing at that time. For example, banks may provide debt financing for developers if they can demonstrate that they have money to cover a minimum percentage of the total costs of the project. More lenient presale policies, in the form of either allowing presale at an earlier time (lower α) or relaxing postsale supervision (lower s), would enhance the developer's financial condition and therefore boost their ability to initiate additional development projects. Although city fixed effects can account for heterogeneous bank-related policies across cities, and year fixed effects can absorb national bank-related policy changes, the aforementioned interaction effects are not captured by these fixed effects. In fact, these effects contribute to the estimated coefficients of presale policies because they are enabled by the change of presale policies in the city. This is consistent with the typical interpretation of the coefficients as the average treatment effect on the treated.

6 Empirical Results

To test our theoretical predictions, we associate presale criterion and postsale supervision to two sets of key outcomes: (a) the probability of unfinished projects, and (b) the extent

of developer multitasking and land auction outcomes. We also explore heterogeneity of our empirical estimates.

6.1 Unfinished projects

To link presale policies with the probability of unfinished projects, we estimate:

$$\text{Unfinished}_{j,t} = \beta_1^u \alpha_{j,t} + \beta_2^u s_{j,t} + \gamma^u X_{j,t} + \theta_j^u + v_t^u + \epsilon_{j,t}^u \tag{5}$$

where the dependent variable $Unfinished_{j,t}$ denotes the probability of a residential project being unfinished in city j and year t. As aforementioned, we define $\text{Unfinished}_{j,t} = \frac{\text{\# of unfinished projects started in city j year t}}{\text{total \# of residential land parcels sold in city j year t}}$. The superscript u denotes the coefficients generated from the unfinished project regressions. Other notations are the same as in Equation (3).

Table 2: Presale and unfinished projects

Dep. Variable	Probability of a project being unfinished (%)				
	(1)	(2)	(3)	(4)	(5)
Presale Criterion	-0.139		-0.136	-0.145*	-0.168*
	(0.0851)		(0.0846)	(0.0819)	(0.0965)
Postsale Supervision		-0.161***	-0.160***	-0.160***	-0.233***
		(0.0505)	(0.0505)	(0.0506)	(0.0697)
Sample mean	0.8%	0.8%	0.8%	0.8%	0.8%
Observations	2,144	2,44	2,144	2,144	1,878
Adjusted R^2	0.438	0.439	0.440	0.445	0.444
Extra controls	No	No	No	Yes	Yes
Donut analysis	No	No	No	No	Yes
City FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes

Notes: (1) This table reports the estimates of β_1^u and β_2^u from Equation (5). (2) To make β_1^u and β_2^u comparable, we normalize presale criterion α and postsale supervision s to a distribution with mean zero and standard deviation 1. (3) Control variables include the cities' GDP growth rate, mayors' characteristics (age, gender, and education attainment), and a dummy of having other policies related to unfinished projects in the focal city-year. To further address potential under-reporting due to limited internet access, we control for the share of population with internet access. (4) All regressions include city and year fixed effects. (5) Robust standard errors clustered at the city level are reported in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 2 reports our regression results progressively in five columns. Column (1) re-

gresses the probability of unfinished projects solely on presale criterion. Column (2) changes the explanatory vairable topostsale supervision. Column (3) includes both presale policies and postsale supervision to capture their combined effects. Column (4) introduces additional control variables. Column (5) employs the donut Difference-in-Differences (DiD) approach, according to Equation (4). All columns include city and year fixed effects, and cluster standard errors by city.

In line with Prediction 1, our estimation results consistently demonstrate a strong, robust, negative link between postsale supervision (s) and the probability of unfinished projects. Regarding presale criterion (α), results indicate a negative link to the extent of unfinished projects, albeit with less precision. Note that, to make the two coefficients comparable, we normalize presale criterion α and postsale supervision s to a distribution with mean zero and standard deviation 1. The coefficients suggest that, increasing postsale supervision by one standard deviation (around 0.29 increase in s on top of its sample mean of 0.22) would reduce the probability of a project being unfinished by 0.16% to 0.23%, which corresponds to 20% to 29% of the sample mean. In comparison, increasing presale criterion by one standard deviation (around 0.12 increase in α on top of its sample mean of 0.33) would have a slightly smaller effect in reducing unfinished projects; the effect is less precise and at most marginally significant with 90% of confidence. Nonetheless, the consistent negative sign of the coefficient of presale criterion supports Prediction 1. The findings in Table 2 also echo the raw pattern we observe in Figure 3: cities with less stringent postsale supervision and presale criterion have a higher probability of unfinished projects. Taken together, our empirical findings provide strong evidence supporting the importance of both presale criterion and postsale supervision in reducing unfinished projects.

In Appendix D, we further explore the impact of presale policies on unfinished projects in both extensive and intensive margins. The results suggest that presale criterion primarily reduces unfinished projects from the extensive margin (i.e. whether having any unfinished projects), while postsale supervision has a more significant impact on the intensive margin (i.e. the probability of unfinished projects conditional on having any unfinished projects). As a robustness check, we utilize the absolute number

of unfinished projects as the dependent variable. The findings, as reported in Table A4, indicate similar patterns.

6.2 Multitasking developers and land auction outcomes

6.2.1 Multitasking developers

As suggested by Prediction 2, a lower presale criterion α could potentially incentivize developer multitasking but postsale supervision may not exert a significant influence on this outcome. To test this prediction, we estimate:

$$\#\text{ of Projects}_{i,j,t} = \beta_1^p \alpha_{j,t} + \beta_2^p s_{j,t} + \gamma^p X_{j,t}^C + \eta^p X_{i,j,t}^P + \theta_j^p + v_t^p + \mu_{i,j,t}^p. \tag{6}$$

The dependent variable $\#\text{ of Projects}_{i,j,t}$ measures the extent of multitasking for developer i, calculated as the number of projects developer i is concurrently working on in city j during year t. The superscripts C and P in X denote city- or developer-city-specific variables. The superscripts p denote the parameters to be estimated in the regression regarding # of projects. The key parameters are β_1 and β_2. As suggested by Cohn, Liu, and Wardlaw (2022), we use Poisson pseudo-likelihood regression with fixed effects to estimate Equation (6).

Consistent with Prediction 2, Table 3 shows that a stricter presale criterion discourages developers from multitasking while postsale supervision has a negligible correlation with developer multitasking. One standard deviation increase in presale criterion (α) reduces the number of projects that developers concurrently work on by 1.7%.

In Table A6, we check the robustness of our results when we exclude the top 50 developers, who typically work on projects in multiple cities. Specifically, a Leju report identifies top 50 developers based on their sales revenue in 2018.[28] In our data, if a developer's name contains keyword(s) that matches any names of the top 50 developers listed in the report, we classify the developer as a "top 50." For example, a company named "Beijing Evergrande Real Estate Development Co., Ltd." is classified as a "top

[28]Source: China Real Estate Information Center: http://m.fangchan.com/data/17/2018-12-31/6485515862089732345.html, retrieved on December 25, 2023.

50" because Evergrande is on the top 50 list from the Leju report. It is worthwhile to note that even though these top 50 developers have received significant media attention, the residential housing projects they developed constitute only 6% of all residential projects during our sample period. Therefore, as Table A6 suggests, our results remain robust.

Table 3: Presale and multitasking developers

Dep. Variable	# of projects (Poisson)				
	(1)	(2)	(3)	(4)	(5)
Presale Criterion (α)	-0.0139**		-0.0141**	-0.0136**	-0.0173*
	(0.00670)		(0.00679)	(0.00683)	(0.00900)
Postsale Supervision (s)		-0.00659	-0.00670	-0.00645	-0.00548
		(0.00421)	(0.00418)	(0.00414)	(0.00610)
Sample mean	1.75	1.75	1.75	1.75	1.75
Observations	364,248	364,248	364,248	364,248	302,404
Pseudo R^2	0.024	0.024	0.024	0.024	0.025
Extra controls	No	No	No	Yes	Yes
Donut analysis	No	No	No	No	Yes
City FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes

Notes: (1) This table reports the estimates of β_1^p and β_2^p from Equation (6), using Poisson pseudo-likelihood regression (Correia, Guimarães, and Zylkin, 2020). (2) We normalize presale criterion α and postsale supervision s to a distribution with mean zero and standard deviation 1. (3) Control variables are the same as in Table 2. (4) All regressions include city and year fixed effects. (5) Robust standard errors clustered at the city level are reported in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

6.2.2 Land market outcomes

One potential consequence of developers multitasking is an increase in land purchases. Following our theory, we anticipate a higher α to decrease both the land auction success rate and the land transaction price. To test these hypotheses, we use the land transaction data in the primary land market and estimate:

$$\text{LandOutcome}_{i,j,t} = \beta_1^L \alpha_{j,t} + \beta_2^L s_{j,t} + \gamma^L X_{j,t}^C + \eta^L X_{i,j,t}^P + \theta_j^L + v_t^L + \mu_{i,j,t}. \tag{7}$$

$\text{LandOutcome}_{i,j,t}$ can take two possible variables: (a) a dummy that indicates whether the land auction for land parcel i in city j during year t is successful or not; and (b) conditional on auction success, the logarithm of the sold price of land parcel i in city j

at year t. The superscript L denotes the estimated coefficients pertain to the land market outcomes. Table 4 reports the estimation results.

Consistent with our model predictions and the results in Table 3, Panel A of Table 4 suggests that a more stringent presale criterion (α) relates to a lower auction success rate. On the other hand, postsale supervision appears to have no significant correlation with the auction success rate.

Table 4: Presale and land auction

	(1)	(2)	(3)	(4)	(5)
Panel A: Auction success=1					
Presale Criterion (α)	-0.0277***		-0.0277***	-0.0287***	-0.0202**
	(0.00758)		(0.00759)	(0.00766)	(0.0101)
Postsale Supervision (s)		-0.00120	-0.000994	-0.000416	-0.000621
		(0.0105)	(0.0105)	(0.0103)	(0.00754)
Sample mean	0.68	0.68	0.68	0.68	0.68
Observations	144,948	144,948	144,948	144,948	122,366
Adjusted R^2	0.093	0.093	0.093	0.093	0.091
Panel B: Log land auction deal price					
Presale Criterion (α)	0.0414		0.0414	0.0145	0.00445
	(0.104)		(0.104)	(0.0180)	(0.0217)
Postsale Supervision (s)		-0.000605	-0.000684	0.0235	0.0199
		(0.0446)	(0.0445)	(0.0159)	(0.0153)
Sample mean	4802.70	4802.70	4802.70	4802.70	4649.05
Observations	95,240	95,240	95,240	95,240	80,365
Adjusted R^2	0.266	0.266	0.266	0.967	0.969
Extra controls	No	No	No	Yes	Yes
Donut analysis	No	No	No	No	Yes
City FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes

Notes: (1) This table reports the estimates of β_1^L and β_2^L from Equation (7). (2) We normalize the presale criterion α and postsale supervision s to a distribution with mean zero and standard deviation 1. (3) Control variables include the cities' GDP growth rate, the mayors' characteristics (age, gender, and education attainment), the other policies that relate to unfinished buildings, and the land auction reserve price. (4) Robust standard errors clustered at the city level are reported in parentheses. (5) * significant at 10%; ** significant at 5%; *** significant at 1%.

Turning to the land price regressions in Panel B, we find that the estimates corresponding to both presale criterion and postsale supervision are insignificant. This may be driven by the unique context of China's land market, where a substantial portion (approximately half) of land is sold at the reserve price. This suggests that only one bidder participates in these auctions. As a result, the limited price variation hampers our ability

to detect a significant relationship between presale policies and land transaction prices. Hence, it is important to acknowledge that the insignificant results in Panel B do not necessarily imply the absence of a true effect.

6.3 Heterogeneity analysis

We focus on two sources of heterogeneity: expected construction costs c and presale revenue R, as suggested by our theoretical model. Predictions 3 and 4 suggest that: (1) construction costs c amplify the impact of presale criterion α and postsale supervision s in reducing unfinished projects; (2) presale revenue has no heterogenous impact on unfinished projects; (3) both construction costs c and presale revenue R can amplify the negative impact of α on developers' multitasking behavior, though the magnitude of the effect of c may be smaller; and (4) c and R would play a limited role in moderating the impact of postsale supervision on multitasking developers.

We use the urban building earthquake resistance requirements as a proxy for expected construction costs c. These requirements are established by the central government and serve as a guideline for construction standards. Cities are classified into three tiers based on their geographic conditions. Approximately 50% of cities are classified as Tier 1, where buildings are designed to withstand magnitude 6 earthquakes. Around 40% of cities fall into Tier 2, with buildings constructed to withstand magnitude 7 earthquakes. The remaining 10% of cities are designated as Tier 3, with buildings designed to withstand magnitude 8 earthquakes. As we move up one tier, the construction costs typically increase by 10% to 15%. To measure presale revenue, we use the average housing price per square meter minus the average land price per square meter in 2010 as a proxy. Using pre-determined R helps us to circumvent the endogeneity of concurrent R.

The heterogeneity results reported in Table 5 are in line with our model predictions. Specifically, we find that construction costs c could amplify the negative link between postsale supervision s and unfinished projects. The interaction term between construction costs c and presale criterion α also exhibits a negative sign, indicating that higher construction costs can also strengthen the negative link between stricter presale criterion

Table 5: Heterogeneity analysis: Construction costs and presale revenue

Dep. Variable	Probability of unfinished project			# of projects (Poisson)		
	(1)	(2)	(3)	(4)	(5)	(6)
Presale Criterion	-0.165*	-0.144*	-0.158*	-0.0163**	-0.0142**	-0.0160**
	(0.0902)	(0.0824)	(0.0891)	(0.00664)	(0.00616)	(0.00643)
Post-presale Supervision	-0.192***	-0.163***	-0.201***	-0.00774*	-0.00680*	-0.00792*
	(0.0557)	(0.0509)	(0.0555)	(0.00431)	(0.00408)	(0.00429)
Presale Criterion × Construction Cost	-0.0565		-0.0555	-0.00736		-0.00500
	(0.109)		(0.112)	(0.00716)		(0.00782)
Post-presale Supervision × Construction Cost	-0.113**		-0.130**	-0.00718*		-0.00709*
	(0.0533)		(0.0540)	(0.00378)		(0.00376)
Presale Criterion × Revenue		-0.0145	-0.00349		-0.00598***	-0.00484*
		(0.0542)	(0.0572)		(0.00214)	(0.00278)
Post-presale Supervision × Revenue		0.0555	0.103		-0.00350	-0.00142
		(0.0686)	(0.0761)		(0.00660)	(0.00636)
Observations	2,144	2,144	2,144	364,248	364,248	364,248
Adjusted R^2	0.446	0.445	0.446			
Pseudo R^2				0.024	0.024	0.024
Extra controls	Yes	Yes	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: (1) Control variables are the same as previously defined in Table 2. (2) We normalize presale criterion α and postsale supervision s to a distribution with mean zero and standard deviation 1. (3) All regressions include city and year fixed effects. (4) Robust standard errors clustered at the city level are reported in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

and unfinished projects. However, the estimation of this interaction term is imprecise, which could be attributed to the imprecise estimation of the standalone coefficient of presale criterion (α) on unfinished projects.

In line with our expectations, presale revenue significantly amplifies the negative link between presale criterion (α) and multitasking behavior among developers. This finding supports Prediction 4 that higher presale revenue strengthens the deterrent effect of a stricter presale criterion on multitasking developers. Note that we observe the interaction term between construction costs and postsale supervision to be negative in Columns (4) and (6), although it is only marginally significant with 90% confidence. This could be attributed to the fact that, in reality, developers can obtain a portion of the supervised construction costs c before the final stage of the game when the postsale supervision s is low. This can enhance the developers' cash flow before $t = 1$.

7 Back-of-the-envelope Analysis

Based on the empirical results presented in Tables 2 and 3, we conduct a back-of-the-envelope analysis to assess the potential impact of alternative presale policies. As admitted before, our estimates reflect the average treatment effect on the treated, and thus include the ripple effects that presale policies may generate through their interaction with other national or city-specific policies even if these policies do not change during our sample period.

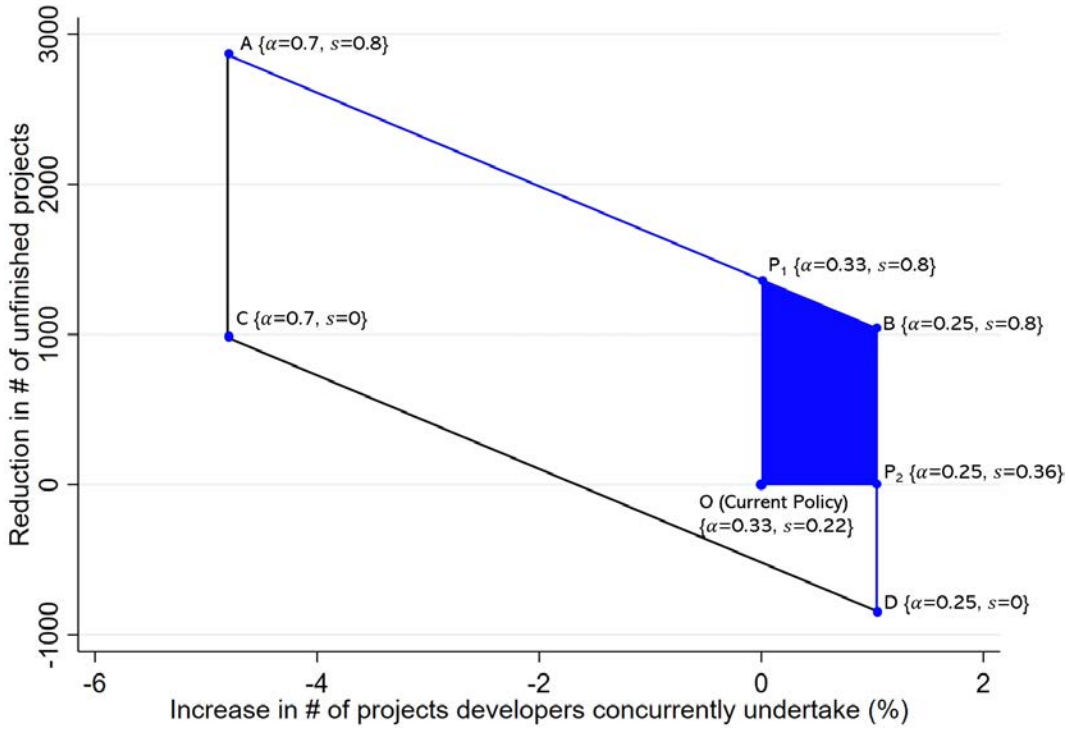
In this exercise, we use the national average of presale criterion (0.33) and postsale supervision (0.22) as the status quo. We then vary the values of presale criterion and postsale supervision based on our regression results,[29] to evaluate the potential effects of different policy settings on the severity of unfinished projects as well as developer multitasking.

Figure 5 illustrates the back-of-the-envelope results. The y-axis represents the *reduction* in the number of unfinished projects, while the x-axis represents the *percent increase* in the number of projects that developers concurrently undertake. The region enclosed by the parallelogram *ABCD* depicts the potential outcome region for all possible combinations of presale criterion $\alpha \in [0.25, 0.7]$, and postsale supervision $s \in [0, 0.8]$. These ranges encompass 95% of our empirical observations. The blue line represents the Pareto frontier, which signifies the highest possible reduction in the number of unfinished projects given different levels of multitasking behavior.

We observe that the current presale policy, at the national average (α=0.33, s=0.22), is inferior to the Pareto frontier. The region shaded in blue designates the Pareto Improvement area. If the national average presale policy shifts to point P_1 (α=0.33, s=0.8), the number of unfinished projects could decrease by approximately 1,360 (58%), without impacting the pace of new housing development. Point A (α=0.7, s=0.8) denotes the strictest presale policy combination in our explored policy range. At this point, the

[29] The estimates we use come from the donut DiD results (Column 5) in Tables 2 and 3. For clarity, we set statistically insignificant coefficients (with p-value above 0.1) to zero. The results remain similar when we use the empirically estimated parameters that are insignificant.

Figure 5: Back-of-the-envelope analysis



Notes: (1) The y-axis represents the *reduction* in the number of unfinished projects compared with the status quo. (2) The x-axis represents the *percent increase* in the number of projects developers concurrently undertake (%). (4) The region shaded in blue is the Pareto Improvement region.

unfinished project issue in China can be completely eliminated, but it would lead to a 5% slowdown in new housing development through less developer multitasking. The presale practices of several developed economies, such as Hong Kong, US, and Australia, have presale policies akin to point A, if α reflects the time when a developer can access the full sales revenue of the new house rather than the time that the developer can start to collect any money from the buyer. Point B (α=0.25, s=0.8) represents a different Pareto improvement, with the number of unfinished projects decreasing by 1,040 (45%), while the pace of new housing development accelerating by 1%.

It is important to note that this back-of-the-envelope analysis provides a preliminary assessment; the actual policy impact may be more complicated and influenced by additional factors beyond presale criterion and postsale supervision. Nonetheless, it highlights the potential for improving the current presale policies in China and the range of outcomes associated with different policy configurations. It also highlights the main eco-

nomic tradeoffs underlying presale policies, namely the occurance of unfinished projects and the pace of new housing development.

8 Conclusion

In this paper, we investigate the costs and benefits of presale policies in China's residential housing market. We begin with a theoretical framework with two key presale policies: presale criterion in terms of construction progress required prior presale and postsale supervision of presale revenue to cover construction costs. The model predicts that a higher presale criterion would undermine the effectiveness of presale as a financial leverage tool, thus lowering the likelihood of the developer undertaking multiple projects simultaneously. In the meantime, the model also predicts that both presale criterion and postsale supervision help to ensure project completion and mitigate the probability of unfinished projects. These predictions highlight the tradeoff between developer moral hazard and potential acceleration of new housing development through presale.

To empirically test our model predictions, we construct a novel dataset that tracks presale policies, unfinished projects, and land auction outcomes in 270 major cities of China from 2010 to 2017. Not only are our empirical results consistent with the theoretical predictions, they but also suggest that China's current presale policy is in the interior of the Pareto frontier. The back-of-envelope results suggest that increasing postsale supervision by 2 standard deviations (from 0.22 to 0.8) can relate to a 58% reduction in unfinished projects, while keeping the pace of new housing development unchanged. Strenghening presale criterion to 0.7 and postsale supervision to 0.8 would eliminate all unfinished projects, but with 5% less developer multitasking which may slow down new housing development.

Overall, our study provides valuable insights into the optimal design of presale policies in the real estate market, which holds significant importance in major economies worldwide. Our results underscore the crucial role of postsale supervision in effectively addressing the issue of unfinished projects in China. The widespread occurrence of un-

finished developments can be attributed to the lack of adequate oversight in the postsale development phase. Moreover, our findings suggest that the relatively lax presale criterion contributes to the rapid urbanization of China, highlighting the role of presale policies as a mechanism for stimulating development speed. However, it is crucial to strike a balance between development speed and ensuring project quality to achieve optimal outcomes and sustainable growth.

Our study is subject to a few data limitations. First of all, since we infer unfinished projects from citizen complaints on a website run by the central government, it could underestimate the problem of unfinished projects because of under-reporting. It also does not tell us whether the unfinished projects have been eventually finished with a delay or remain unfinished as of today. Nor do we know whether any finished projects are subject to serious quality problems, which is another form of moral hazard that could be related to presale policies. Second, lack of exact geocoding prevents us from linking a particular unfinished project to a specific parcel of land sale, this is why we conduct the analysis at the city-year level rather than the project level. Third, there is no doubt that financial tools and related liability regulations – including home mortgage, developer loans, bonds, and foreclosure polices – play an important role in China's residential housing market and may interact with the presale policies in multiple ways. We do not have adequate data to explicitly address them in this paper, but we hope our data collection efforts on the presale policies and unfinished projects across Chinese cities can help other researchers to explore these additional dimensions in future work.

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Appendix

A Proof of the theoretical results

Proof of Prediction 1:
$\frac{\partial Pr_{uf}}{\partial s} = \frac{-(c-\alpha c)}{2\sigma_2} < 0$, and $\frac{\partial Pr_{uf}}{\partial \alpha} = \frac{-(c-s\cdot c)}{2\sigma_2} < 0$

Proof of Prediction 2:
When $R + K - c - M < \sigma_1$, $\frac{\partial Pr_{new}}{\partial \alpha} = \frac{-(R+K-c-M)+(K-M-2\alpha c)}{2\sigma_1} - \frac{1}{2} = \frac{-R+c-2\alpha c}{2\sigma_1} - \frac{1}{2} < 0$, since the presale revenue R is assumed to be greater than the construction cost c.
When $R + K - c - M \geq \sigma_1$, $\frac{\partial Pr_{new}}{\partial \alpha} = -1 + \frac{K-M-2\alpha c}{2\sigma_1} < 0$, since we assume that the initial cash in hand K is moderately small, such that $K < M + \sigma_1 + \alpha c$

Proof of Result Prediction 3:
$\frac{\partial Pr_{uf}}{\partial s \partial c} = \frac{-(1-\alpha)}{2\sigma_2} < 0$, and $\frac{\partial Pr_{uf}}{\partial \alpha \partial c} = \frac{-(1-s)}{2\sigma_2} < 0$

Proof of Result Prediction 4:
$\frac{\partial Pr_{new}}{\partial \alpha \partial R} = \frac{-1}{2\sigma_1} < 0$, when $R + K - c - M < \sigma_1$. When $R + K - c - M \geq \sigma_1$, $\frac{\partial Pr_{new}}{\partial \alpha \partial R} = 0$
$\frac{\partial Pr_{new}}{\partial \alpha \partial c} = \frac{-\alpha}{\sigma_1} < 0$, when $R + K - c - M < \sigma_1$. When $R + K - c - M \geq \sigma_1$, $\frac{\partial Pr_{new}}{\partial \alpha \partial c} = 0$

B Additional data details

Figure A1: Example of a policy document on presale criterion

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厦门市商品房预售管理规定(2022)

第二章 预售项目管理

第五条 预售商品房应当符合下列条件：

（一）已交付全部土地使用权出让金，取得土地使用权证书；

（二）持有建设工程规划许可证和施工许可证；

（三）房屋建设工程承包合同已生效，房屋交付使用日期已经确定；

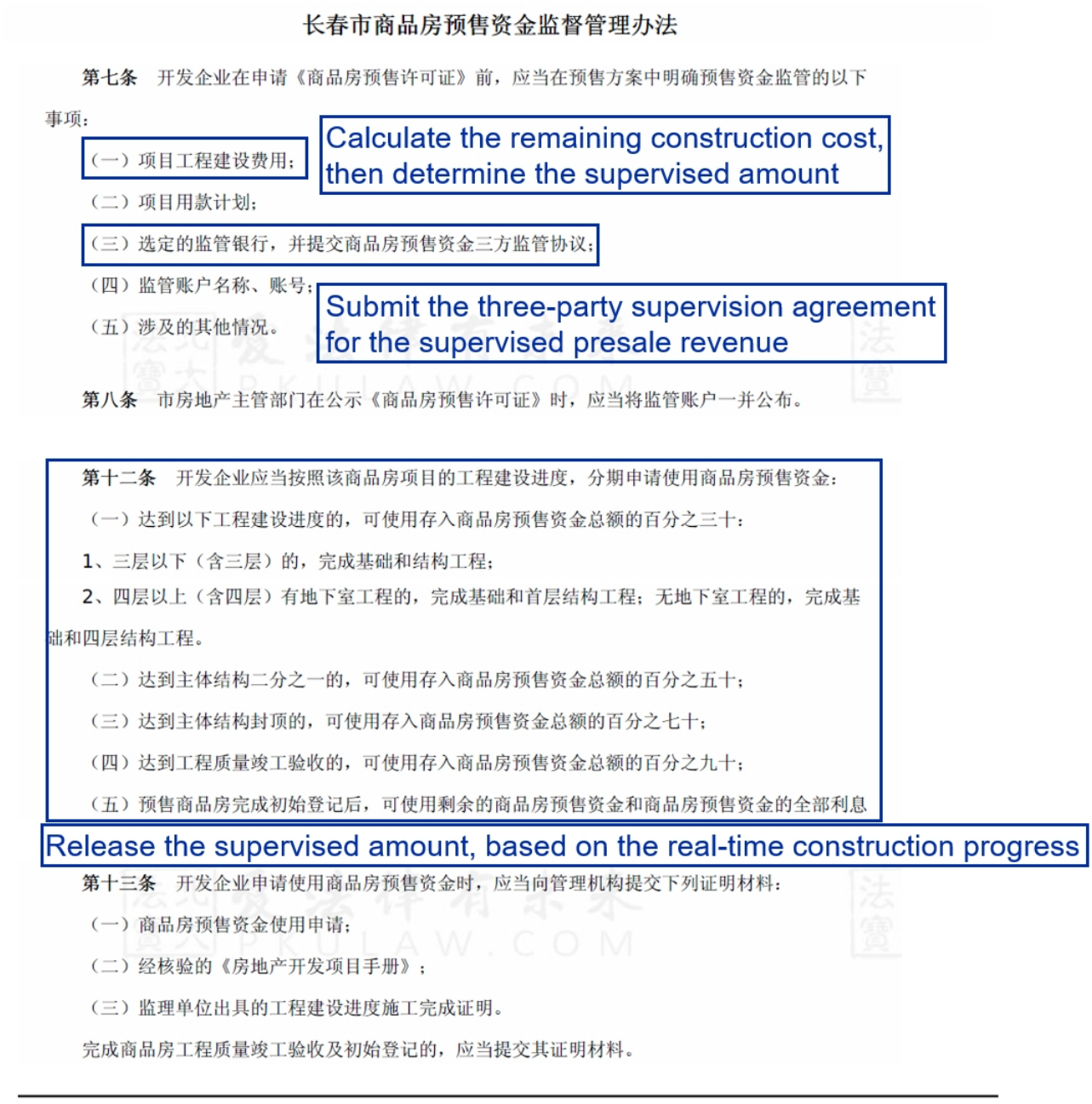
（四）投入开发建设的资金已达到该项目工程建设总投资的25%以上。其中，申请预售商品房项目工程形象进度应达到的标准为：7层以下（含7层）的，已完成主体建筑封顶工程；8层以上（含8层）的，已完成主体结构工程的二分之一以上，且不得少于7层；

（五）已取得预售主管部门核发的商品房预售许可证明。

预售主管部门可以根据市场情况，对前款第四项规定的预售商品房项目工程形象进度进行调整，报市人民政府批准后实施。

Presale criterion:
a. Share of the total construction cost (**25%**)
b. Visual construction progress (**50%** main structure finished)

Figure A2: Example of a policy document on postsale supervision



长春市商品房预售资金监督管理办法

第七条 开发企业在申请《商品房预售许可证》前，应当在预售方案中明确预售资金监管的以下事项：

（一）项目工程建设费用；

Calculate the remaining construction cost, then determine the supervised amount

（二）项目用款计划；

（三）选定的监管银行，并提交商品房预售资金三方监管协议；

（四）监管账户名称、账号；

（五）涉及的其他情况。

Submit the three-party supervision agreement for the supervised presale revenue

第八条 市房地产主管部门在公示《商品房预售许可证》时，应当将监管账户一并公布。

第十二条 开发企业应当按照该商品房项目的工程建设进度，分期申请使用商品房预售资金：

（一）达到以下工程建设进度的，可使用存入商品房预售资金总额的百分之三十：

1、三层以下（含三层）的，完成基础和结构工程；

2、四层以上（含四层）有地下室工程的，完成基础和首层结构工程；无地下室工程的，完成基础和四层结构工程。

（二）达到主体结构二分之一的，可使用存入商品房预售资金总额的百分之五十；

（三）达到主体结构封顶的，可使用存入商品房预售资金总额的百分之七十；

（四）达到工程质量竣工验收的，可使用存入商品房预售资金总额的百分之九十；

（五）预售商品房完成初始登记后，可使用剩余的商品房预售资金和商品房预售资金的全部利息

Release the supervised amount, based on the real-time construction progress

第十三条 开发企业申请使用商品房预售资金时，应当向管理机构提交下列证明材料：

（一）商品房预售资金使用申请；

（二）经核验的《房地产开发项目手册》；

（三）监理单位出具的工程建设进度施工完成证明。

完成商品房工程质量竣工验收及初始登记的，应当提交其证明材料。

Figure A3: Screenshot of the local leaders' message board

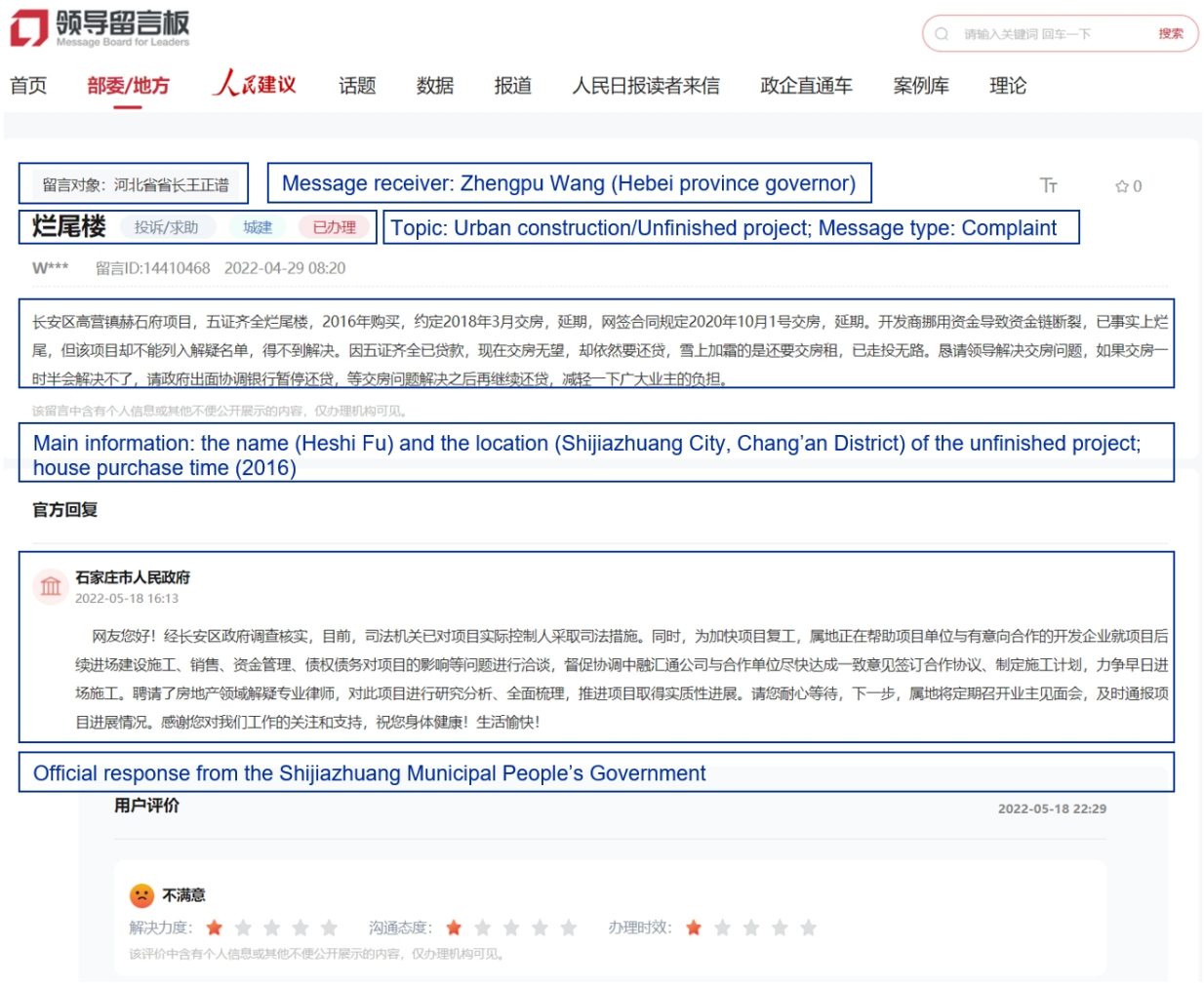
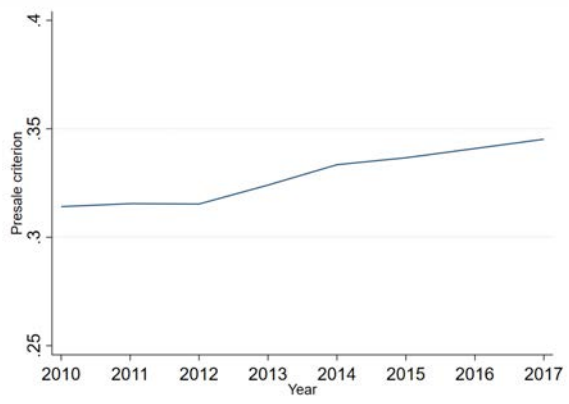
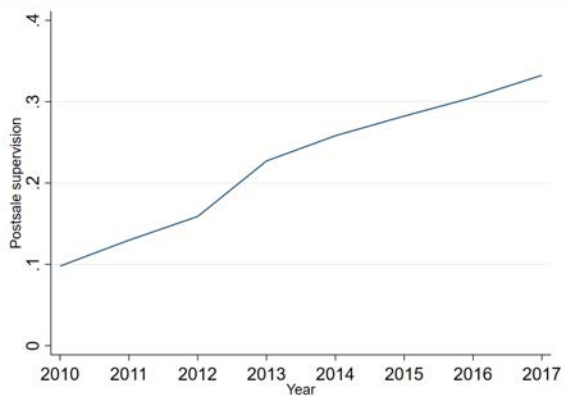


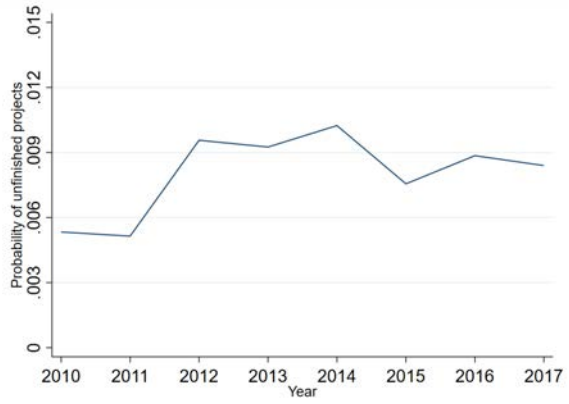
Figure A4: Presale and unfinished projects: Cross-time variation



(a) Presale criterion



(b) Postsale supervision



(c) Probability of unfinished projects

Notes: This figure displays the cross-time variation in the average of presale criterion, postsale supervision, and the probability of unfinished projects from 2010 to 2017.

C Other policies related to unfinished buildings

In this section, we examine whether the changes in presale policies correlate with other policies aimed at reducing unfinished projects. We collected all laws and local government regulations containing the word 'unfinished' (Lan Wei) from the China Law Database. We then set a dummy variable equal to 1 if a city-year has other policies mentioning 'unfinished' and regress it on presale criterion and postsale supervision in our data. The results shown in Table A1 suggest that neither presale criterion nor postsale supervision has a statistically significant correlation with additional policies related to unfinished buildings. We nevertheless control for the dummy of such additional policies in the main regressions for completeness.

Table A1: Other policies related to unfinished buildings

Dep. Variable	Dummy of other related policies				
	(1)	(2)	(3)	(4)	(5)
Presale Criterion	0.00996		0.00991	0.00986	0.0152
	(0.0185)		(0.0185)	(0.0183)	(0.0259)
Postsale Supervision		0.00268	0.00258	0.00152	0.0155
		(0.0115)	(0.0116)	(0.0112)	(0.0162)
Observations	2144	2144	2144	2144	1878
Adjusted R^2	0.607	0.607	0.607	0.608	0.600
Extra controls	No	No	No	Yes	Yes
Donut analysis	No	No	No	No	Yes
City FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes

Notes: (1) The dependent variable is the dummy variable representing the other policies that relate to unfinished buildings. (2) Robust standard errors clustered at the city level are reported in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

D Presale and unfinished projects: Extensive and intensive margins

This section examines the impact of presale policies on unfinished projects in both extensive and intensive margins. The results are presented in Table A2. The dependent variable in Panel (a) is a dummy that switches on if a city-year has *any* unfinished projects. In Panel (b) we examine the impact of presale on the probability of unfinished projects from the extensive margin, only keeping the observations with a positive probability of unfinished projects.

Table A2: Presale and unfinished projects

	(1)	(2)	(3)	(4)	(5)
Panel (a). Extensive margin: Dummy of unfinished project occurance					
resale Criterion	-0.0488**		-0.0485**	-0.0484**	-0.0485*
	(0.0241)		(0.0242)	(0.0235)	(0.0254)
Postsale Supervision		-0.0125	-0.0121	-0.0121	-0.0310
		(0.0204)	(0.0204)	(0.0204)	(0.0228)
Observations	2,144	2,144	2,144	2,144	1,878
Adjusted R^2	0.354	0.353	0.354	0.355	0.364
Panel (b). Intensive margin: Probability of a project being unfinished (%)					
Presale Criterion	0.00940		-0.0242	0.0256	-0.186
	(0.246)		(0.239)	(0.216)	(0.346)
Postsale Supervision		-0.334***	-0.335***	-0.315***	-0.557***
		(0.101)	(0.102)	(0.112)	(0.185)
Observations	797	797	797	797	670
Adjusted R^2	0.429	0.436	0.435	0.446	0.439
Extra controls	No	No	No	Yes	Yes
Donut analysis	No	No	No	No	Yes
City FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes

Notes: (1) This table replicates Table 2, but in panel (a), the dependent variable is the dummy variable representing the occurrence of any unfinished projects. (2) Panel (b) uses the same dependent variable but excludes the city-years that do not have any unfinished projects. (3) Robust standard errors clustered at the city level are reported in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

The decomposition results suggest that presale criteria mainly reduce unfinished projects from the extensive margin. In contrast, post-sale supervision has a more significant impact on the intensive margin. Earlier presale exposes the project to more risks post-sale. Therefore, even in cities with stringent post-sale supervision, some unfinished projects may occur, resulting in the outcome variable being labeled as '1' in Panel (a),

though the probability of a project remaining unfinished is low due to stringent post-sale supervision.

E Further robustness checks

We conduct several robustness checks. First, we use an event study approach to check the pretrend and dynamic treatment effects. We also check the robustness of our results when we use alternative weights to construct the postsale supervision S, and use the absolute number of unfinished projects as the outcome variable. Finally, we test the robustness of using restricted samples.

E.1 Event study results

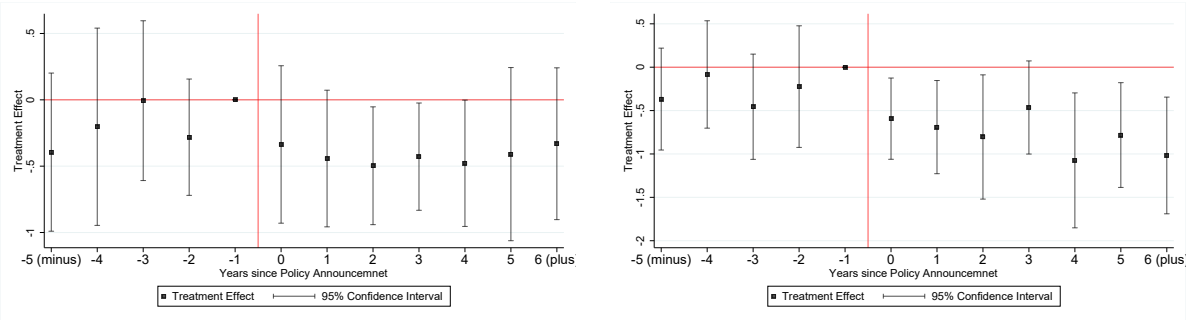
We transform the continuous presale policy variables $\alpha_{j,t}$ and $s_{j,t}$ into binary indicators, denoted by Dsj,t and $D\alpha_{j,t}$. Specifically, we define $Ds_{j,t} = 1$ if $s_{j,t} > 0.5$, which implies that at least two out of the four supervision indicators are met. For presale criterion, we define $D\alpha_{j,t} = 1$ if $\alpha_{j,t} > 0.25$, implying that the city has increased the presale criterion strictly above the national minimum of 0.25.

In Figure A5, we present the event study results of the two presale policy dummies on the probability of unfinished projects. Consistent with our main regression results reported in Table 2 Panel (b), we find a significant drop in the unfinished projects almost immediately after the postsale supervision dummy Ds increases from 0 to 1. This effect remains relatively stable afterwards. In Panel (a), we also find the presale criterion dummy $D\alpha$ reduces the unfinished projects probability, but the estimates are less precise. We do not find a significant difference of pretreatment trends in both graphs.

Figure A6 presents the event study results of the two presale policy dummies on multitasking developers. The results in Panel (a) suggests that during the pre-treatment periods, presale criterion dummy $D\alpha$ has small and insignificant impact on multitasking developers. The impact of $D\alpha$ becomes negative and is increasing over time after the treatment. This pattern can be attributed to the fact that constructing a residential apartment complex typically requires 3 to 4 years to complete. Consequently, in the initial 1 or 2 years after the treatment, developers are still working on the projects they acquired prior to the treatment. Similar to our regressions results, we find an imprecise impact of

postsale supervision dummy Ds on multitasking developers.

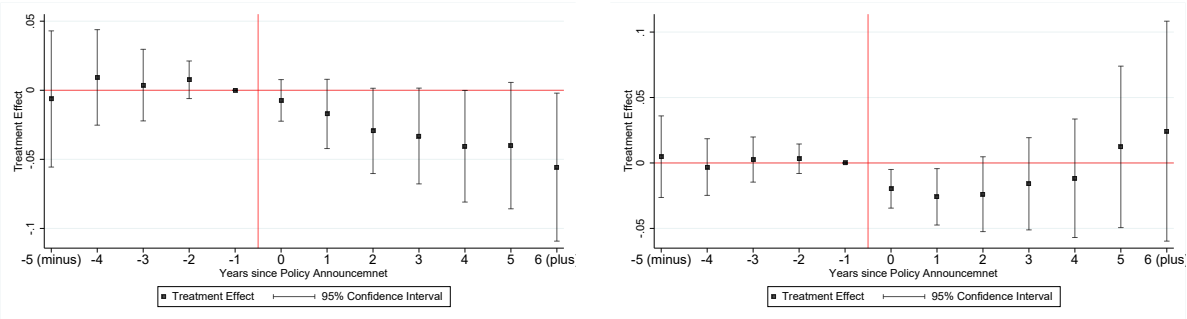
Figure A5: Presale and unfinished projects: Event study



(a) Presale criterion (b) Postsale supervision

Notes: (1) This figure displays the event study, using the variant of Equation 5. (2) In order to improve the statistical power, observations 6 or more years after the treatment are categorized in the event window '6 (plus),' and those 5 or more years prior to treatment are categorized in the event window '-5 (minus). (3) The omitted category $t = -1$ is the calendar year prior to the policy treatment. (4) The capped spikes (I-beams) plot the 95% confidence interval for the estimates.

Figure A6: Presale and multitasking developers: Event study

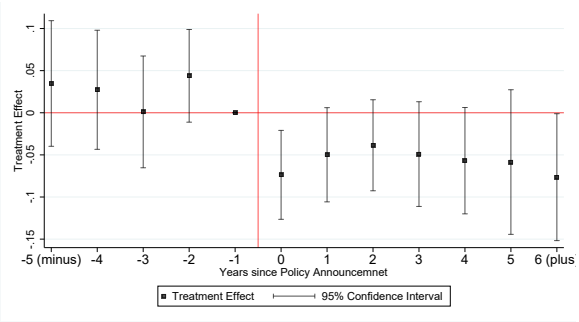


(a) Presale Criterion (b) Postsale supervision

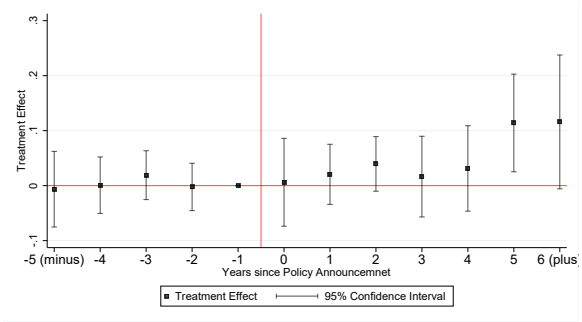
Notes: (1) This figure displays the event study, using the variant of Equation 6. (2) In order to improve the statistical power, observations 6 or more years after the treatment are categorized in the event window '6 (plus),' and those 5 or more years prior to treatment are categorized in the event window '-5 (minus). (3)The omitted category $t = -1$ is the calendar year prior to the policy treatment. (4) The capped spikes (I-beams) plot the 95% confidence interval for the estimates.

Figure A7 presents the event study results regarding auction success rate and land price, revealing an immediate drop in the auction success rate after an increase in the presale criterion dummy $D\alpha$. This effect remains relatively stable in the subsequent years. For the postsale supervision dummy Ds, we generally find it has no impact on

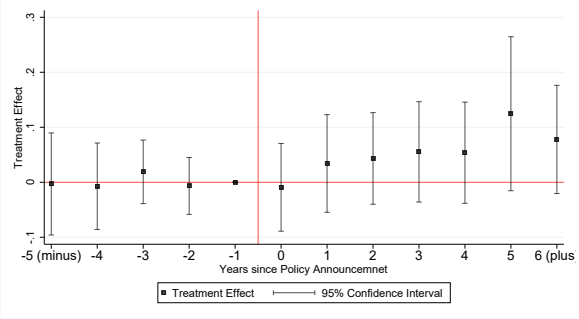
Figure A7: Presale and land market outcomes: Event study



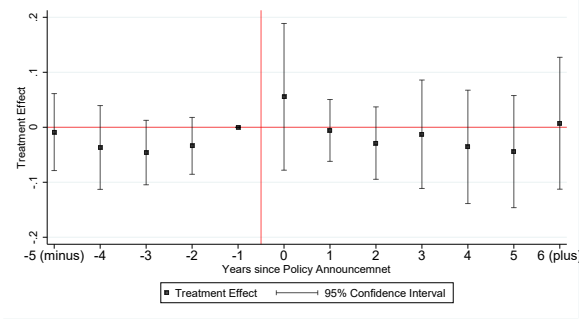
(a) Success rate (Presale criterion)



(b) Success rate (Postsale supervision)



(c) Auction price (Presale criterion)



(d) Auction price (Postsale supervision)

Notes: (1) This figure displays the event study, using the variant of Equation 7. (2) In order to improve the statistical power, observations 6 or more years after the treatment are categorized in the event window '6 (plus),' and those 5 or more years prior to treatment are categorized in the event window '-5 (minus). (3) The omitted category $t = -1$ is the calendar year prior to the policy treatment. (4) The capped spikes (I-beams) plot the 95% confidence interval for the estimates.

the auction success rate. Although there is an imprecise jump happens after 5 years of policy implementation. However, this jump is likely driven by a few observations given that our sample spans for nine years (2010-2017), and many changes in the postsale supervision dummy Ds took place after 2013. Consistent with our regression results, we find no impact of both $D\alpha$ and Ds on land transaction price. As aforementioned, this is due to most lands transacted only have one bidder and are transacted at the reserve price.

E.2 Alternative measures of s

It is plausible to raise concerns about the potential arbitrariness in defining the measure of postsale supervision. To address this, we have constructed two alternative measures,

adjusting the weight assigned to the four key components: S_{cost}, $S_{progress}$, $S_{superstructure}$, and S_{third}. First, we apply uniform weights (0.25 each) to all four components in the construction of the s measurement. The outcomes of this approach are displayed in Table A3 Panel (a). Second, we assign greater weight to S_{cost} and $S_{superstructure}$ (0.3 and 0.4, respectively), in alignment with the emphasis placed on the two components by construction experts. The results of this adjustment can be found in Panel (b). Reassuringly, regardless of alternative measures of s used, the effect of presale policies remains robust.

Table A3: Robustness checks: Alternative measure of postsale supervision (s)

Dep. Variable	Unfinished project	Multitasking	Auction success	Price
	(1)	(2)	(3)	(4)
Panel (a): Alternative $S = 0.25 \cdot S_{cost} + 0.25 \cdot S_{progress} + 0.25 \cdot (1 - \frac{S_{superstructure} - 0.5}{0.5}) + 0.25 \cdot S_{third}$				
Presale Criterion	-0.145*	-0.0136**	-0.0287***	0.0145
	(0.0819)	(0.00683)	(0.00766)	(0.0180)
Postsale Supervision	-0.170***	-0.00688	-0.000442	0.0249
	(0.0536)	(0.00441)	(0.0109)	(0.0169)
Observations	2,144	364,248	144,948	95,240
Adjusted R^2	0.445		0.093	0.967
Pseudo R^2		0.024		
Panel (b): Alternative $S = 0.3 \cdot S_{cost} + 0.15 \cdot S_{progress} + 0.4 \cdot (1 - \frac{S_{superstructure} - 0.5}{0.5}) + 0.15 \cdot S_{third}$				
Presale Criterion	-0.145*	-0.0136**	-0.0287***	0.0145
	(0.0819)	(0.00683)	(0.00766)	(0.0180)
Postsale Supervision	-0.159***	-0.00632	-0.000410	0.0231
	(0.0501)	(0.00405)	(0.0102)	(0.0157)
Observations	2,144	364,248	144,948	95,240
Adjusted R^2	0.445		0.093	0.967
Pseudo R^2		0.024		
Extra controls	Yes	Yes	Yes	Yes
Donut analysis	No	No	No	No
City FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

Notes: (1) This table replicates the results for Column (4) in Table 2, 3, and 4 but uses alternative measures of postsale supervision (s). The results for other columns remain robust. (2) Robust standard errors clustered at the city level are reported in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table A4: Presale and unfinished projects

Dep. Variable	# of unfinished projects (Poisson)				
	(1)	(2)	(3)	(4)	(5)
Presale Criterion	0.0530		0.0358	0.0522	-0.0620
	(0.106)		(0.101)	(0.0953)	(0.142)
Postsale Supervision		-0.153***	-0.151***	-0.131***	-0.213***
		(0.0491)	(0.0486)	(0.0474)	(0.0565)
Observations	2,144	2,144	2,144	2,144	1,878
Peseudo R^2	0.446	0.448	0.448	0.452	0.459
Extra controls	No	No	No	Yes	Yes
Donut analysis	No	No	No	No	Yes
City FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes

Notes: (1) This table replicates Table 2 but uses the dependent variable the absolute number of unfinished projects, using Poisson pseudo-likelihood regression (Correia, Guimarães, and Zylkin, 2020). (2) Control variables are the same as in Table 2. (3) All regressions include city and year fixed effects. (4) Robust standard errors clustered at the city level are reported in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

E.3 An alternative measure of unfinished projects

E.4 Sample restriction

Despite the low cost of submitting posts and the high response rate encouraging property owners to report unfinished projects on the Local Leaders' Message Board, the potential for under-reporting remains. This is especially true for cities with the least stringent presale policies, which may lead to a conservative lower-bound estimate of the policy effect. To investigate this possibility, we report the results in Table A5 after eliminating the 10% of cities with the least stringent presale criterion and postsale supervision in 2010. Reassuringly, the results remain robust to variations in the sample restrictions.

Table A5: Presale and unfinished projects: Sample Restriction

Dep. Variable	Probability of a project being unfinished (%)				
	(1)	(2)	(3)	(4)	(5)
Presale Criterion	-0.133		-0.132	-0.146*	-0.143
	(0.0905)		(0.0905)	(0.0875)	(0.111)
Postsale Supervision		-0.166***	-0.166***	-0.167***	-0.273***
		(0.0622)	(0.0622)	(0.0615)	(0.0891)
Sample mean	0.8%	0.8%	0.8%	0.8%	0.8%
Observations	1,930	1,930	1,930	1,930	1,681
Adjusted R^2	0.433	0.435	0.435	0.441	0.434
Extra controls	No	No	No	Yes	Yes
Donut analysis	No	No	No	No	Yes
City FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes

Notes: (1) This table reports the estimates of β_1^u and β_2^u from Equation (5), but removes the 10% most lenient cities (as of 2010) from the sample. (2) Control variables are the same as in Table 2. (3) Robust standard errors clustered at the city level are reported in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table A6: Presale and multitasking developers: Remove top-50 developers

Dep. Variable	# of projects (Poisson)				
	(1)	(2)	(3)	(4)	(5)
Presale Criterion	-0.0152**		-0.0153**	-0.0149**	-0.0185**
	(0.00658)		(0.00668)	(0.00673)	(0.00897)
Postsale Supervision		-0.00722*	-0.00733*	-0.00703*	-0.00645
		(0.00424)	(0.00421)	(0.00416)	(0.00617)
Sample mean	1.73	1.73	1.73	1.73	1.73
Observations	351,036	351,036	351,036	351,036	291,612
Pseudo R^2	0.024	0.024	0.024	0.024	0.025
Extra controls	No	No	No	Yes	Yes
Donut analysis	No	No	No	No	Yes
City FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes

Notes: (1) This table uses the specification as in Table 3 but removes top-50 developers from the working sample. (2) Control variables are the same as in Table 3. (3) * significant at 10%; ** significant at 5%; *** significant at 1%.