Government Land Sales as a Response to Negative Economic Shocks in China

Yu Qiu*

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Abstract

How do local governments in China respond to negative economic shocks? This study investigates this question by leveraging an institutional feature of China, where local governments own the land and obtain revenue from land sales. Using a shift-share design, I find that city governments use land sales for real estate development to address negative economic shocks resulting from export slowdown. This strategy increases the government's tax revenue collected from the real estate sector and boosts employment in the construction sector in the short run. However, it also leads to higher real estate risks, as evidenced by an increased probability of homebuyers' protests at stalled construction sites due to developers' over-indebtedness. This land sales strategy is more prevalent in cities with newly-appointed leaders. More generally, I find that local governments use land sales to respond to aggregate shocks, such as the COVID-19 pandemic, rather than regional shocks, such as floods and the US-China trade war.

Keywords: Export slowdown; real estate development; land sales; China

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*Department of Economics, University of Pittsburgh (email: YUQ23@pitt.edu). I'm grateful to Daniel Berkowitz, Osea Giuntella, and Muhammad Yasir Khan for their guidance and encouragement throughout this project. I thank Andreas Ferrara, Claire Duquennois, Mazhar Waseem, Nancy Qian, and Randall Walsh for their helpful comments, as well as participants at the Labor & Development Brown bag and Applied Micro Brown bag at the University of Pittsburgh.

1 Introduction

Governments play a crucial role in mitigating risks and providing social insurance against negative economic shocks. However, these shocks can also constrain governments' ability to respond by reducing government revenue and potentially leading to cuts in public spending, which can worsen the shocks. Therefore, understanding how governments respond to these negative economic shocks and the implications of their responses for the economy in both the short and long run is essential.

In this paper, I examine how local governments in China respond to negative economic shocks. This exploration is particularly intriguing given China's status as a leading example of a developing country sustaining a high economic growth rate for decades. Understanding how the Chinese government responds to negative economic shocks is essential for comprehending the sustained economic growth China has achieved over the years. Additionally, China's decentralized institutional structure grants local governments autonomy and overall responsibility to initiate and coordinate reforms, provide public services, and enforce laws within their jurisdictions (Xu, 2011). While regional decentralization equips local politicians with autonomous tools to counter economic shocks, political centralization motivates them to mitigate these shocks, as their performances are evaluated by the upper-level government.

One area where local governments in China have autonomy is in the management and sale of land within their jurisdictions. In China, the State owns the land, and local governments, as the monopolists in the land market, have the autonomy to sell land within their jurisdictions. The revenue generated from these land sales directly goes to local governments' budgets, enabling them to finance various infrastructure projects. Additionally, selling land can stimulate real estate development, which has been a key driver of China's economic growth. The revenue from land sales can also serve as collateral for local governments to raise debt financing through the "Local Government Financing Platform." However, with the increasing risks in the real estate sector in China, there has been significant debate in the media about the Chinese government's reliance on land sales and real estate development to address economic challenges[1]. Despite these discussions, empirical evidence

[1]As put by *The New York Times* (August 22, 2023): "Beijing has often addressed economic troubles by boosting

regarding the link between negative economic shocks and governments' land sales remains scarce.

To test this relationship, this paper examines whether Chinese city governments leverage land sales to respond to negative economic shocks and the role of land sales in the city's economy. This test requires variation in the intensity of negative economic shocks across different localities and the economic shocks being quasi-exogenous. To obtain such shocks, I exploit the setting of a marked slowdown in China's exports during the mid-2010s, when China's annual export growth rate fell from 24.7% between 2001 and 2008 to only 0.8% between 2013 and 2016[2], as my main setting. The slowdown is largely due to the sluggish global trade growth after the 2008 global financial crisis (World Bank, 2020). Since different exporting products experienced varying recovery speeds, cities with different compositions of exporting products were exposed differently to the export slowdown. To complement my analysis, I also explore the context of other negative shocks, including flooding disasters, the US-China trade war, and the COVID-19 pandemic.

To identify the impact of export slowdown, I adopt a shift-share (Bartik) instrumental variable (SSIV) for each city's exposure to the export slowdown following Campante et al. (2023). The SSIV combines the product-level shifts in the global trade change excluding China with the initial product mix at the city level. To validate the SSIV, I follow the guide by Borusyak et al. (2022) to demonstrate that the product-level shocks are as good as randomly assigned, which is equivalent to the exogeneity of the SSIV. I also conduct the product-level analysis and control the incomplete share for robustness checks.

My main finding shows that city governments with greater exposure to export slowdown have higher land sales revenue. Specifically, my IV result shows that a one-standard-deviation increase in export slowdown exposure (approximately $837 decrease in exporting value per worker) would increase the land sales revenue by 4.69%. The increase in land sales revenue is primarily driven by higher sales of residential and commercial land, intended for real estate development. The result is robust using shorter and longer analysis periods, and it is not driven by cities in specific provinces or products with specific HS two-digit codes. I also use different clustering levels and implement

spending on infrastructure and real estate."

[2]The numbers are calculated based on UN Comtrade.

the “tF inference” for IV proposed by Lee et al. (2022) to validate my result.

Additionally, cities exposed to export slowdowns generally exhibit higher land sales revenue. This effect is particularly pronounced among newly appointed city leaders, as selling land is the most straightforward way to buffer the shocks compared with leveraging other strategies such as mobilizing state-owned enterprises and local businesses. Also, these newly appointed leaders might be more incentivized to mitigate shocks due to their longer horizons for continuing their tenures in the current city.

I then delve into the role of land sales during the export slowdown period and in the longer run. Land sales are tightly connected with real estate development, with the evidence that cities with greater exposure to export slowdown, also as those selling more land during the period, have higher investments in real estate projects. I provide evidence that real estate development benefits the city’s development during the export slowdown period by providing the city with higher land-related tax revenue and creating employment opportunities in the construction sector. Specifically, cities with greater exposure to export slowdown have higher land-related tax revenue, including direct land tax revenue and the corporate income tax revenue collected from real estate firms. Meanwhile, developing real estate projects creates job opportunities in the construction sector. Despite the decline in manufacturing employment in cities more exposed to the export slowdown, these cities experienced an increase in construction employment during this period. This indicates that land sales help mitigate the employment loss in the manufacturing sector. Lastly, I investigate a longer-run effect of land sales by linking land sales during the export slowdown period to China’s current real estate risk. I find that cities with greater exposure to the export slowdown during the mid-2010s had a higher probability of experiencing incidents of homeowners’ protests at presold but stalled construction apartments. This phenomenon is attributed to real estate developers’ inability to repay debts and continue construction projects, suggesting the potential risks associated with relying heavily on land sales as a strategy to buffer economic shocks.

Finally, I explore other negative economic shocks beyond the export slowdown during the mid-2010s by examining city governments’ land sales in the context of flooding disasters, the US-China trade war, and the COVID-19 pandemic. I find no evidence that city governments increase land sales in response to flooding disasters or the US-China trade war. However, cities with greater exposure to the COVID-19 pandemic do experience an increase in land sales revenue, driven by higher land prices despite less land area sold. These results suggest that local governments utilize land sales as a strategy to respond to more widespread shocks such as aggregate export slowdown and the COVID-19 pandemic. The land sales strategy is not employed for more regional or local shocks, as cities have other corresponding responses in those cases.

The central contribution of this paper is to document how city governments in China use land sales as a response to negative economic shocks. Existing studies often find the limited ability of local governments to buffer economic shocks in the context of the United States (Feler and Senses, 2017; Jerch et al., 2023; Cromwell and Ihlanfeldt, 2015). This limitation is primarily due to the fact that negative economic shocks tend to reduce local government's revenue. To maintain budgetary balance, local governments have limited options for stimulating the economy, and sometimes they even cut public spending during the downturn. However, in the context of China, Campante et al. (2023) document that local governments more exposed to the export slowdown increase social spending and public security expenditure, and the exposure to the export slowdown did not decrease the government revenue. This paper offers a potential explanation for the differences in local governments' behaviors during the economic downturn that local governments in China can leverage land sales as a tool to buffer the shocks and get an increased land-related revenue.

This paper also connects to the literature studying the effect of international trade. Previous literature largely focuses the impact of trade on the labor market outcomes (Autor et al., 2013; Hakobyan and McLaren, 2016; Acemoglu et al., 2016; Dix-Carneiro and Kovak, 2017); political outcomes (Margalit, 2011; Feigenbaum and Hall, 2015; Jensen et al., 2017; Che et al., 2022) and political polarization (Autor et al., 2020). These studies focus on the impact of an increase in exposure to imports. A recent literature studies the effects of a negative exposure to export slowdown in China on labor market outcomes and political responses (Campante et al., 2023; Ma et al., 2022). This paper joins the literature studying the impact of export slowdown and complements the literature by providing evidence on how export slowdown affects local governments' responses from the perspective of public finance and development policy.

Finally, China's recent real estate issues have been tightened with the institutional feature of governments' land sales (Xiong, 2023). Current literature provides three explanations for why local governments in China are inclined to sell more land. First, fiscal pressure resulting from the tax reform that requires local governments to share tax revenue with the central government has been argued to increase local governments' incentives to boost land sales revenue, which is an off-budgetary revenue (Han and Kung, 2015). Second, promotion incentives drive political leaders to sell more land because land sales can stimulate real estate development and the urbanization process (Wang et al., 2020; Chen and Kung, 2016). Third, Rent-seeking behavior related to land sales revenue has been documented as the third reason (Chen and Kung, 2019, 2016). My study contributes to this literature by showing selling land is adopted by local governments as a tool to buffer negative economic shocks.

The rest of the paper proceeds as follows. Section 2 describes the institutional background. Section 3 describes my data sources, measures, and empirical strategy. My main results on the impact of export slowdown on land sales are presented in Section 4. Section 5 discusses the role of land sales during the export slowdown period. Section 6 explores the impact of other negative shocks on city governments' land sales. Section 7 concludes.

2 Institutional Background

2.1 China's Regionally Decentralized Authoritarian System

China's fundamental institution is described as a regionally decentralized authoritarian (RDA) regime, which is a combination of political centralization and economic regional decentralization (Xu, 2011). On the one hand, the local government officials are appointed and promoted by the upper-level government. This highly centralized structure serves as an instrument for the central government to induce local governments to insert efforts and follow the central government's policies (Li and Zhou, 2005; Wang et al., 2020). On the other hand, regional decentralization gives local governments autonomy and overall responsibility to provide public services and initiate and coordinate policies and reforms within their jurisdictions.

Under this institutional feature, when there are negative shocks, local politicians have incentives to insert efforts to buffer the shocks as their performance will be evaluated by the upper-level government, which determines their career pattern. Meanwhile, the high autonomy of their jurisdictions enables the political leaders to adopt tools to deal with shocks. For example, state-owned firms are used as a tool of employment provision to prevent social unrest (Wen, 2022). The development of local government financing vehicles (LGFVs) and shadow banking has been used as a financing tool (Chen et al., 2020).

2.2 Land Sales in China

In China, the State owns the urban land.[3] The 15th National Congress of the Communist Party of China in 1998 granted local governments de jure ownership over land in their geographical jurisdictions. The local governments were authorized to sell usufruct rights over the land in their jurisdictions by the Land Management Law passed. Selling land (land use right, hereafter using land to refer to land use right), which constitutes the primary land market, has been an important instrument for local government to finance the budget and boost economic growth. Figure 2 shows local governments increasingly rely on land revenue over the years.

The importance of land sales comes from local governments' fiscal need, which stems from two fiscal reforms: the Tax-sharing Reform in 1994 and the Budget Law enacted in 1995. China has a decentralized fiscal system that the local governments have autonomy over their expenditure, and they serve as the central government's tax agencies providing sources of fiscal revenue. To address the continuous decline in the central government's fiscal revenue as a fraction of GDP, the Tax-sharing reform required the local governments to submit a greater share of specific tax revenues to

[3]The agricultural land is owned by rural collectives. The State can buy land from rural collectives and convert the ownership to the State.

the central government [4]. This reform remarkably decreases local governments' fiscal revenue as they need to submit greater amounts to the central government. Furthermore, the Budget Law in 1995 reinforces the fiscal need by prohibiting local governments from running budgetary deficits or obtaining external financing. These constraints have created fiscal pressures on local governments and prompted them to seek alternative financing sources.

Among the available financing sources, selling land stands out because it can be independently decided by local governments and the revenue from land sales does not have to be shared with the central government. Local governments are the monopolists in the land market (urban land market, hereafter land market), and they control the supply of land. To initiate land sales, the local government proposes a sales quota to the central government, which outlines the amount of land that can be sold within a five or ten-year timeframe. Once an agreement is reached, the local government can independently determine the quantity and type of land to be sold. All of the revenue from land sales go into the local government's budget. In addition to the fiscal revenue, land is also important for local governments to attract firms and develop local economies. For example, the sales of industrial land attract firms and promote local industrial development, and the sales of commercial and residential firms boost the development of real estate projects and the urbanization process.

2.3 Export Slowdown in the Mid-2010s

Export has been a primary driver of China's economic growth since 1990s. The average annual export growth rate of China has reached 24.7% between 2001 and 2008[5]. Since the 2008 global financial crisis, the export growth rate of China decreases, mostly driven by the sluggish global

[4]The Tax-sharing reform in 1994 requires local governments to share 75% of the value-added tax revenue with the central government, which before the reform local governments can keep half of the value-added tax revenue. In later years, the state successively introduced reforms on the tax-sharing scheme, which further decrease the tax revenue local governments can hold. For stamp tax, local government used to keep half of the revenue before 1997 and the share decreased to 20% in 1997 and 3% in 2000. For enterprise income tax revenue and personal income tax revenue, which previously fully belonged to local governments, 50% of them should be shared to the central government since 2002 and the number increased to 60% in 2003.

[5]The figure is calculated using data from UN Comtrade.

trade growth (World Bank, 2020). Figure 1 plots the time series of China's export growth rate and the export growth rate of the rest of the world from 2001 to 2022. China's annual export growth rate decreases to merely 0.8% between 2013 and 2016.

Given the prominent role of exports in China's economy, the slowdown in exports generates negative effects on the economy. Campante et al. (2023) document the negative effect of export slowdown on the city's night light intensity, average income, and manufacturing employment. Concurrently, they show cities with larger exposure to the export slowdown during the mid-2010s have more incidents of labor unrest, and in response, the city leaders would spend more on public security and social spending and emphasize stability more in their speeches. Ma et al. (2022) document export slowdown's effect on increasing the city's crime rate.

In Appendix A, I summarize the effect of cities' exposure to the export slowdown on economic performance, employment outcomes, and the city government's budget. Overall, exposure to the export slowdown has a negative effect on cities' economic activities. An interesting pattern emerges regarding city governments' budgets: cities more exposed to the export slowdown exhibit higher expenditures, driven by increases in public security and social spending. Along with the rise in expenditure, the revenue did not decrease in these cities (Table A2). The increase in city governments' spending and the absence of revenue decrease following the export slowdown contrast with the findings of Feler and Senses (2017) that local governments more exposed to the import competition in the US experience lower revenue and public spending.

The government's utilization of land sales as a response to export shocks offers a potential explanation for this observed pattern. Land sales are closely tied to real estate development and the sales of land enable city governments to generate revenue from not only the direct land sales but also land-related taxes collected from the real estate sector. These land-associated economic activities likely contribute to the sustained revenue observed in cities more exposed to the export slowdown, which financed the increasing social spending and public security expenditure. I offer corresponding evidence supporting these arguments in the rest of the paper.

3 Data and Empirical Strategy

3.1 Data Sources and Measures

This section describes my data sources and main variables, including the measures of export shocks, land sales, economic outcomes and labor market outcomes. I focus on the prefectural level city as my unit of analysis, which is the division below the level of the province and above the level of the county in China's administrative hierarchy. My sample includes 328 cities, which consist of almost all prefectural cities across China except Tibet.

3.1.1 Measuring Export Slowdown

The export slowdown measures are from Campante et al. (2023), where the original data comes from China's General Administration of Customs. The database covers the universe of China's exporters and importers. It provides information on the trading firm's location, trade values at the Harmonized System (HS) six-digit product level, and trade partners. I include 4596 HS6 products in my sample. The exposure to export slowdown is measured using the annual change in the city's exporting values per worker:

$$\Delta Export_{ct} = \sum_{k} \sum_{f \in c} \frac{\Delta X_{fckt}}{L_{c,2010}} \tag{1}$$

where f denotes firm, c city, k product, and t time. X_{fckt} is the export values of firm f in product k at year t. $\Delta X_{fckt} = X_{fckt} - X_{fck,t-1}$, is the annual change of firm f's export values. $L_{c,2010}$ is the working-age population (ages 15-64) of the city c in the year 2010, which is before the main sample period 2012-2015. The years before 2012 are avoided because of the potential confounds of the extraordinary stimulus. The extraordinary stimulus, which is the 4 trillion yuan stimulus, was announced in 2008 to stimulate the slumped export-driven economy in the wake of the financial crisis. Meanwhile, the stimulus program is mainly financed by local governments. Selling land is an important financing source for local governments' budgets. The stimulus program in this period might correlate with both the exposure to export slowdown and local governments' land sales behaviors. Years after 2017 are excluded because of the US-China trade war. In the robustness check section, I extend and shrink my analysis sample, and the result remains robust (See section 4.4).

3.1.2 Measuring Land Sales

My data on land sales come from the website of the Land Transaction Monitoring System (http://www.landchina.com/), which provides records of land transactions from the year 2000 till now. For each land transaction, the Ministry of Land and Resources records the transaction date, location of the land parcel (address and postal code), size, total payment, land usage (e.g., residential, commercial, and industrial), land parcel quality (evaluated by the official-in-charge on a 20-point scale), a three-digit industry code of the buyer's firm, and names of sellers and buyers. A total of 906,911 land transactions were recorded between the years 2012 and 2015, with most of these transactions used for residential land (39%), followed by industrial land (23%), infrastructure land (17%), and commercial land (15%).

I generate year-by-city-level measures of land sales by aggregating the land transactions by city and year. Specifically, the measures of interest are the city-level land sales revenue, land sales area (the size of the land sales), average selling price per hectare of the land, and these three measures by different land usage types. Specifically, in consideration that different usage type of land has different price, the measure of the selling price at the city level is computed by the weighted average of land selling price by using the share of land areas across different usage types as the weight.

Figure 3 displays the geographical distribution of land sales revenue and export value change across cities in the year 2015[6]. There is a visual correlation between the negative export shock and the increase in land sales revenue.

[6]The year 2015 is chosen for the reason that this year experiences the most decrease in export value.

3.1.3 Measuring Economic and Labor Market Outcomes

To examine the impact of land sales on the economy, I construct city-level real estate development measures and employment by industry measures.

The data on the city-level investment in real estate projects come from City Statistical Yearbooks. I also construct tax revenue and profit measures in the real estate sector. The date for these measures come from the National Tax Statistics Database (NTSD), which is jointly conducted by the State Administration of Taxation and the Ministry of Finance.[7] The surveys are conducted annually and collect information on taxation and performance for firms in all sectors. The purpose of these surveys is for China's governments to control the tax base information and evaluate the tax policy, which ensures the representativeness and accuracy of the sample.[8] 80% of the samples consist of medium and large firms appearing in every year's survey. The other 20% of the samples are drawn from the remaining firms using a stratified random sampling method by total sales, industry, and types of taxpayers. I aggregate the firm-level tax receipts and profit in the real estate sector to the category-city-year level to generate city-level real estate tax revenue and profit measures. Specifically, I generate the year-by-city-level revenue measure of real estate firms' land tax revenue, corporate income tax revenue, and profits.

The data on employment come from City Statistics Yearbooks. I collect employment data and population data for different industries, including the manufacturing sector, construction sector, mining sector, energy and utility sector, and all the services industries. I define the employment share of each industry by dividing the number of employed workers in the industry by the total population in the city to account for the potential exit of the labor market.

Other city-level controls, such as urban population and share of college students, are also collected from City Statistics Yearbooks.

[7]To my knowledge, there is no dataset collecting city governments' tax revenue by category and industry.

[8]To give a sense of the representative sample, the overall tax receipts reported by the sampling firms account for 75% of the aggregate national tax revenue in 2014 (Fan and Liu, 2020).

3.2 Empirical Strategy

This section describes the regression model and identification strategy to identify the effect of export slowdown. To make it brief, I only describe my main outcome – land sales revenue in this section. The cases of other outcomes are very similar.

3.2.1 Estimating Equation

I regress the city-level land sales revenue on the export shock experienced by the city using the following baseline specification:

$$\Delta logy_{ct} = \beta \Delta Export_{ct} + \delta \Delta X_{ct} + \lambda_c + \mu_{pt} + \epsilon_{ct} \tag{2}$$

where c denotes city, p province and t year. $\Delta Export_{ct}$ is the change in city c's manufacturing export per worker between year $t-1$ and year t defined in Equation 1. $\Delta logy_{ct}$ is the change in log of the outcomes of interest, i.e., land sales revenue and land sales area of city c between year $t-1$ and year t[9]. X_{ct} includes a series of time-varying city-level characteristics, including population composition, including the share of college students and the share of non-hukou residents.[10] λ_c and μ_{pt} capture city fixed effect and province-year fixed effect.

Note that the regression in Equation 2 uses the first differences of both dependent and independent variables. The first-differencing removes the time-invariant determinants of land sales in city c. The city fixed effect captures the possible city characteristics affecting the change of land sales revenue, or city-specific linear time trends in land sales revenue. The province-year fixed effect control for province-specific determinants on the change in land sales revenue over time. I weight each observation by the city's working-age population in 2010 to make the results more representative and cluster the standard errors by provinces. Section 4.4 shows that the results are not sensitive

[9]The log is taken to have a direct interpretation of percentage change. As every city sells land every year, there is no zero in the y variable, which alleviates the concern of log transformation brought up in Chen and Roth (2023).

[10]The control variables are obtained from the City Statistical Yearbooks. In some years, some cities have missing values in the control variables. In this instance, missing values are filled with the placeholder value of 999. To account for this imputation, a corresponding dummy variable is created for each control variable, indicating whether the value had been imputed. These dummy variables are then included in the regression alongside the original control variables.

to these particular choices.

3.2.2 Instrumental Variable Approach

Using ordinary least-squares estimates to estimate Equation 2 is problematic for the following two reasons. Firstly, it might suffer from reverse causality that higher land sales revenue would encourage (discourage) the development of manufacturing firms, which increases (decreases) the change in export values. Secondly, omitted variables can also bias the results that some time-varying unobservable might simultaneously affect the export performances and land sales.

To address the potential endogeneity concern, I follow Campante et al. (2023) and adopt a shift-share (Bartik) instrument for the export shock variable making use of the changes in the global trade flows excluding China (referred to as the "rest of the world" or ROW hereafter). The instrument uses the city-level initial export mix across products as the share and the product-level trade flow change in the rest of the world as the shift. Specifically, the IV for $\Delta Export_{ct}$ is constructed as follows:

$$\Delta ExportROW_{ct} = \sum_k \frac{X_{ck,2010}}{\sum_c X_{ck,2010}} \frac{\Delta X^{ROW}_{kt}}{L_{c,2000}} \tag{3}$$

where $\Delta X^{ROW}_{kt} = X^{ROW}_{kt} - X^{ROW}_{k,t-1}$ is the change in product k's trade flows from ROW to ROW between year $t-1$ and t [11]. $\frac{X_{ck,2010}}{\sum_c X_{ck,2010}}$ is the initial city-level export share for product k. The weighted average of the rest of the world's trade shocks across products is divided by the city-level working-age population in 2000, $L_{c,2000}$, to express the IV as export shock per worker (the unit is 1000 USD). The divided population of $\Delta ExportROW_{ct}$ is chosen in the year 2000 to avoid using the same population denominator of the population in 2010 in $\Delta Export_{ct}$ following Campante et al. (2023).

The validity of the IV in Equation 3 relies on the identification assumptions that (1) conditional on the control of time-varying city characteristics, city fixed effect, and province-year fixed effect, other time-varying city characteristics absorbed in the error term are not correlated with the IV $\Delta ExportROW_{ct}$; (2) there is strong correlation between the IV $\Delta ExportROW_{ct}$ and the key ex-

[11] The data source is UN Comtrade.

planatory variable $\Delta Export_{ct}$; and (3) the IV satisfies the exclusion restriction. Borusyak et al. (2022) establish that the exogeneity assumption holds if the shocks are exogenous, allowing for the endogeneity of the shares. In this case, if the product-level export shocks are not correlated with the error term, the exogeneity assumption is valid. To show this, I run a balance test recommended by Borusyak et al. (2022) (discussed in Section 4.4) and the result indicates that export shocks for the rest of the world can be viewed as good as randomly assigned, which supports the first assumption. For the relevance assumption, the first-stage F statistic supports that $\Delta ExportROW_{ct}$ is a strong IV. I assume the hold of exclusion restriction. The rationale is that the changing trade flows of different products in the rest of the world are determined by the different recovery situations of different countries after the financial crisis, which is hard to predict for city governments in China. Hence, it is hard to imagine the trade flows in the rest of the world would affect city governments' land sales through channels other than the export shocks in their cities.

4 Effect of Export Slowdown on Land Sales

I discuss my main findings on how the export slowdown affects the city government's land sales in this section. I first present the baseline results of export slowdown and land sales revenue (Section 4.1), followed by a decomposition analysis of the land revenue (Section 4.2) and a heterogeneity analysis (Section 4.3). I discuss the robustness checks and Bartik IV validity checks in Section 4.4.

4.1 Baseline Results

Table 1 reports my baseline results based on Equation 2. Column (1) presents the result of OLS estimation. The negative coefficient shows that export slowdown (a decrease in $\Delta Export$) is associated with a higher land sales revenue, although it is not statistically significant. Column (2) reports the result of the instrumental variable approach without additional time-varying city controls. The negative statistically significant coefficient confirms the effect of export slowdown on increasing land sales revenue. The coefficient of IV regression is more negative compared with the OLS coefficient. This could be due to omitted variable bias. The attenuation bias of the OLS estimate could be due to some unobserved time-varying city-specific shocks, such as bottleneck in industrial bottleneck or population loss, that contribute to the export decrease and meanwhile associated with the decrease in land sales. Also, the smaller OLS estimate may be due to the standard attenuation bias arising from the measurement error of $\Delta Export$.

Column (3) reports the IV regression result, further controlling for time-varying city characteristics, including the city population and change in the share of college graduates. The coefficient remains similar to that in Column (2). To give an interpretation of the magnitude of the effect, one standard deviation (approximately $837 per worker in exporting value change) decrease in the export values (i.e., an increase in export slowdown exposure) will increase land sales revenue by 4.69% (calculated based on the result in Column (3)).

One concern for the result is that if there is a pre-determined trend that affects the export slowdown and local government's land sales at the same time, the negative IV coefficient cannot be attributed to the effect of export slowdown on land sales. To test if this is the case, I change the main explanatory variable export shock in this period $\Delta Export_t$ into the export shock in the next period $\Delta Export_{t+1}$. If there is any pre-trend that comoves export slowdown and land sales, we shall expect there is an effect of the next period's export shock on this period's land sales revenue because the next period's export shock absorbs part of the pre-trend. The no effect of next year's export shock on this year's land sales revenue presented in Column (4) alleviates the concern of the pre-trend that drives the result.

Column (5) directly looks at the reduced-form effect of the Bartik IV $\Delta ExportROW$ and finds a consistent negative effect of the export shock that cities with larger exposure of the export slowdown for the rest of the world would have higher land sales revenue.

To visually present the effect of export slowdown on the city's land sales, I first make a binned scatter plot of the first-stage IV specification used in Column (3). Both the explanatory variable $\Delta Export$ and the IV $\Delta ExportROW$ are residualized to remove the city fixed effect, province-year fixed effect, and the effect of city-level time-varying controls. As shown in Figure 4a, there is a strong positive relationship between $\Delta Export$ and $\Delta ExportROW$, which is consistent with the high F statistic and supports the strong IV argument. I later visualize the relationship between the predicted $\Delta Export$ using the IV $\Delta ExportROW$ and the percentage change in land sales revenue (measured by the difference in log land sales revenue). Again, the two axes variables are residualized to remove city fixed effect, province-year fixed effect, and city-level time-varying controls. Figure 4b uses a linear line to fit the binned scatters. The slope of the coefficient is negative and statistically significant, which confirms the baseline results visually.

4.2 Unpacking the Increased Land Sales

I dive into the driving force of the increased land sales revenue in this section. Land sales revenue is a combination of the area of the land sold (quantity) and the selling price. It can also be decomposed into land sales of different usage types. In this section, I explore what type of land and whether the land sales area or price are driving the result.

I specifically explore the effect of export slowdown on land sales revenue, area and price by three types of land: commercial land, residential land, and industrial land. These three types of land differ in their usage, prices, and generated revenue. In terms of price, industrial land has the lowest price among the three. The price of commercial land and residential land can be five times higher than industrial land. Hence selling industrial land brings the lowest current revenue compared with residential and commercial land, which is called the "industrial land discounts" (He et al., 2022). And it's local government's decides on how to allocate these three types of land. Table 2 reports the results by land type. All regressions follow the IV specification in column (3) of Table 1. During the export slowdown period, the increases in land sales revenue are mainly driven by increased commercial land and residential land revenue. Specifically, the increased revenue is brought by the increased sales of the land instead of the increased land price. The export slowdown has no impact on the sales revenue and sales area of industrial land, but it decreases the land price of industrial land.

4.3 Heterogeneity Analysis

I perform four sets of heterogeneity analyses in this section. Through these analyses, I focus on the IV specification as Column (3) in Table 1. Additionally, I add a series of controls of incumbent city leader's characteristics, including city leaders' age, education level, starting office's hierarchical ranking, political connection, predicted promotion prospect, and city hierarchical level by year fixed effect. For each regression for heterogeneity analysis, I add the variable of interest and the interaction term of $\Delta Export$ and the variable while using the shift-share IV $\Delta ExportROW$ and the interaction term of $\Delta ExportROW$ and the heterogeneity variable as two IVs.

Firstly, I check whether the land sales behavior would differ by city leaders' promotion prospects. I consider the party secretaries to be the city leaders because they are more powerful than the city mayors due to the Chinese Communist Party's ruling position. Following Wang et al. (2020), I construct a promotion prospect index for each city leader during the export slowdown period based on their age, starting city's hierarchical ranking, educational level, and political connection[12]. The procedure of the measure construction is as follows. Firstly, I estimate a linear probability model making use of information on city leaders' career patterns and their characteristics between the years 2000 and 2010, which is the pre-slowdown period. Specifically, I regress the dummy variable of whether the city leader gets promoted after their term on the characteristic controls, including their start age, start age by provincial city level interaction term, whether having a graduate degree, the city's hierarchical level, whether they manage the cities in their birth province. Table B1 presents the estimated model. I then use the model to predict the promotion prospects for city leaders during the export slowdown period based on their corresponding characteristics. Column (1) in Table 3 reports the result by promotion prospect. High promotion prospects do not affect the land sales revenue.

I then check whether city leaders' tenure in their cities would affect their land sales. Usually, a city leader will manage a city for five years. The median and mean of city leaders' tenure in the city

[12]The political connection is measured using a dummy variable indicating whether the city the leader manages is in their birth province.

they manage is three years[13]. I then compare the land sales behavior of city leaders whose tenure in current cities is less than or equal to three years and those who govern the cities for more than three years. Column (2) in Table 3 shows cities more exposed to export slowdown would generally have higher land sales revenue, and cities with leaders in current offices for less than or equal to three years would have even higher land sales revenue compared to city leaders who have stayed longer. The more pronounced effect in these relatively newly-appointed leaders aligns with the finding in Chen and Zhang (2021) that political leaders would be selective during their first year to guarantee the economic performance of their cities. Compared with mobilizing state-owned enterprises and local businesses, selling land is more straightforward for city leaders to boost the economy. The higher land sales revenue during an export slowdown for newly appointed city leaders can also be attributed to their longer horizons in the city. Because they anticipate managing the city for several more years, they have greater incentives to mitigate negative economic shocks.

Considering that land sales have been an important financing strategy for local governments, I investigate whether the effect of export slowdown on land sales revenue varies depending on the local government's debt situation. Debt level serves as a measure of the need for land financing, as higher debt indicates a greater need for financing the local government's budget. To construct the debt measure, I collect data on government's debt at the provincial level[14] and calculate the debt to provincial general public budgetary revenue ratio. I then compare the impact of export slowdown in cities in provinces with high and low pre-export slowdown period's debt-to-revenue ratios. Column (3) in Table 3 shows no difference across these cities with different pre-period debt situations.

Lastly, I examine whether city leaders managing cities in their birth provinces would respond more to the export slowdown by selling more land. Column (4) compares the impact of export slowdown on land sales revenue for city leaders managing cities in their birth provinces versus those managing cities outside their birth provinces. However, no such heterogeneity is observed.

[13]The statistics are based on the pre-export slowdown period: 2000-2010
[14]City level debt information is not available.

4.4 Robustness Checks

I perform a battery of robustness checks and IV validity checks to validate my findings in this section.

4.4.1 Basic Robustness Checks

Specification Checks. Before showing the results of alternative specifications, I first show that the result remains stable when the regression is unweighted (Column (1) of Table B2).

To check if my result is robust in different specifications, Columns (2) and (3) of Table B2 drop the city fixed effects and include the lagged forms of the dependent variable. Specifically, Column (2) controls the lagged dependent variable in change, $\Delta \log Revenue_{c,t-1}$, to account for city-specific pretrend in land sales revenue. Column (3) includes the lagged dependent variable in level, $\log Revenue_{c,t-1}$, to control for possible correlation between the lagged level of land sales revenue and the error term. Column (4) simply drops the city fix effects. Table B2 shows the results remain robust across these specifications.

Sample Period Checks. I check if the result holds in alternative sample periods. I replicate the regression specification in Column (3) of Table 1 using an alternative sample between 2011 and 2015 and an extended sample between 2011 and 2017. Columns (1) and (2) in Table B3 report the results of these two sample periods. I then restrict my sample period to only the year 2015, the most severe year of the export slowdown, and control for the province fix effects (Column (3)). I also run a long-difference specification by constructing both the export shock and the IV using the cumulative shocks over the year 2013 to 2015. Province fixed effects are controlled in this specification (Column (4)). In all cases, export slowdown significantly increases the land sales revenue.

Influential Observations. To check if the result is driven by a specific industry, the presence of a specific city, or a specific province, I replicate the baseline estimation excluding one specific industry (HS two-digit level), one city, or one province at a time. I report the maximum and minimum coefficient estimates of these three checks in Table B4. The coefficients in all cases are negative and statistically significant, which suggests the result is not driven by any outlier of industry, city, and province.

Alternative Statistical Inference. Finally, I check whether my results are robust by clustering the standard errors at several alternative levels. Column (1) in Table B5 reports the p-value of the two-sided tests based on the wild cluster bootstrap-t procedure recommended by Cameron et al. (2008) in the concern of the small number of clusters that my sample has 26 provinces.[15] I also implement the "tF inference" for IV proposed by Lee et al. (2022) to confirm the statistical significance of the IV estimate. The $p-$value through the wild cluster bootstrap-t procedure and the tF confidence intervals are reported at the bottom of Column (1). Column (2) in Table B5 clusters the standard error at the city level to allow for the within-city and across-year correlation.

As pointed out by Adao et al. (2019), the regression residuals in the shift-share specification would be correlated across regions with similar sectoral composition, regardless of their geographic proximity, in the presence of unobserved sectoral shifts. As a consequence, clustering standard errors at the geographic unit level will lead to over-rejection of the null hypothesis. To address this concern, I follow Campante et al. (2023) and construct alternative clusters based on the similarity of the city's export structure. Note that the standard-error correction approach proposed in Adao et al. (2019) cannot be applied in my context since the number of products is far larger than the number of cities. Following Campante et al. (2023), the city-level similarity index takes the following form:

$$SimilarityIndex_{c,j}^{ROW} = \sum_{k} min\{\frac{X_{ck}^{ROW}}{X_{c}^{ROW}}, \frac{X_{jk}^{ROW}}{X_{j}^{ROW}}\} \tag{4}$$

where $\frac{X_{ck}^{ROW}}{X_{c}^{ROW}}$ is export share of product k in city c's total exports. The index is constructed using the provincial capital cities as the reference group. Therefore, j denotes the provincial capital city. The index takes a value between 0 and 1, with 0 denoting the two cities having no similarity in their export structure. In Column (3), the cluster group is created by assigning each city to the group of the provincial capital city that is most similar to it. In Column (4), the cluster group is created

[15]Beijing, Shanghai, Tianjin and Chongqing are excluded in my main sample as these four are provincial cities.

by assigning each city to the group of the provincial capital city that is outside its province and most similar to it. Robustness errors in Columns (5) and (6) are two-way clustered at the provincial and export-similarity groups level. All baseline results remain robust to these alternative clustering choices.

4.4.2 Validating the Bartik Instrument

The validity of the IV relies on the identification assumptions that conditional on the control of time-varying city characteristics, city fixed effect, and province-year fixed effect, other time-varying city characteristics absorbed in the error term are not correlated with the shift-share IV. According to Borusyak et al. (2022), this assumption holds when the shifts at the product level are as good as randomly assigned.

In particular, the identification assumption can be written as

$$\sum_k s_k g_{kt} \phi_k \xrightarrow{p} 0 \tag{5}$$

where $g_{kt} = \frac{\Delta X_{kt}^{ROW}}{\sum_c X_{ck,2010}}$ is the shift of product k from the rest of the world divided by the total exporting value of product k in China in 2010. $s_k = \sum_c e_c s_{ck}$ is the weighted average of export exposure to product k across city, where $s_{ck} = \frac{X_{ck,2010}}{L_{c,2000}}$ is city c's initial exposure of product k and e_c is the regression weights in the city-level regression models. $\phi_k = \frac{\sum_c (e_c s_{ck} \epsilon_c)}{\sum_c (e_c s_{ck})}$ is an exposure-weighted expectation of city c's initial characteristics. Equation 5 states the condition of as good as randomly assigned shocks that when weighted by s_k, the correlation of g_{kt} and ϕ_k goes to zero when the sample is large. This can be tested by regressing g_{kt} on ϕ_k weighted by s_k and checking whether the coefficient of ϕ_k is zero.

I consider two sets of city's initial characteristics that may enter ϵ_c hence ϕ_k: (i) city's initial charaterstics in 2010, including the share of college graduates, the share of manufacturing employment, export to GDP ratio, the share of the non-hukou population, log GDP per capita and log fiscal revenue per capita; and (ii) pretrends in the outcomes of interest including change in log land sales revenue, change in log land sales area, and change in log land sales revenue and area across three types of land. Table B6 reports the coefficients and the standard errors for these two sets of city characteristics. All coefficients are not statistically significant, which assures the exogeneity of shocks.

Following the product level regressions, Borusyak et al. (2022) establish that the effect of the export slowdown can also be estimated using product-level regression, and the magnitude should be identical to the city-level regression. To check this, I run a regression of $\Delta LogRevenue^{\perp}_{kt}$ on $\Delta Export^{\perp}_{kt}$ and use $\frac{\Delta X^{ROW}_{k}}{\sum_c X_{ck,2010}}$ as IV, where $\perp$ superscript refers to the product-level analog of the city-level variables.[16] The coefficient of $\Delta Export^{\perp}_{kt}$ is equal to the coefficient of $\Delta Export$ in the city-level regression.

Another concern on the shift-share IV is related to the "incomplete share" problem brought up in Borusyak et al. (2022) that the initial export exposure could be correlated with the time trends in land sales revenue.[17] The city fixed effects remove any time-invariant effect of city's initial exposure share. To address the potential time-varying effect of initial exposure share, I further control the initial exposure share-year fixed effects. I separately control for the quintiles, quartiles, and terciles of the initial export exposure by year fixed effect. Table B8 shows the effect of export slowdown on land sales revenue remains robust when taking the "incomplete share" problem into account.

5 The Impact of Land Sales on the Economy

Local governments' land sales have been tightly connected to the real estate sector. In this section, I explore its impact on both the short-run and longer-run economic outcomes related to real estate sector.Finding in Table 2 reveals that the surge in land sales revenue during export slowdowns primarily stems from the sale of residential and commercial land, which intends to real estate de-

[16]Specifically, $\Delta LogRevenue^{\perp}_{kt} = \sum_c e_c s_{ck} \Delta LogRevenue^{\perp}_{c}$ and $\Delta Export^{\perp}_{kt} = \sum_c e_c s_{ck} \Delta Export^{\perp}_{c}$, where $\Delta LogRevenue^{\perp}_{c}$ and $\Delta Export^{\perp}_{c}$ are the residualized land sales revenue and export shock after controlling the city time varying characteristics, city fixed effects and province-year fixed effects.

[17]The equivalence of exogenous shocks and condition of IV validity builds on the assumption of constant share among observations

velopment. As discussed in Section 5.1, cities with more sales of residential and commercial land during the export slowdown period also have higher real estate investment and tax revenue collected from the real estate firms. Land sales revenue is often used by local governments to fund infrastructure projects. The infrastructure projects and the real estate projects following the land sales increase the demand for construction jobs. Section 5.2 examines this effect on employment. Section 5.3 links the land sales to a longer-run outcome, China's current real estate risks.

From the perspective of identification strategy, while ideally, I would like to directly assess the impact of land sales on land-related outcomes during the export slowdown period, this proves challenging due to econometric limitations. Specifically, there is no suitable instrument for land sales during this period, as the Bartik IV method might not meet the exclusion restriction. Consequently, this section focuses on examining the impact of export slowdowns on land-related outcomes instead. All regressions are similar to the regression used in Column (3) of Table 1.

5.1 Land Sales as a Source of Increasing Tax Revenue

Increasing land sales, driven by residential and commercial land, has been associated with the development of the real estate sector. I first examine the impact of land sales on the city's investment in real estate projects. Column (1) in Table 4 presents this result. Cities with greater exposure to the export slowdown would have higher real estate investment. Approximately one more standard deviation's increase in export slowdown exposure would increase the city's real estate investment by 1.76%. This suggests that the increasing land sales boost the development of the real estate sector.

I then explore how the increase in real estate development contributes to local governments' tax revenue collected from the real estate sector. Specifically, I examine two categories of land-related tax revenue: revenue collected from real estate firms' direct land tax and real estate firms' corporate income tax. Real estate firms' direct land tax includes several components: land deed tax, land use tax, and (pre-paid) land value-added tax. Land deed tax is paid when real estate firms purchase land from the government. The land use tax is imposed once firms begin construction and development on the land. Finally, when real estate firms prepare to sell land or housing units, land value-added tax is (pre)levied. Additionally, real estate firms are subject to corporate income tax, which is levied on their income. The rationale behind this section is that land sales increase direct land tax revenue, while construction and property sales enhance developers' profits, thereby increasing corporate income tax revenue.

Column (2) in Table 4 shows that city governments more exposed to export slowdown had higher land tax revenue collected from the real estate sector. This is consistent with the finding that export slowdown led to more land sales and, consequently, higher direct land tax revenue. Column (3) shows that higher exposure to the export slowdown increases city governments' corporate income tax revenue from the real estate sector. This corresponds with the finding in Column (4) that real estate firms' profits increase more in cities more exposed to the export slowdown.

In summary, the findings in this section suggest that selling land during the export slowdown period provides a source of increasing tax revenue for city governments. This is evidenced by the higher direct land tax revenue and corporate income tax revenue collected from real estate firms in cities more exposed to export slowdowns, which experienced increased land sales.

5.2 Land Sales as a Buffer for Employment Loss

In this section, I check how the export slowdown affected employment in different sectors. To test this, I use the same IV specification as Column (3) in Table 1 and change the outcome variable into the changes in the share of employment in different sectors. Specifically, I examine the following 17 sectors, including manufacturing, construction, mining, production and supply of energy, wholesale and retail trade, transportation and warehousing, accommodation and catering, information technology, finance, research and development, environment and facilities, residential, repairs and other services, education, health and social work, culture, sports and entertainment, administration and social security, real estate services, and leasing and business services. The share of employment in each sector is defined as the ratio of the total number of employment in that sector to the population in that city. To allow for the labor market adjustment effect, I separately check the effect of export slowdown on the current year's sectoral employment share and the sectoral employment share in one year.

Figure 5 plots the impact of export slowdown on employment in different sectors. A notable feature is that cities with greater exposure to export slowdown experienced a larger decrease in manufacturing employment share, which is consistent with the finding in Campante et al. (2023). While for employment share in the construction industry, cities with greater exposure to export slowdown had an increase in the construction employment share. However, the effect takes place one year later.

The increasing employment share in the construction industry is consistent with the finding that cities with greater exposure to the export slowdown sell more land. Land sales can increase the demand for jobs in the construction industry through two channels. On the one hand, the real estate projects following the increased residential and commercial land sales create construction job opportunities. On the other hand, local governments might use the land sales revenue to fund infrastructure projects, which also require construction jobs.

For employment share in other sectors, export slowdown barely has an effect. The export slowdown's effect on increasing construction employment share suggests that land sales play a role in mitigating the employment loss in the manufacturing industry.

5.3 Longer Run: Land Sales and Real Estate Risks

So far, land sales in the short run buffer the export slowdown by increasing the land-related tax revenue and employment share in the construction industry. A natural question is what the long-run impact of land sales is. To dig into the longer-run impact of land sales, I construct a measure of China's real estate risk in the early 2020s and examine how the export slowdown during the mid-2010s affected the city's exposure to real estate risks in the 2020s.

Real estate has been an important sector boosting China's economic growth. For years, property developers enjoyed easy access to credit, and about 90 percent of new homes were "presold".[18] In 2020, Chinese regulatory authorities initiated stringent measures to curb imprudent borrowing

[18]https://www.nytimes.com/2022/08/17/business/china-economy-real-estate-crisis.html

practices, forcing developers to reduce their debt level before taking on more debt. The regulation, together with the sluggish demand for housing during the period, created a cash crunch for many firms that had relied on easy access to debt to keep construction projects humming. As a consequence, these developers did not have enough funding to maintain and continue the construction work of housing that has been sold but construction unfinished. This has spurred protests from homeowners whose apartments were left unfinished.

To measure the city's exposure to real estate risks, I leverage information on the homeowners' collective protests for refusing to pay mortgages on unfinished apartments. The idea is that conditional on potential city characteristics, the existence of homeowners' mortgage protests implies the debt-paying ability of the real estate developers in that city, which is a measure of real estate risks. The information comes from a crowdsourced list titled "WeNeedHome" on GitHub.[19] This online repository collects information on the properties where collectives of homeowners have started or threatened to request a loan suspension for their mortgages on the unfinished apartments. In summary, till now, the number of properties where collectives of homeowners have collective loan suspension actions has reached 348 nationwide, which span 94 cities in China. I construct a city-level home owners' protest binary variable with one indexing that there is at least one property in the city where the owners filed the collective loan suspension request.

To examine how the export slowdown during the mid-2010s affected the probability of home owners' protest incidence in that city during the early 2020s, I leverage the long-difference variation of export slowdown between 2013 and 2015 and instrument it using the cumulative shift-share IV between 2013 and 2015. The outcome variable of interest is the binary variable measuring whether the city has at least one property with a collective loan suspension request. To alleviate the concern of potential confounding variables, I add a series of initial city-level controls measured in the year 2012, including land sales dependence,[20] debt dependence,[21] the share of college students, the share of the urban population, the share of Internet users, the share of mobile phone users, and whether

[19]The GitHub page could be found in https://github.com/WeNeedHome/SummaryOfLoanSuspension.

[20]The land sales dependence is measured as the ratio of land sales revenue and general public budgetary revenue.

[21]The debt dependence is measured as the average ratio of the issuing amount of municipal corporate bonds and general public budgetary revenue

the city is a provincial capital city. Province fixed effect is controlled, and the standard errors are clustered at the province level.

Column (1) in Table 5 presents the effect of export slowdown on the probability of home owners' protests without adding the city-level controls. Cities with greater exposure to export slowdown would have a higher probability of experiencing home owners' protests on unfinished properties. Column (2) further controls the series of city-level characteristics in 2012. The effect remains similar to the result in Column (1). In consideration that local governments might use land sales to buffer other negative shocks, Column (3) additionally controls the city-level negative shock exposures, including the exposure of US-China trade war exposure and Covid exposure.[22] On average, one-standard-deviation increase in exposure to the cumulative export slowdown (approximately 921 dollars decrease in exporting values per worker) would increase the probability of home owners' protests by 7.3 percentage points. The result suggests that in the longer run, cities with greater exposure to export slowdown and more land sales during the mid-2010s slowdown period would experience larger exposure to real estate risks in the early 2020s. But one caveat is that the result could not differentiate whether the risk comes from more risky behaviors the developers take in these cities or the worse confidence in these cities that restrain the house purchases, leading to developers' inability to repay the debt.

6 Exploring Other Negative Shocks

So far, the paper focuses on land sales as a response to negative trade shocks during the mid-2010s. In this section, I examine whether local governments use land sales as a response for other negative shocks. Specifically, I exploit the context of natural floods, US-China trade war, and the COVID-19 pandemic.

[22]The construction of these measures is described in Section 6.

6.1 Floods and Land Sales

Flooding stands out as one of the most prevalent and detrimental natural disasters in China (Shi et al., 2016). The devastating consequences of floods include but are not limited to the threat to human safety, destruction of infrastructure, agricultural losses, displacement of communities, and economic setbacks. To examine how flood disasters affect city governments' land sales, I leverage data from the Dartmouth Flood Observatory's *Global Active Archive of Large Flood Events* (Brakenridge, 2016).[23] The dataset documents the geographical flooding region of each flooding event. I generate the city-level binary flooding variable, $Flood_{c,t}$, which equals to one if city c intersects with the flooding region in year t.

To estimate the impact of flooding disasters on city governments' land sales, I estimate the following equation:

$$logy_{ct} = \beta Flood_{c,t} + \delta X_{ct} + \lambda_c + \mu_{pt} + \epsilon_{ct} \tag{6}$$

where y_{ct} is the land sales revenue/area/price of city c in year t. X_{ct} is the city controls used in Column (3) of Table 1. λ_c and μ_{pt} capture the city fixed effect and province-by-year fixed effect. The standard errors are clustered at the province level. The sample period is between 2006 and 2019.

Table 6 reports the effect of flooding disasters on city governments' land sales. Overall, experiencing flooding disasters does not lead to an increase in city governments' land sales. Instead, it results in a decrease in both commercial land sales revenue and area. This outcome is not surprising, as floods typically lead to a depreciation in land values. Additionally, floods are considered regional shocks that cities can potentially leverage to stimulate growth in other regions within the city.

[23] The data is available at https://floodobservatory.colorado.edu/Archives/index.html.

6.2 US-China Trade War and Land Sales

In this section, I explore the impact of another negative trade shock, US-China trade war, on city governments land sales behavior. The US and China initiated a significant trade war starting in early 2018, which escalated over two years and reversed the trade liberalization progress since the mid-1990s. By September 2019, US tariffs on China has increased by an average of 20.7 percentage points, covering 93% of HS 6-digit products. And the trade war has decreased the city's night-time luminosity (Chor and Li, 2021). To examine how the exposure to the US-China trade war affects city governments' land sales, I leverage data on product-level tariffs imposed by the US and export flow to the US from Bown (2021) and data on city's export mix from China's General Administration of Customs. The exposure to the US-China trade war $\Delta ExportUS_{ct}$ is measured using the annual change in city's exporting values to the US per worker similar to the measure constructed in Equation 1. Similarly, I construct a shift-share IV for the export to US shock leveraging the product-level tariff increase imposed by the US and city's export to US share of the product. The SSIV is constructed as follows:

$$\Delta USTariff_{ct} = \sum_k \frac{X_{ck,2016}}{\sum_c X_{ck,2016}} \Delta USTariff_{kt} \tag{7}$$

where $\frac{X_{ck,2016}}{\sum_c X_{ck,2016}}$ is city c's share of exporting product k to the US of total exporting values of product k to the US in 2016, which is the year prior to the trade war. $\Delta USTariff_{kt}$ is the change in tariff in product k imposed by the US. The sample period is between 2018 and 2020.

To estimate the impact of the US-China trade war on city government's land sales, I use the shift-share IV specification similar to Equation 2 using $\Delta USTariff_{ct}$ as an instrument for $\Delta ExportUS_{ct}$.

Table 7 reports the effect of exposure to the US-China trade war on city governments' land sales. Higher exposure to the US-China trade war did not change city governments' land sales. According to Jiang et al. (2023), the US-China trade war leads to export diversion to countries that are closer and have larger economies. The lack of effect on governments' land sales may be due to responses within the export sectors.

6.3 COVID-19 Pandemic and Land Sales

I then examine if local governments use land sales as a response to the COVID-19 pandemic, which, along with the lockdowns, significantly hurt cities' economic performance. To measure the city's exposure to the COVID shock, I leverage city-level data on tourism revenue and GDP from China Statistical Yearbooks and use the pre-COVID average proportion of tourism revenue to GDP as a proxy of the city's exposure to the COVID-19 pandemic. The rationale behind this measure is that the more a city depends on tourism for its revenue, the larger exposure it experienced from COVID-19, as it lost its important revenue source during the lockdown period.

To estimate the impact of COVID shock on city goverments' land sales, I estimate the following equation:

$$logy_{ct} = \beta HighCOVID_{ct} \times Post_t + \delta X_{ct}\lambda_c + \mu_{pt} + \epsilon_{ct} \tag{8}$$

where y_{ct} is the land sales revenue/area/price of city c in year t. $HighCOVID_{ct}$ is the binary COVID-19 exposure variable, which equals to one if the city has a high pre-COVID period proportion of tourism revenue. $Post_t$ is the dummy variable if $t \geq 2020$. X_{ct} is the city controls similar to the controls in Column (3) of Table 1. λ_c and μ_{pt} capture the city fixed effect and province-by-year fixed effect. The standard errors are clustered at the province level. The sample period is chosen between 2019 and 2021.

Table 8 presents the impact of COVID exposure on land sales. A city with larger exposure to the COVID-19 pandemic would have a higher land sales revenue, which is mainly driven by increased land prices for commercial land. While the land sales revenue increases in cities more exposed to the COVID-19 pandemic, the areas of land sold in these cities decrease. This finding aligns with the research by Chang et al. (2023), which finds that during the COVID-19 period, Chinese cities experienced a simultaneous increase in residential land prices and a decrease in residential land transaction volumes.

While city governments experience an increase in land sales revenue in response to both the export slowdown and the COVID-19 pandemic, the drivers of this increase differ between the two periods. During the export slowdown, the rise in land sales revenue is driven by an expansion in the sales area of residential and commercial land. In contrast, during the COVID-19 period, the increase in land sales revenue was fueled by a rise in the land price of commercial land. This discrepancy could be attributed to varying demands for commercial and residential housing in these two periods, with a decrease in demand for housing following the COVID-19 pandemic.

In summary, while city governments did not utilize land sales in response to flooding disasters or the US-China trade war, they did use them to respond to the COVID-19 pandemic. Flooding disasters and the US-China trade war are more regional or localized shocks that can be addressed by sustaining growth in other regions or diverting exports to other countries. However, the COVID-19 pandemic, similar to the export slowdown period, is a more widespread shock related to the economic recession that makes it challenging to respond by sustaining economic growth in other regions or adjusting the strategy within the impacted sector. The analysis in this section suggests that land sales are used as a response to more broadly impacting negative shocks on the economy.

7 Conclusion

This paper documents how city governments in China use land sales for real estate development as a response to negative economic shocks. In the short run, this strategy buffers against the negative shocks by increasing governments' revenue from the real estate sector and boosting employment in the construction sector. However, it also leads to higher real estate risks in the long run. Governments use land sales to deal with more aggregate shocks instead of more regional shocks.

Given China's ongoing real estate challenges and their implications at both domestic and global levels, my findings provoke additional thoughts that can be interesting for future research. Firstly, local governments might use land sales as a policy tool even beyond the economic downturns. Investigating how local governments' land sales during and beyond the downturns contribute to China's ongoing real estate crisis could unveil insights into its progression. Secondly, as China confronts waning demand for housing due to reasons such as slowing urbanization and declining demography, real estate development becomes less efficient as a growth policy. This prompts an inquiry into how local governments adapt during economic downturns when real estate development loses its effectiveness as a strategy. Understanding the alternative approaches employed by local governments in times of negative shocks could offer insights into China's future economic growth.

I close this paper by noting some limitations. Firstly, my study focuses on the period when real estate development is efficient in driving growth. Concerns may arise about its generalizability to other economic downturns, especially when real estate development loses its efficacy, such as in less urbanized regions and post-COVID periods. Secondly, I analyze the impact of land sales on the economy by leveraging the variations in exposure to the export slowdown. I did not directly estimate the effect of land sales due to the econometric challenges in identifying their impact.[24] While my results that cities exposed to export slowdown generally had higher land sales revenue supports viewing the effect of export slowdown on the land-related outcomes as the effect of land sales, I cannot rule out the possibility that export slowdown can affect the land-related outcomes through channels other than land sales.

[24]It is tempting to use export shocks to instrument for the land sales. However, doing so will violate the exclusion restriction. And there is no other suitable instrument for land sales.

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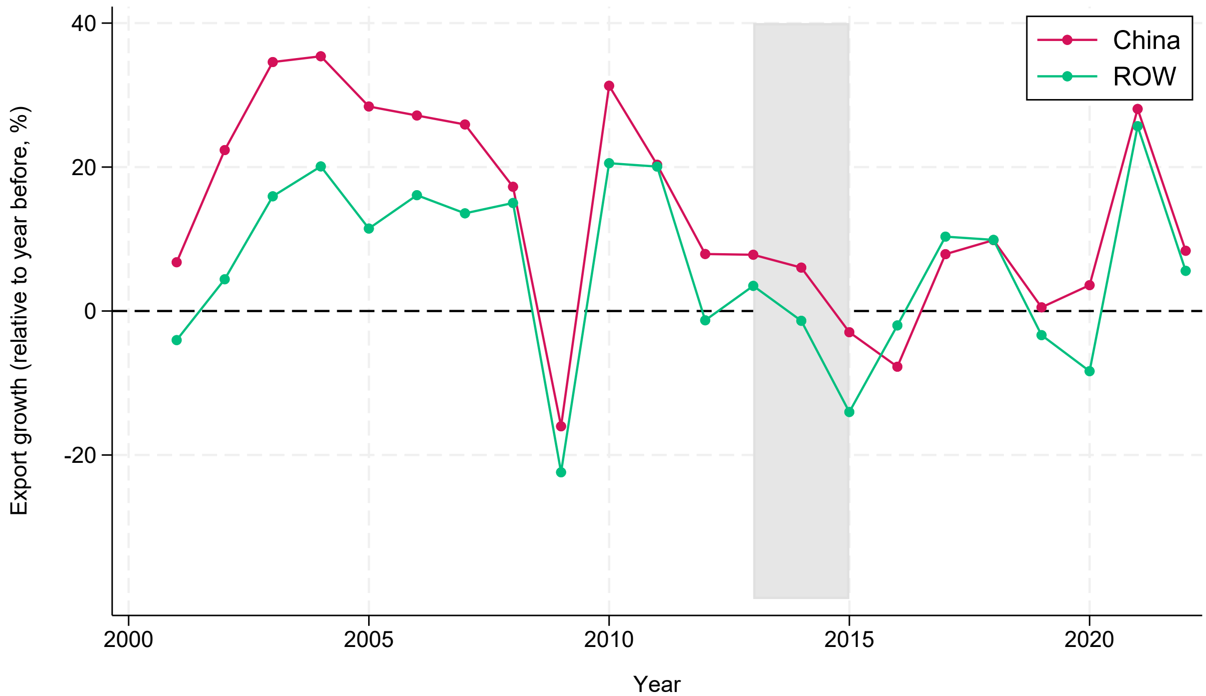
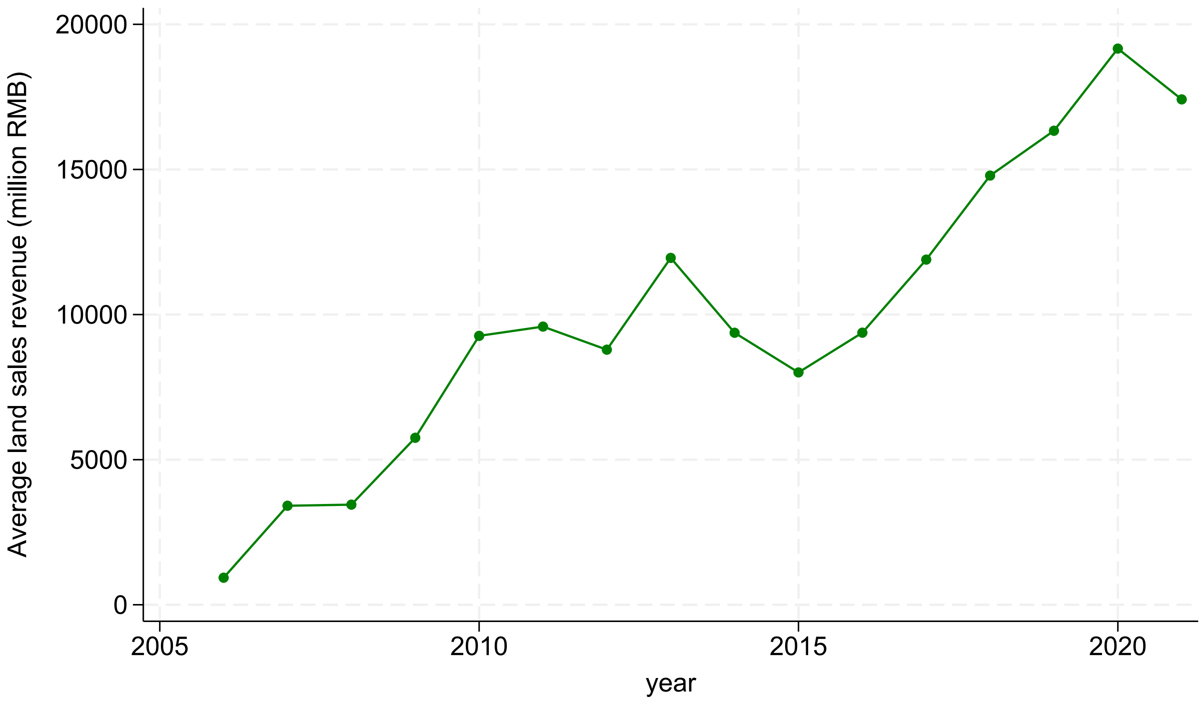
Figures

Figure 1: China's export growth (2001-2021)



Data from *UN Comtrade*.

Figure 2: Time Series of Land Sales Revenue



Notes: The data source is CREIS land transaction data

Figure 3: Geographical Distribution of Annual Change of Land Sales Revenue and Exporting Values in 2015

(a) Δ Land revenue per worker

(b) $-\Delta$ Exporting value per worker

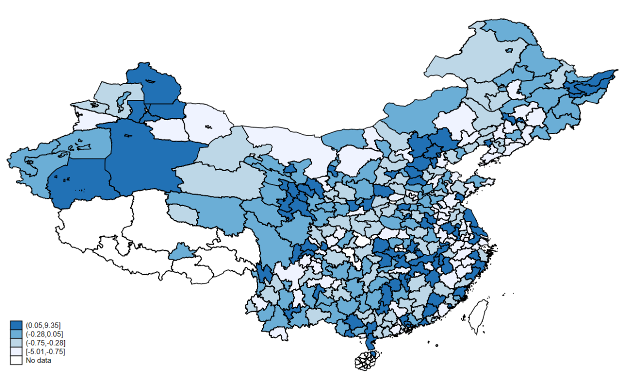
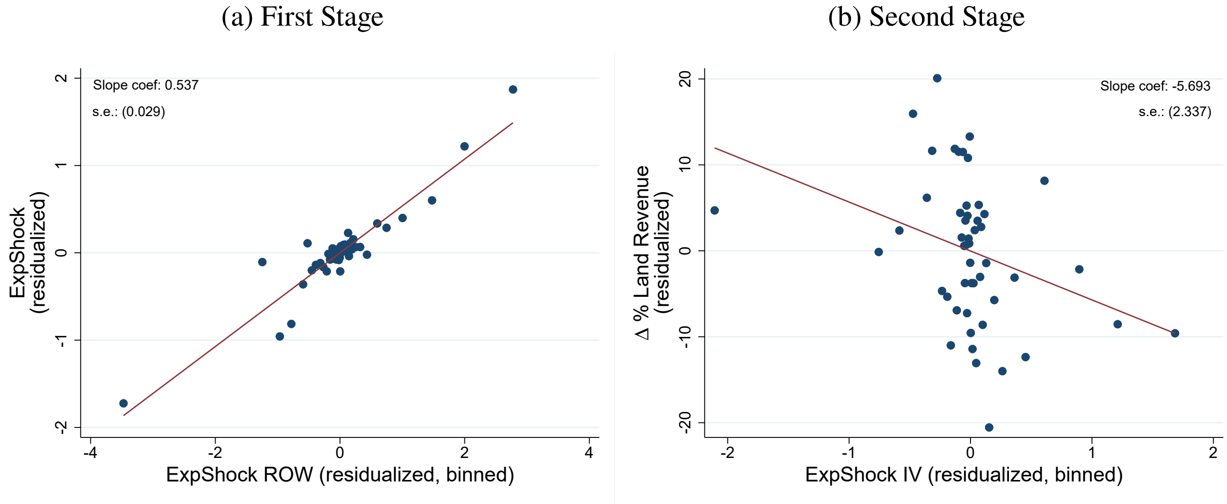
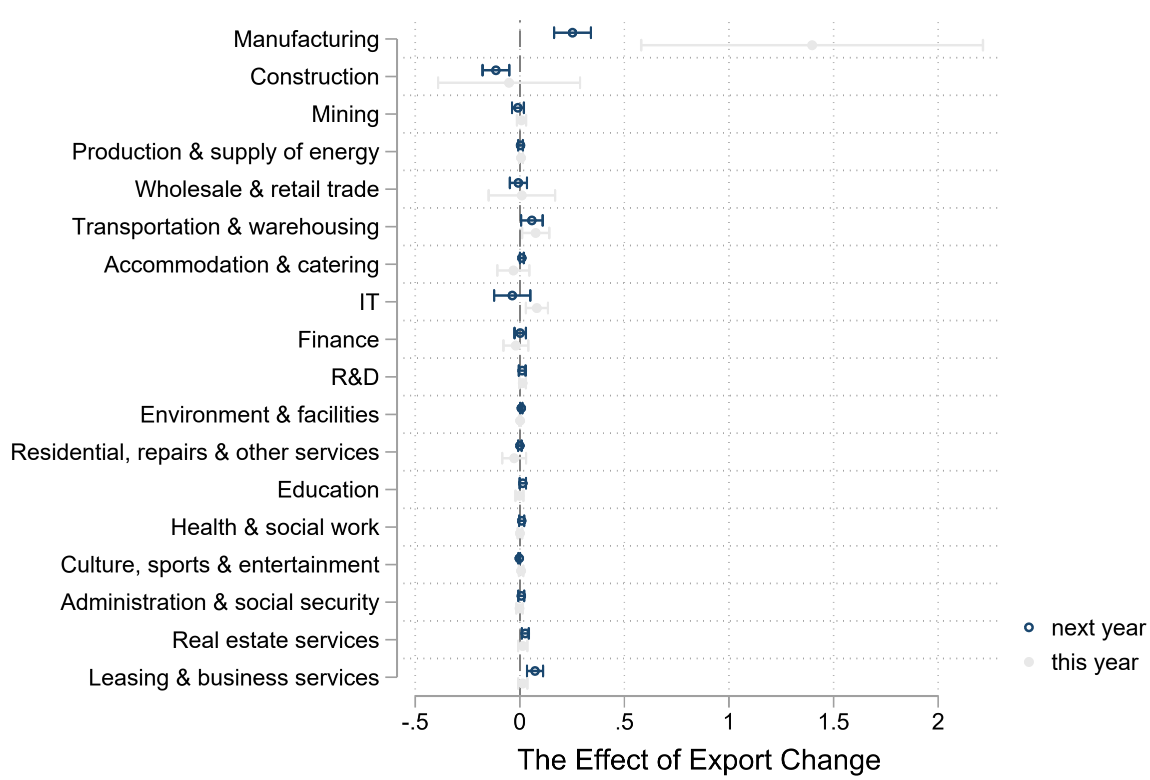


Figure 4: Binned Scatter Plot: City export shocks and land sales revenue



Notes: All variables are residualized to remove the contribution of city fixed effect and province-year fixed effect. The export shock variable is categorized into 50 bins.

Figure 5: Export Slowdown's Impact on Employment Change



Notes: This figure plots coefficients of export shock in the IV regression of change in employment share on export shock. The confidence intervals are at 95% level.

Tables

Table 1: Export Shocks and Land Sales Revenue

	(1)	(2)	(3)	(4)	(5)
	OLS	IV	IV	IV	OLS_RF
ΔExport	-0.016	-0.055***	-0.056***		
	(0.012)	(0.013)	(0.010)		
ΔExport_t+1				0.009	
				(0.019)	
ΔExportROW					-0.034***
					(0.005)
City Controls	Y	N	Y	Y	Y
Province-year FE	Y	Y	Y	Y	Y
City FE	Y	Y	Y	Y	Y
First-stage F stat		64.244	58.227	20.929	
Mean	8162.83	8162.83	8162.83	8162.83	8162.83
Observations	983	983	983	983	983

The dependent variable is the change in log land sales revenue. All regressions are weighted by the prefecture's working-age population in 2010. The city controls include changes in log college graduates and changes in log urban population. The mean is the mean value of the land sales revenue with 1 million RMB as the unit. Column (1) reports the OLS estimates. Columns (2) and (3) report the IV regression results. Column (4) checks whether the export shock next period can affect this period's land sales revenue. Column (5) reports the OLS reduced form result using the Bartik IV $\Delta ExportROW$ directly instead of $\Delta Export$ as the main explanatory variable. The standard errors are clustered at the province level.

* $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$

Table 2: Export Shocks and Different Types of Land Sales

	(1) ΔLog Revenue	(2) ΔLog Area	(3) ΔLog Price
A: Residential land			
ΔExport	-0.036**	-0.048***	0.019
	(0.017)	(0.015)	(0.027)
Observations	983	983	983
B: Commercial land			
ΔExport	-0.145***	-0.055	-0.041
	(0.025)	(0.043)	(0.030)
Observations	983	983	983
C: Industrial land			
ΔExport	-0.009	0.010	0.044**
	(0.025)	(0.031)	(0.019)
Observations	983	983	983

The dependent variables are changes in (1) log land sales revenue, (2) log land sales area, and (3) log average land sales price per acre for residential land (panel A), commercial land (panel B), and industrial land (panel C). All columns use specification in column (3) of Table 1 and report the IV regression results, weighted by the prefecture's working-age population in 2010. All regressions control city time-varying characteristics including changes in log college graduates and changes in log urban population, city fixed effect, and province-year fixed effect. The standard errors are clustered at the province level.

* $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$

Table 3: Heterogeneity of Land Sales

	(1)	(2)	(3)	(4)
	ΔLog Revenue	ΔLog Revenue	ΔLog Revenue	ΔLog Revenue
ΔExport	-0.050***	-0.028*	-0.045**	-0.042***
	(0.016)	(0.015)	(0.022)	(0.015)
ΔExport X High promotion prospect	0.075			
	(0.067)			
ΔExport X Term<=3		-0.044*		
		(0.025)		
ΔExport X High pre-debt/rev			0.010	
			(0.028)	
ΔExport X Birth province				-0.004
				(0.093)
City Controls	Y	Y	Y	Y
Incumbent Controls	Y	Y	Y	Y
Province-year FE	Y	Y	Y	Y
City FE	Y	Y	Y	Y
First-stage F stat	14.847	10.950	13.027	14.426
Observations	968	968	968	968

The dependent variable is the change in log land sales revenue. Four types of heterogeneity are considered: heterogeneity by (1) the city leader's promotion prospect, (2) the city leader's term in the city, (3) the provincial pre-export-slowdown period's debt to revenue ratio, and (4) whether the city is in the city leader's birth province. The promotion prospect is predicted using a linear probability model, which uses information on city leaders' turnover history and characteristics (starting level, age, education level, and political connection measured by birth province) from the year 2000 to 2010. All regressions are weighted by the prefecture's working-age population in 2010. The city controls include changes in log college graduates and changes in log urban population. The standard errors are clustered at the province level.

* $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$

Table 4: Export Slowdown and Land-related Tax Revenue

	(1) ΔLog Real Estate Investment	(2) ΔLog Direct Land Tax Revenue	(3) ΔLog Corporate income tax revenue	(4) ΔLog Profit
ΔExport	-0.021***	-0.137**	-0.088*	-0.478***
	(0.007)	(0.064)	(0.051)	(0.147)
City Controls	Y	Y	Y	Y
Province-year FE	Y	Y	Y	Y
City FE	Y	Y	Y	Y
First-stage F stat	58.284	58.976	58.976	58.976
Observations	839	887	887	887

The dependent variable is the changes in (1) log amount of real estate investment, (2) log direct land tax revenue (sum of land deed tax, land value-added and land use tax) from the real estate sector, (3) log corporate income tax revenue from the real estate sector, and (4) log profits from the real estate sector. The measure of real estate investment is obtained from the City Statistical Yearbooks. All other measures are constructed in the real estate sector at the city level using NTSD. The city controls include changes in log college graduates and changes in log urban population. All regressions are weighted by the city's working-age population in 2010. The standard errors are clustered at the province level.

* p < 0.1 ** p < 0.05 *** p < 0.01

Table 5: Longer run: Export Slowdown and Real Estate Risk

	(1) Homeowners' protest	(2) Homeowners' protest	(3) Homeowners' protest
ΔExport	-0.097***	-0.088**	-0.088**
	(0.034)	(0.041)	(0.042)
City Controls	N	Y	Y
Other Shocks	N	N	Y
Province FE	Y	Y	Y
First-stage F stat	26.138	7.115	7.166
Observations	328	328	277

The dependent variable is a binary variable with one denoting the city experiences at least one incidence of homeowners' protests. All columns report the IV regression results, weighted by the city's working-age population in 2010. The city controls include changes in log college graduates and changes in log urban population. Control of other shocks include the city's exposure to the US-China trade war and the COVID-19 pandemic. The standard errors are clustered at the province level.

* p < 0.1 ** p < 0.05 *** p < 0.01

Table 6: Flood and Land Sales

	(1) Log Revenue	(2) Log Area	(3) Log Price
A: Total land			
Flood	-0.052	-0.044	0.021
	(0.034)	(0.032)	(0.047)
B: Residential land			
Flood	-0.027	-0.019	0.014
	(0.030)	(0.033)	(0.034)
C: Commercial land			
Flood	-0.088**	-0.092*	-0.009
	(0.042)	(0.048)	(0.028)
City Controls	Y	Y	Y
Province-year FE	Y	Y	Y
City FE	Y	Y	Y
Observations	3583	3583	3583

The dependent variables are (1) log land sales revenue, (2) log land sales area, and (3) log average land sales price per acre for total land (panel A), residential land (panel B), and commercial land (panel C). All columns use the regression specification in Equation 6, weighted by the city's working-age population in 2010. The city controls include changes in log college graduates and changes in log urban population. The standard errors are clustered at the province level.
* $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$

Table 7: US-China Trade War and Land Sales

	(1)	(2)	(3)
	ΔLog Revenue	ΔLog Area	ΔLog Price
A: Total land			
ΔExport to US	-0.002	0.001	-0.004
	(0.003)	(0.004)	(0.003)
B: Residential land			
ΔExport to US	-0.004	-0.001	-0.003
	(0.004)	(0.003)	(0.002)
C: Commercial land			
ΔExport to US	-0.003	0.001	-0.003
	(0.005)	(0.003)	(0.003)
City Controls	Y	Y	Y
Province-year FE	Y	Y	Y
City FE	Y	Y	Y
First-stage F stat	3.033	3.037	3.033
Observations	916	916	916

The dependent variables are changes in (1) log land sales revenue, (2) log land sales area, and (3) log average land sales price per acre for total land (panel A), residential land (panel B), and commercial land (panel C). All columns use the regression specification similar to Equation 2 with the exposure variable being $\Delta ExportUS_{ct}$ and the SSIV being $\Delta USTariff_{ct}$ in 7. All the regressions are weighted by the city's working-age population in 2010. The city controls include changes in log college graduates and changes in log urban population. The standard errors are clustered at the province level.
* $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$

Table 8: COVID and Land Sales

	(1) Log Revenue	(2) Log Area	(3) Log Price
A: Total land			
(Year $\geq$ 2020) $\times$ High tourism revenue	0.085*	-0.177*	0.318
	(0.041)	(0.087)	(0.303)
B: Residential land			
(Year $\geq$ 2020) $\times$ High tourism revenue	-0.243	-0.027	0.020
	(0.313)	(0.187)	(0.432)
C: Commercial land			
(Year $\geq$ 2020) $\times$ High tourism revenue	0.288**	0.102	0.775*
	(0.106)	(0.108)	(0.379)
City Controls	Y	Y	Y
Province-year FE	Y	Y	Y
City FE	Y	Y	Y
Observations	839	839	839

The dependent variables are (1) log land sales revenue, (2) log land sales area, and (3) log average land sales price per acre for total land (panel A), residential land (panel B), and commercial land (panel C). All columns use the regression specification in Equation 8, weighted by the city's working-age population in 2010. The city controls include changes in log college graduates and changes in log urban population. The standard errors are clustered at the province level.
* $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$

Appendix

A Export Slowdown in the Mid-2010s

I summarize the effect of export slowdown on cities' economic performance, labor market outcomes, and governments' budget in this section. The impact of export slowdown is estimated using the IV regression in Equation 2.

I measure cities' economic performance using the night light intensity data and individual income data from Campante et al. (2023), who construct these two measures from the VIIRS-DNB dataset and the China Family Panel Studies (CFPS). Columns (1)-(3) in Table A1 report the impact of export slowdown exposure on cities' economic performances. Cities more exposed to the export slowdown have lower night light intensity and individual income.

Columns (4)-(5) examine the impact of export slowdown on employment in all industries and services sector and employment in the manufacturing sector. I obtain the employment data from the City Statistical Yearbooks. The employment share is measured by the ratio of urban employed workers to the urban population. Exposure to the export slowdown decreases the employment share in the manufacturing sector and in all industries and services sectors.

Table A2 examines the impact of export slowdown on city governments' budgets, drawing on data from Campante et al. (2023), where they collect the fiscal information from Fiscal Statistical Yearbooks, Statistical Yearbooks, and balance sheets from city government websites. Columns (1)-(3) indicate that exposure to the export slowdown does not decrease city governments' revenue; if anything, it tends to increase the revenue. On the expenditure side, Columns (4)-(5) show that cities with greater exposure to the export slowdown have higher expenditures, particularly driven by increased spending on public security spending and social spending for stability control (Campante et al., 2023). To validate this impact on government budgets, I also obtain data on city governments' general public budgetary revenue, tax revenue, and general public budgetary expenditure from City Statistical Yearbooks.[25] Table A3 further confirms that cities with larger exposure to the export

[25] General public budgetary revenue comprises both tax and budgetary non-tax revenue, such as penalties and special program receipts, and serves as a major revenue source for local governments. However, it's important to note that

slowdown do not experience decreased revenue; meanwhile, they tend to have higher expenditures.

Table A1: Export Shocks, Economic Performance and Labor Market

	(1) ΔLog Night light	(2) ΔLog Individual income	(3) Δ Employment share	(4) Δ Manufacturing employment share
ΔExport	0.026***	0.061**	0.013**	0.013***
	(0.008)	(0.024)	(0.005)	(0.003)
City Controls	Y	N	Y	Y
Individual Controls	N	Y	N	N
Province-year FE	Y	Y	Y	Y
City FE	Y	Y	Y	Y
First-stage F stat	58.288	9.119	55.088	55.088
Observations	852	30957	837	837

The dependent variables are changes in (1) log night light intensity; (2) log individual income; (3) share of urban employment in all industrial and services sectors among the urban population; and (4) share of urban manufacturing employment among the urban population. All regressions are weighted by the prefecture's working-age population in 2010. The city controls include changes in log college graduates and changes in log urban population. The individual controls in Column (2) include a gender dummy, an urban dummy, age group dummies (21–25, 26–30,31–35,36–40,41–45,46–50, and 51–55), and educational attainment group dummies (illiterate, primary school, middle school, high school, and college or above). The standard errors are clustered at the province level.
* $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$

revenue from land sales, considered off-budgetary revenue, is not classified as general public budgetary revenue. On the other hand, revenue from land-related taxes falls under the category of general public budgetary revenue.

Table A2: Export Shocks and City Government's Budget

	(1) ΔLog Total revenue	(2) ΔLog Tax revenue	(3) ΔLog Non-tax revenue	(4) ΔLog Total expenditure	(5) ΔLog Public security spending	(6) ΔLog Social spending	(7) ΔLog Other spending
ΔExport	-0.012*	-0.011	-0.007	-0.009***	-0.024***	-0.030***	-0.009*
	(0.007)	(0.012)	(0.013)	(0.002)	(0.006)	(0.009)	(0.005)
City Controls	Y	Y	Y	Y	Y	Y	Y
Province-year FE	Y	Y	Y	Y	Y	Y	Y
City FE	Y	Y	Y	Y	Y	Y	Y
First-stage F stat	58.214	58.319	58.280	58.346	58.147	70.235	69.985
Observations	980	966	953	962	957	907	902

The dependent variables are changes in (1) log night light intensity; (2) log individual income; (3) log total GDP; (4) share of urban employment in all industrial and services sectors among the urban population; and (5) share of urban manufacturing employment among the urban population. All regressions are weighted by the prefecture's working-age population in 2010. The city controls include changes in log college graduates and changes in log urban population. The individual controls in Column (2) include a gender dummy, an urban dummy, age group dummies (21–25, 26–30,31–35,36–40,41–45,46–50, and 51–55), and educational attainment group dummies (illiterate, primary school, middle school, high school, and college or above). The standard errors are clustered at the province level.
* $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$

Table A3: Export Shocks and City Government's Budget

	(1) ΔLog General revenue	(2) ΔLog Tax revenue	(3) ΔLog General expenditure
ΔExport	-0.017**	-0.040	-0.013*
	(0.007)	(0.025)	(0.007)
City Controls	Y	Y	Y
Province-year FE	Y	Y	Y
City FE	Y	Y	Y
First-stage F stat	58.334	59.952	58.334
Observations	843	749	843

The dependent variables are changes in (1) log general public budgetary revenue, (2) log tax revenue, and (3) log general public budgetary expenditure. All regressions are weighted by the prefecture's working-age population in 2010. The city controls include changes in log college graduates and changes in log urban population. The standard errors are clustered at the province level.
* $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$

B Supplementary Tables

Table B1: Promotion Incentives

	(1)
	Promotion
Start age	-0.039***
	(0.004)
Graduate degree	0.042
	(0.036)
Provincial city	-0.405
	(0.775)
Deputy-provincial city	-0.085*
	(0.044)
Start age × Provincial city	0.019
	(0.014)
City in the birth province	0.032
	(0.035)
Constant	2.256***
	(0.238)
Observations	703

The dependent variable is a dummy variable of whether the city leader gets promoted. Here I define $Promotion = 1$ if the next position is of a higher hierarchy than the current position. The city in the birth province captures the political connection, and it equals to one if the city leaders govern the cities in their home province. The standard errors are clustered at the city level.
* $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$

Table B2: Robustness: Specification Checks

	(1) ΔLog Revenue	(2) ΔLog Revenue	(3) ΔLog Revenue	(4) ΔLog Revenue
ΔExport	-0.066***	-0.049***	-0.059***	-0.054***
	(0.022)	(0.011)	(0.008)	(0.007)
City Controls	Y	Y	Y	Y
Lagged Y change	N	Y	N	N
Lagged Y level	N	N	Y	N
Province-year FE	Y	Y	Y	Y
City FE	Y	N	N	N
First-stage F stat	43.757	69.811	68.266	71.987
Mean	81.63	81.63	81.63	81.63
Observations	983	983	983	983

The dependent variable is the change in log land sales revenue. All regressions report IV estimates. Column (1) is the unweighted regression. Column (2) drops the city fixed effect and controls lagged change in log land sales revenue. Column (3) drops the city fixed effect and controls the lagged log land sales revenue level. Column (4) drops the city fixed effect. Regressions in Columns (2) to (4) are weighted by the prefecture's working-age population in 2010. The mean is the mean value of the land sales revenue with 1 million RMB as the unit. The city controls include changes in log college graduates and changes in log urban population. The standard errors are clustered at the province level.
* $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$

Table B3: Robustness: Sample Period Checks

	(1) ΔLog Revenue	(2) ΔLog Revenue	(3) ΔLog Revenue	(4) ΔLog Revenue
ΔExport	-0.068***	-0.095***	-0.062***	-0.067***
	(0.011)	(0.012)	(0.010)	(0.025)
City Controls	Y	Y	Y	Y
Province-year FE	Y	Y	Y	Y
City FE	Y	Y	N	N
Sample period	2012-2015	2012-2017	2015	2013-2015
First-stage F stat	54.064	72.952	101.606	21.130
Mean	79.26	80.57	67.01	67.01
Observations	1310	1638	328	328

The dependent variable is the change in log land sales revenue. All regressions report IV estimates and are weighted by the prefecture's working-age population in 2010. Columns (1) and (2) span from the year 2011-2015 and 2011-2017, i.e. export shock for the year 2012-2015 and 2012-2017. Column (3) reports the cross-sectional regression result using data from 2015 only. Column (4) reports the long-difference regression result, where the export shock and IV are constructed as cumulative shocks over the years 2013 to 2016 (spanning the period of 2012 to 2016). For Columns (3) and (4), province fixed effects are used instead of province-year and city fixed effects. The mean is the mean value of the land sales revenue with 1 million RMB as the unit. The city controls include changes in log college graduates and changes in log urban population. The standard errors are clustered at the province level.
* $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$

Table B4: Robustness: Influential Observation Checks

	(1)	(2)	(3)
	ΔLog Revenue	ΔLog Revenue	ΔLog Revenue
Min $\Delta Export$ coef	-0.1069***	-0.0674***	-0.0858***
	0.0221	0.0172	0.0270
Max $\Delta Export$ coef	-0.0557***	-0.0535***	-0.0470***
	0.0092	0.0068	0.0143
City Controls	Y	Y	Y
Province-year FE	Y	Y	Y
City FE	Y	Y	Y

The dependent variable is the change in log land sales revenue. All regressions report IV estimates and are weighted by the prefecture's working-age population in 2010. For Column (1), the regressions drop trade flows from one HS 2-digit section at a time from both the $\Delta Export$ variable and the IV. The smallest and largest export shock coefficients are reported with the associated standard errors. For Columns (2) and (3), the regressions drop one city and one province at a time. The smallest and largest export shock coefficients are reported with the associated standard errors. The city controls include changes in log college graduates and changes in log urban population. The standard errors are clustered at the province level.
* $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$

Table B5: Robustness: Alternative Inferences

	(1)	(2)	(3)	(4)	(5)	(6)
	Prov. level	City level	Export similarity	Export similarity: outside prov.	Prov. + Export similarity	Prov. + Export similarity outside prov.
ΔExport	-0.056***	-0.056**	-0.056***	-0.056***	-0.056***	-0.056***
	(0.010)	(0.025)	(0.020)	(0.020)	(0.007)	(0.007)
City Controls	Y	Y	Y	Y	Y	Y
Province-year FE	Y	Y	Y	Y	Y	Y
City FE	Y	Y	Y	Y	Y	Y
Wild cluster bootstrap-t	0.0000					
tF 95% CI	[-0.077,-0.035]					
tF 99% CI	[-0.089,-0.022]					
Observations	981	981	981	981	981	981

The dependent variable is the change in log land sales revenue. All regressions report IV estimates and are weighted by the prefecture's working-age population in 2010. Column (1) reports the regression clustered at the province level used in the baseline regression. $p-$value is computed through a wild bootstrap-t procedure following Cameron et al. (2008), due to the small number of clusters (28). The tF test for IV proposed by Lee et al. (2022) is also implemented in Column (1)'s baseline regression. Standard errors in Column (2) are clustered at the city level. For Columns (3) and (4), the standard errors are clustered at the export similarity level and the level of the export similarity with cities outside the province. Columns (5) and (6) use the two-way clustering of export similarity and province level.
* $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$

Table B6: Balance Tests of Product Shocks

	(1) Coef	(2) SE
Predetermined City Characteristics:		
Share of college graduates (%*100)	0.0060	(0.0046)
Share of manufacturing employment (%*100)	0.0380	(0.0284)
Export to GDP ratio (%*100)	0.1288	(0.1015)
Share of non-Hukou population (%*100)	0.0882	(0.0667)
Log GDP per capita (*100)	0.0011	(0.0008)
Log fiscal revenue per capita(*100)	0.0017	(0.0013)
Pretrend in Outcomes:		
ΔLog land sales revenue (*10000)	-0.0131	(0.0111)
ΔLog land sales area (*10000)	-0.0547	(0.0477)
ΔLog commercial land sales revenue (*10000)	-0.0619	(0.0623)
ΔLog industrial land sales revenue (*10000)	-0.0762	(0.0599)
ΔLog residential land sales revenue (*10000)	-0.0085	(0.0116)
ΔLog commercial land sales area (*10000)	-0.0490	(0.0535)
ΔLog industrial land sales area (*10000)	-0.0755	(0.0605)
ΔLog residential land sales area (*10000)	0.0314	(0.0316)

This table reports coefficients and standard errors from regressing product-specific weighted averages of pre-export-slowdown period's city characteristics and outcome variables on HS6 product-level export shocks, which is recommended by Borusyak et al., 2022. Standard errors are clustered by HS 4-digit codes. All regressions are weighted by the average HS6 product-level export exposure across prefectures. The predetermined city characteristics are in year 2010 and the pretrend outcomes are chosen in year 2011-2012. The shocks is constructed starting in year 2013.
* $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$

Table B7: Product-level Regression

	(1) $\Delta LogRevenue^{\perp}_{kt}$
$\Delta Export^{\perp}_{kt}$	-0.061***
	(0.006)
First-stage F stat	33.349
Observations	13197

This table reports the result of the product-level IV regression. The dependent variable is product-level analogous to change in log land sales revenue. $ExpShock^{\perp}_{kt}$ is product-level analogous of export change in city's export change. Standard errors are clustered by HS 2-digit codes.
* $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$

Table B8: Controlling for Incomplete Share

	(1)	(2)	(3)
	ΔLog Revenue	ΔLog Revenue	ΔLog Revenue
ΔExport	-0.043***	-0.042***	-0.048***
	(0.010)	(0.010)	(0.010)
City Controls	Y	Y	Y
Exposure-year FE	Y	Y	Y
Province-year FE	Y	Y	Y
City FE	Y	Y	Y
First-stage F stat	44.694	47.157	55.980
Mean	983	983	983

The dependent variable in this table is the change in log land sales revenue. Column (1) controls the quintiles of initial exposure share by year fixed effect. Column (2) controls the quartiles of initial exposure share by year fixed effect. Column (3) controls the terciles of initial exposure share by year fixed effect. Standard errors are clustered by HS 2-digit codes.
* $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$