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Urban Shrinkage and Labor Investment Efficiency: Evidence from China

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Abstract: In the context of unsustainable urban growth patterns and employment difficulties, we examine the impact of urban shrinkage on labor investment efficiency by drawing on the idea of the difference-in-difference model. Using a sample of Chinese firms from 2010 to 2019, our findings suggest that the widespread occurrence of urban shrinkage in China was responsible for a significant portion of the excessive labor investment in most listed companies. These results are robust to alternative specifications. In addition, we further found heterogeneity in the impact of urban shrinkage on labor investment efficiency. For state-owned or mature listed companies, this impact is manifested as the promotion of employment redundancy, while for non-state-owned or young companies, the impact is reflected in alleviating insufficient employment. Thus, we creatively identify a potential channel through which imbalanced development between cities affects corporate and economic sustainability.

Keywords: urban shrinkage; labor investment efficiency; corporate sustainability; sustainable development

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1. Introduction

Recently, the topic of "Kong Yiji's robe" has become popular in China. The CCTV media's use of Kong Yiji's literature to comment on the employment of contemporary university students has sparked widespread social discussions. This phenomenon reveals the imbalance in China's development. The majority of graduates want to find a decent job in a big city with a high population concentration instead of going to a shrinking city in obscurity, making employment difficult. Furthermore, employment and corporate hiring is not only a hot topic but also a matter of the sustainable development of companies and economies. Although China's labor productivity has been showing an increasing trend in recent years, against the background of the disappearance of China's demographic dividend, the rising cost of labor, and the labor shortage problem, China's per capita labor productivity is not growing, but rather slowing down [1]. This, to some extent, reflects that there are problems with labor investment efficiency in Chinese enterprises. Therefore, in the context of regional imbalances, studying the labor investment efficiency of enterprises piqued our interest.

Since the reform and opening up, under the top-level design of the growth model, along with vigorous urbanization construction, China has continued its growth-oriented model for over 30 years. With the drastic changes in the domestic and international environment, fierce competition has emerged among cities and regions, leading to differentiation in growth between regions and within cities [2], until recent years, when more and more cities have begun to deviate from the growth model and experience urban shrinkage [3]. Expansion and shrinkage are two contradictory yet unified aspects of urban development [4]. Some cities are facing continuous population loss, while major urban clusters, metropolitan areas, and provincial capitals are experiencing continuous population concentration [5]. Therefore, whether a city's population is growing or shrinking significantly reflects the development gap between regions. This provides a good opportunity to study how the

population gap between cities resulting from urban shrinkage affects labor investment efficiency, which not only has significant practical implications but also offers a path to explore the theoretical mechanisms of imbalanced development affecting sustainable development.

However, to the best of our knowledge, the existing research has not provided answers about the impact of urban shrinkage on labor investment efficiency in enterprises during China's urbanization process. To investigate this issue, our estimation strategy exploits two sources of variation. The first is time variation arising from endogenous causes. In other words, different shrinking cities have different time points of shrinkage. In the high-speed economic growth context of urbanization in China over the last few decades, urban shrinkage has only started to be widely observed and recognized in recent years. Chinese scholars have identified shrinking cities in China based on data from 2003 to 2014. Their results indicate that urban development in China still focused on growth and a relatively low proportion of cities were shrinking cities or potentially shrinking cities by 2014 [6]. However, other scholars using data from the sixth and seventh national censuses found that 266 cities in China experienced urban shrinkage from 2010 to 2020, accounting for 39% of all cities (684) in China [3]. This suggests that over the past decade, a considerable number of cities have experienced shrinkage, and the time points of shrinkage varied.

The second source of variation is cross-sectional and arises from demographic changes, as determined by cities' conditions. Our identification strategy relies on the interaction of the two sources of variation, and only the interaction can be interpreted as plausibly exogenous. Moreover, the inefficiency of labor investment is further divided into excessive labor investment and inadequate labor investment. Our study uses A-share listed companies in Shanghai and Shenzhen from the period 2010–2019 as the research sample, comparing the differences in labor investment efficiency between cities that have experienced or are more likely to experience shrinkage and cities that are still growing or less likely to experience shrinkage, before and after the widespread emergence of urban shrinkage.

We find that companies that operate in cities with high population concentrations experienced higher levels of labor overinvestment, and the estimates are more significant in the robust estimation. In addition, we show that we obtain similar results when we examine variation across the state-owned nature and length of time listed or established of the company. To verify the causality between urban shrinkage and labor investment efficiency, we conducted a placebo test and passed the placebo test. Together, the results suggest that it is unlikely that urban shrinkage does not affect labor investment efficiency.

Our study shines some light on the following aspects. First, taking the phenomenon of urban shrinkage that has occurred in the urbanization process in China as a representative and indicative example of significant developmental disparities between cities, this study investigates the changes in labor investment efficiency in cities with different development statuses before and after the widespread occurrence of urban shrinkage. It provides an effective supplement to existing research that focuses on internal factors within enterprises and external factors such as institutions and politics when exploring the impact on labor investment efficiency. It also expands the research perspective on urban shrinkage.

Second, this study provides a new mechanism for understanding the impact of urban development processes on sustainable economic development. Due to the existence of a reverse causality relationship between urban development and economic growth, it is challenging to identify the relationship between them. However, the findings of this study provide evidence that the imbalanced development of cities hampers sustainable production and sustainable development.

Finally, this study provides an explanation for the social topic of "Kong Yiji's robe" at the theoretical level. Many young people aspire to have decent jobs in so-called "big cities." However, this research finds that labor investment is excessive in enterprises that are in the population-concentrated "big cities", while the enterprises in the "smaller cities" that need more talent have not met the expectations of many people.

2. Literature Review and Hypotheses

The efficiency of labor investment in enterprises has received considerable attention in research. A rich body of work has investigated the influencing factors of labor investment efficiency in enterprises from the perspectives of information asymmetry and agency conflicts. From the standpoint of information quality and effectiveness, studies have found that high-quality financial reports can effectively improve labor investment efficiency in enterprises [7]. Based on the view of stock information content, Ben-Nasr et al. argue that stock market prices contain a lot of information that managers do not possess, which also helps improve the efficiency of labor investment in enterprises [8]. From the perspective of internal corporate governance, a strong connection between CEOs and the board of directors is more likely to bring out enterprises' inefficiency in labor investment [9]. As regards different types of stakeholder supervision, some researchers have found a positive correlation between long-term investors [10], security analysts [11], and the efficiency of enterprise investment. In addition, the rigid constraints of financing conditions are also an essential factor affecting the efficiency of labor investment in enterprises [12].

Resource-based theory suggests that enterprises need to rely on a specific environmental context for survival, and at the same time, the environment imposes constraints on the operation of enterprises. Therefore, managers need to formulate different business strategies and operational decisions based on the environmental differences faced by the enterprises. When discussing the efficiency of labor investment in enterprises, some studies shift the research perspective to the external environment of enterprises. Considering China's unique political background with a strong government, many scholars have investigated the impact of government intervention [13,14] and official promotion [15] on the efficiency of labor investment in enterprises. Some studies suggest that relaxed short-selling constraints [16] and implementing the Labor Contract Law [17,18] and other external institutional factors can distort labor investment efficiency in enterprises. Other scholars have directly examined the impact of external environmental uncertainty on the efficiency of labor investment in enterprises [19]. Along these lines, we also expect urban shrinkage to influence the labor investment efficiency of firms. However, there is even little research on whether the occurrence of shrinkage in certain cities would affect investment efficiency in enterprises. It is not clear what role urban shrinkage plays in labor investment efficiency.

Based on the urban shrinkage literature, China has been dominated by growth in recent decades; however, urban shrinkage in China has only gradually received attention in recent years. Urban shrinkage is a multidimensional process that includes economic, population, geographic, social, and physical environmental aspects [20]. The connotation of urban shrinkage varies in different historical periods and regional contexts, but it is mainly related to population loss. Population loss is an essential characteristic of urban shrinkage. China is experiencing contrasting spatial phenomena of growth and shrinkage in cities, and this differentiation between growth and shrinkage is becoming increasingly apparent. While the population continues flowing out of shrinking cities, major urban clusters, metropolitan areas, and provincial capital cities face continuous population agglomeration [5].

Theoretically, urban shrinkage accompanied by a large outflow of labor can easily lead to insufficient labor supply and hinder urban economic development, thus affecting overall urban development. Research on the impact of urban shrinkage mainly revolves around the scarcity of human resources in shrinking cities, public fiscal crises, vacancy issues, and urban planning challenges [21]. Recent studies on the consequences of urban shrinkage have investigated its effects on labor productivity [22], eco-efficiency [23], and investment [24]. These research works, however, are relatively macro studies at the city level, lacking a focus on the firm-level response to urban shrinkage in terms of labor investment decisions. It is equally important to understand whether urban shrinkage improves or deteriorates the efficiency of firm-level labor investment. And it is worth mentioning that Yubo Liu et al. divide cities into shrinking and non-shrinking categories and find that local firms in "narrowly shrinking cities" have lower TFP using the shrinking city dummy variable [25]. Like this paper, our research also uses urban shrinkage as an

entry point to study the micro-level of firms. However, they only use the urban shrinkage dummy variable, which disconnects the labor factor flows between cities and fails to capture the allocation of labor across cities.

In the context of labor allocation, Hsieh et al. used occupational distribution data to find that 15–20% of the U.S. economic growth in the period 1960–2008 can be explained by the optimization of labor allocation [26]. Then, the mismatch of the labor force can be a key constraint to economic development, which is reflected in various aspects such as mismatch between different professions, between government and enterprises, between different industrial sectors, and between different regions. From this perspective, urban shrinkage is essentially a mismatch of labor between cities with different levels of development. Murphy et al. studied the effect of labor force allocation among different professions on economic growth rates across countries and found that countries with a higher proportion of law students had lower economic growth rates, and countries with a higher proportion of engineering students had higher economic growth rates [27]. They argue that the talent mismatch caused by more talent going into unproductive rent-seeking activities brings down economic growth rates. In line with this line of thought, Chinese scholars, from the perspective of labor allocation among sectors such as firms and government, have found that a large allocation of talent to unproductive government sectors can be detrimental to economic growth [28] and that human capital in the government and monopoly sectors can also inhibit innovation to varying degrees [29]. Some scholars have also highlighted that the misallocation of labor between different industrial sectors in China has had a significant negative effect on total factor productivity since the reform and opening up [30]. However, the literature directly discussing the impact of labor force allocation between different cities on economic growth is relatively scarce.

To summarize, the existing literature has investigated the efficiency of labor investment in enterprises and the impact of urban shrinkage on labor allocation in enterprises to some extent. However, some aspects still require further exploration, especially the effect of urban shrinkage on firm-level labor investment, which needs more research attention. Existing studies highlight that the population in China's large shrinking cities is concentrated in large cities, resulting in a possible labor supply shortage for enterprises whose actual operations are located in shrinking cities, while enterprises in mega-cities and provincial capitals and other cities with concentrated population are more likely to face a labor supply surplus. Based on the resource-based theory, enterprises' managers are bound to make their labor investment decisions based on the labor market environment. Enterprises located in cities with a high population concentration are more likely to recruit employees easily and do not need a large talent pool. The relative scarcity of labor makes enterprises more motivated to reserve talent and over-invest in labor, while the absolute scarcity of labor may cause enterprises to under-invest in labor, so enterprises in shrinking cities are more likely to have inefficient labor investment.

However, if we look at enterprises' investment in labor from the perspective of managers' expectations in a developmental perspective, the level of economic development in cities with population concentrations is higher than in shrinking cities. Since growth will feed optimism, we may expect firms to indulge in overinvestment in human capital [31]. Furthermore, based on recent research, firms with overconfident CEOs are more likely to have lower labor investment efficiency [32]. An optimistic market environment can boost CEOs' confidence. Operating in large cities with a large population concentration and strong development momentum will raise managers' expectations, thus resulting in over-investment in labor. Operating in a shrinking city, on the other hand, lowers managers' expectations for the future, making these enterprises more flexible in their investment in labor. As long as labor is not so scarce that enterprises are forced to underinvest, then enterprises in shrinking cities are instead more likely to achieve efficient investment in labor. Thus, the relationship between urban shrinkage and firm-level labor investment efficiency remains an empirical question. Considering that most of the listed companies (>90%) are operating in non-shrinking cities, we formulate the following hypothesis:

H1. *The widespread emergence of urban shrinkage deteriorates labor investment efficiency.*

H2. *The widespread emergence of urban shrinkage improves labor investment efficiency.*

3. Research Design

3.1. Sample and Data Source

The enterprise data in this study are sources from the CSMAR database, and data related to urban shrinkage come from the Beijing City Lab and the research findings of the School of Architecture at Tsinghua University [3]. Since the urban shrinkage data published by the City Lab start from 2010 and the COVID-19 pandemic emerged at the end of 2019, to exclude the impact of the pandemic on the labor investment efficiency of enterprises, this study selects relevant data from 2010 to 2019 of A-share listed companies in Shanghai and Shenzhen as the research sample. In the sample selection process, we perform the following treatments to ensure the data's validity: excluding financial companies, special treatment (ST) companies, and samples with missing variables. In addition, we winsorize all continuous variables to eliminate the influence of outliers. Finally, all the data processing in our paper is implemented using stata15.

3.2. Empirical Strategy

The empirical approach in this study is consistent with the difference-in-differences (DID) method. It compares the labor investment efficiency difference between enterprises in cities that are more likely to experience shrinkage and those in cities that are less likely to experience shrinkage before and after widespread urban shrinkage occurs. This study selects the degree of urban shrinkage as a continuous variable to capture more data variability. Since cities begin to experience shrinkage and different cities start to contract at different time points that are difficult to determine, this study relies on existing research on urban shrinkage identification. It selects a specific time point as the treatment time point. Urban shrinkage and growth are gradual processes, and their observations must set particular time intervals [6]. In our study, we identified shrinkage cities in China based on the data from 2003 to 2014, indicating that up to 2014, urban development in China was mainly growing, and the proportion of shrinkage cities and potential shrinkage cities was not high [6]. However, using the data from the sixth and seventh national censuses, it was found that from 2010 to 2020, 266 cities experienced urban shrinkage, accounting for 39% of all cities in China (684) [3]. These research results indicated that the scope of shrinkage in cities was wide, but the severity in most cities was insignificant. Therefore, this study defines 2015 as the treatment time point, where the period before and including 2015 is defined as "before widespread urban shrinkage", and the period after 2015 is defined as "after widespread urban shrinkage". The choice of 2015 as the treatment time point is based on identifying the urban shrinkage degree in the existing literature and will be empirically tested for its reasonability in subsequent analysis. Based on this, this study designs the structure of the empirical analysis model, along with necessary robustness tests and heterogeneity analysis.

Our strategy shares most of the advantages and disadvantages of the standard DID strategy. On the one hand, it allows us to control for both company and time period fixed effects so that all time-invariant differences across companies—such as corporate culture, and industry—and secular changes over time—such as macroeconomic fluctuations—are controlled for. In addition, we control for potentially important factors that may affect labor investment efficiency in the baseline estimates. Thus, we provide a rigorous quantitative analysis of the realistic role of urban shrinkage in labor investment efficiency. Furthermore, considering the disadvantages of the standard DID strategy, which relies on no other shocks occurring around the same time as the widespread emergence of urban shrinkage, we address this identification concern by directly controlling for time- and company-varying factors that might bias our estimates. In the robustness estimates, we control for control variables in the baseline estimates, each interacting with the full set of time period indicator variables. This allows the effect of each control variable to vary flexibly over time.

3.3. Variable Selection

3.3.1. Degree of Urban Shrinkage

Population outflow is a vital characteristic of urban shrinkage. The degree of urban shrinkage in this study is calculated by multiplying the population change index of the corresponding cities in 2010, published by the Beijing City Lab, with the population change index of the related cities in 2020 [3]. Since the City Lab did not publish the population change index for cities that had not experienced shrinkage by 2010, we set the population change index for those cities to 1. The degree of shrinkage in the place where the firm operates is denoted by JYMSC, and the degree of shrinkage in the place where the firm is registered is denoted by ZCMSC. Both variables of JYMSC and ZCMSC take smaller values as the shrinkage degree of the city increases and take larger values as the shrinkage degree decreases. When the city is still in a state of population concentration, the variable (JYMSC or ZCMSC) will be greater than 1. Reference [33] proposes a method to calculate the China balanced development index. Following the same method, we obtain the normalized form of these two variables (JYSCIndex $= \frac{JYMSC-JYMSC_{min}}{JYMSC_{max}-JYMSC_{min}}$, ZCSCIndex $= \frac{ZCMSC-ZCMSC_{min}}{ZCMSC_{max}-ZCMSC_{min}}$). The closer the variable (JYSCIndex or ZCSCIndex) is to 1, the less likely the city is to experience shrinkage, indicating a tendency towards urban population concentration. Conversely, the closer the variable (JYSCIndex or ZCSCIndex) converges to zero, the more likely the city is to experience shrinkage, indicating a higher possibility of shrinkage or the occurrence of shrinkage.

3.3.2. Labor Investment Efficiency

Currently, scholars often use the econometric analysis model proposed by Jung et al. to measure the labor investment efficiency of companies [7] (e.g., [8,9,11,12,34,35]). Therefore, this study also adopts the econometric analysis model proposed by Jung et al. [7] to measure the labor investment efficiency of companies, as shown in the specific Model (1):

$$\begin{aligned}\text{Net\_Hire}_{i,t} = \beta_0 &+ \beta_1\text{Growth}_{i,t-1} + \beta_2\text{Growth}_{i,t} + \beta_3\Delta\text{ROA}_{i,t} + \beta_4\text{ROA}_{i,t} + \beta_5\Delta\text{ROA}_{i,t-1} + \beta_6\text{Return}_{i,t} \\ &+ \beta_7\text{Size\_R}_{i,t-1} + \beta_8\text{Quick}_{i,t-1} + \beta_9\Delta\text{Quick}_{i,t-1} + \beta_{10}\Delta\text{Quick}_{i,t} + \beta_{11}\text{Lev}_{i,t-1} \\ &+ \beta_{12}\text{Lossbin1}_{i,t-1} + \beta_{13}\text{Lossbin2}_{i,t-1} + \beta_{14}\text{Lossbin3}_{i,t-1} + \beta_{15}\text{Lossbin4}_{i,t-1} \\ &+ \beta_{16}\text{Lossbin5}_{i,t-1} + \text{Year} + \text{Industry} + \varepsilon_{i,t}\end{aligned} \quad (1)$$

where *Net_Hire* represents the rate of change in capital per employee, which is the rate of change between the total number of employees in listed companies in the current year and the total market value of individual stocks in that year; *Growth* represents the sales revenue growth rate; *ROA* represents the assets return; *Return* represents the annual stock return rate; *Size_R* represents the percentage rank of the total market value of individual stocks; *Quick* is the quick ratio; *Lev* represents the asset–liability ratio; and $Lossbin_x$ represents the five intervals evenly divided with a step size of 0.005 based on ROA ranging from -0.025 to 0, where Lossbin5 is 1 if ROA falls within the interval range of $[-0.025, -0.02)$ and 0 otherwise. All the variables are defined in the Appendix A. The model also controls time (Year) and industry (Industry) fixed effects. The absolute value of the residual from the regression in this model represents the labor investment efficiency variable (Labeff). When the residual is greater than 0, the absolute value of the residual indicates excessive labor investment (OLabeff), while when the residual is less than 0, the total value of the residual indicates low labor investment (ULabeff). The larger the absolute value of the residual, the more the actual labor investment efficiency of the company deviates from the expected value, indicating a lower efficiency.

3.3.3. Control Variables

Based on the existing relevant literature [7–9,11,12,16,19,34,35], this study selects factors at the company level, such as company size (Size), asset–liability ratio (Lev), quick ratio (Quick), Tobin's Q value (TobinQA), the growth rate of operating income (Growth), operating cash flow ratio (Cashflow), book-to-market ratio (BM), return on assets (ROA),

listing age (FirmAge), number of board members (Board), and the proportion of independent directors (Indep), as control variables in the basic regression model. In addition, this study also controls for year and company fixed effects.

3.4. Model Construction

This study uses Model (2) to examine the impact of widespread urban shrinkage on the labor investment efficiency of listed companies and uses Model (3) to explore the validity of Model (2) and the selection of time breakpoints in Model (2). Furthermore, this study calculates the t-values using the standard errors clustered at the city level where the company operates.

$$y_{i,t} = \beta\ \mathrm{JYSCIndex}{\cdot}I_t^{\mathrm{Post}} + \gamma\ \mathrm{Controls}_{i,t} + \mathrm{Year} + \mathrm{Firm} + \varepsilon_{i,t} \quad (2)$$

where *i* represents different companies, t represents the years from 2012 to 2019, and I_t^{Post} is a dummy variable. When the year is 2016, 2017, 2018, or 2019, the variable takes a value of 1; otherwise, it is 0. The dependent variable represents the labor investment efficiency variable (Labeff), excessive labor investment variable (OLabeff), or insufficient labor investment variable (ULabeff) of the company. All the variables are defined in the Appendix A. The model also controls for year fixed effects and individual fixed effects that may affect the labor investment efficiency of the company—the control for almost all factors that do not change over time or only change with time. The coefficient β in Model (2) is the part we mainly focus on in this study, as it measures the impact of urban shrinkage on the labor investment efficiency of listed companies in China after its widespread occurrence.

$$y_{i,t} = \sum_{j=2013}^{2019} \beta_{\ j}\mathrm{JYSCIndex}{\cdot}I_t^j + \gamma\ \mathrm{Controls}_{i,t} + \mathrm{Year} + \mathrm{Firm} + \varepsilon_{i,t} \quad (3)$$

Unlike Model (2), which constructs interaction terms by multiplying the degree of urban shrinkage at the location where the company operates with dummy variables before and after the time breakpoints, Model (3) constructs interaction terms by multiplying the degree of urban shrinkage at the location where the company operates with each year. In this case, the coefficient of this interaction term explains the relationship between the degree of urban shrinkage each year and the labor investment efficiency of the company. If the widespread occurrence of urban shrinkage in China does indeed have an impact on the labor investment efficiency of companies, then during the period before this phenomenon becomes widespread, or when the proportion of cities experiencing shrinkage or the magnitude of shrinkage is relatively low, the coefficient of this interaction term should be relatively stable. Only when the proportion of cities experiencing shrinkage increases, indicating the widespread occurrence of urban shrinkage, does the coefficient of this interaction term start to show significant changes. It is important to note that Model (3) must select data from a specific year as the base period, and the data from other years are compared to the base period data to calculate the coefficients of the interaction terms. Therefore, focusing on the specific coefficients of the interaction terms in Model (3) is unnecessary. Instead, we are interested in the temporal trend of this coefficient and whether it exhibits significant fluctuations after the time breakpoints.

4. Results

4.1. Descriptive Statistics

Table 1 presents the descriptive statistics of the main variables. Since all variables in the table have undergone the same truncation process, the maximum or minimum values of any two of the three variables, labor investment efficiency (Labeff), labor investment excess (OLabeff), and labor investment insufficiency (ULabeff), are not the same. Moreover, from Table 1, it can be observed that the range between the minimum and maximum values of the labor investment excess variable (OLabeff) noticeably encompasses the interval range of the labor investment efficiency variable (Labeff), whereas the labor investment insufficiency

variable (ULabeff) exhibits the opposite behavior with the smallest interval range, being encompassed by the interval ranges of the other two variables. This indicates that the sample data of listed companies used in this study suggest that the labor investment inefficiency of the majority of listed companies in China manifests as labor investment excess rather than labor investment insufficiency. Additionally, the few companies experiencing labor investment insufficiency exhibit a relatively smaller deviation from efficient investment. On the other hand, the extent of deviation from efficient investment varies greatly among companies with labor investment excess, as statistically reflected by the standard deviation of this variable (OLabeff) being significantly higher (0.4343) than the other two variables (0.1511 and 0.2772). Regarding the degree of urban shrinkage index (JYSCIndex) for the operating location, its variance is 0.2133, indicating significant variation in population dynamics across the operating cities of listed companies in China. The descriptive statistical results of the variables in this study are generally consistent with the existing literature.

Table 1. Distributional statistics.

Variable	N	Mean	sd	Min	p50	Max
Labeff	11,300	0.224	0.277	0.00260	0.144	1.767
OLabeff	4135	0.310	0.434	0.00180	0.154	2.283
ULabeff	7146	0.178	0.151	0.00310	0.140	0.786
JYSCIndex	11,200	0.545	0.213	0	0.463	1
Size	11,300	22.58	1.297	19.66	22.40	26.22
Lev	11,300	0.465	0.201	0.0687	0.464	0.904
Quick	11,300	1.599	2.285	0.0261	1.053	62.79
TobinQA	11,000	2.025	1.297	0.872	1.594	8.251
BM	11,300	1.211	1.252	0.103	0.783	6.704
Cashflow	11,300	0.0461	0.0687	−0.178	0.0447	0.256
Growth	11,300	0.149	0.408	−0.617	0.0846	2.744
ROA	11,300	0.0340	0.0638	−0.264	0.0327	0.214
FirmAge	11,300	2.908	0.309	1.792	2.944	3.970
Board	11,300	2.141	0.202	1.099	2.197	2.890
Dual	11,100	0.241	0.427	0	0	1
Indep	11,300	0.376	0.0574	0.182	0.364	0.800

The data relating to urban shrinkage (JYSCIndex) come from the Beijing City Lab and the research findings of the School of Architecture at Tsinghua University. Other enterprise data are sourced from the CSMAR database.

4.2. Flexible Estimates

The empirical results of Model (3) for the parallel trend test are shown in Table 2. The first column to the third column of Table 3 report the estimated coefficients between urban shrinkage, the labor investment efficiency, the labor investment excess, and the labor investment insufficiency of companies. All control variables, including time and individual fixed effects, are controlled for in these three regressions. From Table 2, it can be observed that before 2015 (including 2015), the estimated coefficients between urban shrinkage and labor investment efficiency, as well as labor investment excess, remain stable near zero, and the coefficients are small. There is a weak positive correlation between the urban shrinkage variable and labor investment insufficiency, with the estimated coefficient also being relatively stable. Importantly, all three columns of estimated coefficients experience a significant turning point after 2015. This can be more intuitively demonstrated through scatter plots showing the changes in estimated coefficients over time.

Table 2. Flexible estimates: the relationship between JYSCIndex and Labeff or OLabeff or ULabeff by time period.

	(1) **Labeff**	**(2)** **OLabeff**	**(3)** **ULabeff**
JYSCIndex_2013	−0.012	−0.174	0.020
	(−0.23)	(−0.71)	(0.58)
JYSCIndex_2014	0.031	0.031	0.026
	(0.57)	(0.14)	(1.03)
JYSCIndex_2015	0.029	−0.032	0.032
	(0.44)	(−0.13)	(1.10)
JYSCIndex_2016	0.059	0.140	−0.015
	(0.81)	(0.63)	(−0.49)
JYSCIndex_2017	0.013	0.100	−0.024
	(0.25)	(0.47)	(−0.77)
JYSCIndex_2018	0.070	0.132	−0.001
	(1.05)	(0.47)	(−0.02)
JYSCIndex_2019	0.047	0.112	0.041
	(0.73)	(0.47)	(1.65)
N	10,727	3946	6781
Controls	Y	Y	Y
r2	0.105	0.125	0.234
r2_a	0.103	0.119	0.231

Notes: The t-values are listed in parentheses.

Table 3. The impact of urban shrinkage: Baseline estimates.

	(1) **Labeff**	**(2)** **OLabeff**	**(3)** **ULabeff**
JYSCIndex_post	0.031	0.161 ***	−0.021
	(1.59)	(2.92)	(−1.36)
Size	0.081 ***	0.133 ***	0.050 ***
	(8.25)	(4.78)	(7.81)
Lev	−0.102 **	0.027	−0.116 ***
	(−2.12)	(0.24)	(−3.60)
Quick	−0.002	0.001	−0.001
	(−0.99)	(0.06)	(−0.55)
TobinQA	0.008 **	0.011	0.003
	(2.07)	(0.89)	(1.13)
BM	−0.014 *	−0.021	−0.038 ***
	(−1.93)	(−1.34)	(−7.45)
Cashflow	−0.021	0.176	0.023
	(−0.44)	(1.20)	(0.55)
Growth	0.122 ***	0.181 ***	0.106 ***
	(8.65)	(3.87)	(14.51)
ROA	−0.649 ***	−0.787 ***	−0.662 ***
	(−8.03)	(−3.85)	(−11.36)
FirmAge	−0.064	0.145	0.004
	(−0.72)	(0.52)	(0.08)
Board	−0.056	−0.101	−0.049 **
	(−1.51)	(−1.06)	(−1.98)
Dual	0.013	0.014	0.006
	(1.30)	(0.48)	(0.83)
Indep	−0.122	−0.486	−0.079
	(−1.34)	(−1.05)	(−1.34)
N	10,727	3946	6781
r2	0.105	0.124	0.233
r2_a	0.103	0.119	0.231

Notes: *, **, *** indicate significance levels of 10%, 5% and 1%, and the t-values are listed in parentheses.

By a flexible estimate of the model (3), the following basic judgments can be made. Firstly, before 2015 (including 2015), no significant trend relationship is found between the urban shrinkage index and the efficiency of labor investment in companies. Most of the samples during this period show estimated coefficients that are stable near zero. Secondly, after 2015, compared to listed companies operating in cities with higher levels of urban shrinkage, companies operating in cities that are less likely to experience shrinkage or non-shrinking cities exhibit lower labor investment efficiency, primarily manifested as

an excessive investment in labor. Lastly, observing the scatter plots in Figure 1a,b it is evident that after the estimated coefficients undergo a significant turning point, they begin to exhibit relative stability. In other words, for listed companies located in cities with good urban development, their labor investment inefficiency does not show a trend of deviating further from the efficient investment but rather maintains a new normal state of inefficient investment. This is consistent with real-world logic, as companies' investments in labor are constrained by various conditions, and they cannot infinitely deviate from efficient investment. This can also partially explain the employment issues reflected in the opening statement of this study, such as the case of "Kong Yiji's robe".

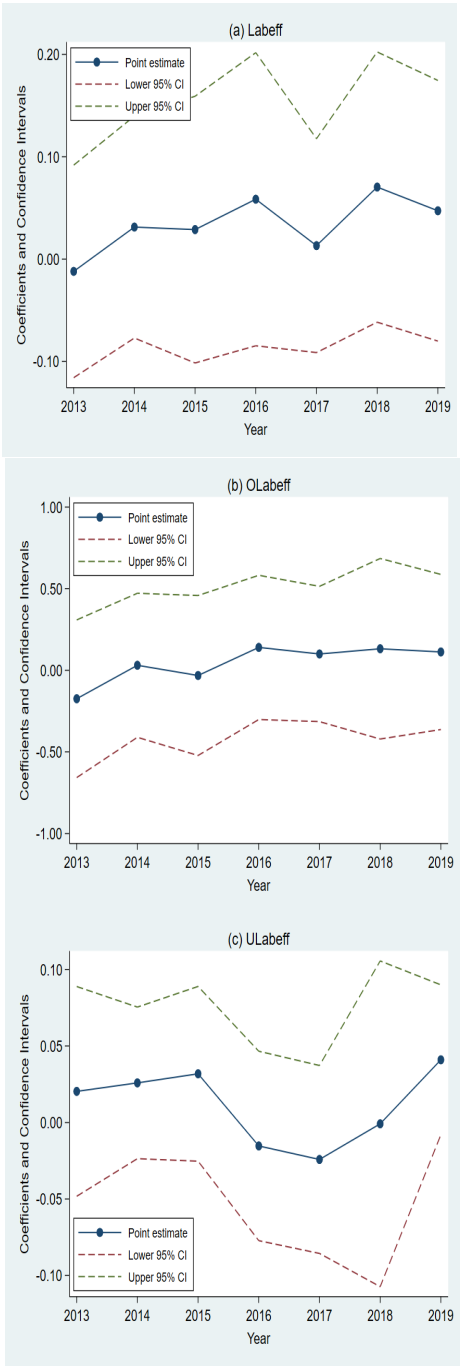

Figure 1. Flexible Estimates of the Relationship between Degree of Urban Shrinkage and Labor Investment Efficiency.

Based on the empirical analysis of the flexible estimation model and combining it with the conclusions from the existing literature on urban shrinkage identification, our study cautiously selects 2015 as the time treatment point. And using it as a basis, the baseline regression can be conducted.

4.3. Baseline Regression

The impact of urban shrinkage on labor investment efficiency in companies is shown in Table 3. This study found that in the subsample of companies with excessive labor investment, after the widespread occurrence of urban shrinkage, the urban shrinkage index is significantly and positively correlated with inefficient labor investment in companies at the 1% level. This means that after widespread urban shrinkage, compared to companies located in shrinking cities, companies located in growing cities are more likely to experience labor investment inefficiency, specifically manifested as excessive labor investment, before the occurrence of widespread urban shrinkage. The research results support the hypothesis H1. From an economic standpoint, for the subsample of companies with excessive investment, for every 0.1 unit increase in the urban shrinkage index, labor inefficiency investment in companies increases by 1.61%. Moreover, we also find labor investment inefficiency slightly increases (0.031) with higher JYSCIndex after the widespread urban shrinkage in the full sample. And the widespread urban shrinkage decreases the labor underinvestment of firms operating in cities with large population concentrations. Given that the economic level of cities with concentrated populations is better than that of cities with shrinking populations, these results are consistent with the findings of recent studies on the relationship between economic growth and firm-level labor investment efficiency [36]; their findings suggest that labor investment inefficiency increases with the expansion of economic activities. Furthermore, they found that economic growth not only increases labor overinvestment but also decreases labor underinvestment, while the impact of changes in the urban shrinkage index on labor investment inefficiency in the full sample and the subsample of companies with labor investment insufficiency is not statistically significant. Overall, it can be seen that both statistically and economically, the widespread occurrence of urban shrinkage significantly promotes excessive labor investment in listed companies operating in population centers such as large cities and provincial capitals.

5. Robustness and Placebo Test

5.1. Robustness Test

While external factors undoubtedly influence a company's labor investment decisions and labor investment efficiency, the existing literature has highlighted that various internal factors, such as different levels of internal and debt financing constraints, the intensity of agency conflicts, and the degree of information asymmetry, are important determinants of labor investment efficiency in companies [7,9,12,35]. In the case of each listed company, its labor investment efficiency is influenced by various internal conditions and the trends in these conditions. To more accurately control for the characteristics of companies and the changes in these characteristics, we adopt the approach used by [37] and include interaction terms between firm-level control factors and year in the model, specifically, as shown in Model (4). The regression results are presented in Table 4.

From Table 4, it can be observed that after more precise control for the variations in firm-level control variables, in the full sample, after widespread urban shrinkage occurs, the urban shrinkage index is significantly and positively correlated with inefficient labor investment in companies at the 10% level. This indicates that after widespread urban shrinkage, companies located in growing cities are more likely to experience labor investment inefficiency compared to companies located in shrinking cities before the occurrence of widespread urban shrinkage. Compared to the baseline regression model (Model 2), the regression results of Model (4) further support hypothesis H1. Similarly, this research conclusion is more significant in the subsample of companies with excessive labor investment, with a significance level ten times higher than that of the full sample. This not

only supports hypothesis H1 but also identifies that the labor investment inefficiency in hypothesis H1 is manifested as excessive labor investment. From an economic standpoint, compared to Model (2), for every 0.1 unit increase in the urban shrinkage index, labor inefficiency investment in companies increases by 55.28%. It is evident that after stricter variable control, the impact of the widespread occurrence of urban shrinkage on labor investment efficiency in listed companies is more pronounced, and the research findings are more robust.

$$y_{i,t} = \beta\ \mathrm{JYSCIndex}{\cdot}I_t^{\mathrm{Post}} + \sum_{j=2013}^{2019} \mathrm{Controls}_{i,t} I_t^j \gamma_j + \mathrm{Year} + \mathrm{Firm} + \varepsilon_{i,t} \quad (4)$$

where *i* represents different companies, t represents the years from 2012 to 2019, and I_t^{Post} is a dummy variable. When the year is 2016, 2017, 2018, or 2019, the variable takes a value of 1; otherwise, it is 0. The dependent variable represents the labor investment efficiency variable (Labeff), excessive labor investment variable (OLabeff), or insufficient labor investment variable (ULabeff) of the company. Unlike Model (2), which adds control variables directly, Model (4) constructs interaction terms by multiplying the control variables with each year. All the variables are defined in the Appendix A. The model also controls for year fixed effects and individual fixed effects.

Table 4. Robustness to the use of the population, and particularly Model (4) instead of Model (2).

	(1) Labeff	(2) OLabeff	(3) ULabeff
JYSCIndex_post	0.043 *	0.250 ***	−0.019
	(1.89)	(3.74)	(−1.26)
Controls (× Year fixed effects)			
Size	Y	Y	Y
Lev	Y	Y	Y
Quick	Y	Y	Y
TobinQA	Y	Y	Y
BM	Y	Y	Y
Cashflow	Y	Y	Y
Growth	Y	Y	Y
ROA	Y	Y	Y
FirmAge	Y	Y	Y
Board	Y	Y	Y
Dual	Y	Y	Y
Indep	Y	Y	Y
N	10,727	3946	6781
r2	0.109	0.158	0.240
r2_a	0.102	0.140	0.231

Notes: * and *** indicate significance levels of 10% and 1%, and the t-values are listed in parentheses.

5.2. Placebo Test

The causal identification in this study is based on the population changes in the location where companies operate because a company's labor investment efficiency is directly related to the labor market conditions in its operational location and has no direct causal relationship with the labor market conditions in its registered location. Therefore, if we replace the shrinkage index of the operational location with the shrinkage index of the registered location, there should not be a significant correlation between this shrinkage index and the labor investment efficiency of companies. In the data used in this study, there are 1517 cases where the operational location and registered location addresses of companies are different, accounting for 13.45% of the total sample. Thes data support conducting a placebo test by replacing the shrinkage index of the operational location with the shrinkage index of the registered location. The results of this test, as shown in Table 5, indicate that there is no significant correlation between the shrinkage index of the registered

location and the labor investment efficiency of companies in both the full sample and the two subsamples. All the variables in Table 5 are defined in the Appendix A.

Table 5. Placebo test: when replacing JYSCIndex with ZCSCIndex, the significance disappears.

	(1) Labeff	(2) OLabeff	(3) ULabeff
ZCSCIndex_post	0.020	0.105	−0.020
	(0.74)	(1.40)	(−0.94)
Size	0.080 ***	0.133 ***	0.050 ***
	(7.10)	(4.42)	(7.45)
Lev	−0.089 **	0.043	−0.114 ***
	(−2.09)	(0.38)	(−3.50)
Quick	−0.002	0.001	−0.001
	(−1.03)	(0.12)	(−0.63)
TobinQA	0.008 **	0.010	0.004
	(2.11)	(0.87)	(1.08)
BM	−0.014 **	−0.022	−0.038 ***
	(−2.47)	(−1.51)	(−8.93)
Cashflow	−0.017	0.159	0.023
	(−0.31)	(0.92)	(0.58)
Growth	0.122 ***	0.185 ***	0.104 ***
	(9.19)	(4.26)	(14.06)
ROA	−0.634 ***	−0.757 ***	−0.664 ***
	(−7.51)	(−3.47)	(−10.52)
FirmAge	−0.065	0.175	0.001
	(−0.83)	(0.71)	(0.03)
Board	−0.054 *	−0.102	−0.047 **
	(−1.77)	(−0.92)	(−2.04)
Dual	0.013	0.015	0.005
	(1.47)	(0.50)	(0.75)
Indep	−0.115	−0.513	−0.066
	(−1.43)	(−1.21)	(−1.33)
N	10,730	3940	6790
r2	0.104	0.123	0.232
r2_a	0.102	0.119	0.229

Notes: *, **, *** indicate significance levels of 10%, 5% and 1%, and the t-values are listed in parentheses.

6. Heterogeneity Analysis

6.1. The Impact of State Ownership

Previous studies have shown that state-owned enterprises tend to employ more staff and are more prone to over-employment compared to non-state-owned enterprises. State-owned enterprises also tend to have higher levels of over-employment after going public compared to other types of enterprises [14]. Therefore, in this study, the sample data are divided into two groups: state-owned and non-state-owned enterprises, to examine the relationship between the shrinkage index of the operational location and the labor investment efficiency of enterprises after the widespread occurrence of urban shrinkage. The regression results for the state-owned enterprise sample group are presented in Table 6, and the regression results for the non-state-owned enterprise sample group are presented in Table 7. In Table 6, the interaction term with labor investment inefficiency and labor investment over-expenditure shows a significant positive correlation at the 1% and 5% levels, respectively, supporting hypothesis H1 of this study. In terms of economic significance, the empirical results for the SOE sample group indicate that the widespread occurrence of urban contraction aggravates the labor investment inefficiency of listed firms operating in cities with high population concentrations, especially aggravating their labor overinvestment, which increases by 0.9% for each 0.1 unit increase in the index of the degree of urban contraction, while the labor overinvestment of firms increases by 4.07%. Combining the regression results in Table 7, the interaction term with labor investment insufficiency

shows a negative correlation at the 5% level. In contrast, the correlation coefficients of the interaction term with labor investment inefficiency and with labor overinvestment lose their statistical significance, indicating that for the sample of non-state firms, the widespread occurrence of urban contraction reduces the labor underinvestment of firms operating in populated cities by 0.39% for every 0.1 unit increase in the index of the degree of urban contraction. This result is consistent with the findings of existing studies. Namely, compared to the non-state-owned enterprise sample, state-owned enterprises are more likely to have over-employment [14]. Furthermore, after the widespread occurrence of urban shrinkage, state-owned listed enterprises operating in cities and provincial capitals with high population concentrations tend to have excessive labor investment, while non-state-owned listed enterprises operating in large cities and provincial capitals tend to have insufficient labor investment, thus alleviating labor shortages.

Table 6. State-owned enterprise sample estimates.

	(1) Labeff	(2) OLabeff	(3) ULabeff
JYSCIndex_post	0.090 ***	0.407 **	−0.001
	(2.80)	(2.60)	(−0.02)
Size	0.085 ***	0.156 ***	0.057 ***
	(4.69)	(2.65)	(5.26)
Lev	−0.105	0.179	−0.159 ***
	(−1.58)	(1.00)	(−4.37)
Quick	0.002	0.022 **	−0.005
	(0.57)	(2.04)	(−1.28)
TobinQA	0.003	−0.008	0.006
	(0.48)	(−0.39)	(1.10)
BM	−0.012	−0.016	−0.033 ***
	(−1.31)	(−0.84)	(−6.13)
Cashflow	−0.037	0.306	−0.023
	(−0.42)	(1.07)	(−0.46)
Growth	0.138 ***	0.183 **	0.117 ***
	(5.66)	(2.15)	(10.79)
ROA	−0.541 ***	−0.661	−0.594 ***
	(−4.76)	(−1.13)	(−6.55)
FirmAge	−0.029	−0.216	0.147 **
	(−0.33)	(−0.38)	(2.32)
Board	−0.030	0.183	−0.060 *
	(−0.44)	(0.88)	(−1.86)
Dual	−0.013	−0.056	−0.001
	(−0.87)	(−0.78)	(−0.07)
Indep	0.016	0.720	−0.087
	(0.15)	(1.37)	(−1.51)
N	4116	1316	2800
r2	0.103	0.157	0.263
r2_a	0.099	0.144	0.257

Notes: *, **, *** indicate significance levels of 10%, 5% and 1%, and the t-values are listed in parentheses.

Table 7. Non-state-owned enterprise sample estimates.

	(1) Labeff	(2) OLabeff	(3) ULabeff
JYSCIndex_post	−0.004	0.037	−0.039 **
	(−0.19)	(0.53)	(−2.03)
Size	0.070 ***	0.105 ***	0.047 ***
	(5.95)	(3.10)	(5.22)
Lev	−0.106 *	0.001	−0.089 *
	(−1.84)	(0.01)	(−1.80)

Table 7. *Cont.*

	(1) Labeff	(2) OLabeff	(3) ULabeff
Quick	−0.005	−0.008	−0.001
	(−1.60)	(−1.36)	(−0.49)
TobinQA	0.006	0.006	−0.001
	(1.23)	(0.43)	(−0.17)
BM	−0.010	−0.025	−0.042 ***
	(−1.07)	(−1.21)	(−4.26)
Cashflow	−0.001	0.166	0.045
	(−0.02)	(0.72)	(0.82)
Growth	0.114 ***	0.169 ***	0.099 ***
	(6.34)	(4.14)	(9.97)
ROA	−0.668 ***	−0.817 ***	−0.681 ***
	(−6.84)	(−3.56)	(−10.21)
FirmAge	−0.057	0.213	−0.072
	(−0.51)	(0.67)	(−1.07)
Board	−0.045	−0.160	−0.025
	(−1.05)	(−1.13)	(−0.67)
Dual	0.021	0.017	0.011
	(1.39)	(0.48)	(1.25)
Indep	−0.170	−1.206 *	0.005
	(−1.11)	(−1.91)	(0.05)
N	6611	2630	3981
r2	0.111	0.130	0.224
r2_a	0.108	0.123	0.220
r2_w	0.111	0.130	0.224

Notes: *, **, *** indicate significance levels of 10%, 5% and 1%, and the t-values are listed in parentheses.

6.2. The Impact of Firm Age

Throughout the lifecycle of a firm, different growth stages exhibit varying risk preferences and investment decision making patterns between mature and start-up enterprises. Following the approach of [38], this study classifies enterprises with a founding age of less than 10 years or a listing age of less than 5 years as young enterprises. The sample is divided into two groups: young enterprises and mature enterprises, to examine the relationship between the shrinkage index of the operational location and the labor investment efficiency of enterprises after the widespread occurrence of urban shrinkage. The regression results for the young enterprise sample group are presented in Table 8. For every 0.1 unit increase in the index of the degree of urban contraction, the labor overinvestment of young firms increases by 4.02%, while at the same time, their labor underinvestment decreases by 0.95%. The regression results for the mature enterprise sample group are presented in Table 9. The widespread occurrence of urban contraction aggravates the labor investment inefficiency of public companies operating in cities with a high concentration of population and particularly aggravates their labor overinvestment, which increases by 0.36% for each 0.1 unit increase in the index of the degree of urban contraction, while the labor overinvestment of companies increases by 1.65%. Combining the results from these two tables, it can be observed that after the widespread occurrence of urban shrinkage, both young and mature enterprises operating in large cities and provincial capitals with high population concentrations tend to exhibit excessive labor investment, at significant levels of 10% and 1%, respectively. Additionally, it alleviates labor investment insufficiency among young enterprises operating in these areas at a significant level of 5%, while increasing labor investment inefficiency among mature enterprises at a significant level of 10%. Although the regression results differ significantly between the two sample groups, they both support hypothesis H1 to some extent.

Table 8. Young enterprise sample estimates.

	(1) Labeff	(2) OLabeff	(3) ULabeff
JYSCIndex_post	0.094	0.402 *	−0.095 **
	(1.03)	(1.69)	(−2.36)
Size	0.186 ***	0.371 ***	−0.043
	(3.22)	(2.92)	(−0.84)
Lev	−0.413	−0.799	−0.595 ***
	(−1.65)	(−0.94)	(−4.98)
Quick	−0.010	−0.031	−0.021 ***
	(−1.20)	(−0.64)	(−3.25)
TobinQA	0.038	0.116	−0.030 ***
	(1.45)	(1.40)	(−3.08)
BM	−0.009	0.077	−0.071 ***
	(−0.12)	(0.68)	(−5.59)
Cashflow	−0.112	−0.426	−0.217
	(−0.54)	(−0.69)	(−1.11)
Growth	0.047	−0.073	0.049 **
	(0.92)	(−0.55)	(2.51)
ROA	−0.849	−0.995	−1.137 ***
	(−1.57)	(−0.45)	(−3.87)
FirmAge	0.192	2.011	−0.562
	(0.15)	(0.58)	(−0.74)
Board	0.193	0.848 **	−0.001
	(1.33)	(2.51)	(−0.01)
Dual	0.062	0.085	−0.011
	(0.99)	(0.30)	(−0.26)
Indep	−0.360	0.811	−0.093
	(−1.26)	(0.77)	(−0.56)
N	1320	522	798
r2	0.115	0.294	0.323
r2_a	0.102	0.268	0.306

Notes: *, **, *** indicate significance levels of 10%, 5% and 1%, and the t-values are listed in parentheses.

Table 9. Mature enterprise sample estimates.

	(1) Labeff	(2) OLabeff	(3) ULabeff
JYSCIndex_post	0.036 *	0.165 ***	−0.022
	(1.75)	(2.87)	(−1.33)
Size	0.081 ***	0.130 ***	0.051 ***
	(8.08)	(4.57)	(7.85)
Lev	−0.098 **	0.020	−0.105 ***
	(−2.03)	(0.18)	(−3.32)
Quick	−0.003	−0.001	−0.001
	(−0.97)	(−0.12)	(−0.47)
TobinQA	0.007 *	0.006	0.004
	(1.84)	(0.52)	(1.37)
BM	−0.014 **	−0.021	−0.039 ***
	(−1.99)	(−1.28)	(−7.48)
Cashflow	−0.016	0.207	0.024
	(−0.32)	(1.33)	(0.58)
Growth	0.123 ***	0.189 ***	0.105 ***
	(8.80)	(4.10)	(14.40)
ROA	−0.661 ***	−0.859 ***	−0.661 ***
	(−8.19)	(−4.52)	(−11.13)
FirmAge	−0.090	−0.010	0.025
	(−0.84)	(−0.03)	(0.48)
Board	−0.055	−0.109	−0.050 *
	(−1.46)	(−1.10)	(−1.97)
Dual	0.012	0.010	0.006
	(1.14)	(0.34)	(0.92)
Indep	−0.113	−0.515	−0.080
	(−1.19)	(−1.06)	(−1.31)
N	10,542	3862	6680
r2	0.107	0.128	0.235
r2_a	0.105	0.123	0.233

Notes: *, **, *** indicate significance levels of 10%, 5% and 1%, and the t-values are listed in parentheses.

7. Conclusions, Limitations, and Future Research

This study constructs a difference-in-differences model by using a sample of A-share listed companies in China from 2010 to 2019 to empirically analyze the impact of widespread urban shrinkage on the labor investment efficiency of enterprises. The findings indicate that the shrinkage index of the operational city has a significant positive effect on labor investment inefficiency of enterprises, primarily manifested as excessive labor investment. Specifically, after the widespread occurrence of urban shrinkage, enterprises in growing cities are more prone to engaging in inefficient investments than those in shrinking cities before the urban shrinkage phenomenon. In parallel trend testing, considering the existing literature, this study cautiously selects 2015 as the treatment point and conducts empirical research based on this assumption. The baseline regression model used in this study is a robust model that simultaneously controls for year fixed effects and firm fixed effects. At the same time, cluster-robust standard errors are employed, allowing for correlation among disturbances at the city level of the operational location. We also apply stringent controls in the basic regression model to satisfy the parallel trends assumption as much as possible to ensure the credibility of the results. Furthermore, the interaction terms between firm-level control variables and year dummies are controlled, thereby controlling for the changes in crucial control variables at the firm level, resulting in more significant results. In addition, we conduct placebo tests to strengthen the causal relationship between the widespread occurrence of urban shrinkage and the labor investment efficiency of enterprises. We find that the impact of urban shrinkage on labor investment efficiency differs for enterprises of different natures or at different stages of growth. For non-state-owned or young enterprises, this impact is more evident in alleviating labor investment insufficiency, while for state-owned or mature enterprises, this impact is more obvious in promoting excessive labor investment. Overall, our study suggests that urban shrinkage plays an important role in firm-level labor investment efficiency.

These findings reveal a pathway through which uneven development affects corporate sustainability and sustainable economic development. And they complement the study on the factors influencing labor investment efficiency and the economic consequences of urban shrinkage in China. Even for the policy-makers, our findings have specific implications. Given that uneven development between cities can lead to inefficient corporate labor investment, it is essential to alleviate cities' high population growth intensity. Similar to the strategies implemented by first-tier cities such as Beijing and Shanghai in recent years, the concept of "functional relocation" should be actively pursued in urban planning and development. On the other hand, cities experiencing severe shrinkage should enhance their attractiveness and formulate plans for urban revitalization, counteracting the shrinkage trend. In addition, we argue that the evidence from China is also useful for developing and transitional economies concerned about employment and urban shrinkage. Finally, we examine labor investment efficiency along with economic indicators. However, several social and demographic effects may also play a role in employment decisions. We believe future research can overcome this research limitation.

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Appendix A

Variable definitions.

Table A1. Variable descriptions.

Variable	Description
	Model (1) variables:
NET_HIRE	Percentage change in the number of employees from year t − 1 to year t.
Growth	Percentage change in sales.
ROA	Return on assets.
ΔROA	Change in return on assets.
Return	Total stock return.
Size	Natural log of market value.
Size_R	A percentile rank of SIZEit-1.
Quick	Quick ratio.
Δquick	Percentage change in the quick ratio.
Lev	Leverage for firm i, measured as the sum of debt in current liabilities and total long-term debt at the end of the year, divided by total assets.
LOSSBINX	There are five separate loss bins to indicate each 0.005 interval of ROA from 0 to −0.025 in the period t − 1 for firm i. For example, LOSSBIN1 is equal to 1 if ROA ranges from −0.005 to 0. LOSSBIN2 is equal to 1 if ROA is between −0.005 and −0.010. LOSSBIN3, LOSSBIN4, and LOSSBIN5 are defined similarly.
	Models (2)–(4) variables:
Labeff	The absolute magnitude of the difference between the actual net hiring and expected net hiring in employees of the firm. Herein, the actual net hiring is measured by NetHire. The expected net hiring is a larger value of LabEff, indicating a lower efficiency in labor investment. Estimated from Equation (1).
OLabeff	When the difference between the actual net hiring and expected net hiring of employees of the firm is greater than 0.
Ulabeff	When the difference between the actual net hiring and expected net hiring of employees of the firm is smaller than 0.
JYSCIndex	Urban shrinkage index in business locations. The closer this variable is to 1, the less likely the city is to experience shrinkage, indicating a tendency towards urban population concentration. A smaller value indicates a higher possibility of shrinkage or the occurrence of shrinkage.
Post	If the year is greater than 2015, take 1. Otherwise, take 0.
Size	The natural logarithm of the firm's market value.
Lev	The ratio of long-term debt over total assets.
Quick	The ratio of the sum of cash and short-term investments and receivables over current liabilities.
TobinQA	(Market value of outstanding shares + number of non-marketable shares × net assets per share + book value of liabilities)/total assets.
Growth	Percentage change in sales from year t − 1 to t for firm i.
Cashflow	Net cash flow from operating activities divided by total assets.
BM	The book-to-market ratio.
ROA	Return on assets.
FirmAge	ln(current year − year of company establishment + 1).
Board	The number of board members is taken as the natural logarithm.
Indep	Independent directors divided by the number of directors.
Dual	If the chairman and ECO are the same, take 1; otherwise, take 0
	Additional variables used in placebo tests:
ZCSCIndex	Urban shrinkage index in the place of registration. The closer the importance of this variable is to 1, the less likely the city is to experience shrinkage, indicating a tendency towards urban population concentration. A smaller value indicates a higher possibility of shrinkage or the occurrence of shrinkage.

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