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Land transfer distortion and overeducation during China's transition period

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Land transfer distortion remains a critical institutional factor in China's economic landscape, but its impact on labor market efficiency, particularly overeducation, is under-explored. This paper empirically examines the association between land transfer distortion and overeducation using a multilevel linear model (HLM) and combined micro and macroeconomic data from the 2020 China Family Panel Studies (CFPS). There are three main findings: (1) Land transfer distortion has a statistically significant positive relationship with the probability of individual overeducation. (2) Overeducation exhibits significant heterogeneity across enterprise ownership types, with State-owned Enterprises (SOEs) showing the highest probability. (3) The correlation between land transfer distortion and overeducation is strongest in SOEs, weaker in private enterprises, and statistically insignificant in foreign-invested enterprises. These findings suggest that optimizing human capital allocation in transition economies requires fundamental market-oriented reforms in land resource distribution to align industrial structures with educational attainment.

KEYWORDS

education structure, hierarchical linear model, land transfer distortion, overeducation, state-owned enterprise

1 Introduction

Following the implementation of the higher education expansion policy by the Chinese government in 1999, there has been an unparalleled increase in the scale of human capital supply. Since the year 2000, the number of new graduates holding associate degree or higher has exhibited an annual growth rate that has consistently exceeded 10%. The 2025 National Postgraduate Admissions Survey Report indicates that since 2015, the number of applicants for master's programs has reached record highs, rising to 2.9 million in 2019 and surpassing 3 million in 2025 to reach 3.88 million. Despite the rapid expansion of human capital in China, the country failed to achieve the innovative growth predicted by human capital theory for a considerable period. On the contrary, China's total factor productivity (TFP) fluctuated at a low level. According to calculations by Wei et al. (2017), the contribution of China's Total Factor Productivity (TFP) to GDP growth was approximately 15% during the period 1978–2009. After 2009, this contribution turned from positive to negative, dropping to only −34.6% in 2015. When human capital is incorporated into the growth accounting framework, the contribution of China's TFP to GDP growth stood at −7.03% between 1999 and 2008 (Whalley and Zhao, 2013). What is puzzling is that China seems to face difficulties in transforming human capital into a core driver of economic growth and technological progress.

Numerous studies have pointed out that severe resource allocation distortions during China's transition period are one of the key factors leading to low TFP (Adamopoulos et al., 2022). Among these distortions, the allocation of land resources is particularly prominent. To incentivize local governments to commit to matters such as economic growth within their jurisdictions, China's central government, in the 1994 "tax-sharing system" reform, granted local governments significant land resource allocation powers, including planning, approval, and leasing. However, the pursuit of short-term GDP growth by China's local governments has led to widespread distortions in land allocation. A prominent manifestation of this is that local governments prefer to lease land to traditional industries with short cycles and quick returns, while providing insufficient land support for innovative industries that require long-term investment and face high risks (Zhang and Cao, 2025). Moreover, this land leasing preference of local governments also crowds out resources for innovative enterprises, hindering the overall technological innovation and industrial upgrading process of the jurisdiction. However, existing studies have mainly revealed the direct impact of land transfer distortion on TFP, with little attention paid to its adverse effects on TFP by influencing productivity-related micro-individual characteristics. This paper aims to provide a valuable supplement in this area.

China's expanding scale of human capital, coupled with the systemic distortions in land transfer structures, may give rise to a severe problem—overeducation—which could undermine China's TFP and long-term economic growth. The concept of overeducation—an individual's level of education exceeds the requirements of their job, was first introduced by Freeman (1976) in *The Overeducated American*, which argued that overeducation was prevalent in the U.S. labor market in the 1970s. Overeducation may lead to decreased individual work motivation, reduced productivity and even health problems (Frank and Hou, 2018; Bedemariam and Ramos, 2021; Damelang and Ruf, 2023; Jones et al., 2025). Given that overeducation exerts such severe negative effects on the productivity of micro-individuals, if the probability of overeducation among micro-individuals is highly correlated with land transfer distortion, it implies that land transfer distortion has a more severe inhibitory effect on TFP than what is generally recognized in existing studies. However, reliable evidence still needs to be provided regarding the correlation between land transfer structure and overeducation.

This study innovatively constructs a "Land Transfer Distortion (LTD)" index based on micro-data from the 2020 China Family Panel Studies (CFPS) combined with macro-regional indicators. On this basis, a Hierarchical Linear Model (HLM) is used to observe the correlation between the land transfer distortions and overeducation. This paper finds that LTD has a statistically significant relationship with the probability of individual overeducation. The regression coefficient of LTD is positively significant and this result remains robust after adding control variables. LTD explains 37.50% of the regional differences in overeducation, confirming that the systemic bias of local governments in land allocation (prioritizing short-cycle traditional industries over innovative industries) is an important institutional factor of overeducation. State-owned enterprises (SOEs) have the highest probability of overeducation. Furthermore, the correlation between LTD and overeducation is strongest in SOEs, followed by private enterprises, and insignificant in foreign-invested enterprises. This is because local governments transfer high-quality land to SOEs at preferential terms to achieve short-term economic goals, prompting SOEs to expand low-tech projects and raise educational thresholds. Private enterprises are indirectly affected by land distortion through industrial space squeezing, while foreign-invested enterprises are less dependent on local land policies due to their global layout.

The contributions of this paper include: First, to our knowledge, this paper is the first to focus on the relationship between land transfer distortion and micro-individual overeducation. It provides a new mechanism for understanding how land transfer distortion leads to TFP losses during China's transition period, serving as a valuable supplement to existing studies. Second, by measuring the suitability between the land transfer structure and the education structure, this paper innovatively constructs a "Land Transfer Distortion (LTD)" index. Observing its correlation with micro-individual overeducation helps deepen the understanding of the degree of land transfer structure distortion during China's transition period. Third, this paper also contributes to deepening the understanding of the institutional factors in the formation of overeducation.

The remaining sections are structured as follows: The second part is literature review; the third part presents the research hypotheses; the fourth part establishes the econometric model and details the relevant data and sources. The fifth part analyzes the empirical results (distribution characteristics and model regression outcomes). The sixth part offers the conclusions and policy recommendations of this paper.

2 Literature review

This paper is related to two strands of literature: the measurement and impact of land transfer distortion in China, and the impact and causes of overeducation.

2.1 Measurement and impact of land transfer distortion in China

In some studies, the DEA method is extensively utilized to measure the land transfer relative efficiency (Ding et al., 2022; Wang et al., 2024). Hsieh and Klenow (2009) proposed a more rigorous structural framework to measure the absolute degree of the factor misallocation. A growing number of scholars have begun to apply this framework to measure land transfer distortions (Peng et al., 2022; Henderson et al., 2022; Huang and Du, 2023; Yu and Luo, 2023). For example, Peng et al. (2022) extended the firm-level misallocation analysis of Hsieh and Klenow (2009) to the spatial dimension, calculating the dispersion of the marginal revenue product of total factors (TFPR) of land elements at the urban level. Huang and Du (2023) constructed a multi-factor distortion measurement framework incorporating land, capital, and labor, and found that industrial land was over-allocated due to low prices; eliminating land allocation distortions could increase China's economic output by approximately 30%. However, studies based on the Hsieh and Klenow (2009) framework have focused primarily on inter-industry land allocation distortions caused by land price distortions, while failing to capture the systematic land transfer distortions arising from local governments' preference for short-cycle and low-risk industries. This paper re-examines land transfer distortions and the resulting losses during China's transition period from the unique perspective of overeducation, aiming to explain such systematic distortions.

Regarding the impacts of land transfer distortions, some studies have focused on their effects on technological innovation, industrial structure, energy efficiency, and other aspects (Ma et al., 2022; Zhou et al., 2023; Ren and Guo, 2025). Relevant to this paper, other studies have analyzed the impact of land transfer distortions on TFP. Some studies showed that the land transfer distortion has an inverted U-shape relationship with TFP (Vollrath, 2009), while others suggested that there is a negative effect. Le (2020) investigates Vietnam's Rice Land Designation Policy via a two-sector quantitative model. The study finds eliminating such land use restrictions boosts Vietnam's real GDP per capita by 8.03%, alongside significant gains in agricultural TFP (37.89%) and labor productivity (40.68%). Chen et al. (2022) pointed out that as a fundamental resource, land allocation efficiency exerts a crucial impact on the allocation efficiency of other production factors as well as overall social productivity. By constructing a quasi-natural experiment based on the land certification reform in Ethiopia, they found that this reform boosted district-level agricultural productivity by 43%. Spolador and Danelon (2024) revealed that the improvement in land suitability within Brazil's agricultural sector has been the primary driver behind the rapid growth of its total factor productivity (TFP) in recent years. Some scholars have focused on the issue of land allocation during China's transition period. Zhang and Yu (2019) argue that the expansion of local governments' land finance centered on land transfer revenues has significantly hindered the improvement of urban TFP; moreover, in the land transfer process, local governments' practice of raising the prices of commercial, service and residential land to subsidize the low-price transfer of industrial land has led to distortions in land prices and the allocation of land resources, further suppressing TFP growth. Peng et al. (2022) contend that TFP losses caused by resource misallocation in China's eastern and central regions mainly stem from land resource misallocation, while those in the western and northeastern regions are primarily driven by capital misallocation. Alternatively, several studies focused primarily on the impacts of land transfer marketization on GTFP (Chen et al., 2020; Xie et al., 2022; Jiang et al., 2022). For example, Xie et al. (2022) explored how land resource misallocation affects urban green total factor productivity (GTFP) using data from 277 Chinese prefecture-level and above cities during 2006–2013, finding it directly reduces local GTFP and hinders that of neighboring cities. Existing studies have not focused on the impact of land transfer distortions on micro-individual characteristics. By analyzing the correlation between land transfer distortions and individual over-education, this study helps deepen the understanding of the mechanism through which land transfer distortions affect TFP.

2.2 Impact and causes of overeducation

Some studies have found that over-education inhibits the improvement of enterprise production efficiency by reducing employees' job satisfaction. Smith (1967) pointed out that employees' labor productivity is a function of their job satisfaction. Thus, when job satisfaction decreases, employees tend to be late, leave early, or have low attendance rates, with significantly reduced work motivation, which in turn inhibits enterprise production efficiency and may even have negative impacts on the entire labor market (Mavromaras et al., 2013; Shevchuk et al., 2015). Bedemariam and Ramos (2021) conducted a nuanced analysis of the impact of overeducation on job satisfaction across three dimensions, namely social returns, intrinsic attributes, and extrinsic factors. Using data on the youth labor force in Spain, their empirical findings revealed that the regression coefficient of overeducation on the social returns dimension of job satisfaction—encompassing status, prestige, and personal relationships—stood at −0.91, representing the largest negative marginal effect. By contrast, the coefficient for the intrinsic attributes dimension, which includes task variety and skill utilization, was −0.177, while that for the extrinsic factors dimension covering wages and promotions was −0.110, indicating the smallest negative marginal effect. Damelang and Ruf (2023) further argued that overeducation gives rise to a host of adverse outcomes, such as wage penalties and diminished job satisfaction. To gauge the severity of these consequences, it is imperative to examine whether formal overeducation constitutes a persistent state rather than a transient phenomenon in the labor market matching process. Drawing on retrospective personal profiles of 4,315 German employees, they found that overeducation tends to be a persistent condition rather than merely a temporary phase in labor allocation. Jones et al. (2025) employ nationally representative longitudinal data derived from the China Family Panel Survey (CHPS) spanning 2014 to 2020 to investigate the nexus between overeducation, earnings, and job satisfaction among Chinese graduates. Their findings indicate that consistent wage and job satisfaction penalties are associated with overeducation across a battery of established measurement metrics, even after accounting for individual and job-related covariates. Overeducation also has significant adverse effects on workers' physical and mental health. Frank and Hou (2018) found that the wage penalty effect of over-education significantly reduces individuals' life satisfaction, and this negative impact is particularly pronounced among skilled immigrants, though it weakens in the long run.

Regarding the causes of overeducation, most existing studies are based on the Job Competition Theory, arguing that factors such as immigration status and sectoral attributes are the primary drivers of over-education. For instance, Nielsen (2011) analyzed the over-education issue among immigrants in Denmark during the period 1995–2002 and found that immigrants with foreign education backgrounds were more prone to over-education than native Danes and immigrants educated in Denmark. Using data from the Iranian Household Income and Expenditure Survey covering 2001–2012, Haddad and Habibi (2017) found that the likelihood of over-education was higher in the public sector than in the private sector. The empirical findings of De Alwis et al. (2020) also indicated that Asian immigrants, especially those born in China, Indonesia and India, had a significantly higher probability of experiencing over-education compared with native Australians and immigrants from other countries. Most existing studies focus on individual characteristics and sectoral attributes, while the impact of institutional factors on overeducation has not received sufficient attention. By focusing on the institutional determinants in the formation of overeducation, this paper enriches the existing body of research.

3 Research hypothesis

During China's transition period, the central government granted local governments extensive economic autonomy—including planning, approving and transferring land resources—to leverage their informational advantages. Given this significant power, regulating local government behavior became a critical governance issue. China's central government primarily regulates local governments by linking performance evaluations to political advancement. In early development phases, local performance assessments centered on GDP growth. Consequently, local governments possess strong incentives to pursue GDP expansion within their jurisdictions to secure political promotion. While this incentive model, called regionally decentralized authoritarian (RDA) regime, effectively stimulated economic growth, it also generated distortions (Xu, 2011). Under RDA regime, a typical problem is that local governments not only focus on land transfer revenues, but also regard land as an important tool for boosting economic growth and enhancing political performance (He et al., 2022). For most underdeveloped regions, driven by intense economic growth pressures and the pursuit of short-term political advancement, local governments tend to allocate land resources toward traditional industries with lower uncertainty and greater benefits for immediate economic growth. Against the backdrop of China's rapidly expanding human capital, this biased land allocation undoubtedly increases employment barriers for human capital, forcing large numbers into low-skill, labor-intensive jobs and triggering overeducation issues. In a few developed regions, local governments face greater growth pressures and are more likely to allocate land resources to technology-intensive industries that benefit long-term economic growth. These technology-intensive industries provide suitable employment opportunities for the expanding human capital pool. Nevertheless, due to the relative scarcity of high-skill-intensive positions, human capital often needs to pursue higher levels of education to signal their capabilities to employers, which further exacerbates overeducation. Overall, land allocation by local governments during China's transition period is closely linked to overeducation. Figure 1 illustrates the above-mentioned mechanism.

Therefore, this paper proposes the following:

> Hypothesis 1: The higher the degree of land transfer distortion, the greater the probability of overeducation.

Enterprises with different ownership structures exhibit significant differences in governance models, operational objectives and market constraints, leading to variations in the probability of overeducation (Megginson and Netter, 2001). Due to the problem of owner absence in state-owned enterprises, managers lack incentives to take responsibility for profits, directly resulting in low corporate innovation efficiency. In response, China implemented a reform to separate ownership and control rights in state-owned enterprises during the transition period. While this separation helps alleviate the short-term incentive issues of enterprise managers, it fails to address the long-term incentive problems in talent selection and employment. State-owned enterprise managers do not have to bear the capital risks of enterprise bankruptcy, which often induces adverse selection and leads to insufficient capabilities of these managers. More importantly, state-owned enterprises have long shouldered certain policy burdens

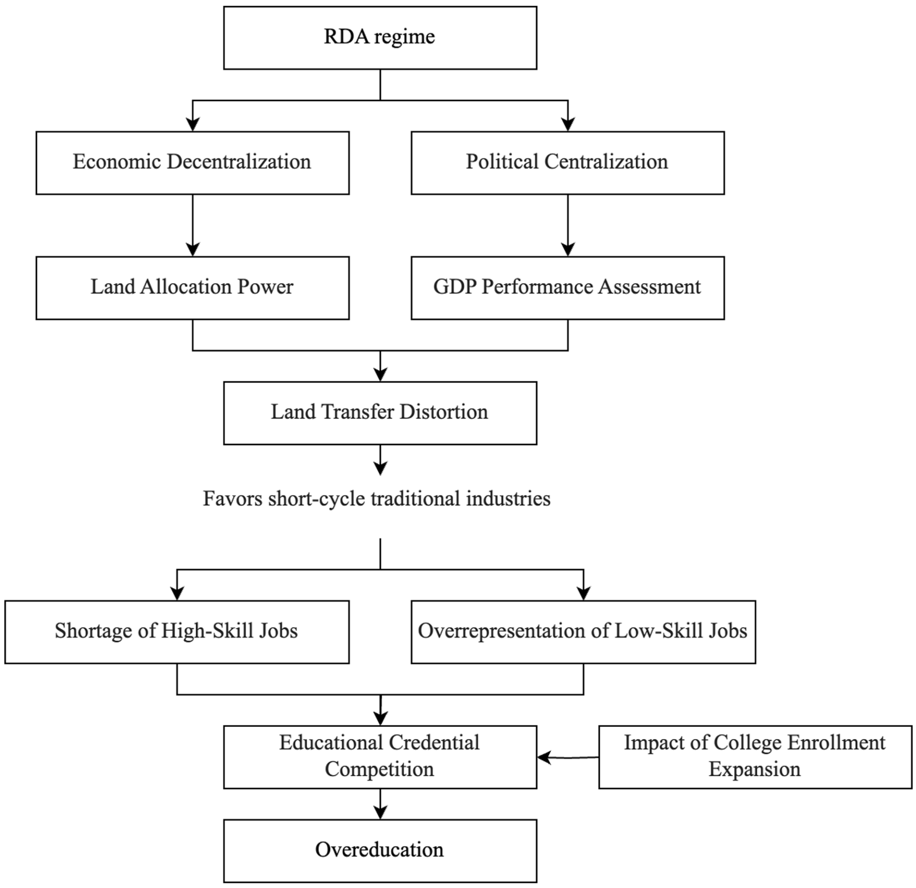

FIGURE 1
Mechanism of the link between land transfer distortion and overeducation.

and the government tends to compensate them through entry restrictions, fiscal subsidies and other means. This makes it difficult to define the operational performance of state-owned enterprise managers. Even if the enterprise operates poorly, managers can still avoid accountability by citing social burdens. This significantly increases the probability of state-owned enterprise managers abusing their power, such as expanding the proportion of profit retention, arbitrarily distributing bonuses and using construction funds to improve employee welfare. This not only further reduces the innovation motivation of state-owned enterprises but also leads to the existence of a "wage premium" within them. According to data from the China Statistical Yearbook, the average annual wages of employees in urban non-private units and private units in 2024 were 124,100 yuan and 69,500 yuan, respectively. The former was 1.79 times the latter, with an absolute gap of 54,600 yuan. This causes a large number of human capitals to flow into state-owned enterprises with relatively low innovation efficiency, thereby inducing overeducation. Therefore, this paper proposes the following research hypothesis:

> Hypothesis 2: The probability of overeducation in state-owned enterprises is higher than that in private enterprises and foreign-invested enterprises.

From the perspective of the correlation between land transfer distortion and overeducation, state-owned enterprises have the strongest correlation with land transfer distortion. The core logic lies in the transmission mechanism between the economic objectives undertaken by state-owned enterprises and the growth pressure of local governments. During the transition period, local governments face heavy pressures to achieve economic objectives such as GDP growth and employment security. As important carriers for local governments to regulate the economy, state-owned enterprises are often entrusted with the responsibility of fulfilling these major tasks. The greater the local growth pressure, the more inclined local governments are to increase investment support for state-owned enterprises (Liu et al., 2025). Such investments are mostly concentrated in traditional industries or low-technology threshold fields with short cycles and quick returns—these industries have a strong demand for land resources but limited capacity to absorb high-skilled human capital. To meet the short-term economic objectives of local governments, local governments will transfer a large amount of high-quality land resources to state-owned enterprises on preferential terms for the expansion of short-cycle projects, resulting in significant distortions in the land transfer structure (Fei, 2020). After acquiring land resources, state-owned enterprises often raise educational thresholds in recruitment to match the scale of project expansion and policy orientation, attracting a large number of highly educated talents (Sun et al., 2022). However, short-cycle, low-technology projects themselves cannot fully absorb the knowledge and skills of highly educated talents, leading to a serious mismatch between academic qualifications and job requirements. This in turn forms a strong correlation between land transfer distortion and overeducation in state-owned enterprises. Therefore, this paper proposes the following research hypothesis:

> Hypothesis 3: The correlation between land transfer distortion and overeducation in state-owned enterprises is stronger than that in private enterprises.

4 Model development, variable selection and data sources

4.1 Model construction

When analyzing the impact of suitability of educational structure on overeducation, suitability of educational structure is a macro-level regional variable, while overeducation data is derived from the adult database of the China Family Panel Studies (CFPS) project, representing a micro-level variable. Micro-level variables such as whether individuals are overeducated are embedded within regional macro-level variables, constituting a two-level data structure of "individual-region." Hierarchical linear models provide a robust analytical framework encompassing both macro- and micro-level data. Given this, this paper employs a two-stage hierarchical linear model to analyze the impact of the suitability of educational structures on overeducation. The specific model is as follows:

Layer 1 (Micro-Level model)

$$prob(overedu = 1) = p \tag{1}$$

$$\log\left[\frac{p}{1-p}\right] = OE, \tag{2}$$

$$OE_{rc} = \beta_{0c} + \beta_{nc} X_{nrc} + \varepsilon_{rc}. \tag{3}$$

Layer 2 (Macro-level model)

$$\beta_{0c} = \gamma_{00} + \gamma_{0m} Z_{mc} + \mu_{0c}, \tag{4}$$

$$\beta_{nc} = \gamma_{n0} + \gamma_{nm} Z_{mc} + \mu_{nc}. \tag{5}$$

Equations 1–3 denote the Layer 1 micro-level model, Equations 4,5 denote the Layer 2 macro-level model, known as the coefficient equations. $Overedu = 1$ denotes that the binary response for the dependent variable is "yes" for the r-th individual in the c-th province, meaning overeducation exists; $prob(overedu = 1) = p$ denotes the probability p that the r-th individual in the c-th province experiences overeducation, i.e., the dependent variable; OE_{rc} denotes the function of the dependent variable determining whether the r-th individual in the c-th province is overeducated; X_{nrc} denotes the n-th micro-level variable of the r-th individual in the c-th province, i.e., ownership. Z_{mc} denotes m-th macro-level variables of c-th province, i.e., the degree of land transfer distortion. ε_{rc} is random effects at layer 1. μ_{ic} is random effects at layer 2.

4.2 Variable selection and description

4.2.1 Dependent variable

In previous studies, three primary methods have been used to measure overeducation: Firstly, the mode or mean method (Verdugo and Verdugo, 1989). This method utilizes respondents' educational attainment and occupational information, using the average educational level of each occupation as the required educational level. The respondents' actual educational attainment is then compared against this average educational level; Secondly, the job analysis method or objective approach (Rumberger, 1987) involves comparing the educational background of job seekers with the educational requirements for various positions as determined by occupational analysts; Thirdly, the subjective method (Allen and Van der Velden, 2001) involves staff members conducting self-assessments to determine whether their educational background aligns with their current job positions. The objective method employs educational classification standards revised in 1997, which are significantly outdated. The modal method's foundational assumption posits that the modal or average level of education constitutes the appropriate educational attainment. This premise warrants reconsideration within China's macroeconomic context of rapid advancement in educational structures and continuous industrial upgrading. This paper employs a subjective approach. By screening the 2020 CFPS adult database sample, it utilizes two indicators—respondents' self-reported highest level of education attained and the educational requirements of their current job, focusing on employed individuals with work experience. Generally speaking, employees possess a comprehensive understanding of the knowledge base, management skills and innovative capabilities required for their roles. This provides reliable data support for the study of overeducation in this paper. This paper defines that the respondent has received overeducation ($OE = 1$) if the indicator "highest level of education attained by individuals" is higher than the indicator "educational requirements for the position."

4.2.2 Layer 1 explanatory variables

(1) Ownership. This study assigns a value of 1 to government departments, public institutions and state-owned enterprises (*firm_gq*) and a value of 0 to other private enterprises/individual businesses, foreign/Hong Kong, Macao and Taiwan-funded enterprises, other types of enterprises and private non-enterprise organizations; For robustness testing, this paper sets the following dummy variables, respectively, for foreign/Hong Kong, Macao and Taiwan-funded enterprises and other types of enterprises (*firm_wq*), assigned a value of 1 for the former and 0 for the latter and for private enterprises/individual businesses (*firm_sq*), assigned a value of 1 for the former and 0 for the latter.

(2) Industry Classification. In terms of industry classification, drawing upon relevant research, this paper characterizes the level of regulation across different industries using the proportion of state-owned enterprises' fixed assets within their respective industries. A higher proportion indicates a higher level of regulation within the industry or a lower degree of competition within that industry. Based on the specific regulatory intensity measurements for each industry, calculate the mean for each proportion. Use this mean as the threshold to classify the 19 industries in the sample into high-regulation and low-regulation sectors. Industries with raw proportion values above the mean are classified as high-regulation sectors. Assign *ind_mo* a value of 1 if the industry falls under the high-regulation category and 0 otherwise.

(3) Other control variables. Including urban–rural classification (*urban*): 1 for urban areas and 0 for rural areas; the Party membership dummy variable (*party*): 1 for Party members and 0 for others and the internet importance dummy variable (*internet*): coded 1–5 based on varying degrees of importance, with higher values indicating greater significance; Work Experience (*experi*): Since the CFPS data does not provide statistics on workers' work experience, this paper adopts Mincer's (1974) method for calculating work experience. Using age minus years of schooling and 6 (the age at which schooling began) as a proxy for work experience; age (*age*) and household size (*family*). In terms of occupational classification, this paper categorizes occupations into 6 groups: Occupation 1 (*prof1*): Unit managers; Occupation 2 (*prof2*): Professional and technical personnel; Occupation 3 (*prof3*): Clerical/administrative staff; Occupation 4 (*prof4*): Service personnel; Occupation 5 (*prof5*): Production and Manufacturing Workers; Occupation 6 (*prof6*): Other Workers (including casual laborers, temporary workers, unskilled manual laborers, mineral extractors, etc.). Occupation type is a dummy variable, valued at 1 if true and 0 otherwise.

4.2.3 Layer 2 explanatory variables

(1) Land Transfer Structure (*LTS*) and Educational Structure (*ES*). This paper employs vector angles to measure *LTS*. Firstly land transfer industries are categorized into five groups based on capital intensity. The proportion of transferred land area within each industry serves as a component of the spatial vector, thereby forming a set of 5-dimensional land transfer spatial vectors $X_0 = (x_{01}, x_{02}, x_{03}, x_{04}, x_{05})$; Secondly, select the basic unit vector set $X_1 = (1,0,0,0,0)$, $X_2 = (0,1,0,0,0)$, $X_3 = (0,0,1,0,0)$, $X_4 = (0,0,0,1,0)$, $X_3 = (0,0,0,0,1)$ as reference vectors and sequentially calculate the angles between the land transfer spatial vector X_0 and each of them, as specified in Equation 6:

$$\theta_j = \arccos\left(\frac{\sum_{i=1}^{5} x_{ji} x_{0i}}{\left(\sum_{i=1}^{5} x_{ji}^2\right)^{\frac{1}{2}} \left(\sum_{i=1}^{5} x_{0i}^2\right)^{\frac{1}{2}}}\right) \tag{6}$$

where x_{ji} denotes the i-th component of the basic unit vector set, while x_{0i} denotes the i-th component of vector X_0. Finally, determine the weight of angle θ_j and calculate the advancement index of land transfer (LTS), as shown in Equation 7:

$$LTS = \sum_{j=1}^{5} W_j \theta_j \tag{7}$$

where W_j as the weight, combined with the monotonically decreasing property of the inverse cosine function, indicates that the smaller the proportion of land area allocated to relatively low capital-intensive industries, the larger the proportion allocated to relatively high capital-intensive industries and the larger the value of θ_j. Given this, this paper assigns values of 5, 4, 3, 2, 1 to W_1, W_2, W_3, W_4, W_5, respectively.

This paper also employs the vector angle to measure *ES*, categorizing education into four levels: primary school, junior high school, senior high school and university graduates or above. The angle weights are assigned values of 4, 3, 2, 1, respectively.

Land transfer distortion (*LTD*). The relationship between the suitability of educational structure and *LTS* can be understood from two perspectives: the more advanced the *LTS* in developed regions, the closer their industrial technologies align with the global technological frontier. Consequently, technological progress becomes increasingly reliant on human capital for research and innovation, thereby increasing demand for innovative labor and attracting greater inflow of human capital. *LTS* in underdeveloped regions is relatively primitive compared to that in developed areas. Their industrial technologies lag significantly behind the global technological frontier, primarily advancing through technology introduction or imitative learning. The demand for imitative labor is relatively high. Educational development provides regions with an appropriate educational structure to support industrial growth and supply matching human resources. Therefore, aligning educational structures with LTS enables the optimal allocation of human capital, promotes regional industrial upgrading, and further enhances economic growth. Based on the above analytical logic, this paper draws upon Smits et al. (1998) hierarchical matching method for educational attainment in marriage, to construct an indicator of the *LTD*. Firstly, the values of *LTS* and *ES* are equally divided into 13 levels based on quantiles, assigned values from 1 to 13, with the educational structure level denoted as $rank_{edu}$ and the land transfer structure level denoted as $rank_{lts}$. Secondly, unlike Smits' approach of using the absolute value of educational attainment differentials as a proxy for educational matching, this paper calculates *LTD* by taking the absolute difference between their respective levels. As shown in Equation 8:

$$LTD = \left| rand_{lts} - rand_{edu} \right|. \tag{8}$$

(2) Other control variables. From a macro perspective, institutional barriers that cause labor market segmentation often exacerbate the phenomenon of overeducation in developing countries. The control variables for Layer 2 include the following three indicators: fiscal self-sufficiency rate (*self*, the ratio of local fiscal revenue to local fiscal expenditure); financial scale (*fins*, the ratio of year-end deposit and loan balances of financial institutions to GDP); financial efficiency (*fine*, the ratio of year-end loan balance of financial institutions to their year-end deposit balance); openness (*open*, the ratio of total imports and exports to GDP); R&D expenditure intensity (*RD*, the proportion of R&D expenditure in GDP); Infrastructure (*infr*, operating mileage of railways).

4.3 Data source

This paper utilizes databases at both the macro and micro levels.

4.3.1 Micro-level household indicators

The data for the micro-level variables in Layer 1 are sourced from the China Family Panel Studies (CFPS) project conducted by the China Social Science Survey Center at Peking University in 2020. The variables used in this paper primarily originate from an adult database. Since 2014, this database has included a new question in its survey regarding respondents' educational requirements for their current jobs, enabling us to determine whether respondents exhibit overeducation or undereducation. It also encompasses demographic variables, occupation, enterprise, industry, region, and other information, providing reliable and comprehensive data for the study. In consideration of the potential heterogeneous effects of educational structure appropriateness on overeducation under varying levels of industry regulation, we matched adult questionnaire data with National Bureau of Statistics industry data based on the *GB/T 4754-2017 Classification Code for National Economic Industries*. This process established a variable reflecting the regulatory intensity across 19 distinct industries corresponding to our sample. The samples were filtered to include cases with non-missing data on job-required education, highest education attainment, employment status, industry, enterprise, occupation, region, urban or rural residence, Party membership, age and work experience. Further exclusions were made for individuals under 16 or over 60 years old, self-employed persons and agricultural workers, as well as incomplete data from Tibet, Ningxia, Qinghai, Hainan and Xinjiang. With 26 provinces/municipalities/autonomous regions covered, the final cross-sectional dataset comprised 1,689 samples.

4.3.2 Macro-regional indicators

Layer 2 macro data for 26 provinces/municipalities/autonomous regions are sourced from *Statistical Yearbooks 2021*, *China Statistical Yearbook 2021*. Land transfer data originates from the China Land Market Network, which includes characteristics such as plot location, land area and industry classification by quartile. To align with this study's objectives, samples with missing information on plot location, land transfer area, or industry type (based on the second quartile) were excluded, and only industrial sector data were retained. This paper examines the relationship between the *LTD* and whether individuals are overeducated, taking into account numerous regional factors. Among these, "level of financial development," "degree of trade openness" and "fiscal self-sufficiency rate" emerge as key determinants influencing individuals' pursuit of higher education. Table 1 presents the descriptive statistics for all variables in this paper, as follows.

5 Research analysis

5.1 Feasibility test

Before utilizing multilevel linear models, it is essential to first assess the model's feasibility. The null model (also known as the intercept model or unconditional mean model) decomposes the overall variance in overeducation into individual and regional components. The significance of regional differences is assessed by examining the intraclass correlation coefficient. If the intergroup correlation for overeducation is insignificant, traditional linear regression models may suffice. Conversely, if significant, generalized multilevel linear models should be considered for the analysis. Table 2 presents the results of the null model regression, revealing that the between-group variance for overeducation (*OE*) is 0.0561, statistically significant at the 1% level. The intergroup correlation coefficient (ICC) reaches as high as 18.79% [=0.0561/(0.2425 + 0.0561)], indicating that regional differences explain 18.79% of the total variation in overeducation. This indicates significant regional differences in overeducation (*OE*), warranting further analysis using generalized multilevel linear models.

5.2 The relationship between land transfer distortion and overeducation

On the basis of the null model, we incorporate Layer 2 variables to examine the correlation between land transfer distortion (*LTD*)

TABLE 1 Descriptive statistics of main variables.

Stratified variable	Variable name	Mean	Standard deviation	Variable name	Mean	Standard deviation
Layer 1 variable	*OE*	0.38	0.49	*Family*	4.39	1.9
	firm_gq	0.19	0.39	*Internet*	3.48	1.52
	firm_sq	0.74	0.44	*prof1*	0.05	0.21
	firm_wq	0.03	0.18	*prof2*	0.2	0.4
	ind_mo	0.31	0.46	*prof3*	0.11	0.31
	Age	34.03	11.2	*prof4*	0.35	0.48
	Party	0.07	0.26	*prof5*	0.25	0.43
	Urban	0.6	0.49	*prof6*	0.04	0.2
	experi	18.75	12.55			
Layer 2 variable	*LTD*	2.77	2.3	*Open*	0.53	1.3
	fins	3.27	1.15	*Self*	0.52	0.18
	Fine	0.75	0.61	*RD*	2.41	1.95
	infr	9.12	0.72			

TABLE 2 Null model regression results[a].

Dependent variable		*OE*
Fixed effects	*Constant*	0.1324*** (6.0331)
Random effects	Within-group variance	0.2425
	Between-group variance	0.0561*** (47.8867)
Sample size		1,689

***, **, *denote significance at the 1%, 5%, and 10% levels, respectively; values in parentheses under fixed effects represent robust standard errors and *T*-values, while values in parentheses under random effects denote chi-square values.
[a]In the regression where overeducation is used as the dependent variable, this study excludes samples with under-education in order to eliminate their impact on the regression results.

TABLE 3 The relationship between *LTD* and *OE.*

Dependent variable		*OE*	
Regression		(1)	(2)
Fixed effects	*Constant*	0.1052*** (4.1933)	0.0752*** (5.8892)
	LTD	0.0458*** (8.5590)	0.0405*** (6.3878)
Random effects	Within-group variance	0.2425	0.2425
	Between-group variance	0.0408*** (55.4120)	0.0391*** (51.7987)
Control variables at layer 2		No	Yes
Sample size		1,689	1,689

***, **, *denote significance at the 1%, 5%, and 10% levels, respectively; values in parentheses under fixed effects represent robust standard errors and *T*-values, while values in parentheses under random effects denote chi-square values.

and overeducation. Column (1) of Table 3 reports the regression results with only *LTD* included. The regression coefficient of *LTD* is 0.0458, which is statistically significant at the 1% level. This indicates that the higher the degree of land transfer distortion, the greater the probability of overeducation, verifying Hypothesis 1. Column (2) of Table 3 presents the regression results after adding control variables and it can be seen that the regression result of *LTD* remains robust. From the perspective of random effects, after incorporating *LTD*, the between-group variance decreases from 0.0561 to 0.0408 compared with the null model, a decrease of 37.50% [= (0.0561−0.0408)/0.0561*100%]. This indicates that land transfer distortion explains 37.50% of the regional differences in overeducation. This further strengthens Hypothesis 1, demonstrating that land transfer distortion is closely associated with overeducation during China's transition period.

5.3 Distribution characteristics of overeducation

To verify Hypothesis 2, this paper analyzes the distribution differences of overeducation from three dimensions—enterprise ownership nature, industry regulation level and individual micro-characteristics—based on the benchmark model regression results (see Table 4). The core logic is to clarify the heterogeneous performance of overeducation across different enterprise types and verify the hypothetical inference through empirical evidence.

Enterprise ownership is a key factor affecting the probability of overeducation and the regression results show significant differences among enterprises of different types. For state-owned enterprises (*firm_gq*), the regression coefficient is 0.4930, which is statistically significant at the 1% level. This indicates that state-owned enterprises have a significantly higher probability of overeducation compared to other enterprise types, which strongly supports Hypothesis 2. First, state-owned enterprises have long faced the problem of owner absence and low innovation efficiency (Zhu, 2012). Due to the lack of effective profit incentive mechanisms, enterprise operators are not motivated to improve resource allocation efficiency, leading to the mismatch between R&D investment and actual demand. A large number of high-educated talents engaged in low-value-added work cannot fully exert their educational advantages, resulting in overeducation. Second,

TABLE 4 Fixed effects distribution of overeducation.

Variable	Coefficient	Variable	Coefficient	Variable	Coefficient
Ownership of the enterprise where the individual works					
firm_gq	0.4930*** (3.2678)	*firm_sq*	0.2111*** (4.1660)	*firm_wq*	−0.0167 (−0.0455)
Degree of regulation of the industry where the individual works					
ind_mo	0.2837*** (3.0709)				
Individual characteristics					
Age	0.1741*** (6.0440)	*party*	0.4582** (2.1615)	*urban*	−0.2335** (−2.4783)
experi	−0.1570*** (−5.7022)	*family*	−0.0477** (−2.0562)	*internet*	−0.2429*** (−10.5441)
Occupations					
prof1	0.0172* (2.2570)	*prof2*	0.0908* (1.8535)	*prof3*	0.0098 (0.6304)
prof4	0.1795** (2.0827)	*prof5*	0.1992* (2.1288)	*prof6*	0.6351 (1.1991)
Sample size	1,689				

***, **, *denote significance at the 1%, 5%, and 10% levels, respectively; values in parentheses represent robust standard errors and *T*-values.

state-owned enterprises have obvious wage premiums. According to the China Statistical Yearbook, the average annual wage of urban non-private units in 2024 was 124,100 yuan, 1.79 times that of private units (69,500 yuan). This wage premium attracts a large number of high-educated talents to compete for limited positions, even if the positions do not require such a high educational level, leading to a serious imbalance between talent supply and position demand. Third, the talent evaluation and promotion mechanism of state-owned enterprises excessively emphasizes academic qualifications. For the purpose of career development, employees have a strong incentive to pursue higher academic qualifications, forming "passive overeducation" that is disconnected from job needs.

For private enterprises (*firm_sq*), the regression coefficient is 0.2111, which is also significant at the 1% level but lower than that of state-owned enterprises. This indicates that the probability of overeducation in private enterprises is lower than that in state-owned enterprises, but still exhibits a significant degree of overeducation. First, the imperfect intellectual property system in China's transition period has weakened the willingness of private enterprises to carry out independent innovation. Due to the high cost of protecting intellectual property rights and the high risk of technological imitation, private entrepreneurs are more inclined to choose low-cost technical imitation rather than independent R&D and innovation (Li and Luo, 2017). This makes private enterprises mainly concentrated in labor-intensive industries with low technological content and low added value and their demand for high-educated talents with innovative capabilities is extremely limited. Under the model of technical imitation, private enterprises cannot provide sufficient high-quality positions that match the knowledge and skills of high-educated talents. These talents can only engage in low-skill jobs that do not require high educational backgrounds, resulting in the waste of educational resources and the occurrence of overeducation. Second, under China's current financial system dominated by large state-owned banks, private enterprises face severe financing constraints, which further restricts their investment in independent innovation and technological upgrading. Without the support of core technologies, private enterprises are difficult to upgrade to the high-end industrial chain, and their demand for high-educated talents remains at a low level, which in turn exacerbates the phenomenon of overeducation.

For foreign-invested enterprises (*firm_wq*), the regression coefficient is −0.0167, which is not statistically significant, but the negative value indicates that the probability of overeducation is the lowest among the three types of enterprises. Foreign-invested enterprises have matured human resource management systems and scientific talent matching mechanisms. Their recruitment standards are strictly based on job responsibilities and skill requirements and they do not blindly raise academic thresholds (Björkman and Lu, 2001). At the same time, their evaluation of employees focuses on comprehensive abilities such as work performance, innovation consciousness and teamwork and academic qualifications only serve as a basic reference. In addition, foreign-invested enterprises have matured intellectual property protection systems and strong independent innovation capabilities. Their industrial layout is mostly concentrated in high-tech and high-value-added fields, which can fully absorb the knowledge and skills of high-educated talents, thus minimizing the occurrence of overeducation. All above verify Hypothesis 2.

Across industries with varying levels of regulation, the coefficient for *ind_mo* is 0.2837 and significant at the 1% level. This indicates that industries with higher levels of state regulation are associated with a significantly higher probability of overeducation. This phenomenon is closely related to the dominant position of state-owned enterprises in highly regulated industries. Highly regulated industries such as education, medical care and transportation are mostly dominated by state-owned enterprises, which inherit the characteristics of state-owned enterprises such as wage premiums and academic qualification-oriented evaluation. At the same time, these industries have strong monopolistic characteristics and high entry barriers, which attract a large number of high-educated talents to gather. However, due to the low innovation efficiency of state-owned enterprises in the industry and the lack of effective talent allocation mechanisms, the supply of high-educated talents exceeds the actual demand of the industry, leading to a higher probability of overeducation.

On the individual micro level, urban residents (−0.2335), with work experience (−0.1570), household size (−0.0477) and internet information access (−0.2429) were all significantly negative at the 5% or 1% level. This indicates that individuals with these characteristics have a low probability of experiencing overeducation. The reason lies in the fact that urban residents have more employment opportunities

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to choose from compared to rural residents, making it relatively easier for them to find jobs matching their educational qualifications. Conversely, rural residents are more likely to lower their expected returns in order to secure employment, thereby increasing the likelihood of overeducation. Work experience and education represent two distinct forms of human capital with a substitution effect. For individuals, overeducation often serves as a strategy to accumulate work experience in order to secure more suitable job opportunities. Consequently, individuals with richer work experience exhibit a significantly lower probability of overeducation. Larger households tend to place greater emphasis on the returns of education and are more inclined to seek employment suitable for their educational attainment, resulting in a lower probability of overeducation. The internet provides access to useful information that enhances knowledge and skills, thereby mitigating the disadvantages of educational deficiencies and partially offsetting overeducation. Conversely, higher age (0.1741) correlates with increased overeducation likelihood, possibly because older workers in the sample often engage in low-education-requirement jobs like urban sanitation or retail. Significant overeducation also exists among Party members (0.4582), consistent with China's current reality.

Overeducation exhibits heterogeneity not only across individuals, enterprises, industries and occupations, but also among different regions. Table 5 presents the random effects distribution for overeducation. The results indicate that the random effects for enterprises of different natures *firm_gq*, *firm_sq*, as well as for industries with varying levels of regulation *ind_mo*, are all significant at the 10% level. This indicates that the phenomenon of overeducation exhibits significant regional differences across enterprises of different natures and industries with varying levels of regulation. But the random effects for *firm_wq*, indicating that there are no significant regional differences in overeducation among foreign-invested enterprises.

5.4 Land transfer distortion and the between-group differences in overeducation across individual characteristics

Due to differences in *ES* and *LTS* across regions resulting from varying stages of economic development, the *LTD* also produces heterogeneous impacts across different areas. Consequently, it is suggested that the pace of educational upgrading will be more rapid than that of *LTS*. If a mismatch occurs between the two upgrading processes, i.e., a decline in the appropriateness of the educational structure, it will exert a certain impact on the phenomenon of overeducation among employed individuals. In this case, this paper incorporates the appropriateness of the educational structure as a Layer 2 variable into the model to analyze the causes of overeducation. Therefore, after embedding the abovementioned explanatory variables as Layer 2 variables, the regression results describe the cross-level interaction effects on overeducation. This impact is revealed through the regression coefficient nested within the Layer 2 variable *LTD* in the model.

In Column (1) of Table 6, the interaction coefficients between *firm_gq* and *firm_sq* with *LTD* are 0.0247 and 0.0031, respectively and are significant at the 5% level and 10% level, respectively. The interaction coefficient between *firm_wq* and *LTD* is 0.1530, not significant. This indicates that the higher the *LTD*, the high the probability of overeducation in both state-owned and foreign enterprises. Column (2) of Table 6 reports the regression results after incorporating control variables and the regression results remain basically unchanged. Hypothesis 3 is verified.

Local governments, under heavy economic growth pressure, increase investment in state-owned enterprises (SOEs), focusing on short-cycle, quick-return traditional industries. These industries demand ample land but poorly absorb high-skilled human capital, prompting local governments to transfer high-quality land to SOEs at preferential terms and distort land transfer structures. To align with project expansion and policy goals, SOEs raise recruitment educational thresholds to attract high-educated talents, yet short-cycle, low-technology projects fail to fully utilize their knowledge and skills—forging a strong correlation between land transfer distortion and overeducation. Private enterprises face land access difficulties and low reliance on government land allocation. Land distortion affects them indirectly: SOEs' overexpansion in traditional industries squeezes their development space, restricting industrial upgrading and demand for high-educated talents. Coupled with an imperfect intellectual property system, private enterprises tend to adopt technical imitation and concentrate in labor-intensive industries, further weakening the direct correlation between land distortion and their overeducation. Finally, foreign-invested enterprises, with independent global layouts and mature intellectual property protection systems, have investment decisions less influenced by local government land policies.

By comparing the regression results of Column (1) in Table 6 with those in Table 5, the random effects for *firm_gq* and *firm_sq* are 0.8428 and 0.0605, respectively, indicate that the layer 2 macro variables explain 25.74% [= (0.1060–0.0843)/0.1060 × 100%] and 17.36% [= (0.0710–0.0605)/0.0710 × 100%] of the differences in regional variations of overeducation among state-owned enterprises and foreign enterprises. The random effects for *ind_mo* are 0.0237, indicate that the layer 2 macro variables explain 47.68% [= (0.0350–0.0237)/0.0350 × 100%] of the regional variation in overeducation

TABLE 5 Distribution of random effects for overeducation.

Variable	Between-group variance	Variable	Between-group variance	Variable	Between-group variance
Enterprises of different natures					
firm_gq	0.1060** (38.9028)	*firm_sq*	0.0710** (38.4324)	*firm_wq*	0.0951 (26.6708)
Industries with varying levels of regulation					
ind_mo	0.0350*** (49.4546)				

***, **, *denote significance at the 1%, 5%, and 10% levels, respectively; values in parentheses denote chi-square values.

TABLE 6 Impact of suitability of educational structure on overeducation.

Dependent variable	*OE*							
Regression	(1)				(2)			
Variables at layer 1	*firm_gq*	*firm_sq*	*firm_wq*	*ind_mo*	*firm_gq*	*firm_sq*	*firm_wq*	*ind_mo*
LTD	0.0247** (2.4568)	0.0031* (1.9853)	0.1530 (0.6546)	0.0081* (1.9467)	0.0246** (2.1065)	0.0029* (1.9229)	0.1531 (0.7020)	0.0089* (2.0467)
Constant	0.5647* (1.988)	0.2610* (1.9144)	−0.3226 (−0.2941)	0.1538 (0.4355)	0.6410* (1.7091)	0.2417 (1.6519)	−0.1034 (−0.2007)	0.1306 (0.4616)
Between-group variance	0.0843** (37.5334)	0.0605** (34.8225)	0.1059 (23.4919)	0.0237*** (45.6185)	0.8011** (39.4015)	0.0595** (35.2011)	0.1000 (23.7656)	0.0199*** (45.6185)
Control variables at layer 1	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control variables at layer 2	No	No	No	No	Yes	Yes	Yes	Yes
Sample size	1,689	1,689	1,689	1,689	1,689	1,689	1,689	1,689

***, **, *denote significance at the 1%, 5%, and 10% levels, respectively; values in parentheses denote chi-square values.

within highly regulated industries. Based on the above analysis, Hypothesis 3 is further verified.

6 Conclusions and implications

Using 2020 China Family Panel Studies (CFPS) microdata, land transfer data and macroeconomic indicators, this study constructs a "land transfer distortion (*LTD*)" index and employs a Hierarchical Linear Model (HLM) to explore the relationship between land transfer distortion and overeducation during China's transition period. The core conclusions are as follows: (1) Land transfer distortion has a statistically significant positive relationship with the probability of individual overeducation. (2) Overeducation exhibits significant heterogeneity across enterprise ownership types. State-owned enterprises (SOEs) have the highest probability of overeducation. (3) The correlation between land transfer distortion and overeducation varies by enterprise type. The correlation between land transfer distortion and overeducation is strongest in SOEs, followed by private enterprises and insignificant in foreign-invested enterprises.

The theoretical implications of this research are multifaceted and contribute significantly to the literature on resource misallocation and overeducation. First, this study supplements the explanation for China's low total factor productivity (TFP) puzzle from a new perspective. By revealing the indirect channel through which land transfer distortion affects TFP by increasing individual overeducation, it enriches the theoretical understanding of the economic consequences of factor misallocation during the transition period. Second, the research expands the application scope of resource misallocation theory to the micro-labor market field. It confirms that macro-factor market distortion (land transfer distortion) can lead to micro-labor market mismatch (overeducation), bridging the theoretical gap between macro-factor allocation and micro-labor market outcomes. Third, this study deepens the understanding of the institutional determinants of overeducation. Unlike existing research focusing on individual characteristics and sectoral attributes, it identifies land transfer distortion and enterprise ownership system as key institutional factors shaping overeducation, enriching the theoretical framework of overeducation research in transition economies.

Practically, compared with existing policy recommendations that focus on optimizing land marketization or adjusting higher education scale alone, this study's policy implications are more systematic. To address land transfer distortion and alleviate overeducation, policymakers should promote market-oriented reforms in land allocation by establishing competitive bidding mechanisms for industrial land, linking land supply to green development indicators, and strengthening land use efficiency supervision to guide resources toward high-tech and innovative industries. For enterprises, deepening SOE reform to optimize innovation-oriented assessment and talent evaluation systems, enhancing intellectual property protection and financial support for private enterprises to boost their independent innovation capabilities, and leveraging foreign-invested enterprises' advanced talent matching experience can improve talent allocation efficiency. In terms of education and labor markets, adjusting higher education talent training structures to align with industrial demands, building multi-dimensional talent information matching platforms using big data, and breaking institutional barriers to talent flow will reduce structural mismatches. Additionally, reforming local government performance evaluation by reducing GDP-weighted indicators and incorporating land-education structure matching and overeducation reduction into assessments, along with promoting inter-regional resource coordination, will guide local governments toward long-term sustainable development.

This study conducts empirical analysis by combining macro-level land transfer distortion data and micro-level individual overeducation data. The two-way data matching effectively alleviates potential reverse causality between the two variables, but it is still difficult to completely avoid endogeneity bias caused by omitted variables. Therefore, this research focuses on testing the correlation between land transfer distortion and overeducation, without in-depth verification of the causal relationship. Future studies can further deepen causal identification: for instance, by adopting multi-year panel data to construct quasi-natural experiments (e.g., taking exogenous shocks such as land policy adjustments and land certification reforms as entry points) to more accurately identify the causal chain between land transfer distortion and overeducation, and systematically explore the dynamic evolutionary characteristics of this relationship over time. In addition, there is considerable room for optimization in the measurement methods of core indicators: the accuracy of overeducation measurement can be improved by integrating subjective evaluations and objective standards (e.g., combining individual self-assessments with occupational educational requirement criteria); refine the industrial classification granularity of land transfer structure and the academic level division of educational structure to enhance the measurement precision of the LTD. At the same time, the internal mechanism through which land transfer distortion affects overeducation still needs to be further clarified. Future research can focus on examining the mediating effects of variables such as industrial structure upgrading and technological innovation, and incorporate regional development levels, occupational types, etc., into the heterogeneous analysis framework to provide empirical support for formulating more targeted policy recommendations.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Author contributions

LC: Data curation, Writing – original draft, Methodology, Writing – review & editing. YS: Writing – review & editing, Data curation, Supervision, Conceptualization. MX: Supervision, Writing – review & editing.

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