World Journal of Economics and Business Research
Print ISSN: 2960-0073
Online ISSN: 2960-0081
DOI: https://doi.org/10.61784/wjebr3101

HOW DOES THE GOVERNMENT GUIDANCE FUND DRIVE THE UPGRADING OF CORPORATE HUMAN CAPITAL? — BASED ON THE PERSPECTIVE OF EMPLOYEE EDUCATION LEVEL

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Abstract: As a pivotal policy-based financial instrument, whether government guidance funds (GGF) can facilitate human capital upgrading is essential for assessing the efficiency of fiscal capital allocation. Utilizing a sample of A-share listed companies in Shanghai and Shenzhen from 2006 to 2023, this study employs a two-way fixed effects model to examine the impact of GGF investment on employees' education level and its underlying mechanisms. The empirical results demonstrate that GGF investment has significantly increased the proportion of highly educated talent within enterprises, a finding that remains robust across various sensitivity tests. Mechanism analysis reveals that this promotional effect stems from a certification effect prior to investment, which bolsters corporate reputation through government endorsement to attract talent. Post-investment, the funds exert resource and governance effects, indirectly optimizing human capital structures by mobilizing policy resources and incentivizing long-term innovation. Heterogeneity analysis further indicates that this effect is more pronounced among high-tech enterprises, firms with executives possessing overseas backgrounds, and those located in regions with lower market potential. This research moves beyond traditional financial performance metrics, providing micro-level evidence for optimizing the performance evaluation of GGF and advancing human capital-driven development strategies.
Keywords: Government guidance fund; Human capital upgrading; Resource synergy; Enterprise innovation

1 INTRODUCTION

Government guidance funds (GGF), acting as strategic policy-oriented financial instruments, have expanded significantly in scale. However, whether these substantial public funds effectively translate into the upgrading of human capital–the core element of enterprise competitiveness—remains a critical empirical question for assessing micro-level resource allocation efficiency. In practice, invested firms may prioritize the expansion of physical assets over talent reserves, making it an urgent task to explore the factor allocation effects of policy-driven capital.

Concurrently, as China's economy transitions toward high-quality development, structural mismatches in the labor market have become increasingly prominent. On one hand, human capital, represented by employees' education level, serves as the cornerstone for firms to maintain sustainable competitive advantages and internalize advanced technologies. On the other hand, despite the expansion of higher education, a paradox persists between the employment difficulties faced by highly educated graduates and the recruitment challenges for high-skilled personnel in enterprises. If firms tasked with industrial upgrading cannot effectively absorb high-quality labor, economic growth will struggle to decouple from its reliance on low-skilled inputs. Therefore, examining the dynamic evolution of internal labor structures is vital not only for micro-enterprise growth but also for the macro-proposition of alleviating structural employment contradictions.

Classical theory suggests that capital tends to cluster in high-tech industries, generating complementary demand for high-skilled labor and thus raising education level. Paradoxically, abundant policy resources do not always lead to an optimized human capital structure; they may even trigger a crowding-out effect due to the substitution relationship between capital and labor, resulting in a "heavy assets, light talent" allocation bias. Existing literature falls short in this complexity. Most prior studies focus on the direct impact of funds on "hard" outputs, such as patent counts, financial performance, or digital transformation [1]. Consequently, the internal labor structure—a "soft" factor—is often treated as a "black box", overlooking the potential distorting effects of policy funds on micro-allocation mechanisms. Furthermore, few studies distinguish between the "certification effect" of GGF prior to investment and the "resource" and "governance" effects post-investment [2], making it difficult to reveal the dynamic mechanisms governing human capital allocation.

To address these gaps, this study draws upon the resource dependence theory, signaling theory, and the "triple effect" framework of GGF. Utilizing a sample of Shanghai and Shenzhen A-share listed companies from 2006 to 2023, we systematically examine the impact of GGF on employees' education level. The core objective is to uncover the "black box" of internal resource allocation and test whether policy capital serves as a touchstone for attracting high-skilled talent or inadvertently exacerbates the substitution of high-skilled labor by capital. Theoretically, this paper extends beyond traditional financial metrics by shifting the analytical focus to the factor input structure, enriching the micro-governance literature on government venture capital through a delineation of pre- and post-investment effects.

Practically, the research conclusions provide a robust basis for optimizing GGF performance evaluation systems, suggesting that policymakers should integrate high-quality employment absorption into assessment frameworks to ensure that industrial policies drive human-centered, high-quality development.

2 LITERATURE REVIEW

Existing literature on the economic consequences of government guidance fund (GGF) primarily emphasizes their enabling effects on corporate technological innovation and digital transformation. As a nexus between the government and the market, GGF function as "patient capital", fostering internal value-creation by alleviating financial constraints and optimizing corporate governance [3]. These mechanisms, in turn, catalyze Research and Development (R&D) activities and strengthen supply chain resilience. At the industrial level, the development of GGF not only optimizes capital allocation to support digital transitions, but also spearheads the development of "new quality productive forces" through a synergistic coordination with scientific innovation. Furthermore, macro-level evidence suggests that GGF significantly stimulate the digital economy and bolster urban entrepreneurial vitality. Despite these diverse perspectives, the prevailing consensus remains that the core value of GGF lies in facilitating tangible investments—such as equipment and technology—via financial support.

Regarding the determinants of employees' education level, prior research has largely focused on macro-policy shocks. From an institutional perspective, stringent labor protection may inadvertently dampen the innovation-driven demand for highly educated staff [4], while fiscal pressures on local governments can compel firms to reduce their allocation of high-level human capital. Conversely, policy interventions aimed at cost reduction—such as social security fee cuts, government talent subsidies [5], and strategic industrial policies [6]—have been shown to significantly increase the corporate demand for high-skilled personnel. These findings underscore that policy interventions and the external institutional environment are pivotal determinants in shaping internal human capital structures.

In summary, while prior studies confirm that GGF effectively drive tangible investments in technology and equipment, a significant theoretical gap remains regarding their impact on the "soft" factor of corporate human capital. First, current GGF research is predominantly centered on financial and operational outcomes—such as supply chain resilience, stock price stability, or digital transformation—rarely shifting the analytical focus on the micro-level dimensions of human capital structure. Second, although some literature acknowledges that industrial policies can stimulate demand for highly educated talent, the specific mechanisms through which GGF operate as specialized capital instruments remain under-explored. Specifically, when policy capital is injected on a large scale, is there a complementary effect of resources to attract more highly educated talent, or is there a crowding-out effect on high-quality labor due to excessive pursuit of physical asset expansion? More importantly, existing research fails to delineate the "certification effect" prior to investment from the "resource effect" and "governance effect" post-investment, so it is difficult to reveal its dynamic role in the allocation of corporate human capital. This study addresses these deficiencies by employing a "triple-effect" analytical framework to explore the nexus between GGF and employee education levels, offering vital theoretical and practical insights into the micro-level resource allocation efficiency of policy-driven capital.

3 RESEARCH HYPOTHESES

The impact of government guidance fund (GGF) on employees' education level is multidimensional, operating through distinct mechanisms before and after the investment phase. Drawing upon the "triple-effect" framework (certification, resource, and governance) proposed by Meng et al. (2024), this study delineates the following pathways.

First, from the perspective of signaling theory, GGF exert a distinct "certification effect". As market-oriented vehicles for policy-driven capital, GGF investment behaviors carry the authoritative endorsement of government credit. Unlike traditional venture capital, GGF undergo rigorous screening processes and multi-departmental collaborative evaluations prior to investment. This stringent, audit-based progression enables invested firms to obtain a unique institutional certification. The injection of policy capital sends a robust signal to the labor market that the firm aligns with national strategic priorities and possesses long-term growth potential. Highly educated professionals prioritize not only compensation but also organizational prospects and social prestige. GGF intervention acts as a de facto implicit guarantee by the public sector, significantly bolstering the firm's reputation capital in the talent market. By mitigating information asymmetry between elite talent and enterprises, GGF enhance the firm's attractiveness to a high-quality workforce. Consequently, GGF investment decisions translate into a competitive reputational advantage, driving the systematic upgrading of employees' education backgrounds.

Second, based on resource dependence theory, GGF facilitate a "resource synergy effect". The capital injection by a GGF is not merely a direct provision of liquidity but also a positive signal released to both the market and the administrative hierarchy. Given the budget constraints faced by local governments, this political endorsement—grounded in professional due diligence—effectively reduces information gaps between the state and the firm. Consequently, invested enterprises are more likely to be integrated into local key support systems, subsequently gaining access to "policy bundles" such as R&D awards and talent recruitment subsidies. This synergy of public financial resources serves an essential "value-creation" function, substantially alleviating the financial burden of recruiting high-cost, highly educated personnel. With strengthened financial capacity, firms are better positioned to optimize their internal human capital structure by absorbing high-quality labor on a broader scale.

Third, grounded in agency theory, GGF generate a "governance improvement effect". Unlike commercial capital focused on short-term exits, GGF possess the attributes of "patient capital". Guided by national strategies and demonstrating a higher tolerance for innovation failures, GGF can effectively curb managerial myopia and short-termism often found in private equity. By improving corporate governance, GGF incentivize firms to pursue long-term, high-risk, and disruptive technological innovations. As firms move toward the technological frontier and increase their innovation complexity, the requirements for absorbing cutting-edge knowledge and managing complex projects rise accordingly. This demand for factor upgrading, triggered by the expansion of innovation activities, renders traditional low-skilled labor insufficient for high-quality development strategies. This creates an "induced demand" for highly educated personnel (e.g., those with Master's or Doctoral degrees), ultimately leading to a rise in the overall education level of the workforce.

Based on the above analysis, this paper proposes the following core hypothesis:

H1: Government guidance funds investment has a significant positive impact on the education level of enterprise employees.

4 METHODOLOGY

4.1 Variable definitions and assessment

4.1.1 Dependent variable: employee higher education level (EDU)

Following Liu and Li (2024), this study measures high-level human capital as the proportion of employees holding a master's degree or higher relative to the total workforce. This metric serves as a proxy for the firm's specialized talent structure and its demand for highly educated human capital.

4.1.2 Independent variable: government guidance funds investment (GGF)

In the baseline regression, the primary independent variable (GGF) represents the intensity of investment, subjected to logarithmic transformation for dimensional consistency. For robustness tests, we construct a dummy variable, GGFdum, which equals 1 if a listed company received GGF investment (either directly or indirectly) in a given year, and 0 otherwise.

4.1.3 Control variables

Consistent with Wang (2018) and related studies, we control for several firm-level factors: leverage (Lev), return on assets (ROA), ownership concentration (Top1, measured by the largest shareholder's stake), Tobin's Q (TobinQ), and firm age (ListAge). Furthermore, we include year fixed effects and industry fixed effects to account for macroeconomic fluctuations and time-invariant industry characteristics. Detailed variable definitions are provided in Table 1.

Table 1 Descriptive Statistics

Variable	Obs	Mean	Std.Dev.	Min	Max
EDU	49551	0.078	0.117	0	1
GGF	49551	2.245	37.876	0	1772
Lev	49551	0.421	0.206	0.028	0.908
ROA	49551	0.035	0.066	-0.556	0.222
Top1	49551	0.341	0.149	0.078	0.758
ListAge	49551	2.002	0.947	0	3.526
TobinQ	49551	2.005	1.333	0.795	17.676

4.2 Model

To examine the impact of GGF investment on corporate talent demand, this study employs a two-way fixed effects model for the baseline regression:

$$\mathrm{EDU}_{it} = \beta_0 + \beta_1 \mathrm{GGF}_{it} + \sum \mathrm{Controls}_{it} + \mathrm{Ind} + \mathrm{Year} + \varepsilon_{it} \quad (1)$$

where i and t index firm and year, respectively. EDU_{it} is the proportion of highly educated employees, GGF_{it} denotes GGF investment intensity, and $\mathrm{Controls}_{it}$ represents firm-level control variables as defined in variable definitions. Ind and Year are industry and year fixed effects, ε_{it} is the error term, and β_1 is the coefficient of interest.

4.3 Data Description

This study utilizes a sample of Chinese A-share companies listed on the Shanghai and Shenzhen Stock Exchanges from 2006 to 2023. Data regarding government guidance funds (GGF) investments were primarily manually collected from corporate annual reports and official announcements, then cross-checked with datasets from Gong et al. (2021) and Yang and Zhang (2023). Information on highly educated personnel was retrieved from the "Workforce Composition"

section of corporate annual reports. Financial and governance data were sourced from the China Stock Market & Accounting Research (CSMAR) database and the Wind database.

To ensure data reliability, the initial sample was filtered according to standard academic practices: (1) excluding firms in the financial and insurance sectors; (2) excluding companies with abnormal trading status, such as ST, *ST, and PT; and (3) removing observations with missing key variables. To mitigate the influence of extreme values, all continuous variables were winsorized at the 1st and 99th percentiles. The final dataset consists of an unbalanced panel of 49,551 firm-year observations. Data processing was conducted using Stata 18.0.

5 EMPIRICAL ANALYSIS

5.1 Descriptive Statistic Analysis

Table 1 reports the descriptive statistics for the main variables. The dependent variable, EDU, has a mean value of 0.078, indicating that the average proportion of employees with postgraduate degrees or above in the sampled enterprises is 7.8%. This suggests that high-level human capital in Chinese listed firms is generally at a nascent stage. The standard deviation of 0.117 indicates significant heterogeneity in human capital structures across different enterprises. The independent variable, GGF (investment intensity), shows a mean of 2.245 and a high standard deviation of 37.876. This substantial dispersion reflects the sparse nature of GGF participation among listed firms and the significant differences in investment scales, providing sufficient variation for the empirical identification of policy effects.

The statistical characteristics of the control variables are consistent with prior studies. The average leverage ratio (Lev) is 0.421, indicating a moderate level of corporate debt. The mean return on assets (ROA) is 0.035, representing stable but modest profitability. Ownership concentration (Top1) averages 34.1%, suggesting a relative concentration of control rights. The mean Tobin's Q is 2.005, reflecting favorable market valuations. Finally, the mean listing age (ListAge, log-transformed) is 2.002. All variables exhibit reasonable volatility across the sample, confirming the dataset's suitability for rigorous regression analysis.

5.2 Baseline Estimate

Table 2 reports the benchmark regression results examining the impact of government guidance funds (GGF) on the education level of enterprise employees. Column (1) presents the unconditional regression without control variables; the coefficient of GGF is 0.624, which is statistically significant at the 1% level. As firm-level control variables, industry fixed effects, and year fixed effects are progressively incorporated in Columns (2) through (4), the coefficients of GGF remain remarkably stable—ranging from 0.511 to 0.637—and consistently maintain significance at the 1% level.

Taking the fully controlled model in Column (4) as the primary reference, the coefficient of GGF is 0.511. From an economic perspective, this indicates that—holding other factors constant—each additional 1 million RMB in GGF investment is associated with an average increase of approximately 0.511 percentage points in the proportion of highly educated employees. This magnitude is economically significant, providing robust empirical evidence in support of Hypothesis H1. Regarding the control variables, the leverage ratio (Lev) exhibits a significant negative correlation with EDU, suggesting that high financial leverage may constrain a firm's capacity to invest in high-level human capital. Conversely, Tobin's Q (TobinQ) is significantly and positively correlated with EDU, indicating that firms with higher market valuations are more effective in attracting and retaining elite talent. The coefficients for Return on Assets (ROA), Ownership Concentration (Top1), and Firm Age (ListAge) do not reach statistical significance, which is largely consistent with findings in extant literature.

Table 2 Basic Results: the Effect of GGF on EDU

	(1)	(2)	(3)	(4)
	EDU	EDU	EDU	EDU
GGF	0.624***	0.637***	0.579***	0.511***
	(0.16)	(0.16)	(0.16)	(0.16)
Controls	No	Yes	Yes	Yes
Ind	No	No	Yes	Yes
Year	No	No	No	Yes
N	49551	49551	49551	49551
adj. R^2	0.000	0.008	0.072	0.076

Note: *** is p<0.01, ** is p<0.05, * is p<0.10. Firm-level clustered standard errors. Notation applies to all tables below.

5.3 Robustness Tests

Table 3 reports several tests conducted to verify the stability of our baseline results. First, we employ alternative measurements for both the dependent and independent variables: using the natural logarithm of the number of highly

educated employees in Column (1) and a binary indicator for GGF investment in Column (2) yields coefficients of 15.555 and 0.018, respectively, both significant at the 1% level. Second, to mitigate potential reverse causality and sample selection bias, we introduce a one-period lagged independent variable in Column (3) and re-estimate the model using Propensity Score Matching (PSM) in Column (5). Both coefficients (0.641 and 0.421) remain positive and significant at the 1% level. Finally, our results hold in Column (4) after clustering standard errors at the industry-year level to ensure rigorous statistical inference. Collectively, these findings confirm that the positive impact of GGF on corporate human capital is highly robust to alternative specifications and endogeneity concerns.

Table 3 Robust Tests Results

	(1) EDU	(2) EDU	(3) EDU	(4) EDU	(5) EDU
GGF	15.555***	0.016***	0.641***	0.511***	0.421***
	(2.13)	(0.01)	(0.18)	(0.18)	(0.16)
Controls	Yes	Yes	Yes	Yes	Yes
Ind and Year FE	Yes	Yes	Yes	Yes	Yes
N	49551	49551	43385	49551	3040
adj. R^2	0.182	0.076	0.073	0.076	0.100

Note: *** is p<0.01, ** is p<0.05, * is p<0.10. Firm-level clustered standard errors. Notation applies to all tables below.

5.4 Heterogeneity Analysis

To explore the boundary conditions of GGF's impact on human capital upgrading, this study conducts sub-sample regressions across three dimensions: executive international experience, industry attributes, and regional market potential. The results are reported in Table 4.

First, regarding executive international experience, the coefficient of GGF is 0.599 for firms whose executives have overseas backgrounds, while it is 0.187 and statistically insignificant for those without. The inter-group difference test confirms a significant disparity, suggesting that executives with global visions are more adept at leveraging GGF resources to attract elite talent.

Second, in terms of industry attributes, the impact of GGF is highly concentrated in high-tech industries, with a significant coefficient of 0.731. Conversely, the coefficient for non-high-tech industries is -0.195 and insignificant, with the inter-group difference significant at the 1% level (p=0.000). This underscores that the talent-driving effect of policy capital is contingent upon the inherent innovation intensity and skill-biased demand of the industry.

Third, concerning market potential, the coefficient of GGF is notably higher in regions with low market potential compared to high-potential areas, with a significant inter-group difference. This indicates that in institutional environments where market mechanisms are less developed, GGF serve as a crucial institutional supplement, effectively compensating for the scarcity of private capital and facilitating corporate human capital investment.

Table 4 Sub-sample Results

	(1) Oversea Yes	(2) Oversea No	(3) High-Tech Yes	(4) High-Tech No	(5) Mp High	(6) Mp Low
GGF	0.599***	0.187	0.731***	-0.195	0.363	0.665***
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Ind and Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	27081	22470	29270	20281	19127	20883
adj. R^2	0.086	0.074	0.071	0.086	0.069	0.082
Empirical P-value	0.008		0.000		0.042	

Note: *** is p<0.01, ** is p<0.05, * is p<0.10. Firm-level clustered standard errors. Notation applies to all tables below.The Empirical P-value is obtained from Fisher's Permutation Test (Fisher's Combination Test), which is used to test the statistical significance of the coefficient difference of the core explanatory variable GGF between the two groups of regressions.

5.5 Mediation Analysis

This study further investigates the specific channels through which GGF influence corporate human capital upgrading. Following the methodological framework proposed by Jiang (2022) [7], we examine the impact of the primary independent variable GGF on three key mediating variables. The results are presented in Table 5.

First, Column (1) assesses the "Certification Effect" using corporate reputation (Reputation) as the dependent variable. Following Guan and Zhang (2019), we construct a composite reputation score based on 12 indicators using factor analysis, and then rank the scores into ten groups, assigning values from 1 to 10 [8]. The coefficient of GGF is 33.437,

significant at the 1% level. This finding indicates that GGF investment significantly bolsters corporate reputation, confirming the certification mechanism: the entry of policy capital transmits a positive quality signal to the labor market, thereby enhancing the firm's attractiveness to elite talent.

Second, Column (2) examines the "Resource Synergy Effect" with government financial subsidies (Subsidy) as the dependent variable, measured as the natural logarithm of total government subsidies. The coefficient of GGF is 16.642, significant at the 1% level. This provides empirical evidence for the resource effect: invested enterprises are more likely to secure synergistic policy support, such as additional fiscal subsidies. This influx of public resources effectively alleviates the financing constraints that typically hinder the recruitment of high-cost, highly educated personnel.

Third, Column (3) evaluates the "Governance and Induced Demand Effect" by using enterprise innovation (Innovation) as the dependent variable. Following Quan and Yin (2017), we measure innovation by the natural logarithm of weighted patent applications, where invention patents, utility model patents, and design patents are assigned weights of 3, 2, and 1, respectively [9]. The coefficient of GGF is 14.291, significant at the 1% level. This confirms the innovation-driven demand mechanism: GGF, characterized as patient capital, incentivize long-term corporate innovation. This intensified innovative activity, in turn, generates a skill-biased induced demand for high-level human capital to manage and internalize complex technological advancements.

Table 5 Mechanism Tests Results

	(1)	(2)	(3)
	Reputation	Subsidy	Innovation
GGF	33.437***	16.642***	14.291***
	(3.22)	(2.18)	(2.15)
Controls	Yes	Yes	Yes
Ind and Year FE	Yes	Yes	Yes
N	49513	45935	49514
adj. R^2	0.328	0.174	0.427

Note: *** is p<0.01, ** is p<0.05, * is p<0.10. Firm-level clustered standard errors. Notation applies to all tables below.

Economically, these effects are sizable: a one-unit increase in GGF corresponds to improvements of 33.44 in reputation, 16.64 in subsidies, and 14.29 in innovation output, representing approximately 12.4%, 9.7%, and 11.2% of their respective sample means. This indicates that the three mechanisms are not only statistically significant but also economically meaningful.

In conclusion, the results in Table 5 demonstrate that GGF indirectly drive the upgrading of corporate human capital by enhancing reputation, attracting complementary fiscal resources, and stimulating innovation-led labor demand.

6 CONCLUSIONS

Using a sample of Chinese A-share listed companies from 2006 to 2023, this study finds that investment by government guidance funds (GGF) significantly increases the proportion of highly educated employees—a result that remains robust across various sensitivity tests. Mechanism analysis reveals that GGF facilitate human capital upgrading through a tripartite pathway: a certification effect before investment, and resource synergy and governance improvement effects after investment. Heterogeneity analysis further shows that the positive effect is more pronounced in high-tech industries, firms with executives holding overseas backgrounds, and enterprises located in regions with lower market potential, underscoring that the talent-enhancing effect of policy capital is highly contingent on internal governance and external institutional environments.

These findings offer several policy implications for improving the allocation efficiency of policy-oriented capital. First, the performance evaluation system for GGF should be refined to incorporate human capital indicators, moving beyond conventional financial returns to emphasize people-centered development. Second, the institutional design of GGF should be optimized to strengthen their "patient capital" attributes, thereby encouraging long-term innovation and fostering a virtuous cycle between innovation-driven demand and talent upgrading. Third, targeted policy interventions should be implemented to maximize the marginal impact of GGF in high-tech industries and regions with lower market potential, while building a synergistic policy ecosystem that integrates fiscal subsidies and talent incentives to systematically advance national human capital strategies.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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