Inefficient Equilibrium Traps and Mitigation Strategies in University-Industry Collaborative Talent Development: A Perspective of Incomplete Information Games

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Abstract. Despite longstanding policy advocacy for school-enterprise collaboration as a cornerstone of vocational education, a persistent "low-level equilibrium" trap hinders effective talent cultivation in underdeveloped regions such as Xinjiang. This interaction results in a supply-demand mismatch, evidenced by local data showing that fewer than 20% of participating firms articulate clear competency standards with hiring promises, and employer satisfaction with graduates stands at only 87% despite a high major-related employment rate. The study conceptualizes this impasse as an outcome of incomplete information dynamic games, where both parties rationally choose suboptimal strategies based on asymmetric information and unverifiable commitments. By constructing a game-theoretic model, the paper aims to systematically analyze the formation conditions and evolutionary path of this inefficient equilibrium.

Keywords: Incomplete Information Games, Low-Level Equilibrium Trap, School-Enterprise Cooperation

1 Introduction

School-enterprise cooperation and industry-education integration constitute the essential characteristics of vocational education, serving as the fundamental pathway for cultivating high-quality technical talents. Despite progressive policy advocacy since 2005—from initial cooperative training models to the 2026 institutionalization of "demand-driven, industry-education integration"—significant tension persists between policy consensus and practical outcomes[1].

Particularly in underdeveloped regions like Xinjiang, a "low-level equilibrium" dilemma emerges: enterprises participate yet avoid clear competency standards or hiring commitments due to market uncertainty; conversely, colleges adopt risk-averse, gener-

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alist training strategies lacking enterprise-specific adaptation. This "fuzzy participation—general cultivation" combination reduces short-term costs but creates long-term supply-demand mismatches[2-4]. Xinjiang data reveals fewer than 20% of cooperating enterprises articulate clear standards, while graduate employer satisfaction stands at merely 87% despite 86% major-relevant employment rates.

This dilemma stems fundamentally from strategic behavior under incomplete information[5]. Enterprises withhold private demand information; colleges cannot verify commitments and thus conservatively avoid specialized investments. Both parties rationally prioritize risk minimization over mutual gains, falling into an inefficient equilibrium of mutual wait-and-see—a classic incomplete information dynamic game where beliefs and strategies co-evolve toward suboptimal stability.

2 Delimitation of Game Subjects and Strategy Spaces

In the complex interactions of school-enterprise cooperation, the two core game players are vocational colleges (represented by Xinjiang higher vocational colleges) and enterprises (particularly local enterprises in Xinjiang). From a game-theoretic perspective, both parties face distinct strategy spaces in their collaborative engagement: the enterprise's core strategies center on whether to "articulate clear employment standards" and whether to "provide employment commitments"; the school's core strategies involve choosing between "targeted specialized cultivation" and "general competency cultivation." These strategic choices are shaped by multiple factors, constituting a typical incomplete information dynamic game scenario[6-8].

2.1 Enterprise Decision Logic and Payoff Function

The enterprise's decision-making in school-enterprise cooperative interactions represents a cost-benefit trade-off. When an enterprise chooses to articulate clear employment standards and provide employment commitments, its expected benefits include: acquiring technical and skilled talents highly matched to job requirements, significantly reducing recruitment and training costs; securing quality human resources in advance, thereby diminishing market uncertainty; and shaping talents aligned with corporate cultural characteristics through participation in the cultivation process[9]. However, it must also bear substantial costs: human and time resources invested in jointly designing training programs with schools; potential disruption to normal production efficiency from providing internship positions; and risks arising from market fluctuations when making hiring commitments[10]. Empirical research in Xinjiang indicates that local enterprises are generally small-scale with weak risk resistance capabilities, rendering these cost factors particularly significant in their decision-making.

Conversely, when an enterprise opts for fuzzy articulation of standards without providing commitments, its payoff function exhibits inverse characteristics: while saving on cultivation investment costs, it must bear the long-term costs of talent mismatch; maintaining employment flexibility comes at the expense of losing the strategic advantage of talent reserves. In Xinjiang's industrial structure, where small and medium-

sized enterprises constitute a high proportion, their "homo economicus attributes" lead to a tendency to avoid short-term costs and select fuzzy strategies when external incentives are absent. Survey data reveals that over 50% of Xinjiang enterprises believe interns' knowledge and skills fail to meet production requirements, yet have not clearly communicated specific standards.

2.2 Vocational Colleges' Decision Logic and Payoff Function

As the other player in the game, vocational colleges' strategic choices are similarly grounded in rational calculation. As shown in Table 1, the benefits of choosing targeted specialized cultivation include: improving students' major-relevant employment rates and employment quality; enhancing the stickiness of school-enterprise cooperation to acquire more enterprise resources; and boosting the school's professional reputation and competitiveness. However, the costs incurred encompass: transformation costs of reconstructing curriculum systems and faculty capabilities; risks of training program obsolescence due to shifts in enterprise demands; and potential weakening of students' career mobility from excessive specialization.

Conversely, the payoff function of choosing general competency cultivation manifests as: reducing adjustment costs arising from fluctuations in enterprise demands; broadening students' employment adaptability; and conforming to stability requirements in education system evaluations. Xinjiang higher vocational colleges face the reality of diverse student sources and significant foundational disparities, exhibiting a stronger tendency toward "safe strategies"—data reveals that over 80% of local institutions opt to strengthen general competency cultivation when lacking explicit commitments from enterprises.

Table 1. Payoff Matrix of School-Enterprise Cooperation Game

Assumptions on Payoff Structure			
Player	Private Cost	Cooperative Behavior	Payoff Type
Enterprise	C_e	SE_1(Clear Commitment)	Private Benefitr_e Public Benefit$g$
School	C_s	SS_2(Specialized Training)	Private Benefit r_s Public Benefit$g$

3 Equilibrium Analysis under Incomplete Information Dynamics

3.1 The Dilemma of Optimal Equilibrium Strategies

Under ideal conditions, school-enterprise cooperation could achieve the Pareto-optimal equilibrium of (clear standards, specialized cultivation). However, as the analysis deepens, we recognize that realizing this equilibrium requires satisfying several critical conditions:

First, the optimal equilibrium demands that enterprises accurately forecast talent demand specifications for the next 1-3 years, which imposes certain requirements on their human resource management capabilities. Even for small and micro enterprises with relatively stable production structures and employment standards, once talent demand specifications are determined, enterprises must still be willing to bear the risks associated with employment commitments. This constitutes a test of their operational stability, planning sophistication, and decision-making rationality.

Second, assuming enterprises adopt the optimal strategy of "precisely expressing demands and providing employment commitments," matching these employment demands and ultimately meeting enterprise standards similarly places high demands on vocational colleges. To achieve the optimal equilibrium, vocational colleges must possess the capacity to flexibly adjust curriculum systems and faculty structures, thereby responding to the diverse and evolving employment demands of different enterprises. For Xinjiang specifically, where vocational education started late and suffers from weak developmental foundations, colleges often find themselves in a state of "willing but unable" when confronted with enterprise cooperation requirements.

Third, both parties must establish highly trusting relationships and effective coordination mechanisms. Evolutionary game research demonstrates that when enterprises participate deeply and institutions actively promote cooperation, this strategy combination constitutes a stable Evolutionarily Stable Strategy (ESS) and represents the optimal solution of the model.

However, in Xinjiang's actual environment, this equilibrium faces triple obstacles: the rapid pace of industrial structure upgrading makes it difficult for enterprises to predict medium- and long-term talent demands; the lag in vocational education system adjustments prevents schools from responding promptly to enterprise changes; and the absence of effective contractual guarantees undermines mutual trust. As Xinjiang's industries undergo transformation—from traditional agriculture and energy toward modern manufacturing and services—significant fluctuations in talent demand structure intensify the difficulty for enterprises to formulate long-term employment commitments.

3.2 Adaptive Equilibrium of General Competency Cultivation

Confronted with enterprises' fuzzy strategies, schools rationally opt for general competency cultivation, forming an adaptive equilibrium. This equilibrium is characterized by: schools focusing on foundational skills and general education, reducing curriculum investments tailored to specific enterprises; enterprises experiencing a decline in the proportion of "ready-to-use" talents while saving on collaborative cultivation costs; and students acquiring broader employment adaptability yet potentially facing challenges in job-specific competitiveness.

This equilibrium is particularly prevalent in Xinjiang's higher vocational education, with deep-seated causes rooted in: school evaluation systems prioritizing overall employment rates over major-relevant employment rates, making general competency cultivation better suited to addressing diversified employment demands; heterogeneous student quality rendering specialized cultivation excessively costly; and insufficient enterprise participation impeding access to authentic job competency requirements. Data

reveals that while Xinjiang higher vocational college graduates achieve approximately 86% major-relevant employment rates, employer satisfaction stands at merely 87%, indicating that although general competency cultivation ensures basic employment, it fails to satisfy enterprises' high-quality demands.

4 Commitment Failure in Incomplete Information Dynamics: Origins and Consequences

4.1 Deep-Seated Motivations for Enterprise Fuzzy Strategies

The fuzziness in enterprises' employment standards and commitments essentially represents rational risk-aversion under conditions of incomplete information, stemming specifically from three fundamental contradictions:

Asymmetry Between Information Articulation Costs and Benefits. Clear articulation of job competency standards requires systematic mapping of competency models and dedicated human resource investment, yet Xinjiang's small and medium-sized enterprises generally lack human resource management capabilities. Research indicates that enterprises with clear standards must increase human resource costs by approximately 15%, while expected benefits remain uncertain due to unpredictable school cultivation outcomes.

Risks of Employment Commitments and Absence of Guarantees. Xinjiang enterprises face substantial market fluctuations and rapid policy environmental changes; making employment commitments 1-2 years in advance exposes them to predicaments such as capacity adjustments and project cancellations. The current institutional framework lacks risk-sharing mechanisms—for instance, governments have not established school-enterprise cooperation risk compensation funds, leaving enterprises to bear breach risks independently.

Positive Externalities and Property Rights Deficiencies in Talent Cultivation. Talents cultivated through enterprise participation in school-enterprise cooperation may be "poached" by competitors, generating positive externalities. The current system lacks effective property rights protection mechanisms, preventing enterprises from obtaining exclusive returns on their investments. Practices within Xinjiang's logistics vocational education group demonstrate that "localized property rights protection mechanisms" (such as priority hiring rights and service period agreements) can mitigate such risks.

4.2 The Rational Logic Behind Schools' Generalization Strategies

Confronted with enterprise fuzzy strategies, schools' choice of generalized cultivation similarly represents a risk-minimizing rational decision, grounded in three primary considerations:

Risk of Sunk Costs in Specific Investments. Targeted cultivation requires dedicated investment in specialized teaching resources (specialized equipment, customized teaching materials, faculty training). Once cooperating enterprises reduce hiring or alter standards, these investments become sunk. With single-source funding and weak risk-

resistance capabilities, Xinjiang higher vocational colleges exhibit stronger preferences for general-purpose investments.

Balancing Diversified Employment Demands and Resource Constraints. Xinjiang's industrial structure is highly diversified, with dispersed student employment, rendering the adaptation efficiency of targeted cultivation relatively low. Data reveals that the employment rate of Xinjiang higher vocational graduates within the same enterprise falls below 30%, significantly lower than the 50% level in eastern regions, prompting schools to favor general competency cultivation.

Systemic Bias in Educational Evaluation Systems. Current assessments emphasize general indicators such as overall employment rates and credential acquisition rates, lacking specialized evaluations of "major-relevant quality" and "starting salary levels." Institutional incentives thus orient toward general competency cultivation.

5 Conclusion

5.1 Signaling Mechanisms and Commitment Assurance

Resolving information asymmetry requires establishing effective signaling mechanisms and credible commitment guarantees:

Standardized Articulation of Enterprise Demands. Industry associations should take the lead in formulating Xinjiang Key Industry Job Competency Standards, transforming fuzzy enterprise demands into quantifiable competency units. Drawing on the experience of Changji Prefecture's "Vocational Education Group Job Competency Mapping," job requirements are decomposed into knowledge, skill, and competency modules, with five-level certification standards set for each module, providing schools with evidence-based cultivation guidelines.

Institutionalized Design of Employment Commitments. Implement a "tiered commitment mechanism": at the initial cooperation stage, enterprises provide indicative hiring ratios (e.g., 30%); during the mid-term, priority interview agreements are signed based on student performance; and formal hiring lists are confirmed before the internship period ends. This design both reduces enterprises' one-time commitment risks and provides schools with grounds for gradual investment.

Third-Party Contract Enforcement Guarantees. Government human resources and social security departments should establish School-Enterprise Cooperation Credit Records, offering tax reductions (e.g., 30% reduction in education surcharges) and honorary awards to enterprises fulfilling commitments, while blacklisting dishonest enterprises. Pilot programs in Aksu Prefecture, Xinjiang, demonstrate that this measure increased enterprise commitment fulfillment rates by 25%.

5.2 Institutional Innovation and Incentive Compatibility Mechanisms

Altering the payoff structure of the game requires constructing an incentive-compatible institutional environment:

Differentiated Fiscal Support. Establish a fiscal appropriation system based on cooperation depth, allocating funds to specialized cultivation programs at a coefficient of

1.2; create a "Specialized Cultivation Quality Reward Fund," providing enterprises with subsidies of 3,000–5,000 yuan for each customized-trained student hired. This measure directly transforms the payoff functions of both schools and enterprises.

Mixed-Ownership Training Bases. Promote the "Factory-within-School" model of Xinjiang Applied Vocational Technical College: enterprises contribute equipment and technology (holding 30–40% equity shares), while schools provide facilities and faculty (holding 60–70% equity shares), jointly establishing training entities with legal person status. Enterprises compensate cultivation investments through production revenues, while schools obtain authentic production environments, forming complementary resource allocation.

Reform of Educational Evaluation Systems. Beyond employment rate indicators, incorporate composite metrics such as the "Major-Relevant Quality Coefficient" (= average starting salary / industry average level) × "Enterprise Satisfaction Index" × "Long-term Employment Rate," guiding schools' transition from general cultivation toward precision cultivation.

5.3 Third-Party Coordination and Regional Governance Mechanisms

Introducing coordinating parties to break the low-efficiency equilibrium requires strengthening third-party functions:

Corporatized Operation of Vocational Education Groups. Promote the model of Xinjiang Modern Logistics Vocational Education Group: establish corporatized operation alliances guided by government, led by institutions, with enterprises as main bodies and industries in coordination. Implement "Five Unifications" within the group: unified cultivation standards, unified curriculum systems, unified training bases, unified faculty certification, and unified employment services. Following implementation at Xinjiang Applied Vocational Technical College, this model increased enterprise participation by 40% and improved talent-job fit by 35%.

Digital Platform-Enabled Information Sharing. Construct an autonomous region-level "Industry-Education Integration Information Platform" realizing three major functions: enterprises real-time publishing of job competency demand mapping; schools displaying talent cultivation capability radar charts; and students generating personal competency digital profiles. Through intelligent matching, information search costs are reduced and fuzzy demands are made explicit. The Zhejiang Aid-Xinjiang project "Cloud Handshake Smart Platform" has preliminarily achieved these functions, effectively promoting east-west school-enterprise resource docking.

Cross-Regional Talent Adjustment Mechanisms. Addressing the characteristic of high volatility in Xinjiang enterprise demands, establish an "Autonomous Region Vocational Education Talent Reservoir": students from enterprises failing to honor commitments are incorporated into a unified adjustment system and prioritized for recommendation to similar enterprises; government provides relocation subsidies for cross-regional employment (e.g., 3,000 yuan per person). This mechanism reduces enterprise commitment risks and enhances schools' willingness to engage in targeted cultivation.

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References

1. Zhang, Z. Q. Research on problems and countermeasures of school-enterprise cooperation [J]. Chinese Vocational and Technical Education,2012,(04), 62-66.
2. Chen, N. Y., Zhou, C. Q., & Wu, Z. P. Connotation and realization approaches of industry-education integration [J]. *China University Science & Technology2014,* (08), 40-42.
3. Huang, Y. N. Preliminary study on school-enterprise cooperation models in higher vocational education [J]. Research in Educational Development,2006*,* (10), 68-73.
4. Hong, Z. Y. Several issues and reflections on deep school-enterprise cooperation in higher vocational education [J]. Journal of Higher Education*,2010*, 31(03), 58-63.
5. Pan, H. S., Wang, S. B., & Long, D. Y. Analysis of current situation and influencing factors of school-enterprise cooperation in Chinese higher vocational education [J]. Research in Higher Education of Engineering,2013*,* (03), 143-148.
6. Haisheng P, Shibin W, Deyi L. Analysis of the Current State of School-Enterprise Cooperation in Chinese Higher Vocational Education and Influencing Factors[J].Research in Higher Education of Engineering, 2013, 49(3):152-165.
7. Zhen H. The Vocational School-enterprise Cooperation:Problems and Policy Analysis[J].China Higher Education Research, 2013.
8. Honglei Y, Yuan X, Caiyun Z, et al.Construction of practice bases outside school based on college-enterprise cooperation alliance mode[J].Experimental Technology and Management, 2011.
9. Bin-Shan Z. The Exploration and Practice of School-enterprise Cooperation "Factory in Schools" Mode[J].Journal of Huanggang Polytechnic, 2009.
10. Liang H, Ahmad A. The Study on the Change of School-enterprise Cooperation Policy in China's Vocational Education[J].Educational Administration: Theory and Practice, 2024, 30(3).