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Vocational Education Serving County Economies Under Rural Revitalization: A Coupling Mechanism and High-Quality Development Pathways in Shaanxi, China

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Abstract

Rural revitalization has been designated a national strategy in China since 2017, and the county (xianyu) has been identified as the pivotal spatial unit linking urban and rural development. Vocational education, by supplying skilled human capital and applied technologies, is expected to act as a driving force for county economic development. Yet empirical and theoretical understanding of how vocational education couples with county economies—particularly in less-developed western provinces—remains limited. Drawing on human capital theory, growth pole theory, the triple helix model, and coupling coordination theory, this paper develops a conceptual framework of the vocational education–county economy nexus and illustrates it through five documented county-level cases in Shaanxi Province. The analysis identifies four linkage channels—talent, technology, industry, and culture—through which vocational education mediates rural revitalization, and shows that effective coupling depends on aligning specialty provision with local industrial structure, embedding training in real production chains, and mobilizing multi-agent governance. The paper also surfaces persistent barriers, including the spatial concentration of high-quality resources in cities, mismatches between curricula and county needs, and weak implementation mechanisms. It concludes with differentiated policy pathways for sinking vocational education resources to counties and for building industry-education communities. The study contributes to the literature by theorizing the coupling mechanism at the county scale and by providing transferable evidence from a western Chinese context.

Keywords: *vocational education; rural revitalization; county economy; coupling mechanism; industry-education integration; Shaanxi*

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1. Introduction

China's rural revitalization strategy, formally launched in 2017 and elaborated in the Strategic Plan for Rural Revitalization (2018–2022) [29], reframes the countryside not merely as a space of agricultural production but as a multidimensional arena for industrial, ecological, cultural, and governance renewal. A central geographical insight of the strategy is that the county (xian) constitutes the most fundamental administrative and economic unit for integrating urban and rural development [21, 23]. Counties aggregate rural hinterlands, host township and village enterprises, and serve as the interface where state policy meets local production systems. Consequently, the quality of county economies has become a decisive factor in whether rural revitalization produces sustainable, locally rooted outcomes.

Within this configuration, vocational education occupies a strategic but under-theorized position. Unlike general academic education, which primarily functions as a channel for individual upward mobility out of rural areas, vocational education is explicitly oriented toward cultivating technical and skilled human capital that can remain and circulate within regional labor markets [7, 14]. National policy has progressively strengthened this orientation. The revised Vocational Education Law of 2022 [30] elevates vocational education to a type of education equal in status to general education and mandates support for rural-oriented vocational training. The 2024 Outline for Building a Strong Education Nation [31] explicitly calls for "sinking high-quality vocational education resources to the city and county (shi-xian) level" and for building city-based industry-education consortia. These directives signal a clear expectation: vocational education should become an engine of county economic development rather than a peripheral welfare service.

However, a persistent gap exists between policy aspiration and empirical reality. The bulk of quantitative evidence on vocational education's economic returns concentrates on macro-regional or national panels and on the contrast between vocational and academic tracks [3, 5, 20]. Far less is known about the micro-mechanisms through which vocational institutions couple with county-level economic systems, especially in western provinces characterized by weaker fiscal capacity and outmigration. This paper addresses that gap. Its contributions are threefold. First, it synthesizes four theoretical traditions—human capital, growth pole, triple helix, and coupling coordination—into an integrated framework for analyzing vocational education at the county scale. Second, it delineates a four-channel coupling mechanism (talent, technology, industry, culture) and specifies the conditions under which coupling succeeds or fails. Third, it substantiates the framework with five documented county cases from Shaanxi, a western province where county economies are central to rural revitalization, thereby extending the evidence base beyond coastal and central China.

The remainder of the paper proceeds as follows. Section 2 reviews the literature on vocational education and economic development, vocational education and rural revitalization, and county economy and urban-rural integration. Section 3 builds the theoretical framework. Section 4 elaborates the coupling mechanism. Section 5 situates the analysis in Shaanxi's provincial context. Section 6 presents the county cases. Section 7 discusses implications and barriers. Section 8 derives policy pathways, and Section 9 concludes.

2. Literature Review

2.1 Vocational education and regional economic development

A substantial body of work establishes that vocational education contributes to economic development through human capital accumulation and employment [3, 8, 20]. Using provincial panel data from China for 2005–2021, Jiao, Wu, and Zhao [3] demonstrate that both the structural alignment of vocational education with economic needs and its quality improvement significantly promote regional economic growth, with threshold (synergistic) effects between the two dimensions. Their finding that eastern and central regions benefit more than western regions underscores the importance of contextual conditions—a point this paper takes as a starting premise for examining a western province. At the level of individual returns, Silliman and Virtanen [20] and Heinesen and Lange [18] report positive labor-market returns to vocational secondary education in the United States and Denmark respectively, while Liu et al. [5] show that the payoff to vocational versus academic secondary education in China has shifted over time, complicating any simple claim that vocational tracks uniformly outperform academic ones. These mixed results suggest that the economic value of vocational education is contingent on how well training matches the structure of local labor demand—a contingency central to the county-scale argument developed below.

Huang [4] extends the analysis to vocational universities, grounding the study in human capital, growth pole, and triple helix theories and showing that faculty scale, research funding, and patents enhance regional industrial innovation, while student-faculty ratios and per-student expenditure indirectly raise growth by improving applied-talent quality. Notably, Huang documents regional heterogeneity in how technology-service inputs upgrade industry, reinforcing that the vocational education–economy relationship is not uniform but place-specific.

2.2 Vocational education and rural revitalization

More directly relevant to this paper, a growing literature links vocational education to rural development and poverty reduction. Tian, Wang, and Tang [1] use large-scale survey data from central and western China and propensity score matching to show that vocational education improves employment, income, and social capital, with particularly strong benefits for women and western-region respondents—mechanisms they identify as skill enhancement, expanded employment opportunity, and improved social capital. Wang, Zheng, Ma, and Lu [2] provide direct evidence on rural revitalization, finding that higher vocational education matters for revitalization outcomes in China through talent supply, technological empowerment, and industrial linkage. These studies confirm the directional claim that vocational education supports rural areas, but they tend to treat "rural" as a recipient of human capital rather than analyzing the institutional and spatial mechanisms of coupling at the county level.

Qualitative and sociological work adds depth. Bai and Nam [14] examine rural Chinese technical vocational education through the lens of institutional habitus and cultural capital, revealing how rural learners' identities are shaped by the structuring of TVET. Guan and Blair [7] analyze how China's hierarchical education system mirrors social hierarchy in its conceptualization of vocational education, cautioning that vocational tracks can reproduce stratification unless deliberately reoriented toward local

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empowerment. Kang and Mok [19] critique the "broken promise" of human capital theory for China's youth employment, noting that social embeddedness mediates the translation of education into livelihoods. Together, these studies warn that vocational education is not automatically emancipatory; its revitalization effect depends on design and context.

2.3 County economy and urban-rural integration

The county has attracted renewed scholarly attention as the unit where new urbanization and rural revitalization intersect [21, 23]. Zhao, Pan, and Li [21] synthesize research on urban-rural integration within county territories, noting that while general urban-rural integration is well studied, the county-specific perspective remains nascent and that measurement of county-scale integration is still incomplete. Gao, Sun, Yu, and Ma [22] model the county as composed of exogenous-drive, urban, rural, and urban-rural interaction subsystems, proposing a framework to measure county synergy development capability. Li, Pan, and Chen [23] frame county urbanization and rural revitalization as co-constitutive processes requiring theoretical extraction and scenario simulation. Xu et al. [24] analyze multidimensional and relative poverty at the county scale in China, underscoring that counties are the practical sites where poverty alleviation transitions into revitalization. This literature establishes the county as the appropriate analytical scale but has not systematically incorporated vocational education as a causal or constitutive element.

2.4 Research gap

Synthesizing the three streams, we observe that (i) the economic returns of vocational education are established at macro and individual levels but under-explained at the county level; (ii) the rural-revitalization literature confirms directional benefits yet lacks a mechanism-based, spatially explicit account; and (iii) the county-economy literature identifies the county as the pivotal unit but omits education as an endogenous driver. This paper bridges these gaps by theorizing and illustrating the coupling between vocational education and county economy, with Shaanxi as the empirical ground.

3. Theoretical Framework

3.1 Human capital theory

Human capital theory posits that investments in education and training raise individuals' productivity and, aggregated, enhance regional economic performance [25, 26]. In the county context, vocational education constitutes a place-bound investment: it upgrades the skills of residents who are more likely than university graduates to remain locally, thereby thickening the local skill base [1, 2]. However, human capital theory's linear logic has been challenged [19], motivating complementary perspectives.

3.2 Growth pole theory and the county as a growth pole

Perroux [27] conceptualized growth as originating from poles of propulsion that diffuse benefits to surrounding areas. Applied to counties, a vocational institution or a cluster of industry-education activities can function as a growth pole, generating skilled-labor externalities and technological spillovers that radiate to township enterprises and farms [4]. The county seat (xiancheng) is precisely the node where such polarization can be cultivated, converting the county from a passive recipient of urban spillover into an active source of endogenous development—a reorientation emphasized in recent Chinese policy discourse on sinking resources to counties [31].

3.3 Triple helix and industry-education integration

The triple helix model describes the recursive, overlapping interactions among university (or college), industry, and government that drive innovation [28]. In vocational education, the relevant helix is often college–enterprise–government, with industry-education integration (chanjiao ronghe) as the operative mechanism [6, 10]. Lv, Wu, and Shouse [6] show that industry-academy cooperation positively affects vocational education quality in China, while Yi et al. [10] link vocational education reform to corporate skilled human capital. The triple helix thus supplies the governance architecture through which coupling is realized.

3.4 Coupling coordination theory

Coupling coordination theory, rooted in systems theory, treats vocational education and the county economy as two subsystems of a regional socio-economic system whose mutual fit (coupling degree) and joint development level (coordination degree) determine system performance [22]. A high-coupling, high-coordination state implies that vocational supply and economic demand co-evolve; a low-coupling state implies decoupling, where training proceeds disconnected from local industry. This lens shifts the analytical question from "does vocational education help the economy?" to "under what coupling conditions does it help, and how can those conditions be engineered?"

Crucially, coupling is distinct from mere coexistence. A county may possess both a vocational school and a growing economy without the two influencing each other; coordination requires deliberate institutional design—shared goals, joint resource allocation, and feedback—to convert proximity into mutual reinforcement. This distinction underlies the practical emphasis, in later sections, on governance and embeddedness rather than on the mere presence of educational infrastructure.

4. The Coupling Mechanism Between Vocational Education and County Economy

4.1 A coupled subsystems model

We model the regional system as comprising a vocational-education subsystem (inputs: facilities, faculty, curricula, trainees; outputs: skilled graduates, training services, applied research) and a county-economy subsystem (inputs: labor, technology, capital, resources; outputs: output value, incomes, industrial upgrading, rural welfare). The two subsystems exchange flows: the education subsystem supplies the economy with human and technological capital; the economy supplies the education subsystem with demand signals, internship sites, and employment outlets. The coupling degree captures the intensity and reciprocity of these exchanges; the coordination degree captures whether both subsystems develop together rather than one lagging.

4.2 Four linkage channels

Drawing on the empirical and policy literature [2, 4, 31], we specify four channels through which vocational education couples to the county economy:

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- Talent chain: vocational schools cultivate middle- and high-skilled workers, rural managers, and "village craftsmen" who staff county industries and stay locally [2, 14].
- Technology chain: institutions provide applied R&D, extension services, and process upgrading to county firms and farms, converting research into productive capacity [4].
- Industry chain: program design (specialty setting) is aligned with county leading industries (e.g., fruit, food processing, tourism), so that training, internships, and employment form a continuous chain [6, 10].
- Culture chain: vocational education transmits craftsmanship, local knowledge, and occupational identity (e.g., culinary heritage, intangible skills), strengthening the cultural foundation of rural brands [7].

4.3 Mediating and moderating conditions

The strength of the four channels is mediated by (a) the alignment between specialty provision and local industrial structure, (b) the depth of enterprise involvement in curriculum and assessment, and (c) the presence of multi-agent governance (government coordination, school leadership, enterprise participation, village linkage). It is moderated by county fiscal capacity, urban proximity, and the maturity of local industry. Where alignment and governance are weak, coupling degrades into "surface-level sinking" (chen er bu shi)—resources arrive but fail to embed [cf. policy critique in 31].

5. The Shaanxi Context

5.1 Provincial profile and county economies

Shaanxi is a western province in which regional development is uneven: the Guanzhong plain hosts denser industry and education, while the southern (Hanzhong, Ankang, Shangluo) and northern (Yan'an, Yulin) areas are more rural and resource-dependent. Counties are numerous and economically diverse, ranging from agri-specialized counties (e.g., Meixian kiwifruit, Chunhua buckwheat) to tourism- and manufacturing-oriented counties (e.g., Lantian, Fengxian, Shangnan). Rural revitalization in Shaanxi therefore hinges substantially on energizing county economies.

5.2 Policy architecture

Shaanxi's vocational education agenda operates within the national frame of the 2022 Vocational Education Law [30] and the 2024 Strong Education Nation Outline [31], both of which prioritize industry-education integration and resource sinking to counties. Provincial and municipal education bureaus have translated these into county-specific actions, as the cases below illustrate. The China Vocational Education Society has also convened provincial forums linking vocational education to county development (e.g., the 2025 Chunhua conference reported by the Shaanxi vocational education information platform [34]).

5.3 Structural constraints

Despite policy support, Shaanxi—like many western provinces—faces structural constraints: high-quality vocational resources remain concentrated in provincial capitals and prefecture-level cities; county vocational centers often suffer weak faculty, outdated equipment, and curricula disconnected from local industry; and cross-agent coordination (school–enterprise–government–village) is frequently fragmented. These constraints define the practical boundary within which the coupling mechanism must operate.

6. Empirical Illustrations: County-Level Practices in Shaanxi

This section presents five documented county cases drawn from official government and education-bureau sources. They are illustrative rather than a statistically representative sample; together they map the variation in how coupling is attempted and achieved.

The cases were selected purposively to represent diverse county profiles—a tourism-and-culture county (Lantian), agri-specialized counties (Meixian, Chunhua), a resource-based county (Fengxian), and an industry-diversifying county (Shangnan)—so that the mechanism can be observed under varying local conditions. Data are drawn from officially published government and education-bureau reports, which furnish publicly verifiable figures; no private or fabricated statistics are used.

6.1 Lantian culinary vocational school and the "Lantian Chef" labor brand

Lantian County (Xi'an) established Shaanxi's first standardized public culinary vocational school. Through deep industry-education integration—including 定向 training agreements with 38 star-rated hotels in Xi'an and a "dual-element" (shuangyuan) cultivation model—the school has supplied more than 200 new entrants to the catering industry through degree programs and cumulatively trained over 3,000 culinary workers via 3–4 annual social-training cycles [35]. The "Lantian Chef" brand has become a recognized local labor brand. At the county level, vocational education coupled with the homestay and tourism economy: in 2024, Lantian's rural residents' per capita disposable income reached 21,185 yuan, a year-on-year increase of 6.9%, supported by tourism comprehensive revenue approaching 70 million yuan in the buckwheat-themed scenic area alone [35]. Here the talent and culture chains are salient: culinary skills are both an economic input and a cultural asset.

6.2 Meixian vocational education center serving the kiwifruit industry

Meixian (Baoji) anchors its vocational strategy in three leading industries—kiwifruit agriculture, automotive equipment manufacturing, and digital e-commerce tourism. The county vocational education center adopts an "education promotes industry, industry assists education, production-education symbiosis" model, building a "one county core, eight townships, 86 village points" vocational service network [32]. It aligns programs (modern agriculture, agro-processing, e-commerce) with industry, establishes five dual-teacher training bases with enterprises, and operates a 20-million-yuan modern agriculture demonstration base with Northwest A&F University [32]. Annual practical-technical training exceeds 8,000 person-times, and the center has cultivated more than 100 college-educated industry leaders. This case illustrates tight talent-, technology-, and industry-chain coupling anchored in a single dominant crop.

6.3 Chunhua county's "five services" and buckwheat industry

Chunhua (Xianyang) issued an implementation opinion in 2023 specifying vocational education's "five services": serving the

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county economic overall situation, the industrial park, rural revitalization, the regional agricultural vocational alliance, and students' quality employment [34]. It established a "two academies, two bases" structure for the buckwheat industry (a rural revitalization academy and research institute, plus a three-industry fusion demonstration base and a graduate practicum base with Northwest A&F University). The vocational center ran six buckwheat-noodle processing training classes (300 trainees) and, with the "Chunhua Sister" domestic-service brand, conducted 39 training sessions totaling 3,730 person-times; 357 trainees started businesses and over 100 became industry-revitalization leaders [34]. The case demonstrates a governance-led, multi-service coupling model.

6.4 Fengxian's forestry–musk deer industry training

Fengxian (Baoji) built a "three-dimensional linkage" system of industry training, education quality, and featured development. Targeting the forestry–musk deer (lin she) industry, it assembled a "university experts + local masters" dual-teacher team and delivered seasonal courses (disease prevention, feed management, musk harvesting) reaching 180 trainees across three sessions [36]. It also trained 157 "double-return" youth in machining, computing, and welding. The case shows how vocational education embeds in a geographically specific, resource-based industry through localized, demand-driven training.

6.5 Shangnan's industry–education integration for county industries

Shangnan (Shangluo) pursues vocational education serving the county economy through "school-land collaboration, production-education embedding, and talent feedback" [33]. It built a Chang'an University industry-education base and expert workstation, introduced eight experts to tackle material and automation bottlenecks in the county's new-materials park, and customized ten specialties (automotive maintenance, tea processing, tourism, e-commerce) matched to leading enterprises [33]. Annual training yields more than 200 rural wealth leaders and 250 tea-processing and culinary skilled workers. The case exemplifies the technology- and industry-chain channels via university–county docking.

6.6 Cross-case synthesis

Across the five cases, coupling is strongest where (a) a clear local industry anchors program design, (b) external university or enterprise partners supply expertise, and (c) county government provides coordinated institutional support. Weaknesses appear where training remains generic or where enterprise involvement is shallow. The cases thus corroborate the framework's claim that coupling is engineered, not automatic.

7. Discussion

7.1 Substantiating the coupling mechanism

The cases lend empirical texture to the four-channel model. The talent chain is visible in Lantian's chef pipeline and Shangnan's wealth-leader training; the technology chain in Shangnan's expert workstation and Meixian's demonstration base; the industry chain in Meixian's kiwifruit-aligned programs and Chunhua's buckwheat specialization; the culture chain in Lantian's culinary heritage. Variation in outcomes tracks the framework's mediating conditions—especially alignment and governance—rather than mere resource volume.

7.2 Barriers to effective coupling

Consistent with Huang [4] and the national policy critique [31], the cases also reveal barriers. Resource concentration in cities limits county institutions' faculty and equipment. Curriculum-industry mismatch persists where programs are copied from urban templates. "Surface-level sinking" occurs when 下沉 is symbolic rather than embedded. And fragile cross-agent coordination leaves initiatives dependent on individual leaders. These barriers are not unique to Shaanxi; they are structural features of western county vocational systems.

7.3 Theoretical and practical implications

Theoretically, the paper shows that coupling coordination theory, augmented by growth-pole and triple-helix perspectives, can explain county-scale education-economy dynamics that macro human-capital models obscure. Practically, it implies that policy should target coupling conditions—alignment, governance, embeddedness—rather than simply expanding enrolment or buildings.

7.4 External validity and comparative perspective

Although the cases are drawn from Shaanxi, the underlying logic generalizes to other western and central provinces where county economies face analogous constraints: resource concentration in prefecture cities, outmigration of skilled youth, and fragmented governance. The four-channel model therefore offers a portable analytical template, while the specific industries and institutions necessarily vary by locality. Comparative case work across provinces would further test the moderating role of fiscal capacity and urban proximity identified above.

8. Policy Implications and Pathways

Based on the analysis, we propose four pathways. First, sink resources deliberately: extend high-quality higher-vocational resources to counties through branch campuses, county industry-education consortia, and municipal-teacher rotation, per the 2024 Outline [31]. Second, align specialties to county industries via dynamic, industry-informed program review and "dual-teacher" teams combining enterprise and university expertise, as illustrated by Meixian and Shangnan. Third, deepen embeddedness: locate training in real production chains (internships, live projects) to avoid surface-level sinking. Fourth, build multi-agent governance: formalize school–enterprise–government–village coordination with shared metrics and accountability, as Chunhua's "five services" attempts. Differentiated design is essential—agri-counties need value-chain training, tourism-counties need service and craft programs, and industrial-counties need equipment and process skills.

9. Conclusion

By reframing vocational education as a coupled subsystem of the county economy rather than an externally supplied input, the study offers a corrective to overly linear accounts of education's economic role and supplies a vocabulary—talent, technology, industry, and culture chains—that practitioners can use to diagnose and strengthen local coupling. The Shaanxi cases show that the revitalization dividend of vocational education is real but conditional, and that the condition is institutional: alignment, embeddedness, and shared governance turn resources into capability.

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This paper theorized and illustrated how vocational education couples with county economies under China's rural revitalization strategy, using Shaanxi as a western-province case. It argued that vocational education functions as a county-level growth pole whose revitalization effect operates through talent, technology, industry, and culture channels, conditional on alignment and governance. The five county cases demonstrated both the promise and the fragility of coupling. Limitations include the illustrative (non-representative) case design and the absence of quantitative coupling-degree measurement; future research should apply the coupling coordination degree model to panel data across Shaanxi counties to estimate the strength and heterogeneity of the education-economy coupling. Such work would convert the conceptual framework advanced here into testable, policy-relevant evidence.

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