Financial Economics Research; Vol.2, No.3; 2025
E-ISSN: 3006-3663 P-ISSN: 3006-3655
DOI: https://doi.org/10.70267/fer.250203.276285
Published by: Zeus Press

Study of the Impact of the Yarlung Zangbo Hydropower Station Construction on the Development of Tibet's Cement Industry from the Perspective of the Policy-market Game

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Abstract

This study analyzes the impact of the Yarlung Zangbo River hydropower project (Yaxia Project) on Tibet's cement industry from a policy-market game perspective. We find that policy-driven demand conflicts with supply-side constraints (e.g., capacity replacement and environmental policies). This results in a policy-regulated oligopoly where local and external firms compete differently on the basis of location, technology, and cost. We suggest that enterprises adopt flexible supply chains and recommend that the government balance capacity control with infrastructure goals.

Keywords

Yarlung Zangbo River, Yaxia Project, Tibet, cement enterprises, policy

1. Introduction

1.1 Research Background and Significance

1.1.1 National Strategic Significance and Investment Scale of the Yaxia Project

On July 19, 2025, the hydropower project in the lower reaches of the Yarlung Zangbo River commenced in Nyingchi, Tibet. As the world's largest hydropower project, it has a total investment of approximately 1.2 trillion yuan, equivalent to 12 times the total investment of the Qinghai–Tibet Railway. This project will provide stable energy guarantees for national strategies such as “Eastern Data and Western Computing” and play a key role in promoting China's sustainable development and enhancing its international influence.

1.1.2 Research Significance

This study breaks from the traditional “demand-supply” paradigm, offering a more dynamic policy-market game perspective on how major projects affect regional industries. This research helps firms understand the impact of policy on their competitive position. It also helps the government balance capacity control with infrastructure goals.

1.2 Research Concepts and Methods

This study adopts a “policy-market” dual game analytical framework, with qualitative analysis as the main method and quantitative analysis as a supplement.

2. Literature Review and Review of the Analytical Framework

2.1 Review of Domestic and Foreign Research Status

2.1.1 Research on the Regional Economic Impact of Major Projects

Foreign research started early, with typical studies on large-scale transportation infrastructure (such as the Channel Tunnel and the U.S. Interstate Highway System), revealing its profound impact on lowering costs, fostering synergy, and reshaping regions. Domestic research has focused mainly on projects such as the Three Gorges Project and the South-to-North Water Diversion Project and has analyzed their benefits in terms of energy, navigation, tourism, and water resource allocation from multiple perspectives. However, both domestic and foreign studies on the impact of hydropower projects in high-altitude, ecologically fragile areas on specific industries are scarce.

2.1.2 Research on Competition Patterns and Policy Constraints in the Cement Industry

Foreign research focuses on market structure and corporate competition strategies. For example, Porter's five forces model is widely used to analyze competition in the cement industry and to examine threats from existing competitors, potential entrants, substitutes, the bargaining power of suppliers, and the bargaining power of buyers. Domestic research focuses on policy regulation, such as how capacity replacement overcomes overcapacity and how environmental policies raise entry barriers and drive innovation. However, current research lacks an in-depth exploration of the dynamic interaction mechanism between policies and markets, especially how policy and market forces game to shape the industrial pattern in regional cement markets, which has not been fully discussed.

2.1.3 Limitations of Existing Research

First, most macrolevel studies lack microlevel analyses of specific industries and fail to identify precise impact pathways. Second, while the roles of policy and the market are recognized, their interactive mechanism is overlooked. Furthermore, research on regional markets with unique conditions, such as Tibet, is insufficient, offering little context-specific guidance.

2.2 Analytical Framework of This Paper: “Policy-Market” Game Model

To overcome the limitations of existing research, this paper attempts to establish a new analytical framework to interpret the impact of the Yarlung Zangbo hydropower station construction on Tibet's cement industry more comprehensively. This paper argues that the traditional linear “demand–supply” model cannot capture the complexity of Tibet's market. Therefore, it proposes a “policy-market” dual game model in which “policy” and “market” are two core variables that are relatively independent yet intertwined, jointly shaping the industrial pattern.

2.2.1 Two Core Dimensions of the Model—the Policy Dimension (Visible Hand)

Refers to the intervention force led by the government through mandatory or guiding means. Its core subvariables include demand-side policies, such as national strategic investment (such as the Yaxia Project) and regional development plans, which directly create market demand; and supply-side policies, such as capacity replacement policies, environmental access standards, and work safety permits, which strictly restrict market supply; and environmental policies, such as ecological red lines and carbon emission requirements, which determine enterprises' production costs and modes.

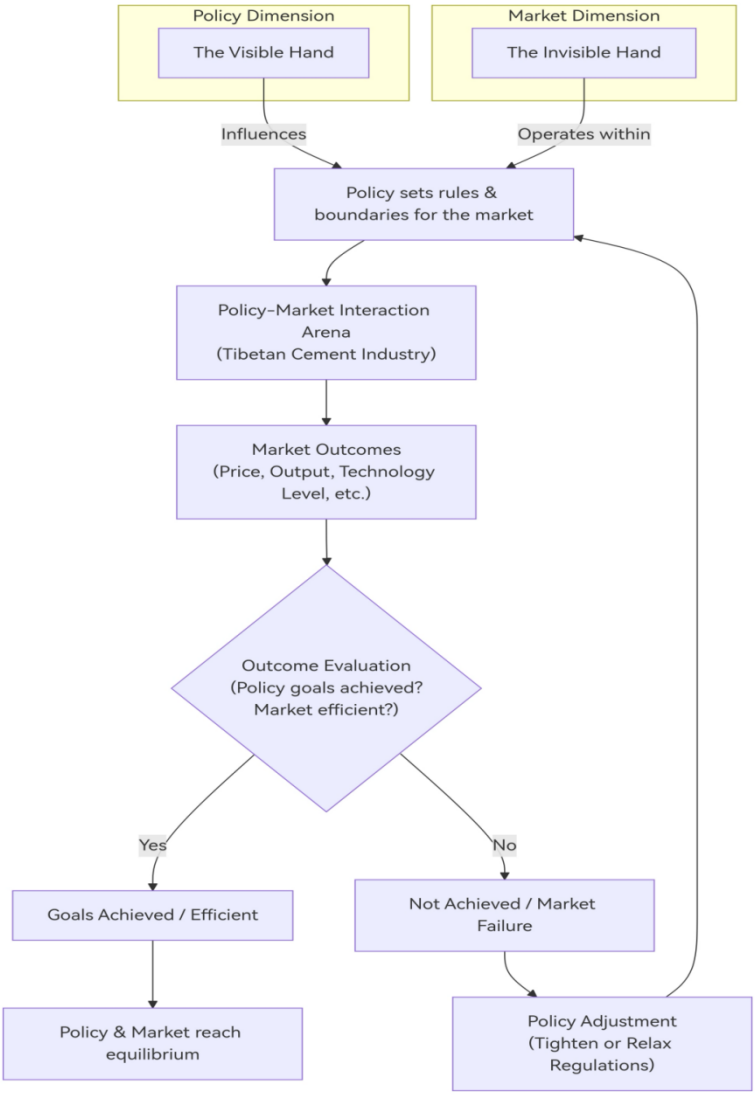
Market Dimension (Invisible Hand): Refers to the forces formed by spontaneous interactions among market players such as enterprises and consumers within the rules defined by policies. Its core subvariables include demand rules, such as scale, structure (such as the proportion of special cement), and timeliness (pulsed demand) of demand; competition rules, such as competitive behaviors among enterprises (such as price wars

and technological competition); and cost rules, such as logistics costs and raw material costs, which are determined by geographical endowments.

2.2.2 Operation Mechanism of the Model

The two dimensions interact dynamically: Policy forces define market rules and boundaries through top-down design. Then, market forces drive firm competition, pricing, and innovation on the basis of demand and cost. Market outcomes (e.g., high prices) feed back to policymakers, potentially leading to policy adjustments (e.g., relaxed capacity limits), forming a dynamic closed-loop system.The above-described interaction mechanism between the policy and market dimensions is illustrated in Figure 1.

Figure 1: The operational mechanism of the policy-market game model



3. Policy Perspective: Rules and Shaping of Tibet's Cement Market by the Yaxia Project

As show in figure 1,based on the "policy-market" game analysis framework constructed in this paper, the Yaxia Project first exerts a fundamental shaping effect on the Tibet cement market from the policy dimension.

3.1 Demand-Side Policies

Market creation by the National Will Yaxia Project is essentially a major strategic deployment under China's national energy security strategy, Western development strategy, and “dual carbon” goals. Therefore, the cement demand it creates, in terms of scale, structure, and timing, is entirely dominated by policy.

3.1.1 Massiveness and Rigidity of Scale

The total investment of the Yaxia Project has reached 1.2 trillion yuan. According to UBS estimates, its total cement demand is expected to be 43 million tons. This demand scale is several times greater than Tibet's current annual output (approximately 13.3 million tons), which is sufficient to instantly disrupt the original supply–demand balance of Tibet's cement market. This demand stems from national budgets and long-term plans, which are unaffected by regional economic cycles, local residents' purchasing power, or real estate prosperity, resulting in strong planning and rigidity.(Zhitong Finance, 2025)

3.1.2 Specialization and High-end Orientation of Structure

Owing to its location on the Qinghai–Tibet Plateau, which is characterized by frequent geological activity and alpine and anoxic conditions, the Yaxia Project has extremely strict requirements for cement performance, which will concentrate on consuming high-grade cement (P.O 42.5 and above), low heat, sulfate resistance, and high durability. This directly determines that not all cement enterprises can participate in the supply; only those with corresponding technical capabilities and production licenses can enter this “game”.

3.1.3 Pulsed and Phased Timing

The construction period of the Yaxia Project spans 10--20 years, with its demand showing a distinct “pulsed” characteristic: the first decade experiences a peak in main construction, during which cement demand is highly concentrated; in the next five years, demand decreases sharply. This tide-like rhythm, which is strongly dominated by the progress of national projects, poses three operational challenges to cement enterprises. First, inventory management becomes more complex. Enterprises need to ensure strategic stockpiles of raw materials during peak periods and avoid overstocking finished products during troughs. Second, there is a high capacity flexibility requirement. Enterprises must enhance their ability to respond to fluctuations through methods such as staggered production and supply chain collaboration. Third, cash flow faces periodic pressure. Procurement expenditures are concentrated while there is a payment cycle for receivables, requiring enterprises to strengthen capital planning and turnover management. Therefore, enterprises' operational models need to shift from conventional production to project-oriented agile management to cope with this market reality shaped by national cycles.(Zhitong Finance, 2025)

3.2 Supply-Side Policies

Constraints and Protection of Capacity Replacement Against the backdrop of nationwide supply-side structural reform in China's cement industry, the supply capacity of Tibet's cement industry is strongly constrained by a set of extremely strict capacity control policies. Among them, the “capacity replacement” policy is at the core, requiring all new cement production line projects to obtain quotas by eliminating backward capacity and following the “reduced replacement” principle (e.g., 1.5:1 or 2:1), meaning that new capacity must be less than or equal to the total eliminated capacity.(Yang, 2025)(China Development and Reform, 2024)

3.2.1 Rigid Constraints on Supply Expansion

This policy locks the national total ceiling of cement capacity from the top-level design. For Tibet, this means that even if the Yaxia Project brings 43 million tons of demand, local cement enterprises (such as Tibet Tianlu) cannot easily expand supply by building new production lines. Any capacity expansion plan must first find eliminable quotas within or outside the region and go through complex and lengthy approval processes. This directly results in a serious lag in the local supply response to demand surges in the short to medium term, making it difficult for the supply–demand contradiction to be resolved through market mechanisms. Moreover, obtaining capacity replacement quotas itself requires high economic costs, which significantly increases the investment threshold for new production lines and weakens enterprises' investment willingness and capabilities.(Chen & Liu, 2025)

3.2.2 Administrative Barriers to External Competition

For external cement giants intending to enter Tibet's market, the capacity replacement policy also applies. If they want to build new production lines in Tibet, they also face difficulties in finding quotas and obtaining approvals. This greatly delays or even prevents external competitors from entering the market through direct investment in factories, avoiding disorderly capacity competition and vicious price wars in Tibet's market in the short term. This policy protects the market share and first-mover advantage of local leading enterprises such as Tibet Tianlu from the impact of "dimension reduction strikes" by external giants against the backdrop of nationwide overcapacity.(Chen & Liu, 2025)

3.2.3 Dual Roles of Policies

The capacity replacement policy prevents overcapacity but also suppresses the supply response to demand, creating supply gaps and increasing price pressure during the project's peak. This policy combination of "liberalizing the demand side while controlling the supply side" is the fundamental institutional reason for a series of distorted phenomena in Tibet's cement market in the future (such as high prices and reliance on external imports).

3.3 Environmental Policies

The ecological environment of the Red Lines of Tibet is extremely fragile and difficult to restore once damaged. Therefore, the state has established the strictest ecological protection red lines and environmental access systems.

3.3.1 Hard Constraints on Site Selection and Raw Materials

Approval for the site selection of new production lines and the mining of supporting mines is extremely difficult. Enterprises cannot freely choose optimal sites, resulting in significantly increased costs and uncertainties in raw material acquisition.

3.3.2 Mandatory Improvement of Technical Standards

To meet ultralow emission standards, enterprises must invest heavily in introducing the most advanced environmental protection facilities (such as flue gas purification, desulfurization, and denitrification systems) and bear high operation and maintenance costs. This directly increases the fixed cost per unit of product.

3.3.3 Fundamental Transformation of Production Methods

The traditional production model pursuing "minimum cost" is not feasible in Tibet; it must shift to an "environmental protection first" model. Any cost savings at the expense of the environment are not allowed.

4. Market: Game of Demand, Competition and Cost under the Policy Framework

As show in figure 1,within the rules and boundaries set by policies, the forces in the market dimension begin to exert their influence, which is mainly reflected in the game dynamics across three levels: demand, competition, and cost.

4.1 Characteristics of Demand: Cycles of Surge and Ebb

4.1.1 Surge Period (Peak Construction, Approximately the First 8--10 Years)

The project enters the main construction phase, which includes dam foundation excavation, dam concrete pouring, giant tunnel excavation and lining, etc. This phase is the absolute peak of cement demand, with consumption accounting for most of the total demand. The short-term concentrated outbreak of demand severely increases the maximum capacity of the local supply chain, easily leading to supply shortages, increasing prices, and attracting external cement influx through various channels.(Zhuochuang Information, 2025)

4.1.2 Ebb Period (End of Construction, Approximately the Last 3--5 Years)

The main project has essentially been completed, shifting to unit installation, interior decoration, and auxiliary facility construction. During this phase, the cement demand plummets, possibly only a fraction of the peak period. Market demand decreases sharply, but the capacity invested in meeting peak demand remains. The supply–demand relationship reverses instantly, making overcapacity an unprecedentedly acute problem, intensifying market competition and putting downward pressure on prices.

4.1.3 Such Severe Demand Fluctuations Constitute Core Risks for Enterprise Operations

Investment Risk: Aggressive expansion may lead to idle capacity and sunk costs postproject. Operational risk: Firms require robust production planning and cash flow management to handle volatility.

4.2 Forms of Competition: Local Leaders' Defense and External Giants' Offensive

4.2.1 Local advantages of Tibet Tianlu (600326. SH)

As the absolute local leader in Tibet, Tibet Tianlu's core strategy is to maximize and secure the policy dividends brought by the Yaxia Project through its irreplaceable inherent advantages. Core advantages:

(1) Geographical advantages

Production bases are adjacent to the project, with extremely short transportation radii and rapid response capabilities, forming its most solid “moat”.

(2) Policy advantages

As regional state-owned enterprises, they enjoy natural affinity in obtaining project information, coordinating with the government, and meeting “local procurement” requirements.

(3) First Mover Advantage

It has almost monopolized the local market, with mature sales channels and customer relationships. Competition strategy: Its strategy is to integrate deeply and strive to become the main supplier. By deploying capacity in advance and signing long-term strategic supply agreements with project constructors, it converts policy opportunities into long-term stable orders to consolidate its market dominance.(Shanghai Stock Exchange, 2025b)

4.2.2 "Resource" Advantages of External Enterprises such as Conch (600585. SH) and Huaxin (600801. SH)

(1) Technical advantages (haraxin cement)

Huaxin has top-tier technology in high-grade, low-heat special cement, which is essential for key parts such as the Yaxia dam. It can "leverage the market with technology", making the project party choose it because of the irreplaceable performance of its products.(Shanghai Stock Exchange, 2025a)(Zhuochuang Information, 2025)

(2) Cost and Efficiency Advantage (Conch Cement)

Conch has world-leading operational efficiency and cost control capabilities. Even when logistics costs from bases in Sichuan and Yunnan for long-distance transportation are included, its final quotation may still be competitive. It can "overcome distance with efficiency" through its logistics system for long-distance precise supply. Competition strategy: Their strategies involve differentiated entry. Huaxin targets high-performance special cement, whereas Conch uses its cost advantage to conduct "price sniper" during peak demand or undertake excess orders that Tibet Tianlu cannot handle.(Sina Finance, 2025)

4.3 Cost Determinants: Geographical Endowments and Logistics Thresholds

In Tibet's cement market, cost is the fundamental determinant and is shaped primarily by geographical endowments rather than managerial efficiency.

4.3.1 Logistics Costs

Unlike mainland cement enterprises, where "coal and electricity costs" dominate, the core cost item for Tibet's cement enterprises is "logistics costs", both for bringing in raw materials and distributing finished goods, dominating the cost structure due to Tibet's remote location. This makes the proportion of logistics in the total cost of Tibet's cement much greater than that of mainland enterprises (usually <15%).

4.3.2 "Logistics Threshold" and Market Boundaries

High logistics costs form a clearly calculable "market access price threshold".

Formula: Tibet's market cement threshold price ≈ Sichuan/Qinghai cement ex-factory price + full logistics costs to Lhasa market impact:

(1) Protection Effect

As long as the "production cost + short-distance transportation fees within the region" of local cement factories in Tibet is lower than this "threshold price", they are in a protected position. Even if external cement has lower costs, it cannot easily defeat local cement in terms of price.

(2) Pricing benchmark effect

This "threshold price" became the market anchor and price floor for Tibet's cement prices. Local enterprises' pricing strategies can be based on this, enjoying a geographically protected "price comfort zone".

4.3.3 Impact of Future Variables

This "threshold" is not eternal; its height is affected mainly by a key variable: the completion and operation of the Sichuan–Tibet Railway. Expected impact: Railway transportation significantly reduces unit cargo transportation costs, thereby significantly lowering the height of the "logistics threshold". This will be a major variable in the future market pattern. A lower threshold means enhanced offensive capabilities of external competitors (especially Conch Cement), partial weakening of local enterprises' geographical advantages, and expected increased market competition intensity.

5. Game Equilibrium and Strategic Suggestions

5.1 Expected Equilibrium

As show in figure 1,on the basis of the game analysis of “policy” and “market”, the future form of Tibet's cement market will evolve into a unique pattern of “oligopolistic competition under policy regulation”. National capacity policies and environmental red lines strictly limit the number of enterprises and production methods, ensuring overall market controllability and avoiding disorderly expansion. The market is dominated by a few core enterprises (Tibet Tianlu, Conch, Huaxin, etc.). Instead of engaging in price wars, they conduct “differentiated games” on the basis of their core advantages, sharing the market together but with uneven shares and profits.

5.2 Strategic Suggestions for Enterprises

5.2.1 Local Enterprises

Long-term flexible supply contracts with constructors should be signed, strategic cement reserves should be established to mitigate demand fluctuation risks, and comprehensive solutions from cement and aggregates to commercial concrete should be provided to increase stickiness. 5.2.2 External Enterprise Technology Leverages: Focusing on the niche market of high-performance special cement and exchanging technological irreplaceability for premiums and orders. Cost Penetration: Optimize logistics systems into Tibet, calculate the total cost of “ex-factory price + logistics”, and conduct targeted pricing during peak demand to undertake excess orders.

5.3 Policy Suggestions for the Government and Associations

5.3.1 Government Implementation of Differentiated Capacity Policies

(1) Implementing differentiated capacity policies, creating green channels for project-critical cement plants, and prioritizing approvals under strict environmental standards A mandatory exit mechanism for added capacity postproject is essential to prevent future overcapacity.

(2) Investing in logistics infrastructure to lower regional logistics costs and improve efficiency

(3) Establishing a dynamic policy evaluation mechanism to assess demand–capacity matching and inform timely adjustments

5.3.2 For Industry Associations Formulate Regional Standards

The lead in formulating “standards for plateau engineering special cement” is to guide orderly competition through technical specifications, avoid the elimination of high-quality products by inferior ones, and establish collaboration platforms: Build information docking and capacity allocation platforms between enterprises and project parties to coordinate resources during peak periods and avoid vicious hoarding and price out of control.

6. Main Research Conclusions, Limitations, and Prospects

6.1 Main Research Conclusions

By constructing a “policy-market” dual game analytical framework, this study conducts an in-depth analysis of how the construction of a hydropower project in the lower reaches of the Yarlung Zangbo River affects Tibet's cement industry, drawing the following core conclusions:

(1) The impact mechanism of the Yaxia hydropower station extends far beyond simple demand; it is essentially the result of complex games between policy and market forces. Top-down policies set up the markets’ rules and boundaries, whereas bottom-up market forces drive strategic interaction and resource allocation within them. The two are intertwined and mutually restrictive, jointly determining the final direction of the industry.

(2) The equilibrium point of the game points to a market form of oligopolistic competition under policy regulation. The future Tibetan cement market will be a pattern where a few giants compete and coexist with differentiation on the basis of their core advantages under strict policy constraints.

(3) The success or failure of enterprises depends on their ability to match the strategic positions created by the "policy-market" game accurately. Local leaders need to transform from "producers" to "comprehensive service providers", strengthen geographical advantages, and manage demand fluctuation risks; external giants need to abandon frontal attacks and seek breakthroughs in niche markets through "technology leverage" or "cost penetration" strategies. Success for enterprises hinges on adapting to these unique "policy-market" rules. This study concludes that in regions such as Tibet, major projects create a policy-disrupted market, necessitating a dynamic, theoretical perspective over linear models.

6.2 Research Limitations and Prospects

6.2.1 Research Limitations

(1) Data acquisition is limited by the availability of enterprises' microoperational data. This research is mostly based on industry macro data and listed companies' public annual reports and fails to conduct more refined quantitative analyses of key financial indicators such as cost structures and profit margins.

(2) Simplification of Model Construction: The "policy-market" game framework established in this study is based mainly on qualitative analysis and fails to use econometric methods to construct mathematical models for accurate parameterized simulation and testing of the interaction between two variables.

6.2.2 Future Prospects for Deepening Research Directions

Future research can focus on two directions: first, a deep exploration of how Tibet's ecological compensation mechanism and internalization of environmental protection costs specifically affect enterprises' competitiveness and profit models; second, a "project–industry" collaborative development model can be constructed to quantitatively evaluate the long-term multiplier effects and risks of major engineering clusters on regional economies. Optimizing Research Methods: Subsequent studies can obtain first-hand data through large-scale enterprise questionnaires and in-depth interviews or use cutting-edge methods such as complex network analysis and agent-based modeling (ABM) to dynamically simulate the interaction process between policies and market players, making research conclusions more explanatory and predictive.

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Funding

This research received no external funding.

Conflicts of Interest

The authors declare no conflict of interest.

Acknowledgment

This paper is an output of the science project.