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Lesson for Vietnam to Learn from Asian Countries' Financial Instruments for Railway Projects

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ABSTRACT
The development of Vietnam's railway infrastructure faces challenges in securing adequate funding and attracting private sector investment, which necessitates innovative financial strategies. This study aims to propose a comprehensive financial framework tailored to address these challenges. The research employs a comparative analysis method, examining financial instruments used in railway projects across several Asian countries, including Laos, Indonesia, Hong Kong, Japan, Singapore, Taiwan, South Korea, and China. The findings reveal two key insights: (1) integrating railway infrastructure development with Transit-Oriented Development (TOD) and Land Value Capture (LVC) mechanisms significantly boosts government revenues through property development aligned with TOD and LVC principles; (2) diversifying revenue sources—such as fare revenues, property development, and government subsidies-is crucial for ensuring the financial sustainability of Public-Private Partnership (PPP) railway projects and reducing associated risks, thereby encouraging private sector involvement. The proposed framework provides actionable strategies for Vietnam's specific context, offering implications for policymakers to enhance the viability of railway infrastructure projects through innovative financial models.

Keywords: Railway Project, Public-Private Partnerships, Transit-Oriented Development, Land Value Capture.

INTRODUCTION

Improving transportation infrastructure is one of the key elements in supporting sustainable economic growth in developing countries. According to World Bank data, global logistics costs average around 10.7% of GDP, but in Vietnam this figure reaches 16.8% of GDP. The imbalance of the transportation system is one of the main causes, with the dominance of road transportation at 60.2%, air transportation at 36.6%, and rail transportation which only accounts for 0.5-1.0% of total freight (Stambrook, 2006). The reliance on road transportation leads to high logistics costs, environmental damage, and significant congestion in major cities such as Hanoi and Ho Chi Minh City.

Table 1. New railway infrastructure in Vietnam

No.	Project	Length (km)
A	Urban railway projects	547.1
A1	Ho Chi Minh city	229.1
A2	Hanoi city	318
B	Ordinary railway projects	2417
C	North-South HSR project	1545

Addressing this issue, the Vietnamese government set out an ambitious plan to develop new railway infrastructure that includes major corridor lines, high-speed rail (HSR), as well as urban rail. Key projects include the construction of 547.1 km of urban rail networks, 2417 km of regular rail projects, and a 1545 km North-South HSR project. However, the implementation of these projects faces serious challenges, including limited public investment, reliance on Official Development Assistance (ODA) loans, and low efficiency of investment through public-private partnership (PPP) schemes.

Previous research shows that Asian countries such as Hong Kong, Japan, Singapore and South Korea have successfully developed innovative financial instruments to support rail infrastructure projects. Studies by (Dhindaw et al., 2021) highlight the effectiveness of Transit-Oriented Development (TOD) and Land Value Capture (LVC) in increasing government revenue from property development around stations. In addition, the subsidy-based and risk-sharing (BTO-RS) Public-Private Partnership (PPP) model in South Korea has also been shown to attract private sector investment without increasing the government's financial burden.

The urgency of this research lies in the pressing need to develop a financial model that fits the Vietnamese context, given that reliance on ODA loans poses long-term risks to the country's financial stability. Moreover, the low interest of the private sector to invest in railway infrastructure projects under the PPP framework indicates the need for new, more innovative approaches. This research also offers a comparative perspective with other Asian countries, which can provide valuable lessons for Vietnam.

As a novelty, this research focuses on the integration of TOD and LVC strategies in the Vietnamese context, which has not been discussed much in depth in previous literature. By exploring ways of revenue diversification through ticket revenue, government subsidies, and property development, this research is expected to provide innovative solutions to improve the efficiency of railway infrastructure investment in Vietnam.

Based on the above background, the main objective of this research is to identify and evaluate financial instruments that the Vietnamese government can use to finance railway projects while improving investment efficiency through PPP schemes, focusing on the relevance of instruments such as Transit-Oriented Development (TOD), Land Value Capture (LVC), and franchising models. The benefits of this research include the provision of innovative financial models, improved sustainability of infrastructure projects through revenue diversification,

reduced reliance on foreign loans, and increased private sector participation, which is expected to contribute significantly to Vietnam's economic and social development through the development of more efficient transportation infrastructure.

RESEARCH METHOD

This study employs secondary data sourced from publicly available reports and peer-reviewed research. The methodology involves a comparative analysis of financial instruments used in railway projects across various Asian countries to derive lessons applicable to Vietnam.

RESULT AND DISCUSSION

Implementation of Financial Instruments for Railway Infrastructure in Asian Countries

This section reviews key financial instruments in Asian railway projects, focusing on TOD, LVC, and franchising models

TOD, introduced by Peter Calthorpe in the 1990s, promotes high-density, mixed-use development around transit stations to boost public transport use and system efficiency [6]. TOD, introduced by Peter Calthorpe in the 1990s, promotes high-density, mixed-use development around transit stations to boost public transport use and system efficiency (Choi et al., 2023); (Jones, 2023); (Hankamp, 2023).

LVC captures the rise in land and property values near transit stations to recover capital costs, as ticket revenues are often insufficient. In cities like Beijing, Wuhan, and Shanghai, property values increase significantly within 2 km of railway lines (Tan et al., 2019); (Shi & Fu, 2022). Combining TOD and LVC promotes urban sustainability by lowering housing and transport costs while improving capital recovery (Renne et al., 2016), (Z. Li et al., 2019).

Franchising, a PPP model, grants private entities the right to operate and maintain railway services for a set period. Revenue is mainly from fares, but franchisees may also receive subsidies or engage in real estate development, integrating LVC and TOD for capital recovery and sustainability.

Franchising as a Fare-Based Financial Instrument for Capital Recovery

Laos–China Railway

The Laos–China Railway, a 414 km line connecting Boten to Vientiane, cost USD 5.9 billion. The project is a Sino-Lao joint venture, with Laos holding 30% through the Lao National Railway State Enterprise and Chinese state-owned enterprises contributing the rest. It operates under a build-operate-transfer (BOT) model with a 75-year project duration—five years for construction and a 50-year concession, extendable by 20 years. While successful in terms of schedule and budget, Laos faces significant debt, about USD 1.5 billion, leading to land and resource concessions to China (Hang et al., 2023).

Jakarta-Bandung HSR

The 142.3 km Jakarta-Bandung HSR, operating at speeds of 350-380 km/h, is a 60-40 joint venture owned by PT Kereta Cepat Indonesia China (KCIC). China Development Bank financed 75% of the USD 6 billion cost, with a 10-year grace period and 2% interest. Indonesian enterprises in joint venture handled land acquisition, and the government granted KCIC a 50-year concession. Project delays pushed the completion from 2019 to 2022, and cost overruns raised the total to USD 7.2 billion, leading to an extension of the concession period to 80 yearss (Maryani & Abidin, 2022).

Franchising as a Fare- and Subsidy-Based Financial Mechanism for Capital Recovery

Korean Railways

Attracting private investment in South Korea's railway sector is challenging due to financial risks. To address this, the Minimum Revenue Guarantee (MRG) was introduced in some Build-Transfer-Operate (BTO) projects, with the government covering revenue shortfalls. However, this increased public sector financial burden, leading to the adoption of the Maximum Concession Cost (MCC) mechanism, which only covers operational losses. Later, the Build-Transfer-Operate with Risk Sharing (BTO-RS) model was introduced to share both investment and operational risks between the public and private sectors. While the BTO-RS model balances costs and risks, it requires thorough risk assessments (Lee et al., 2022); (Maryani & Abidin, 2022).

Urban railways in Korea also struggle to attract private investment due to limited revenue from fare-based financial instruments under the PPP model. Fares, capped by government regulations, are the sole revenue source for PPP-Urban Rail Transit projects, making it hard to secure financial investment for the lifecycle of urban rail transit (URT) systems (Chang & Phang, 2017), (Pulido et al., 2018).

Franchising as a Balanced Fare- and Subsidy-Based Financial Mechanism with LVC and TOD for Capital Recovery

Urban Railways

To attract private investment, some cities combine LVC with TOD for sustainable financing. LVC captures the increased value of land around transit stations and reinvests it to cover part of the capital costs for railway infrastructure. LVC methods are typically classified as either (Suzuki et al., 2015):

1) Tax/fee-based methods: Indirect taxes or fees from property owners.
2) Development-based methods: Direct transactions of properties that increase in value due to railway infrastructure development.

Table 2. A summary of URT with LVC

Project	LVC category	Fare regulation
Tokyo	Development-based	Yardstick regulation [22]
Singapore	Fee-based, government-led LVC	Price cap, operators bear revenue and cost risks
Hong Kong	Development-based	Price cap

In Tokyo, the metro system uses the Rail + Property (R+P) model, a development-based LVC mechanism (Table 2). Land and railway companies are privately owned, with fare regulation via yardstick benchmarking (Chang & Phang, 2017).

In Hong Kong, the Mass Transit Railway (MTR) Corporation operates under the R+P model. MTR generates revenue from non-fare sources like property development, rentals, and commercial businesses at stations, making the metro financially self-sufficient without government subsidies (Table 3).

In Singapore, the government auctions land to private developers, with proceeds going into the general budget (Table 2). The Land Transport Authority (LTA) owns and builds rail infrastructure, while SMRT operates it under strict fare regulations, exposing SMRT to cost and revenue risks. In 2016, LTA bought back SMRT for US$1.06 billion.

Table 3. MTR Corporation's Operating Profit Contributions (billion USD) (X. Li & Love, 2022)

MTR Operations	2013	2014	2015	2016	2017
Hong Kong transport operation	0.85	0.89	0.91	0.97	0.95
Hong Kong station commercial businesses	0.52	0.57	0.61	0.64	0.70
Hong Kong property rental and management businesses	0.39	0.43	0.47	0.50	0.52
Hong Kong property development	0.18	0.53	0.37	0.04	0.14
Total Profits	2.07	2.55	2.45	2.33	2.72

Intercity Railways

Intercity rail projects, unlike urban rail, leverage increased land values around stations to support financing. The Guangzhou-Shenzhen-Hong Kong Express Rail Link (XRL) is an example, with two key sections:

1) **Shenzhen XRL section:** Public sector funds 100% of capital, with state and provincial governments each contributing 50%. Shenzhen Metro Group Co., Ltd. (SZMC), a stakeholder, provided 27.43% of the investment and operates the route. SZMC also partnered with private developers for property projects above stations but relies on government subsidies to mitigate operating deficits (Gong et al., 2021). SZMC is required to invest in social housing during real estate booms.
2) **Hong Kong XRL section:** The railway facilities are owned by the government. The Special Administrative Region (SAR) Government has entered into an entrustment agreement with MTR Corporation Limited to oversee the construction and operation of the XRL project. Hong Kong employs alternative value capture instruments, such as selling land above the station through public bidding, which generates public revenue. In addition to land auctions, Hong Kong captures increased land value from existing properties through its well-established tax administration system, which serves as a secondary public revenue source.

Discussion and Lessons Learned for Vietnam

Discussion

Railway projects typically generate positive spillover effects across various economic sectors; however, they often exhibit low investment efficiency and entail significant financial risks. One of the key challenges in attracting private investment in railway infrastructure is the issue of capital recovery. Addressing this challenge is critical to ensuring the financial viability of such projects.

Table 1. Comparison of Financial Instruments for Railway Projects in Asia

Project	Investor	Operator	Revenue of operator		
			Fare	Subsidy	LVC
URTs in Tokyo	Private companies	Private companies	Yardstick regulation [22]	None	Development-based
URTs in Singapore	SOE	PPP (*)	Price cap	None	None
URTs in Hong kong	PPP (*)	PPP (*)	Price cap	None	Development-based
Jakarta-Bandung HSR	Joint Venture	Joint Venture	Normal	None	None
Laos-China Railway	Joint Venture	Joint Venture	Normal	None	None
Korean Railways	PPP	PPP	Normal	Risk- sharing	None
Shenzhen XRL section	SOE	SOE	Regulation	Risk- sharing	Development-based
Hongkong XRL section	SOE	PPP (*)	Regulation	None	Development-based

(*) The SOE issues shares on the stock market, thereby transitioning into a PPP entity.

Various financial instruments help balance risks through subsidies. Inkorea, MRG attracts private investment but increases the public sector's burden, whereas MCC reduces this burden but may require longer concession periods. The BTO-RS model offers a more balanced risk-sharing approach between the government and private investors.

The length of concession periods in these models reflects the balance between risk, ticket sales revenue, and government subsidies. When private investors face higher risks, such as capped fare revenues or decreases in ticket sales, concession periods may need to be extended to ensure the financial viability of the projects. Alternatively, when the government assumes a greater portion of the risk through subsidies, concession periods may be shorter but result in higher public expenditure.

Revenue generation in urban metro systems depends on balancing fare income, non-fare revenue from LVC and TOD, along with government subsidies. While fares are a key revenue source, fare caps in cities like Tokyo, Hong Kong, and Singapore limit operators' ability to raise fares, creating financial risks, particularly as operational costs increase. The Rail+Property (R+P) model, successfully implemented in Hong Kong and Tokyo, effectively leverages LVC to support financial sustainability. In Hong Kong, non-fare revenue reduces the dependency on government

subsidies, enabling more sustainable concession periods. In contrast, Singapore's reliance on fare revenue led to financial instability for SMRT, raising concerns about the viability of PPP models. When fare revenue proves insufficient, as in Singapore, concession periods may need to be extended, or government support may become necessary. Models that integrate LVC and TOD, such as those in Hong Kong, offer more balanced and financially resilient concession periods.

In intercity rail, as seen in Laos and Indonesia, ticket sales are the main revenue source. Laos' 75-year concession and Indonesia's extension from 50 to 80 years highlight the need for longer periods to recover costs, especially with delays and overruns in construction phase.

Research on the XRL rapid rail link indicates that fare revenue alone is insufficient to cover total costs. Shenzhen relies more on government subsidies and property development through risk-sharing to meet its social obligations. In contrast, Hong Kong's more market-driven approach, which disregards social obligations, successfully captures increased property values to cover a significant portion of costs, leading to more balanced concession periods.

In conclusion, the adoption of Transit-Oriented Development (TOD) and Land Value Capture (LVC) strategies generates significant public revenue by auctioning land above railway stations through public bidding or by capturing the increased value of surrounding properties via a well-established tax administration system, providing an additional public revenue source. Furthermore, the diversification of revenue streams is widely acknowledged as a crucial approach to addressing the challenge of capital recovery in railway projects. By reducing dependence on fare revenues, operators can leverage alternative income sources such as government subsidies and real estate development through TOD and LVC mechanisms. This approach enhances financial sustainability, shortens concession periods, and increases the attractiveness of railway projects to private investors.

Lessons Learned for Vietnam

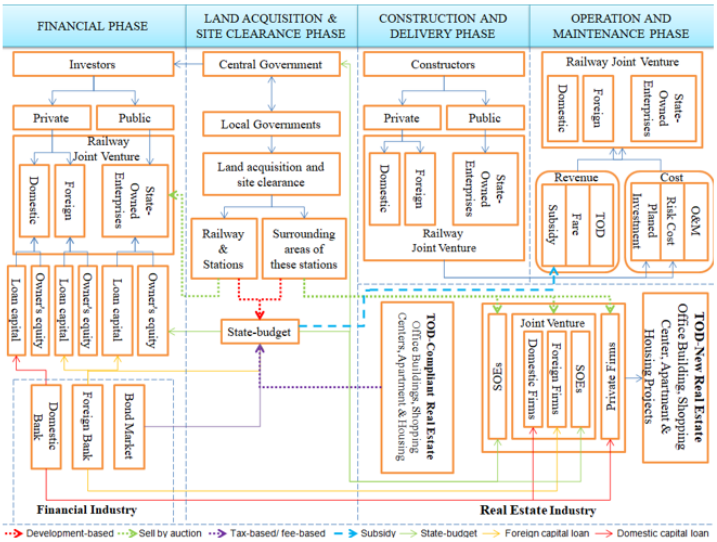

Figure 1. Proposal for the financial mechanism of railway projects in Vietnam

Based on the analysis of financial instruments for railway projects across Asia, the proposed financial model for Vietnam (Figure 2) emphasizes revenue diversification as a means of enhancing capital recovery feasibility. This model aims to encourage private sector participation in railway projects, thereby reducing the government's reliance on public investment.

Financial Instruments for Railway Joint Ventures

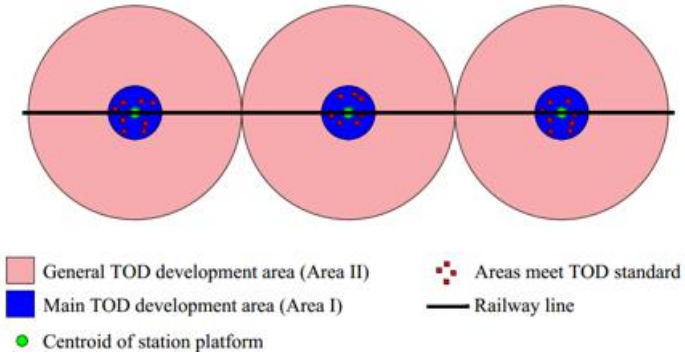

Figure 2. Proposed TOD Planning in Vietnam

Railway joint ventures are strategic for Vietnam's railway development, involving SOEs, private companies, and international partners. These partnerships leverage diverse strengths across financial, construction, and operational phases, promoting technology transfer and capacity building. The proposed financial model highlights the importance of diversifying revenue and investment sources, as outlined below.

Diversifying revenue sources

Diversification of revenue sources has been identified as a critical factor in capital recovery due to its balanced approach across three distinct streams:

1) Fare and ticket sales: The implementation of a planning strategy based on the TOD model plays a significant role in enhancing passenger utilization of railway infrastructure. This strategy not only improves accessibility but also increases ticket sales revenue, thereby optimizing the economic potential of railway operations.
2) LVC: LVC involves granting railway joint ventures the rights to exploit real estate above and around railway stations (Figure 2). This generates additional revenue, which contributes to the financial stability and sustainability of the investment model.
3) Government Subsidies: In cases where direct revenue generation is insufficient, governments may provide subsidies to share financial risks. These subsidies ensure that railway joint ventures can continue to maintain and expand services, alleviating the financial burden associated with capital recovery.

Diversifying Investment Capital

Railway joint ventures can further enhance financial feasibility by diversifying their sources of investment capital:

1) Private Sector: In addition to their own capital, private sector stakeholders can secure loans

from both domestic and international commercial banks. The availability of diversified revenue sources improves the attractiveness and accessibility of investment in railway infrastructure systems.

2) SOEs: In addition to receiving sponsorship from the state budget, SOEs can indirectly access loan capital from foreign banks through government-backed financing.

Financial Instruments for State Budget

TOD and LVC are key instruments for generating revenue for the state budget, utilizing the following methods:

Development-Based Method

Through TOD planning, the state can implement land acquisition policies in areas (Figure 1) that do not conform to TOD design standards. This allows for the creation of land funds for LVC implementation, which can then be monetized through the auction of land parcels within designated areas.

Tax-Based or Fee-Based Methods

For TOD-compliant projects (Figure 1), the state can impose taxes on increased land value resulting from railway development. Policies like Taiwan's TOD FAR reward system (Yen et al., 2023) can incentivize investment in nearby the projects.

Additionally, the state can secure capital through preferential loans from international financial institutions and issue sovereign or infrastructure bonds to fund SOE investments in railway joint ventures and real estate. The state budget also covers land acquisition, site clearance, and subsidies for railway joint ventures during operations.

Advancing the Real Estate Industry

The real estate industry serves as an indirect financial tool for both the state budget and railway operators through TOD and LVC strategies. When real estate development aligns with TOD planning, it enhances the attractiveness and accessibility of railway infrastructure, leading to increased passenger numbers and improved operational efficiency of railway projects. Additionally, this alignment generates revenue for the state budget and operators through development-based, tax-based, or fee-based methods under the LVC strategy, contributing to long-term financial sustainability.

The diversity of investors and the leadership of SOEs are essential for promoting sustainable development within the real estate industry. A diverse group of investors, including domestic and foreign private companies as well as SOEs, enhances competitiveness, spurs innovation, and improves product quality. Moreover, this diversity mitigates risks, strengthens market resilience during economic downturns, and provides a larger capital pool for large-scale real estate developments.

In parallel, SOEs play a crucial role in stabilizing the real estate market by reducing speculation and preventing market volatility. They also fulfill their social obligations by providing affordable housing, thereby contributing to social equity. Strong leadership within SOEs ensures

compliance with regulations, fosters transparency, and builds public trust. Together, these factors significantly enhance the overall sustainability and effectiveness of the real estate industry.

To achieve this, targeted financial instruments are necessary. Private sector entities can secure capital from both domestic and international financial institutions or issue shares on the stock market, while SOEs can initially obtain funding through the state budget (Figure 1).

CONCLUSION

This study examined financial instruments in railway projects across Asia, focusing on Hong Kong, Japan, Singapore, Taiwan, Laos, Korea, and China. Based on these, a financial strategy was proposed to address two key challenges in Vietnam's railway development: securing government investment and attracting private sector participation.

Regarding Government Investment Capital, this study recommends utilizing sovereign bonds, infrastructure bonds, loans from international financial institutions, and LVC. LVC, particularly when integrated with TOD planning, is highlighted as a key tool. By capturing the increased land value near railway stations, LVC helps mitigate financial risks while making a substantial contribution to the state budget. To attract private sector investment, the strategy emphasizes project feasibility and profitability by diversifying revenue through fare sales, LVC, and government subsidies, while offering protections like revenue guarantees and risk-sharing to ensure capital recovery and private sector engagement.

In summary, the proposed model aims to secure sustainable funding for Vietnam’s railway infrastructure, ensuring financial viability and long-term sustainability through a balanced mix of public and private financing.

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