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The tipping point: financial fragility of a property-led model of transit-oriented development in an emerging economy

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Transit-Oriented Development (TOD) is increasingly adopted in emerging economies to manage urbanization, but the financial models underpinning these projects often face significant institutional and market risks. This study addresses a gap by using a financial model not merely as a predictive tool, but as a diagnostic lens to critique the implementation of Indonesian TOD policy. We argue that the dominant model being built is not an integrated transport system but a financially fragile, property-led real estate project. This paper conducts an in-depth, quantitative single-case study of the Poris Plawad TOD project in Greater Jakarta. A Discounted Cash Flow (DCF) model was developed to assess the project's Net Present Value (NPV) and Internal Rate of Return (IRR) over a 25-year lifecycle. A comprehensive sensitivity analysis and stress-test scenarios were performed to evaluate the project's viability against correlated, "front-loaded" risks. The analysis reveals that the project is marginally viable under its base case, with an IRR (10.30%) that only slightly exceeds the WACC (8.74%). The stress-test scenarios demonstrate that the project is not resilient. A realistic scenario combining a 3-year delay and a 20% CAPEX overrun causes the project to become unfeasible, with an IRR of 5.80%. The findings show this financial fragility is a direct result of its model of a real estate venture structurally disconnected from high-capacity rail transit. The paper recommends a combination of Land Value Capture (LVC), Viability Gap Funding (VGF), and tailored Rail + Property (R + P) models to create a more resilient financial foundation for TOD initiatives in emerging economies.

KEYWORDS

transit-oriented development (TOD), financial feasibility, sensitivity analysis, public-private partnership (PPP), infrastructure finance, Indonesia, emerging economies

1 Introduction

Transit-Oriented Development (TOD) has emerged as a promising strategy to enhance urban mobility and to support more sustainable growth. At its core, TOD seeks to shape urban mobility using the "5Ds" concept: Density, Diversity, Design, Destination accessibility, and Distance to transit (Cervero and Kockelman, 1997; Ewing and Cervero, 2010). Each of these components encourages transit use while reducing people dependency on cars and limiting low-density sprawl (Ewing et al., 2017). Yet TOD is believed more than a planning principle, but also a financial mechanism. Big infrastructure investments, property development, and public policy all interact to generating long-term urban and economic value (Cervero and Murakami, 2009; Suzuki et al., 2015). Achieving this balance presents challenges for project stakeholders, requiring an alignment of public policy and private interest for investment.

Global successes illustrate different pathways to TOD viability. Hong Kong's "Rail + Property" model relies on a unique governance structure where a single entity captures land value uplift to create a self-financing cycle that delivers reliable service and high ridership. This approach is reinforced by strong governance with the government both regulating and owning a majority stake in MTR Corporation – a majority government-owned public transport operator and property developer in Hong Kong (Cervero and Murakami, 2009). On the other hand, Japan's TOD achieve high public transit ridership because of connectivity, cultural acceptance of commuting, and reliable service, among other aspects. The Tokyu Den-en Toshi Line case shows that even suburban developments like Tama New Town are highly connected, enabling convenient commutes to employment hubs like Shibuya (Guo et al., 2018).

Yet elsewhere, outcomes can totally be different. In São Paulo, TOD initiatives have accelerated real estate development but often displaced low-income residents due to rising property values and insufficient affordable housing (Leite et al., 2023). In Delhi, weak multimodal integration and planning misalignments have limited accessibility and equitable ridership (Ann et al., 2019; Phani Kumar et al., 2018). And in Bangkok, fragmented governance, unstructured planning, and complex land ownership make coordination difficult and value capture around station diminished (Nutayakul and Weerawat, 2025).

Indonesia now finds itself at a critical juncture. Urbanization reached 53.1% in 2015 and is projected to climb to 66.6% by 2035 (Mardiansjah et al., 2021) and congestion costs in Greater Jakarta alone are estimated at US$ 6.6 billion annually (Jakartaglobe.id, 2025). In response, the government has embedded TOD in the National Medium-Term Development Plan (RPJMN 2020–2024) and together with Japan International Cooperation Agency (JICA) formulate JABODETABEK Urban Transportation Policy Integration Project Phase 2 in 2019, targeting nodes in Jakarta and its surrounding areas such as City of Tangerang, Bekasi, Bogor and many others (Japan International Cooperation Agency, 2019). These efforts aim to foster compact growth, reduce vehicle kilometers traveled, and encourage private-sector participation and land value capture.

Although TOD might promise potential benefits in term of urban growth and people mobility, the literature has not adequately explored how the financial feasibility models of TODs in emerging economies are stressed by specific institutional factors like fragmented governance and uncertain land acquisition processes. This study addresses that gap by using a financial model as a lens to diagnose these structural vulnerabilities. This study examines whether the financial landscape of a TOD in Greater Jakarta, with its heavy reliance on private commercial revenue, is aligned with or in conflict with the public policy goals of creating resilient and equitable urban infrastructure.

By offering a grounded financial assessment of TOD in Indonesia, this research provides a crucial framework for policymakers, transport authorities, and investors. It seeks to clarify financial risks, support the development of more robust PPP structures, and ultimately help ensure that TOD contributes to social and economic returns of urban development.

The remainder of the paper is structured as follows: Section 2 reviews relevant literature; Section 3 describes the methodology and assumptions; Section 4 presents results; Section 5 discusses policy and investment implications; and Section 6 concludes with limitation and recommendations.

2 Literature study

2.1 The TOD model: a nexus of planning and finance

TOD is a widely recognized urban planning strategy that integrates mixed-use, walkable developments around high-capacity transit hubs to manage urbanization and reduce car dependency (Forouhar and Hasankhani, 2018; Zhong and Li, 2016). By concentrating various activities around transit hubs, TOD can promotes mobility, and supports more efficient land use. Beyond its urban planning value, TOD also generates significant economic benefits, including increased property values, higher land-use efficiency, job creation, and consumer spending on local businesses.

The success of TOD projects often depends on their financial viability, as measured by common metrics such as capital expenditures (CAPEX), operational expenditures (OPEX), and net present value (NPV) (Li et al., 2010). Careful financial modeling is essential to ensuring the sustainability of TOD projects, as it helps identify potential financial risks, such as fluctuating demand and cost overruns, that could impact the project's profitability (Su et al., 2024; Venner and Ecola, 2007). These assessments are critical in emerging economies, where fiscal constraints and governance challenges can expose financial and operational risks.

In this context, TOD functions as a bridge between urban planning objectives and economic feasibility. When well-executed, TOD enables public agencies to leverage land value capture and private-sector investment to finance infrastructure while fostering compact and connected urban forms. Conversely, weak financial planning can compromise not only the sustainability of transit systems but also their broader economic and social objectives, particularly in markets with limited institutional and regulatory capacity.

2.2 Financial models and institutional contexts in TOD

Successful TOD globally rely on various financial models designed to capture the land value from public transit investment. These models are not one-size-fits-all, but shaped by local institutional contexts, including governance structures, and market maturity. A comparative look at global experiences reveals a clear pattern where financial viability is deeply intertwined with institutional capability.

One of the most well-known approaches is the 'Rail + Property' (R + P) model executed in Hong Kong (Cervero and Murakami, 2009). Its success lies on a unique institutional arrangement where a single, quasi-public entity (the MTR Corporation) controls the transit system and is granted development rights over surrounding land. This allows it to directly capture real estate profits to subsidize transit operations, with farebox recovery ratios often exceeding 100%. This self-financing cycle is enabled by strong, centralized governance where the government is both the regulator and majority owner, creating a cohesive and efficient system (Loo et al., 2010). With this scheme, MTR can balancing public accountability with corporate efficiency. This transit accessibility enhances land value, which in turn funds transit growth, ensuring both financial sustainability and governance cohesion.

On the other hand, Singapore's TOD model uses state-led land leasing under a highly centralized governance framework. The Land Transport Authority (LTA) and Housing Development Board (HDB) jointly plan transit expansions with residential and commercial growth in mind (Niu et al., 2019). Revenues from long-term land leases form a stable funding base, while strong institutional alignment minimizes fragmentation and accelerates decision-making (World Bank, 2018). This model demonstrates how financial resilience is reinforced by a unified governance framework capable of adapting to future urban and economic challenges.

Other contexts use different mechanisms. Many cities in the United States and Latin America use Land Value Capture (LVC) instruments like betterment levies or special assessment districts, where a portion of the increased property tax revenue from the area around the station is expected to cover some infrastructure (Berawi et al., 2019; Mathur and Smith, 2013). London's King's Cross redevelopment, for example, pooled resources from landowners, rail authorities, and private developers under a single delivery vehicle (World Bank, 2018). Increased property tax revenues were reinvested in the transport network for urban renewal alongside transit improvements. But, this scheme require a much complex, multi-tiered governance to coordinate between various public authorities and private developers (Holgersen and Haarstad, 2009). The Greater London Authority (GLA) provides strategic oversight, while Transport for London (TfL) ensures operational cohesion, and borough councils retain local planning powers.

The effectiveness of TOD then depends on who governs, how they govern, and how the project is financed. Cities with integrated land control and institutional cohesion (e.g., Hong Kong, Singapore) tend to generate self-reinforcing financial returns, while those relying on fragmented or incentive-driven models (e.g., London) often prioritize gradual, context-sensitive growth. The comparison between these approaches can be seen in Table 1.

While these value capture models are foundational, their reliability as a stable revenue source is not guaranteed. The actual financial yield of LVC or TIF mechanisms depends heavily on local market conditions and on the policy design. For instance, Berawi et al. (2021) showed that Jakarta's MRT project estimated significant potential LVC recovery (e.g., 53.8%), but the real-world outcomes can vary (Duncan et al., 2020). Research shows the impact is often not uniform across all stations, and many plans fail to account for the substantial costs of other non-transit infrastructure (like water, sewer, and public spaces) needed to support the new density. This condition can decrease the net fiscal benefits, making the LVC tool less reliable than anticipated.

TABLE 1 Comparison between multiple cities on financial and institutional approach.

City	Financial approach	Institutional strength	Key takeaway
Hong Kong	Rail + property revenue capture	Integrated corporate-public entity	Self-financing, globally scalable
Singapore	State-led land leasing	Strong centralized governance	Financial resilience, strategic adaptability
London	PPP with tax reinvestment	Multi-tier governance with flexibility	Urban renewal through collaboration

2.3 Institutional and market risks in emerging economy infrastructure

Delivering projects in emerging economies is rarely straightforward. Projects often run into an institutional hurdles and market uncertainties that disrupt both budgets and schedules. In Southeast Asia, cost overruns is a chronic underestimation of expenses during the early planning stages. This is not always accidental but sometimes it stems from overconfidence in favorable outcomes (optimism bias), and other times it is a deliberate move to make projects look more attractive on paper (Park and Papadopoulou, 2012). Studies across developing markets have shown these patterns are especially common in mega-projects, where early cost estimates often reflect political or institutional agendas more than technical reality (Asiedu and Adaku, 2020; Famiyeh et al., 2017). It helps explain why overruns happen even in projects that, on paper, appear technically sound.

But costs is only part of the problem, other things such as governance gaps often make things worse. In Southeast Asia, overlapping authority between national, provincial, and municipal bodies tends to slow down approvals, shift project scopes midstream, and create misalignment in coordination (Park and Papadopoulou, 2012). On top of that, poor data sharing and fragmented information systems are leads to planning errors and execution delays (Asiedu and Adaku, 2020). Weak collaboration between agencies and leadership gaps raise transaction costs and slow down decision-making, so even after estimates are revised, small discrepancies can snowball into major overruns (Famiyeh et al., 2017).

Land acquisition is another recurring challenge. Delays in clearing sites, disputes over compensation, and lengthy relocation processes regularly push back critical milestones, increase overheads and financing costs (Mevada and Devkar, 2017). Legal and regulatory hold-ups, as well as disagreements on compensation often force late-stage design changes and contract renegotiations (Nikjow et al., 2021). This problem is particularly acute in public–private partnerships (PPPs), where unclear rules about who carries the land-related risks tend to unsettle investors and raise transaction costs (Winata and Gultom, 2024).

3 Case study selection and description

The Poris Plawad TOD is situated in the Poris Plawad Terminal in Tangerang, part of the Greater Jakarta area. The location is 1 km from a major highway gate, ensuring excellent regional access, and a mere 20-min drive from Soekarno-Hatta International Airport. This proximity to Indonesia's main air hub creates substantial demand for residential and commercial spaces, positioning the TOD as a vital transit point for travelers and airport workers alike (see Figure 1).

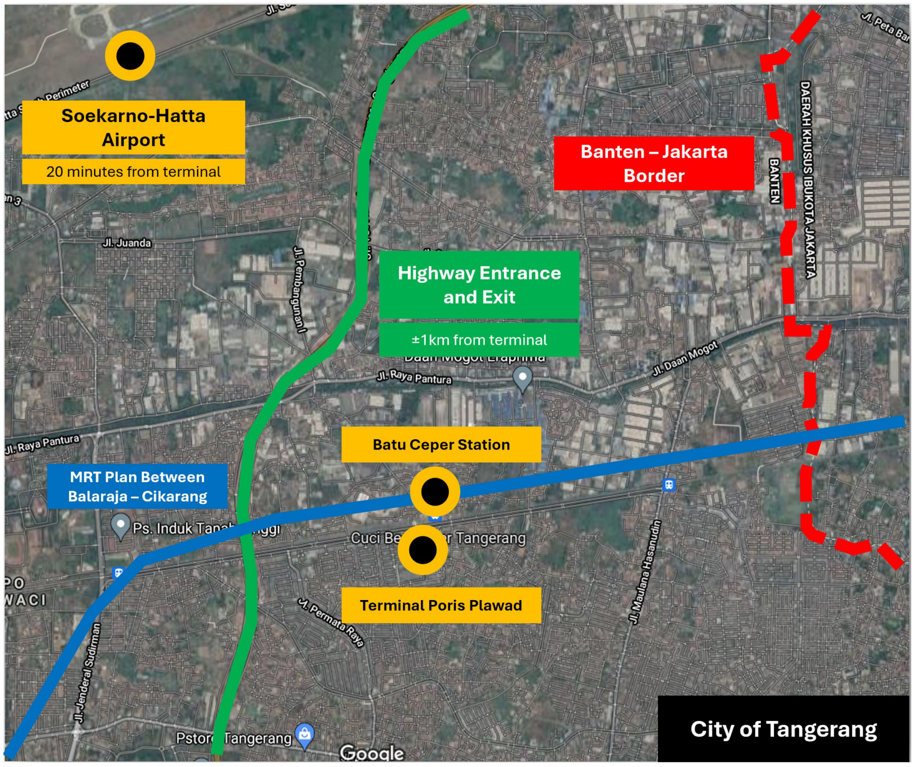

FIGURE 1
Location of the case study TOD.

The TOD has a 4.5-hectare of land which is jointly held by the Ministry of Transportation (1.9 ha) and the City of Tangerang (2.6 ha). This dual ownership has fostered strong collaboration, with both government bodies sharing a commitment to transforming the terminal into a central development hub.

Currently, the Poris Plawad Terminal already functions as a hub, integrating multiple modes of transport. The terminal is a nexus for a wide array of bus services, including:

- Intercity and Interprovincial buses (AKAP & AKDP)
- Transjakarta routes connecting to Greater Jakarta
- The local Transtangerang bus service

This is complemented by a dense network of public minivans (angkutan kota) serving 16 local and 6 intercity routes.

Rail connectivity is also robust. The nearby Batu Ceper Station serves both the KRL Jabodetabek commuter line (providing a vital link to central Jakarta) and the Soekarno-Hatta Airport Train, further cementing the TOD's role as a key transportation interchange.

Despite these advantages, the existing terminal buildings are in a moderate condition and have not yet reached their full potential. Facilities such as commercial spaces and ticketing services remain underutilized due to suboptimal passenger numbers, indicating a clear need for further development. TOD development is expected to improve the condition of the station, and enhance economic activity nearby the station to generate income both businesses and the government.

4 Financial analysis

This study adopts a quantitative, single-case study approach to conduct an in-depth financial analysis of the Poris Plawad TOD project. The case study method is appropriate for examining a contemporary phenomenon within its real-world context (Yin, 2009), allowing for a detailed investigation of the project's financial landscape.

The data for this study was obtained primarily from the Poris Plawad TOD project's official documentation, including its financial feasibility report and investment summaries. These sources provided projected data for CAPEX, OPEX, and multi-stream revenues. This primary data was contextualized with information from government reports and urban planning documents. The study acknowledges the inherent limitation of using developer-provided projections, which may contain optimism bias. To mitigate this, the financial model was critically assessed and stress-tested through a sensitivity analysis, as detailed in subsequent section.

4.1 Capital expenditure

CAPEX in this study is a preliminary estimate derived from the project's functional areas and associated unit costs. The total project cost is composed of two primary elements: Direct Construction Costs and Indirect Construction Costs.

The Direct Construction Cost (C_D) is the total cost of all physical project components. It was calculated by multiplying the area of each component (A_i) by its specific unit cost (U_i) and summing the results for all components.

$$C_{D\,total}=\sum_{i=1}^{n}\left(A_i\ x\ U_i\right)$$

The Indirect Construction Costs (C_I) were then estimated as factors of the total Direct Construction Cost. These factors account for 1% for Planning, 1% for Construction Supervision, and a 2% Contingency charge.

The Indirect Construction Costs (C_I) covers ancillary expenses necessary for project execution. These costs were calculated as a percentage of the total Direct Construction Cost (C_D). The indirect costs included Planning Costs (P_P), Construction Supervision Costs (P_S), and Contingency Costs (P_C), with percentages of 1, 1, and 2%, respectively.

$$C_I = C_D\ \mathrm{x}\left(P_P + P_S + P_C\right)$$

The final Total Project CAPEX (C_T) is the sum of the direct and indirect costs.

$$C_T = C_D + C_I$$

4.2 Operational expenditure

OPEX costs were estimated as a percentage of the initial capital investment for each facility. The rates varied by function: 5.5% for the retail area, 2.6% for office space, and 2.0% for the hotel, bus terminal, minivan terminal, and sports center. The lowest factor of 1.0% was applied to the park-and-ride facility and the green area.

4.3 Revenue

The total annual revenue is forecast by identifying and quantifying each potential income source within the project. The annual revenue for each individual stream (R_i) was calculated using a unified formula that incorporates the service tariff, total capacity, projected occupancy rate, and an annualization factor.

The general formula applied to each revenue stream is:

$$R_{i\,total}=\sum_{i=1}^{n}T_i\ x\ S_i\ x\ O_i\ x\ F_i$$

Where:

- R_i = total annual revenue for a specific stream i.
- T_i = tariff, which is the base price per unit (e.g., per m^2/month, per night, per hour).
- S_i = capacity, representing the total available inventory of a given unit (e.g., total leasable area, number of hotel rooms, number of parking spots).
- O_i = occupancy rate, the projected utilization percentage for the first year of operation. This rate varies for each revenue stream to reflect specific market conditions and demand forecasts.
- F_i = annualization factor, a multiplier used to convert periodic revenue into an annual figure.

The key revenue streams identified for this project include commercial and office rentals, hospitality (hotel rooms), parking (cars and motorcycles), advertising (videotron spots), and recreational facility fees (multipurpose and badminton courts).

The calculation for each was tailored by the Annualization Factor (Fi):

- For revenues generated on a monthly basis, such as commercial, retail, and office space rentals, an annualization factor of 12 was used.
- For revenues generated on a daily basis, including hotel rooms, parking fees, and facility rentals, an annualization factor of 360 was used to represent the operational days in a year.

The Total Annual Operating Revenue for the project is the summation of the annual revenues from all identified streams. This bottom-up approach ensures that the forecast is grounded in the specific operational capacities and market assumptions for each component of the development.

4.4 Financial modeling and key assumptions

To evaluate the project's financial viability, a Discounted Cash Flow (DCF) model was used to project performance over a 25-year lifecycle. This period includes a 3-year construction phase followed by 22 years of operation.

The model is based on nominal cash flows (incorporating inflation) and is calculated on a pre-tax basis to evaluate the project's fundamental economic viability. The financial plan makes a very cautious assumption. It ignores what the project could be sold for at the end of its 22-year life. This means the project must prove its profitable only from its yearly income, without counting a final sales price.

The model's primary outputs, the NPV and Internal Rate of Return (IRR), are derived from the following assumptions.

- Infrastructure guarantee costs

The financial model accounts for costs associated with the infrastructure guarantee provided by PT. Penjaminan Infrastruktur Indonesia. These fees are calculated as a percentage of the total construction cost:

- Upfront fee: a one-time charge equivalent to 1% of the total construction cost, payable at the beginning of the project.
- Recurring fee: an ongoing fee of 0.30% of the total construction cost, incurred periodically throughout the project's life.

To ensure rigor, the Weighted Average Cost of Capital (WACC) of 8.74% was used as the discount rate. This rate was derived from the Capital Asset Pricing Model (CAPM), incorporating a risk-free rate based on 25-year Indonesian government bonds (7.22%), a market return of 11.50%, and an equity beta for the emerging market retail sector (1.06) to reflect the project's specific risk profile.

4.5 Sensitivity analysis: simulating institutional and market risks

To evaluate the robustness of the project's financial projections and identify the most critical risk factors, a sensitivity analysis was conducted. This analysis measures how the project's key financial performance indicators such as NPV and IRR respond to changes in core assumptions.

The methodology employed a one-at-a-time (OAT) approach. Starting from a defined base case scenario, each selected variable was independently adjusted within a range while all other assumptions were held constant. This technique effectively isolates the financial impact of each individual risk factor.

The variables selected for this analysis represent the primary sources of uncertainty in the project's cost, revenue, and timeline. The specific scenarios tested are detailed in Table 2.

For each scenario, the resulting NPV and IRR were calculated and compared against the base case. This allows for a quantitative ranking of risks, thereby highlighting the variables to which the project's financial viability is most sensitive.

5 Results

5.1 Project overview

The Poris Plawad TOD project will occupy space from both BPTJ and the City of Tangerang. The total developed area on BPTJ land includes a variety of spaces, such as the AKAP and AKDP bus terminals, commercial spaces, and green areas. The total built-up area is 122,757.97 m^2. On the other hand, the City of Tangerang land is set to host a range of developments, including two podiums, three towers, and park and ride facilities. The total built-up area for this section is 68,227.8 m^2. The concept design can be seen in Figure 2.

5.2 Financial projections

The financial viability of the Poris Plawad TOD was modeled based on the projected capital expenditures, operational costs, and revenue streams. The key inputs for this analysis are detailed below.

The total CAPEX for the project is estimated at approximately US$ 101.6 million, as detailed in Table 3. The primary cost driver is the development of the commercial area, which accounts for over 45% of the total construction costs. Followed by bus terminal, public minivans terminal, and hotel residential.

The first year of OPEX is projected to be US$ 3.42 million (see Table 4 for the details). Ongoing operational costs are heavily weighted toward the retail and commercial functions, which constitute over 71% of the annual total. Other buildings functions are less than 8% from the total OPEX.

Projected annual revenue for the first year of operation is US$ 10.5 million (see Table 5 for more details). The project's financial model relies heavily on income from its commercial and property assets, with retail space rentals alone generating over 77% of the total revenue. Other revenue streams are less than 9% from the total annual projection revenue.

5.3 Projected financial performance (base case)

The financial performance of the project under the base case assumptions was evaluated using standard investment metrics. The key indicators, summarized in Table 6, assess the project's profitability and its ability to generate returns over its life cycle.

The analysis indicates that the project is financially viable, though the margin of return is slim. With a calculated IRR of 10.30%, the project's projected return slightly exceeds the WACC of 8.74%. The positive NPV further confirms that the project is expected to generate more value than its initial investment, while the 13-year payback period is within an acceptable timeframe for a large-scale infrastructure development.

5.4 Sensitivity analysis

A sensitivity analysis was conducted to assess the robustness of the project's financial outcomes against fluctuations in key variables. This

TABLE 2 Scenarios for sensitivity analysis.

Variable	Variation	Description
CAPEX	±20%	To assess the impact of construction cost overruns or savings.
OPEX	±15%	To model variations in ongoing operational and maintenance costs.
Real estate revenue	±20%	To reflect uncertainty in market demand and rental income.
OPEX inflation	±2%	To test the effect of higher or lower than expected inflation on operational costs.
Project timeline	+3 years	A specific scenario to quantify the financial impact of a significant construction delay.
Land acquisition cost	+30%	To model a potential overrun in the initial cost of land.
Policy-driven revenue	±10%	To assess the impact of changes in government support or subsidies.

FIGURE 2
Concept design of TOD in the case study.

analysis quantifies the impact of these uncertainties on the project's NPV, IRR and payback period.

The financial model under the base case scenario is projected to yield an NPV of $3,307,032, an IRR of 10.30%, and a payback period of 11 years and 6 months. These figures serve as the benchmark for evaluating the following scenarios.

5.4.1 High-impact variables

The analysis confirms that the project's feasibility is highly sensitive to three primary factors of project delays, real estate revenue, and capital expenditure, which significantly affect not only profitability but also the time required to recover the initial investment.

- A 3-year delay presents the most significant risk. This scenario causes the NPV to become highly negative, reduces the IRR to 8.54%, and extends the payback period dramatically to 14 years and 6 months, the longest of any scenario tested.
- A 20% shortfall in real estate revenue reduce the project feasibility (negative NPV, 9.28% IRR) and lengthens the payback period to 13 years and 3 months. In contrast, a 20% revenue increase shortens the payback period to 10 years and 3 months.
- A 20% cost overrun extends the payback period to 12 years and 11 months. Conversely, a 20% cost saving shortens the payback period significantly to 10 years and 1 month, the fastest capital recovery scenario.

5.4.2 Moderate and low-impact variables

The project is more resilient to changes in other areas, with these variables having a much smaller effect on the capital recovery timeline.

- A 10% decrease in policy support or a 30% land cost overrun extends the payback period, but more moderately to 12 years 4 months and 11 years 7 months, respectively.
- The project is notably resilient to operational costs. A significant 15% variance in OPEX has a negligible effect on the IRR and only change the payback period by a single month.

The Figure 3 illustrates the significant impact of project delays and revenue shortfalls. For a detailed breakdown of all metrics, including IRR and the payback period, refer to Table 7.

5.5 Combined scenarios

To complement the sensitivity analysis and to address that key risks in infrastructure projects are often correlated, a combined stress-test was performed. This analysis models two distinct, high-probability scenarios by combining the project's most sensitive variables. These scenarios are designed to simulate the "tipping points" that could render the project unfeasible.

5.5.1 Scenario A: the "institutional failure" scenario

This scenario models the "front-loaded" institutional and execution risks that are well-documented in emerging economy infrastructure projects, including uncertain land acquisition and governance gaps. This test combines the project's two most significant negative variables of a 3-year project delay and a 20% CAPEX overrun. This simulates a common outcome where protracted land disputes or

TABLE 3 CAPEX breakdown.

No	Task	Area (m^2)	Unit cost (US$/$m^2$)	Total cost (US$)
A	Direct construction cost			
1	Bus terminal	13,348	911.09	12,161,207.77
2	Public minivans terminal	11,732	911.14	10,689,517.13
3	Park and ride	13,130	679.74	8,924,933.80
4	Commercial area	36,716	1,215.37	44,623,467.44
5	Office area	6,788	620.60	4,212,665.32
6	Hotel residential	7,185	1,423.42	10,227,284.75
7	Sports center	5,716	866.35	4,952,038.80
8	Green area	281	2,848.66	800,474.55
9	Drainage system	6,399	42.38	271,204.26
10	Access road	11,198	76.71	858,946.95
	Sub total			97,721,740.77
B	Indirect construction cost			
	Planning costs (1%)			977,217.41
	Construction supervision costs (1%)			977,217.41
	Contingency costs (2%)			1,954,434.82
	Sub total			3,908,869.64
C	Total project CAPEX (A + B)			101,630,610.41

TABLE 4 Projected OPEX—year 1.

Building function	Annual OPEX (US$)	% of total OPEX
Office	109,529.30	3.20%
Hotel	204,545.69	5.98%
Retail (commercial)	2,454,290.71	71.73%
Bus terminal (AKAP, AKDP)	243,224.16	7.11%
Public minivan terminal (Angkot)	213,790.34	6.25%
Park and ride	89,249.34	2.61%
Green area (park)	8,004.75	0.23%
Sports center	99,040.78	2.89%
Total	3,421,675.06	100%

TABLE 5 Projected annual revenue streams (year 1).

Revenue category	Revenue stream	Projected annual revenue (US$)	% of total revenue
Commercial & property	Retail spaces	8,100,000	77.1
	Hotel rooms	900,000	8.6
	Office rental	735,000	7.0
Transportation and parking	Parking fees	206,700	2.0
Ancillary revenue	Advertising	527,000	5.0
	Sport center	19,400	0.2
	SME fees	16,000	0.1
Total		10,504,100	100

TABLE 6 Summary of base case financial performance.

Indicator	Value	Bencmark/note
Project IRR	10.30%	Exceeds WACC of 8.74%
Project NPV	US$ 3,307,032.17	Positive value indicates profitability
Payback period	11 years 6 months	-

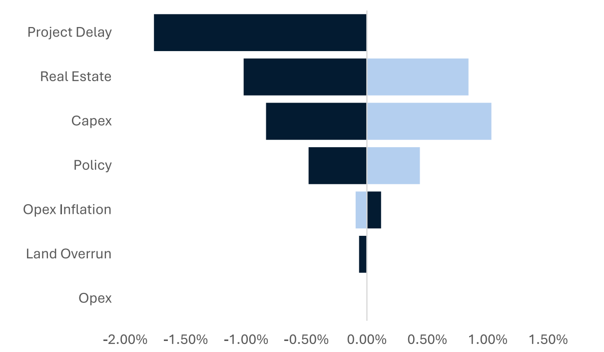

FIGURE 3
The magnitude of variables impact on the project's feasibility.

bureaucratic delays push back the start date, which in turn inflates construction costs.

5.5.2 Scenario B: the "market failure" scenario

This scenario models the long-term revenue and market risks identified in the discussion. It reflects a future where market demand is softer than projected, potentially due to e-commerce competition or a failure to secure retail anchors. This test combines two critical revenue shortfalls of a 20% shortfall in real estate revenue nd a 10% decrease in policy-driven revenue. This simulates a "double-blow" where the project's primary revenue stream (77% of total) underperforms, and public support (subsidies or guarantees) is also reduced. The results of these combined scenarios, presented in Table 8, reveal the project's profound financial fragility.

The results show that while the project is marginally viable under its base case, it is not resilient to the co-occurrence of common risks. The "Institutional Failure" scenario results in a deeply negative NPV (US$ 23.31 million) and an IRR (6.80%) which falls dramatically below the 8.74% WACC. Similarly, the "Market Failure" scenario also got negative NPV (US$ 28.13 million) and an IRR (5.66%). This analysis confirms that the

TABLE 7 Sensitivity analysis results.

Scenario	NPV (US$ million)	IRR (%)	Payback
Base	3,307,032.17	10.30	11y 6 m
CAPEX −20%	23,081,270.43	11.33	10y 1 m
CAPEX +20%	−16,467,206.09	9.47	12y 11 m
OPEX −15%	3,727,090.04	10.30	11y 6 m
OPEX +15%	2,886,974.31	10.30	11y 7 m
RealEst Rev. −20%	−17,688,689.67	9.28	13y 3 m
RealEst Rev. +20%	24,302,754.02	11.14	10y 3 m
OPEX Infl +2%	3,071,737.44	10.42	11y 5 m
OPEX Infl −2%	3,068,540.42	10.21	11y 7 m
Project Delay 3y	−19,403,542.91	8.54	14y 6 m
Land Overrun +30%	1,902,887.32	10.24	11y 7 m
Policy −10%	−7,190,828.75	9.82	12y 4 m
Policy +10%	13,804,893.10	10.74	10y 10 m

TABLE 8 Combined stress-test scenario results.

Scenario	NPV (US$ million)	IRR (%)
Base case	$3.31	10.30%
A: institutional failure (3y delay + 20% CAPEX)	−$23.31	6.80%
B: market failure (−20% RealEst rev. + − 10% Policy)	−$28.13	5.66%

project's financial "tipping point" is not a remote possibility but a likely outcome given the correlated nature of its primary risks.

6 Discussion

The financial analysis indicates that the Poris Plawad TOD project is economically feasible under the base case scenario, yet its viability is marginal. With a projected IRR of 10.30% that only slightly surpasses the WACC of 8.74%. This thin margin confirms the project exists in a difficult financial position where minor negative deviations can erase profitability, lacking the financial cushion needed to absorb common project risks. This finding contrasts with more clear-cut positive assessments of TODs in developed contexts and highlights a critical challenge for TOD implementation in emerging economies. The projects may meet the minimum investment threshold but lack the financial cushion needed to absorb common project risks.

The findings clearly indicates that the project's financial feasibility can be determined before the first day of operation. However, the project's true "tipping point" is revealed in the Combined Scenarios (Table 8), which model the realistic co-occurrence of these risks.

- The "Institutional Failure" scenario (a 3-year delay + 20% CAPEX overrun) renders the project unviable, with an IRR of 5.80%.
- The "Market Failure" scenario (a 20% real estate revenue shortfall + 10% policy revenue loss) is similarly unfeasible, with an IRR of 5.66%.

Both scenarios fall dramatically short of the 8.74% WACC, confirming that the project is not resilient to the correlated risks common in large-scale infrastructure.

These scenarios prove what the analysis suggested that the project's financial outcome is dictated by its "front-loaded" risk profile. There is a contrast between the high sensitivity to "front-end" (CAPEX, Project Delay, and Land Overrun) variables and the low sensitivity to "back-end" (OPEX) variables. This front-loaded risk profile means that the most critical phase for ensuring financial success is the planning and construction stage. Project management resources must be intensely focused on accurate cost estimation, disciplined execution to avoid delays, and securing land at the budgeted price. As the data shows, later operational efficiencies, while important, will not help the project from early-stage failures.

Beyond construction, the single greatest ongoing risk is market performance. Although this findings confirm that farebox revenue is often insufficient for financial sustainability (Berawi et al., 2019; Gunawan et al., 2020), this extreme dependence on commercial revenue stream can creates a long-term vulnerability. The rise of e-commerce and digitalization, accelerated by events like the COVID-19 pandemic, has reshaped retail real estate by reducing demand for traditional retail space and increasing the need for physical stores to adapt their business models (Nanda et al., 2021). Retail vacancies and declining rents in some urban areas are also linked to oversupply driven by zoning and land use decisions (Brooks and Meltzer, 2025). This risk cannot be controlled in the same way as construction costs. The project's business strategy must focus on de-risking this revenue stream through measures like securing pre-lease agreements with anchor tenants, developing phased commercial offerings that can adapt to market absorption rates, or incorporating flexible-use spaces. These high "front-loaded" and "market" risks are not random; they are a direct symptom of the project's underlying model.

However, this analysis reveals that the project's financial fragility is not simply a matter of high risk. It is a direct consequence of the project's fundamental model. This case study exposes a structural misalignment between Indonesia's "TOD" policy and the "property-led" financial model being implemented. The financial model has a structural disconnect from high-capacity rail transit. The "transit" component is a road-based bus terminal, and the model includes no financial integration with rail ridership (e.g., farebox revenue) or transit-specific value capture. The project is therefore forced to shoulder the high costs and "front-loaded" risks of a dense, mixed-use development without capturing the unique financial benefits of a high-capacity rail system.

A broader comparative analysis situates the Poris Plawad project within the wider context of TOD financing in emerging Asian economies. A direct, standardized financial benchmarking for TODs is difficult due to commercial sensitivities and variations in project scope. However, available data suggests that the financial landscape of the Poris Plawad project is not an outlier. For example, a state-owned enterprise managing TOD projects in Greater Jakarta derived between 56 and 93% of its revenue from property and commercial estates between 2021 and 2024 (Adhi Commuter Properties, 2024). This mirrors Poris Plawad's projection and indicates that a heavy reliance on private real estate revenue is the dominant model for contemporary Indonesian TODs. The underlying financial logic of capturing land value uplift is validated by experiences in cities like Bangkok (Vichiensan et al., 2022), but the financial fragility identified in our sensitivity analysis suggests this model carries a systemic risk.

Given this systemic fragility, the long-term sustainability of the TOD model requires more robust public-sector de-risking strategies. For Indonesia, three instruments stand out as the most actionable to strengthen TOD financing and resilience. First, an adapted land value capture (LVC) framework can ensure that a portion of the significant land value uplift generated by new transit investments directly supports public objectives. However, the long-term stability of this captured value is also a key consideration (Zolnik, 2020). By introducing betterment levies or special assessment taxes on properties near stations, local governments could create recurring revenue streams to fund transit operations, infrastructure maintenance, or affordable housing in TOD zones. Second, viability gap funding and credit guarantees can play a pivotal role in reducing the financial fragility revealed in sensitivity analyses. Government-backed funding for early phases or partial risk guarantees would lower borrowing costs and help attract private investment, making PPP more viable. Finally, a tailored rail + property (R + P) model where transit agencies are granted development rights near stations and structuring profit-sharing agreements with developers. This strategy could provide stable, diversified revenues to reinvest in system upgrades and operations. Together, these instruments would help Indonesia move beyond an over-reliance on volatile retail income, creating a more balanced and sustainable financial base for its TOD initiatives.

7 Conclusion

This study finds that the financial position of the Poris Plawad TOD is the direct result of a structural mismatch between the global TOD model and the "property-led" institutional conditions found in the case study. The analysis shows that, on paper, the project is marginally viable. The base case IRR stands at 10.30%, only slightly above the 8.74% WACC. Yet, the picture shifts dramatically under realistic, correlated risk. This fragility, suggested in the base case, is quantified by the combined stress-tests. The "Institutional Failure" scenario (a 3-year delay + 20% CAPEX overrun) yields an unviable IRR of 5.80%, while the "Market Failure" scenario (revenue shortfalls) results in an IRR of 5.66%. In other words, its success rests on two fragile pillars: the tight control of "front-loaded" construction costs and the steady performance of its commercial spaces. The stress-tests prove these pillars cannot withstand the combined institutional and market risks common to such projects.

This condition confirms that Indonesian TODs cannot rely solely on a real estate formula. The project's financial fragility is a direct diagnosis of its design which from "property-led" model financially disconnected from the "transit" component. The findings underscore that active de-risking strategies and robust PPPs are essential. Without significant governance reforms and innovative public financing mechanisms such as the LVC and R + P models discussed, TODs in Indonesia risk becoming financially unsustainable real estate ventures with a transit station attached. In the end, this model will fail to deliver on the promise of resilient and equitable urban growth.

Despite these findings, this study has several limitations. The analysis is based on secondary data and projections. This condition may not fully capture the uncertainties in large-scale infrastructure projects. For example, the model relies on "anticipated demand for transportation services" and "commercial occupancy," but lacks the specific demographic data or rail ridership projections that would be essential for a true TOD. This omission is, itself, a critical finding that reinforces the project's "property-led" nature. The DCF model is also a static projection and does not account for active asset management, such as re-leasing strategies, or the high opportunity cost of dedicating land to low revenue assets like parking. Furthermore, demand forecasting can be influenced by external factors such as economic downturns or shifts in transportation behavior, and this study has not explored non-financial risks (political, regulatory, and social factors) in depth. Adding these considerations in future research might affect the project's outcomes.

This study opens several avenues for future research. First, post-implementation studies are needed to compare projected financial outcomes with the actual operational performance of TOD projects. This could help identify gaps in demand forecasting and highlight areas for improvement in future planning. Second, future work should expand the scope to develop a comprehensive risk management framework that integrates both financial and non-financial risks, such as political instability or social resistance to development. Finally, comparative studies analyzing the effectiveness of different PPP models (e.g., DBFOM vs. BOT) would provide invaluable insights for structuring future sustainable urban developments.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Author contributions

HR: Writing – original draft, Conceptualization, Methodology, Supervision. PM: Writing – original draft, Formal analysis, Investigation, Validation, Visualization, Writing – review & editing. IP: Conceptualization, Resources, Supervision, Writing – original draft. YA: Data curation, Formal analysis, Investigation, Writing – original draft.

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The authors declare that Gen AI was used in the creation of this manuscript. Portions of the text were revised for clarity using ChatGPT (GPT-5, OpenAI, 2025). The tool was used to improve grammar and readability but did not contribute to the generation of scientific content or interpretation of results.

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