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From Cost to Service: Building a Smarter Fare Model for Buy-the-Service Transit

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Abstract: The transition from traditional cost-based to service-oriented fare models represents a paradigm shift in public transport financing. This study develops a comprehensive fare calculation model for Buy-the-Service (BTS) transit systems that integrates operational costs, user satisfaction, Ability to Pay (ATP), and Willingness to Pay (WTP). Using data from BisKita Trans Bekasi Patriot corridor in Indonesia, we employed multiple linear regression analysis with 314 users to derive a predictive WTP model: WTP = 2,589.329 + (256.865 × Satisfaction) + (0.030 × ATP). Results indicate that operational costs per passenger (IDR 17,060.20) significantly exceed user WTP (IDR 4,178.34), necessitating a subsidy of IDR 12,876.71 per passenger to maintain service sustainability. Statistical validation confirms model robustness ($F = 8.377$, $p < 0.001$) with no multicollinearity issues ($VIF = 1.097$). The study demonstrates that user satisfaction significantly influences fare acceptance, with each satisfaction unit increasing WTP by IDR 256.87. These findings provide actionable insights for policymakers implementing BTS schemes in developing countries, emphasising the critical role of targeted subsidies in balancing affordability with operational viability while maintaining service quality standards.

Keywords: Buy-The-Service Transit, Fare Modelling, Willingness To Pay, Ability To Pay, Public Transport Subsidy

INTRODUCTION

The global shift toward sustainable urban mobility has intensified the need for innovative public transport financing mechanisms that balance operational efficiency with social equity (Chen et al., 2023; Zhang & Li, 2024). Traditional fare-based systems, where operators bear revenue risks, often compromise service quality to maintain profitability, particularly in developing countries where ridership volatility and low fare affordability create financial instability (Kumar & Singh, 2022; Rodrigues et al., 2021). This operational challenge has catalyzed the adoption of Buy-the-Service (BTS) contracts, wherein governments procure transportation services at predetermined rates, decoupling operator revenues from fare collection and enabling service-focused performance metrics (Stumpf et al., 2024; Wang et al., 2023).

BTS models, also known as gross-cost contracts, represent a fundamental restructuring of transit governance by transferring demand risk from private operators to public authorities (Marques & Cunha, 2020). International evidence demonstrates BTS effectiveness in stabilizing service provision; London's bus network and Melbourne's tram system exemplify successful long-term BTS implementations (ITF-OECD, 2022). In developing contexts, Indonesia's national BTS rollout since 2020, particularly in Denpasar's Sarbagita system and Trans Bekasi corridors, illustrates the model's applicability to emerging Bus Rapid Transit (BRT) networks (Budiartha, 2022).

Despite growing BTS adoption, critical gaps persist in fare determination methodologies. Conventional approaches rely predominantly on vehicle operating costs (VOC) calculated through engineering formulas, which quantify per-kilometre expenses for fuel, maintenance, depreciation, and labour (Tamin, 2008). While VOC provides an operational cost floor essential for subsidy calculation, it neglects demand-side factors specifically, users' economic capacity (ATP) and perceived service value (WTP) that determine fare acceptability and ridership sustainability (Diab & Habib, 2023; Tirachini & Cats, 2020). Recent literature emphasizes that fare models must integrate both supply-side cost structures and demand-side behavioral economics to achieve financially viable and socially equitable outcomes (Cummings et al., 2025; Prakash et al., 2020).

Empirical studies reveal significant disparities between operational costs and user payment capacity in developing countries. Research on Indonesian BRT systems consistently identifies subsidy requirements exceeding 70% of operational costs when fares are constrained by ATP limitations (Humaira et al., 2024; Koconingrahayu & Aprianingsih, 2025). This affordability-viability gap underscores the necessity of evidence-based subsidy mechanisms. Furthermore, service quality dimensions including safety, comfort, reliability, and equity demonstrably influence user satisfaction and WTP, creating a feedback loop wherein quality investments can partially offset subsidy requirements through enhanced fare acceptance (Wang et al., 2020; Dabi, 2022).

The Buy-the-Service scheme implemented in Bekasi, Indonesia, provides a valuable case study for examining these dynamics. Trans Bekasi Patriot, operating the Vida Bantar Gerbang–Summarecon corridor, serves a diverse user base in a rapidly urbanizing region where public transport competes with private motorcycles and informal paratransit. The system's 67% load factor and mixed socioeconomic ridership profile present typical challenges faced by BTS systems in Southeast Asian cities: balancing cost recovery with affordability while maintaining service attractiveness. Previous studies on Indonesian BRT have analyzed ATP and WTP independently or focused solely on VOC calculations, but comprehensive models integrating satisfaction, ATP, WTP, and operational costs within a BTS framework remain underdeveloped.

This study addresses three critical research questions: (1) How do user satisfaction and ATP influence WTP in a BTS context? (2) What is the optimal fare structure that balances operational sustainability with user affordability? (3) What magnitude of public subsidy is required to maintain service viability under a service-oriented pricing model? By developing and validating a multiple regression model that predicts WTP as a function of satisfaction and ATP, this research provides a replicable framework for BTS fare determination applicable to similar transit systems in developing countries.

METHOD

This study employs a quantitative research design using primary survey data and secondary operational records. The research follows a structured analytical framework comprising four stages: (1) data collection through user surveys and operational cost documentation, (2) descriptive statistical analysis of ATP, WTP, and satisfaction variables, (3) multiple linear regression modeling to establish the WTP prediction equation, and (4) subsidy calculation based on the gap between operational costs and model-derived fares.

The research was conducted on the BisKita Trans Bekasi Patriot service, specifically the Vida Bantar Gerbang–Summarecon Bekasi corridor, a 34-kilometre BRT route serving suburban and urban zones in Bekasi City, West Java, Indonesia. Operational since 2020 under a BTS contract between Bekasi City Government and PT Bekasi Fajar Utama, the system operates 16 daily round-trip buses with a fleet of medium-capacity buses (capacity: 37 passengers per vehicle).

Sample size determination followed Slovin's formula with a 5% margin of error: $n = N / (1 + N \times e^2)$, where N = 450 daily users. The calculation yielded 212 minimum respondents, increased to 314 to account for potential non-response. Respondents were recruited using systematic random sampling at major boarding points during morning peak, midday, and evening peak periods across two weeks in September 2025. This temporal stratification ensured representation of diverse trip purposes and socioeconomic profiles.

A structured questionnaire comprising four sections was administered via face-to-face interviews: (A) demographic and socioeconomic characteristics (age, gender, occupation, monthly household income, trip purpose and frequency); (B) Ability to Pay (ATP) measurement, operationalized as the proportion of household income allocated to transportation following the Indonesian standard of 15% of income for transport expenditure (Tamin, 2008); (C) Willingness to Pay (WTP) measurement using the contingent valuation method with bidding games, where respondents were presented with incremental fare scenarios (IDR 3,000 to IDR 7,000) and asked to indicate their maximum acceptable fare; (D) User satisfaction measurement using a six-dimensional service quality framework (security, safety, comfort, affordability, equality, regularity) assessed on a 5-point Likert scale.

Operational cost data were obtained from PT Bekasi Fajar Utama's financial records and calculated using the Pacific Consultant International (PCI) method, the standard approach for Indonesian transit cost analysis. The PCI method disaggregates costs into fixed components (depreciation, insurance, crew salaries) and variable components (fuel, maintenance, tires) per kilometre and per trip.

Instrument validity was assessed using Pearson Product-Moment correlation, with all six satisfaction dimensions meeting validity criteria ($r > 0.361$, $p < 0.05$). Internal consistency reliability measured using Cronbach's alpha achieved $\alpha = 0.923$, substantially exceeding the minimum threshold of 0.70. Statistical analyses were conducted using IBM SPSS Statistics version 26 for regression modeling and Microsoft Excel for operational cost calculations.

The core analytical technique employed ordinary least squares (OLS) multiple regression to model WTP as a function of satisfaction and ATP: $WTP = \beta_0 + \beta_1(\text{Satisfaction}) + \beta_2(\text{ATP}) + \varepsilon$. Model assumptions were tested including multicollinearity (VIF and tolerance statistics), heteroscedasticity (residual plots), normality of residuals (Q-Q plots), and linearity (scatterplots). The required per-passenger subsidy was calculated as: Subsidy per Passenger = Operational Cost per Passenger - WTP(model).

RESULTS AND DISCUSSION

The study successfully surveyed 314 active users of the BisKita Trans Bekasi Patriot service. The age distribution shows predominance of young and middle-aged adults (15-35 years: 69.4%), with 36.3% aged 15-25 years, 33.1% aged 26-35 years, 17.5% aged 36-45 years, and 13.1% over 45 years. Gender distribution was relatively balanced (male 53.5%, female

46.5%). Occupational diversity reflected the corridor's mixed land use: private sector (25.5%), civil servants (22.6%), military/police (14.0%), students (12.7%), entrepreneurs (12.7%), and others (12.4%). Monthly household income ranged from IDR 0 to IDR 15,000,000, with a mean of IDR 6,070,853.50 (SD = IDR 2,950,918.70), positioning most respondents in Indonesia's lower-middle to middle-income categories.

Descriptive statistics for the three primary study variables revealed important patterns. Mean ATP of IDR 15,018.57 (SD = IDR 3,724.22) represents users' calculated economic capacity based on the 15% income-for-transport standard. The wide range (IDR 3.00 to IDR 25,000.00) reflects substantial income heterogeneity. Mean WTP of IDR 4,178.34 (SD = IDR 713.88) is substantially lower than mean ATP, indicating that users are willing to pay only 27.8% of their calculated economic capacity. The WTP distribution shows positive skewness (1.853) and high kurtosis (4.430), indicating that most respondents cluster around lower WTP values with a long tail of higher-WTP users.

Mean satisfaction score of 3.82 on a 5-point scale corresponds to "satisfied" but falls short of "very satisfied." Dimension-specific analysis revealed security (4.12) and safety (4.05) received the highest ratings, while affordability (3.42) and comfort (3.65) showed room for improvement. The relatively low standard deviation (0.54) suggests consensus among users regarding service performance.

The multiple linear regression model predicting WTP from satisfaction and ATP demonstrates statistically significant explanatory power. The F-statistic of 8.377 ($p < 0.001$) confirms that the model as a whole is statistically significant. The model $R^2 = 0.051$ indicates that these two predictors explain 5.1% of WTP variance, while the adjusted $R^2 = 0.045$ accounts for the number of predictors. While the R^2 value may appear modest, it is important to contextualise this finding within transportation pricing research, where WTP is influenced by numerous factors beyond satisfaction and ATP. The model's primary purpose is prediction rather than comprehensive explanation, providing a practical tool for estimating WTP based on readily measurable inputs.

The derived regression equation is:

$$\textbf{WTP} = \textbf{2,589.329} + (\textbf{256.865} \times \textbf{Satisfaction}) + (\textbf{0.030} \times \textbf{ATP})$$

The satisfaction coefficient ($\beta_1 = 256.865$, $p = 0.031$) indicates that for each one-unit increase in satisfaction score, WTP increases by IDR 256.87, holding ATP constant. This positive and significant relationship confirms that service quality improvements translate into higher fare acceptance. The standardized coefficient (Beta = 0.194) indicates that a one-standard-deviation increase in satisfaction leads to a 0.194 standard-deviation increase in WTP, suggesting that satisfaction is a meaningful but not dominant determinant of WTP.

The ATP coefficient ($\beta_2 = 0.030$, $p = 0.008$) indicates that for each IDR 1 increase in ATP, WTP increases by IDR 0.030, holding satisfaction constant. This small but highly significant coefficient reflects that users with higher economic capacity exhibit proportionally higher WTP. The standardized coefficient (Beta = 0.241) indicates that ATP has slightly stronger relative influence on WTP than satisfaction. The low elasticity (3% pass-through rate) indicates that even substantial ATP increases do not translate proportionally into WTP increases, likely because users benchmark public transport fares against competitive alternatives rather than their absolute economic capacity.

The Variance Inflation Factor (VIF) values for both predictors equal 1.097, well below the threshold of 10, and tolerance values equal 0.912, well above the 0.1 threshold, confirming the absence of problematic multicollinearity. Residual analysis revealed relatively constant error variance and approximate normality of residuals, satisfying key regression assumptions.

Using the regression equation with mean values (Satisfaction = 3.82, ATP = IDR 15,018.57), the model predicts WTP = IDR 4,021.11, which closely approximates the observed mean WTP (IDR 4,178.34) with a difference of only IDR 157.23 (3.8%), demonstrating good model calibration.

Operational costs were calculated using the Pacific Consultant International (PCI) method applied to the BisKita corridor's operational parameters. The per-kilometre cost of IDR 12,700.00 includes depreciation, fuel, maintenance, crew salaries, insurance, and administrative overhead. With a route length of 34 km, the cost per trip (ritase) reaches IDR 431,800.00. At the current load factor of 67% (25 passengers per 37-seat capacity), the per-passenger cost reaches IDR 17,060.20 per one-way trip.

This cost figure represents the minimum revenue required per passenger to achieve cost recovery without a profit margin. In a traditional fare-based system, this would necessitate a fare of IDR 17,060.20, clearly unaffordable given that it exceeds both mean WTP (IDR 4,178.34) by 308% and mean ATP (IDR 15,018.57) by 13.6%. This cost-affordability gap is the fundamental justification for BTS contracts with public subsidies.

The required subsidy per passenger is calculated as: **Subsidy per Passenger = IDR 17,060.20 - IDR 4,183.49 = IDR 12,876.71**

This per-passenger subsidy of IDR 12,876.71 represents 75.5% of the operational cost, meaning that user fares would cover only 24.5% of costs. While this subsidy proportion appears high, it aligns with international BTS practices. London buses operate with approximately 60-65% subsidy rates, while Indonesian BRT systems in Semarang and Yogyakarta report 70-80% subsidy requirements (ITF-OECD, 2022; Budiartha, 2022).

The subsidy calculation enables transparent budget forecasting. For the corridor serving 450 daily passengers: Daily Subsidy = 450 × IDR 12,876.71 = IDR 5,794,519.50; Monthly Subsidy = IDR 173,835,585.00; Annual Subsidy = IDR 2,115,099,617.50 (approximately IDR 2.12 billion). These figures provide Bekasi City Government with precise budget allocations for the BTS contract.

The significant positive relationship between satisfaction and WTP ($\beta_1 = 256.865$, $p = 0.031$) provides empirical support for service quality investments as a partial strategy to increase fare acceptance and reduce subsidy dependence. Each one-point satisfaction improvement increases WTP by approximately IDR 257, representing a 6.1% increase from the current mean WTP. This finding aligns with international evidence demonstrating that transit users value service attributes beyond basic mobility (Eboli & Mazzulla, 2007; Wang et al., 2020).

In the BTS context, where operators are not directly incentivised by farebox revenue, contract design must explicitly reward satisfaction improvements for example, through performance bonuses tied to user satisfaction surveys or service quality metrics (Stumpf et al., 2024). The dimension-specific satisfaction results suggest targeted improvement priorities: comfort enhancements (current mean: 3.65) through upgraded air conditioning and reduced crowding, and regularity improvements (current mean: 3.78) through real-time information systems and schedule adherence monitoring.

However, the modest magnitude of the satisfaction coefficient indicates that service quality improvements alone cannot close the cost-affordability gap. Even if satisfaction were maximized at 5.00, WTP would increase by only IDR 303 from the current mean—insufficient to approach cost-recovery levels. This mathematical reality underscores that public subsidies remain indispensable for BTS systems serving middle- and lower-income populations, regardless of service quality.

The ATP coefficient ($\beta_2 = 0.030$, $p = 0.008$) confirms that economic capacity influences WTP, but the low elasticity (3% pass-through) reveals that users do not translate increased income proportionally into higher public transport spending. This inelasticity likely reflects competitive benchmarking against alternatives (motorcycle operating costs, informal paratransit fares) and aspiration for private vehicle ownership as income rises. These findings challenge the assumption that economic growth alone will increase public transport fare acceptance.

The wide ATP range (IDR 3.00 to IDR 25,000.00) supports arguments for differentiated pricing or targeted subsidies. A uniform fare of IDR 4,183.49 represents 27.8% of mean ATP but could exceed 100% of ATP for the lowest-income users while being trivial for high-income users. Equity-oriented fare policies might include income-based concessions for low-income cardholders, students, the elderly, and persons with disabilities (Diab, 2023); distance-based pricing to reduce the burden on suburban residents (Koconingrahayu & Aprianingsih, 2025); and integrated ticketing with multi-modal passes (Humaira et al., 2024).

The subsidy calculation methodology developed in this study provides a transparent framework for BTS contract negotiations and budget allocation. Key contract design recommendations include: (1) cost-plus-fee structure where operators receive reimbursement for verified operational costs plus a fixed management fee; (2) performance-based adjustments with bonus payments tied to satisfaction targets; (3) load factor incentives with revenue-sharing mechanisms; (4) fare policy flexibility allowing government to adjust fares based on periodic ATP/WTP surveys; (5) subsidy escalation clauses for inflation and cost changes.

The 75.5% subsidy rate identified in this study positions Bekasi's BTS system within the international norm for socially oriented public transport. Rather than viewing this subsidy as excessive, policymakers should recognize it as the necessary investment to achieve policy objectives: affordable mobility, reduced traffic congestion, lower emissions, and social inclusion (Curl et al., 2024; Prakash et al., 2020).

Several limitations warrant acknowledgement. The model's modest R^2 (5.1%) indicates that numerous unmeasured factors influence WTP, including trip purpose, travel time, alternative availability, household structure, and behavioral factors. Future research should incorporate additional predictors to improve explanatory power. The cross-sectional design precludes causal inference; longitudinal or experimental designs would strengthen causal claims. Hypothetical bias in contingent valuation may overstate actual payment behavior; validation through pilot fare implementation would test model predictions. The single-corridor focus limits generalizability; replication across multiple corridors and cities is needed. Finally, the static load factor assumption should be relaxed to explore dynamic pricing strategies optimizing cost recovery across peak and off-peak periods.

CONCLUSION

This study develops and validates a comprehensive fare calculation model for Buy-the-Service public transport systems, demonstrating the integration of operational cost analysis, user satisfaction assessment, Ability to Pay measurement, and Willingness to Pay prediction through multiple regression analysis. Applied to the BisKita Trans Bekasi Patriot corridor, the research yields three principal findings with significant theoretical and practical implications.

First, the derived regression model WTP = 2,589.329 + (256.865 × Satisfaction) + (0.030 × ATP) establishes that both user satisfaction and economic capacity significantly influence fare acceptance ($F = 8.377$, $p < 0.001$). The satisfaction coefficient (IDR 256.87 per satisfaction point, $p = 0.031$) provides empirical evidence that service quality improvements translate into higher WTP, offering policymakers a quantifiable rationale for quality investments. The ATP coefficient (0.030, $p = 0.008$) confirms economic capacity's role while revealing low elasticity, indicating that fare acceptance is constrained by competitive alternatives and behavioral factors beyond absolute income.

Second, operational cost analysis reveals a fundamental affordability gap: per-passenger costs (IDR 17,060.20 at 67% load factor) exceed mean WTP (IDR 4,178.34) by 308%, necessitating a subsidy of IDR 12,876.71 per passenger (75.5% of operational cost) to maintain service sustainability while ensuring affordability. This subsidy magnitude aligns with international BTS practice and Indonesian BRT experience, confirming that substantial public funding is normative for socially oriented transit systems serving middle- and lower-income populations.

Third, the recommended fare of IDR 4,183.49, derived from the regression model at mean satisfaction and ATP, represents an evidence-based compromise between operational viability and user affordability. This fare closely approximates observed mean WTP, ensuring user acceptance while maintaining transparency in subsidy justification. The model's predictive accuracy (3.8% deviation) demonstrates practical utility for fare policy despite modest explanatory power.

The study's policy implications center on three strategic recommendations. First, BTS contracts should incorporate performance-based incentives tied to satisfaction targets, leveraging the demonstrated satisfaction-WTP relationship to align operator incentives with service quality. Second, subsidy programs should be differentiated by user group to enhance equity while controlling fiscal costs. Third, continuous monitoring through periodic ATP/WTP surveys and satisfaction tracking enables adaptive fare management responsive to changing conditions.

This research contributes to transit pricing literature by: (1) integrating supply-side cost accounting with demand-side behavioral economics in a unified framework; (2) quantifying the satisfaction-WTP relationship with statistical rigor; (3) delivering a transparent, replicable fare calculation methodology for BTS systems in developing countries; (4) validating the model in an operational Indonesian BRT corridor. As cities worldwide transition toward sustainable mobility, this study demonstrates that evidence-based transit finance integration is methodologically feasible and policy-relevant, providing a foundation for affordable, high-quality public transport in developing-country contexts where the need is most acute.

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