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Opportunity Cost of Limited Border-Crossing Services at the Temajuk–Telok Melano Corridor, Indonesia: A Defense-Economics Assessment

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Abstract: Indonesia reactivated the Temajuk Border Crossing Post (PLB Temajuk) on 21 August 2026, reopening the Temajuk–Telok Melano corridor. Services remain limited to pedestrian crossings by border residents, and the post has not yet attained full customs-area status or vehicle crossings. This study estimates the opportunity cost of this limited operationalization from a defense-economics perspective. Using a desk-based secondary valuation design, we combine a relatively calibrated gravity model—benchmarked to foreign-visitor flows at PLBN Aruk—with benefit transfer, a local output multiplier, and Monte Carlo simulation (200,000 draws). At a 50% realization penetration rate, median potential visits are 7,100 per year (P10–P90: 3,000–13,600). The associated foregone tourism foreign exchange is Rp9.0 billion per year (Rp3.7–17.9 billion), local output stimulus is Rp19.4 billion (Rp7.6–42.6 billion), and potential own-source revenue (PAD) for Sambas Regency is Rp266 million (Rp110–527 million). These estimates are conditional on assumptions about the share of local-oriented crossers and the relative attractiveness of Temajuk. The findings support gradual opening, risk-based customs management, and rupiah-based cross-border payment arrangements.

Keywords: Border Crossing Post; Border Tourism; Defense Economy; Local Revenue; Opportunity Cost

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A. Introduction

Contemporary defense concepts are no longer solely about military strength but also prioritize economic resilience as a primary defense, particularly along land borders

far from the seat of government. Studies on the management of Indonesia's land borders indicate that national policies tend to prioritize security, while local governments emphasize community welfare (Shergi Laksmono et al., 2026). Other regions with similar trends such as Vietnam and China have shifted from viewing borders as barriers toward fostering connectivity, though with openness that remains strictly controlled (Chu & Duong, 2024). In the border regions of West Kalimantan, there are isolated areas that must rely on neighboring countries for markets and basic necessities; obstacles along official routes can drive transactions toward unrecorded channels. Thus, the policy is not about choosing between security and the economy, but rather managing both in sequence.

Border areas are strategic spaces where the state exercises sovereign control while simultaneously providing economic opportunities for its residents. In the field of defense economics, the success of border management is not determined solely by the strictness of territorial control, but also by institutional capacity to ensure legal, safe, and sustainable economic activities. Su (2024) monstrates that the development of border tourism brings together the interests of security, mobility, and economic accumulation. Meanwhile, Gao et al. (2019) how that changes in border crossing regimes can reshape the relationships between the state, the market, and local communities.

The Temajuk–Telok Melano Corridor connects Temajuk Village, Paloh Subdistrict, Sambas Regency, West Kalimantan, with the Telok Melano area in Sarawak, Malaysia. On August 21, 2026, the National Border Management Agency (BNPP) reactivated the Temajuk Border Crossing Post (PLB) along with the Telok Melano Border Control Post (PKS) based on a bilateral border crossing agreement (Antara News, 2026). However, according to the research document on which this article is based, the initial phase of operations remains focused on border residents and does not yet include vehicle crossings or customs functions equivalent to those of a main post. Thus, the administrative opening has not automatically resulted in fully functional economic connectivity.

Under ideal conditions, the government would have established symmetrical border crossing points (BCPs) on both sides of the border, with a clear legal basis and adequate customs, immigration, and quarantine (CIQ) services for people, vehicles, and goods. Effective facilitation has been shown to influence trade flows among ASEAN countries, particularly through the reduction of non-tariff barriers and institutional coordination (Thu & Thanh, 2021). Geographical distance and institutional barriers constrain tourist flows, while local cultural proximity can encourage them (Li et al., 2024). For Temajuk, ideal conditions mean reducing institutional barriers without weakening 2 oversights, so that residents can gain legal market access and conduct transactions recorded in rupiah. Within the framework of the defense economy, the measure of a checkpoint's success is not based solely on the number of crossers, but rather on the extent to which the checkpoint transforms the border from a vulnerable peripheral space into a government-monitored economic hub.

According to the Department of Statistics Malaysia (2025), the potential tourist flow and economic valuation of the Temajuk recreational corridor based on the calibration of foreign national arrival data at the Aruk Border Crossing Point (PLBN) for the period January - August 2026 amount to 24,093 travelers (an average of 3,011 travelers per month) after accounting for the normalization of transit weights to Singkawang and Pontianak (AAruk = 2.20A_{Aruk} = 2.20AAruk = 2.20) and adjustments to the mid-market exchange rate. Meanwhile, according to Bank Indonesia (2026), the exchange rate is Rp4,343 per 1 MYR, which increases the valuation of foreign exchange spending, demographic data from the Department of Statistics Malaysia (DOSM) regarding the population of the Lundu Administrative District (33,479 people) and the Kuching Division (678,021 people excluding Lundu), as well as estimates of tourist spending patterns based on the 2024 Domestic Tourism Survey. The potential number of visits and economic losses resulting from the closure of the border post were modeled on an annual and monthly scale. Since some model parameters could not be identified from the data, the following two graphs present the median simulation results for three penetration test points (p = 20%, 50%, and 80%).

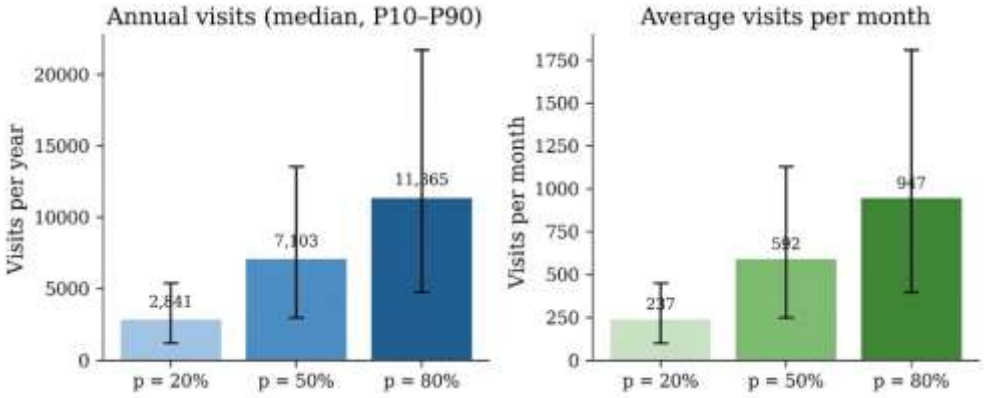


Figure 1. Bar Chart of Potential Tourist Visits (Annual and Monthly) Simulation Median (line: P10–P90)

Source: Processed by the Department of Statistics Malaysia (2025)

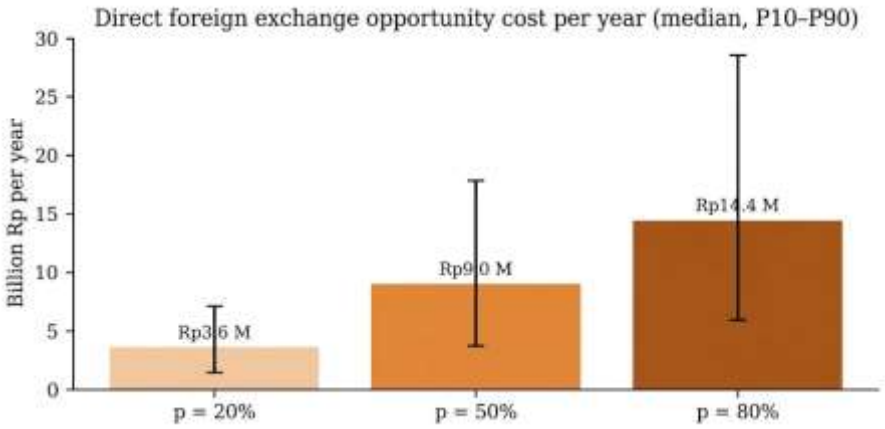


Figure 2. Bar Chart of Direct Foreign Exchange Opportunity (Fiscal Loss) – Simulation Median (line: P10–P90)

Source: Processed by the Department of Statistics Malaysia (2025)

The figure shows the relationship between the probability level (p) and the estimated opportunity cost of direct foreign exchange per year measured in billions of rupiah. The median value increases with the rise in probability, namely Rp3.6 billion at p = 20%, Rp9.0 billion at p = 50%, and Rp14.4 billion at p = 80%, with the range of uncertainty indicated by the error lines (P10–P90). Academically, this graph illustrates that the higher the likelihood of cross-border economic activities or tourist visits, the greater the potential foreign exchange earnings that can be generated, while also showing the value fluctuation variations that reflect the risks and uncertainties in the annual economic estimates.

Based on field officer data from August to early October 2026, a total of 542 Border Crossing Pass documents have been issued to residents of Paloh District. There were 172 Indonesian citizens recorded as departing to Malaysia and 108 citizens returning, while there have been no Malaysian citizens crossing (Bank Indonesia, 2026). Currently, PLB Temajuk does not yet have the status of a full customs area like the established official PLBN. The flow of incoming goods is only permitted for Indonesian citizens (WNI) who are local residents using the Cross-Border Identity Card (KILB) issued by Customs, where its utilization is still very minimal (recorded 9 people in August, 64 people in September, and 12 people in the first week of October 2026). The crossing of two-wheeled and four-wheeled vehicles cannot yet be accommodated due to limited office facilities, the unavailability of inspection lane layouts, the absence of X-ray scanners, and the status of the post not yet being a full customs area. Thus, the reactivation has occurred formally, but its economic function has not yet been operational (Jakarta Newspaper, 2026).

For border residents, official connectivity is also linked to transaction costs, the predictability of travel procedures, and market choices. Shifting economic activities toward formal border crossings can improve record-keeping and open up business opportunities, but these effects cannot be assumed to occur automatically. Travel decisions are influenced by the attractiveness of the destination, the ease of obtaining documents, transportation options, and time costs. Therefore, the potential for activity in this corridor must be explicitly assessed within a range of uncertainty. This study does not treat every person crossing the border as a tourist, nor does it equate the possibility of increased visits with a guaranteed increase in national foreign exchange earnings. These conceptual limitations are necessary to ensure that economic arguments in defense of the border do not exceed the scope of available evidence. This is evident in the Smokol trade on Sebatik Island, which residents view as an activity in a gray-zone border area rather than a security threat (Sarjono et al., 2022).

The gap between physical connectivity and institutional readiness is significant because demand for cross-border travel is influenced by distance and administrative barriers. Rosselló-Nadal & Santana-Gallego (2024) found that national borders continue to influence international tourism flows, while their ther study indicates that visa requirements can suppress tourism mobility (Rosselló & Santana-Gallego, 2024) Shao et al. (2024) highlight the influence of geographic and administrative distance on

tourist flows. These findings provide a theoretical foundation for examining the potential delayed economic benefits at pioneer border posts such as Temajuk.

Studies on the Kalimantan border generally examine major border posts such as Entikong, Aruk, and Badau, or focus on border diplomacy (Purnama & Iswardhana, 2022). Meanwhile, economic assessments of pioneer border posts oriented toward tourism services are not yet available. Studies in Russia and Kazakhstan show that the potential for cross-border tourism is realized very unevenly across regions (Tanina et al., 2022). This study fills that gap through a scenario-based assessment of opportunity costs, rather than a measurement of actual losses. Three research questions are posed: what is the potential number of visitors from Sarawak to Temajuk; what are the hypothetical unrealized amounts of tourism spending, local output, and local government revenue; and how can these results be used to design a border opening that still protects defense interests? The novelty lies in the combination of benchmark post calibration, uncertainty simulation, and the interpretation of defense economic policy in the newly reactivated corridor.

B. Methods

This study employs a descriptive quantitative design in the form of a secondary economic valuation without a primary survey. Key information includes the number of foreign nationals crossing at the Aruk Border Crossing Point (PLBN), the population of their regions of origin in Sarawak, overland travel distance, tourist expenditures, the ringgit-to-rupiah exchange rate, and fiscal indicators for Sambas Regency. This design is intended to establish an initial scenario when observations of foreign tourists passing through the Temajuk Border Crossing Point are not yet sufficient for causal econometric estimates. Therefore, the results should not be interpreted as definitive projections of what will occur after full opening.

The calibration input in the draft manuscript is 24,093 foreign nationals crossing at the Aruk Border Crossing Point (PLBN) from January through August 2026. Linear extrapolation yields 24,093 × 12/8 = 36,139.5, or approximately 36,140 crossers per year. This data is derived from records provided by the author of the initial draft and has not been found in any official statistical 5 publications accessible to the public. The reference population is based on the 2020 Malaysia Census, including the 33,479 residents of Lundu (Department of Statistics Malaysia, 2022). The model road distances follow the parameters from the original manuscript: Kuching–Aruk 95 km; Lundu–Aruk 35 km; Kuching–Temajuk 138 km; and Lundu–Temajuk 52 km. All distances are treated as a road network approximation, not the results of new geodetic measurements.

The relative gravity model is expressed as $V_{pot} = V_{Aruk} \times \Theta \times (M_{Temajuk} \div M_{Aruk})$, where $M = Pop_1 \div D_{1e} + Pop_2 \div D_{2e}$, the parameter s is the proportion of Aruk travelers oriented toward local destinations, r is Temajuk's relative attractiveness relative to Aruk's local area, and e is the distance decay elasticity. The formula previously written as "A_Aruk = 2.20 A_Aruk" has been removed because it is

tautological. The factor 2.20 is explicitly stated as an assumption regarding the ratio of total Aruk travelers to locally oriented travelers; thus, in the baseline scenario, $s = 1/2.20 \approx 0.4545$. This factor is not an identified field statistic.

The assumed number of realized visits is $V = p \times V_{pot}$, where p represents a penetration scenario of 20%, 50%, or 80%. The parameter p is not randomly selected and does not represent a statistical probability. Potential uncaptured tourism spending is defined as $B = V \times E \times ER$, where E is the average expenditure per trip in MYR and ER is the rupiah exchange rate per MYR. The baseline value of E, MYR234, is derived from Malaysia's 2024 domestic tourism statistics, while the baseline exchange rate of Rp4,343/MYR is taken from calculations in the initial draft using Bank Indonesia's exchange rate series. This inter-regional transfer of values assumes similarities in tourist profiles that have not been directly tested (Department of Statistics Malaysia, 2025); (Bank Indonesia, 2026).

The gross local output stimulus is calculated as $\Delta Y = k \times B$, where k is tested within the range of 1.2–3.333. This multiplier factor is a scenario parameter, not a Sambas-specific input output coefficient. The illustrative local revenue component is calculated as $PAD = 0.10 \times \delta \times B + Rp10{,}000 \times V$, where δ represents the proportion of expenditures assumed to be covered by taxable items. The second component can only be classified as local fees if the taxable items, rates, collectors, and payment procedures have a valid legal basis; privately managed levies are not considered PAD. Thus, PAD should not be equated with lost local government cash revenue.

Using Aruk as a comparison point requires caution in interpreting the parameters. Aruk has a different network of travel destinations, so the observed number of travelers cannot be directly transferred to represent demand for Temajuk. The coefficient s reduces the likelihood of irrelevant transit, while r represents relative preferences for coastal tourism, culinary experiences, or social visits. Neither has been estimated based on tourist choices. The assumption of independence among parameters in the initial sampling may also be unrealistic, as destination attractiveness may be related to travel costs and spending profiles. Therefore, the model's external validity is lower than its arithmetic validity; application for decision-making requires new evidence on destination choices.

Uncertainty was examined using the results of 200,000 Monte Carlo simulations reported in the source paper, with parameters s, r, e, spending, exchange rates, multipliers, distance, and the base tax rate tested across a range of assumptions. This analysis retains the summary of results from the original paper; it does not claim to have reproduced the entire simulation since the internal code and data files were not included. The median and the 10th and 90th percentiles (P10–P90) describe the conditional output distribution of the model, not empirical confidence intervals. Sensitivity is assessed by comparing variations in a single parameter as well as alternative designs for the combined parameter draw $\Theta = s \times r$.

Table 1. Scenario Parameters and Value Sources

Notation	Variable	Empirical Value	Reference Source	Explanation and Justification
WN A_{Aruk}	Realization of foreign travelers at Aruk PLBN	24,093 people (Jan–Aug 2026)	Author's information source (unpublished data; informant identity withheld)	Real data for eight months at the nearest post; annualized to 36,140 people/year ($24,093 \div 8 \times 12$).
ER	MYR/IDR Middle Transaction Exchange Rate	IDR 4,342.60 per MYR (rounded to IDR 4,343)	Bank Indonesia, Transaction Exchange Rate Calculator (Jan–Sep 2026)	Arithmetic mean of nine monthly data points in 2026 (January: 4,174.46 to September: 4,376.38).
Pop 1	Population of Kuching Division excluding Lundu	678,021 inhabitants	DOSM Malaysia, Census 2020	The 2020 Census recorded 711,500 inhabitants for Kuching Division including Lundu (33,479 inhabitants). Greater Kuching (770,000) is used as the upper bound for testing.
Pop 2	Population of Lundu & Sematan	33,479 inhabitants	DOSM Sarawak (Population Census 2020)	The figure of 35,000 inhabitants is used as the upper bound of the test range.
D1, D2	Overland road network distance	138 km & 52 km (to Temajuk); 95 km & 35 km (to Aruk)	Public Works Department (JKR) & GIS Google Maps	Pan-Borneo Highway route: Kuching–Temajuk (138 km / ~2.2 hours); Lundu–Temajuk (52 km / ~50 minutes).
E	Average expenditure per tourist per trip	MYR 234 (baseline); range MYR 220–381	DOSM, Domestic Tourism Survey 2024 and DTS (States) 2024; processed (Section 2.2.1)	Baseline: estimated daily travel expenditure in Sarawak. Lower bound: national daily expenditure. Upper bound: average for all Sarawak trips (including overnight stays).
MPC lokal	Local Marginal Propensity to Consume	0.70	Statistics Indonesia (BPS) Sambas Regency, Sambas Regency in Figures 2025	Conservative assumption. The value of 0.80 in the previous draft was not successfully verified from the BPS portal and needs rechecking in the publication.
Δ	Proportion of expenditure subject to PBJT (tax base)	0.274 (range 0.162–0.274)	DOSM, DTS 2024 Table 6	Accommodation 11.2% + food & beverages 16.2% = 27.4% (upper bound). Food & beverages only 16.2% (lower bound, day-trippers).
K	Local output multiplier	1.2–3.333	Researcher's assumption; upper bound derived from MPC 0.70	The upper bound refers to $1 \div (1 - 0.70) \approx 3.333$.
P	Realization penetration	0.2; 0.5; 0.8	Test points	Not randomized; output is linear with respect to p.

Source: data from the Department of Statistics Malaysia (2025), processed by the researcher

According to (Law Number 1 of 2022 on Financial Relations Between the Central Government and Regional Governments, 2022), foreign exchange opportunity costs are calculated as Loss = V × E × ER, where E is spending per tourist and ER is the exchange rate. The local output stimulus is calculated as ΔY = k × Loss. Potential local revenue consists of the Tax on Certain Goods and Services (PBJT) amounting to 10% × δ × Loss, plus a destination fee of Rp10,000 per visitor. The multiplier k is tested within the range of 1.2–3.333. The upper bound is derived from 1 ÷ (1 − MPC) with MPC set at 0.70 (assumption), while the lower bound accounts for import leakage. According to Nowak & Sahli (2025), this can alter the impact of tourism expansion on real income. The benefit transfer method transfers tourist spending values from an existing survey (DTS 2024) to the study location, thereby eliminating the need for a primary survey, the risk is price level differences in Temajuk, which are discussed in the limitations section.

Uncertainty Test

All parameters in Table 1 were simultaneously and independently sampled from a uniform distribution 200,000 times, and the results were reported as the median with a P10–P90 range, which are the 10th and 90th percentiles. This range illustrates the distribution of the model results based on the reported assumptions, not a statistical confidence interval. As a comparison, the pairs s and r were replaced with a single uniform draw Θ in the range of 0.125–1.8. One-parameter sensitivity and Spearman rank correlation are used to identify the sources of uncertainty. This calculation uses Python and NumPy (PCG64 generator, seed 20261010). A uniform distribution was chosen because there is no information about the most likely value within the range; this choice is not entirely neutral, so it was tested with a comparative design. Opportunity cost here means the potential benefits that are not captured, not the measured losses. This interpretation aligns with the literature that views travel restrictions as a large-scale economic disruption for the tourism (Gössling et al., 2021). All the raw data used is sourced from authoritative references as summarized in Table 2.

Table 2. Parameters, Baseline Values, and Test Ranges

Parameter	Baseline Value	Test Range	Source status
S (local orientation)	0,4545	0,25–0,60	Researcher's assumption (≈ 1 ÷ 2,20)
r (relative attractiveness)	2,50	0,5–3,0	Researcher's assumption
e (distance decay)	1,2	1,0–2,0	Researcher's assumption
E (MYR per tourist)	234	220–381	Transfer from DOSM 2025
ER (IDR per MYR)	4.343	4.174–4.440	Historical value of the document, requires export from BI
K (local multiplier)	3,333	1,2–3,333	Researcher's assumption
P (realization penetration)	0,5	0,2; 0,5; 0,8	Fixed scenarios, not probabilities

Source: Processed by the researcher (2026)

C. Results and Discussion

Results

Potential Visits

For potential visits with base values of s = 0.4545, r = 2.5, and e = 1.2, the initial model yields approximately 26,136 potential visits per year before accounting for penetration factors. At p = 50%, the deterministic result is approximately 13,068 visits. In contrast, the Monte Carlo simulation yields a median of 7,100 visits per year, with a P10–P90 range of 3,000–13,600. This discrepancy is mathematically reasonable because an evaluation based on a single combination of parameters is not identical to the median output from many combinations of parameters. A median of approximately 7,100 visits is equivalent to 592 visits per month, but the actual distribution may not be uniform due to weekends and holiday seasons. Tourism Office (2025) The accommodation occupancy rate in Sambas Regency was recorded at 23.56% in 2024, so room capacity at the median flow does not appear to be a constraint, although seasonal spikes and the specific capacity of Temajuk are not yet reflected in these figures. The simulation also provides a P10–P90 range of 3,000–13,600 for annual visitation potential before factoring in realization, indicating a wide margin of uncertainty. The order of magnitude is 26,136 potential visits per year, below Aruk's flow of 36,140 per year, which makes sense since Temajuk is a stopover destination without onward travel to major cities.

According to the Bank Indonesia (2026) report using a relatively calibrated gravity model, the parameters in Table 2, and the mid-rate of Bank Indonesia (average Rp4,343/MYR), the simulation results of visits and foreign exchange losses at three penetration test points are presented in Table 3. Each cell reports the median with a P10–P90 range from 200,000 Monte Carlo draws. The line "s, r uniform" is the main design and the line "Θ uniform" is the comparison design.

Table 3. Simulation Results of Visits and Foreign Exchange Losses per Penetration Test Point and Drawing Design

P	Design	Visits/year median (P10–P90)	Average/ month median	Average /weekend median	Vehicles/ weekend median	Foreign exchange (MYR million) median (P10–P90)	Foreign exchange loss (IDR billion/year) median (P10–P90)
20%	s, r uniform	2.800 (1.200–5.400)	233	54	18	0,8 (0,4–1,7)	3,6 (1,5–7,1)
20%	Θ uniform	3.900 (1.200–7.000)	325	75	25	1,1 (0,4–2,2)	4,9 (1,5–9,3)
50%	s, r uniform	7.100 (3.000–13.600)	592	137	46	2,1 (0,9–4,2)	9,0 (3,7–17,9)
50%	Θ uniform	9.700 (2.950–17.600)	808	187	62	2,8 (0,9–5,4)	12,2 (3,7–23,3)
80%	s, r uniform	11.400 (4.800–21.700)	950	219	73	3,4 (1,4–6,6)	14,4 (6,0–28,6)
80%	Θ uniform	15.500 (4.700–28.200)	1.292	298	99	4,5 (1,4–8,7)	19,5 (6,0–37,3)

Source: Bank Indonesia (2026)

Note: Median and range P10–P90 from Monte Carlo simulation. Vehicles per weekend are estimated with an occupancy of 3 people per vehicle; the average weekend is calculated as annual visits ÷ 52, assuming all visits occur on weekends. Rounding: visits to the nearest 100, monthly average to 10, and foreign exchange to 0.1 million.

Opportunity Cost of Foreign Exchange, Local Output, and Local Government Revenue

Opportunity cost of tourism spending. At p = 50%, the deterministic value can be calculated directly: 26,136 × 0.50 × MYR234 × Rp4,343 ≈ Rp13.28 billion per year, rounded to Rp13.3 billion. This figure is the result of a base-case calculation, not the Monte Carlo median. The reported Monte Carlo median is Rp9.0 billion per year, with a P10–P90 range of Rp3.7–17.9 billion. The reference to the deterministic value as "around the 75th percentile" has been removed, as percentile placement requires verification against the raw simulation distribution. 's term "fiscal loss" has also been changed to "potential uncaptured tourism spending" because tourist spending is not government tax revenue.

Table 4. Simulation Results per Penetration Test Point (median; P10–P90 in parentheses)

P	Visits per year	Foreign exchange (Rp billion per year)	ΔY (billion IDR per year)	PAD (Rp million per year)
20%	2.800 (1.200–5.400)	3,6 (1,5–7,1)	7,8 (3,0–17,0)	106 (44–211)
50%	7.100 (3.000–13.600)	9,0 (3,7–17,9)	19,4 (7,6–42,6)	266 (110–527)
80%	11.400 (4.800–21.700)	14,4 (6,0–28,6)	31,0 (12,2–68,2)	426 (177–844)

Source: processed by the researcher (2026)

Note: 200,000 Monte Carlo draws. The median of PAD components cannot be summed to obtain the total median.

Overall, at a 50% penetration rate, the Sambas Regency Government's cash loses independent revenue with a median of around Rp266 million per year (P10–P90: Rp110–527 million), which should be allocated to fund the maintenance of border streetlights, tourism environmental sanitation, and integrated security post facilities.

The Tourism Office (2026) performance report records realized revenue from restaurant taxes of Rp6,575.8 million, hotel taxes of Rp855.5 million, entertainment taxes of Rp471.7 million, lodging fees of Rp38.0 million, and recreation and sports facility fees of Rp51.8 million, for a total of Rp7,992.9 million in local revenue from the tourism sector, or 2.65% of the total local revenue of Rp301,165.4 million.

Table 5. Comparison of Temajuk's PAD Potential with the 2025 Tourism PAD Realization in Sambas Regency

Comparison	2025 Realized Value (IDR million)	Temajuk Median Potential p=50% (IDR million)	Percentage of Potential to Realization
Total tourism sector Local Revenue (PAD)	7.993	266	3,3%
Restaurant tax	6.576	PBJT: 193 (portion of restaurant PBJT)	2,9% (PBJT)
Recreation and sports venue Retribution	52	Retribution: 71	137% (exceeds regency realization)
Total Local Revenue (PAD) of Sambas Regency	301.165	266	0,09%

Source: processed by the researcher (2026)

Note: This comparison is indicative because the potential of Temajuk is an estimate and the realization of the district includes all regional tax objects. The retribution figure needs to be read carefully because the Rp10,000 per visitor rate has not yet been verified against the regional regulation.

Local output and PAD. Using a multiplier model, the median gross output stimulus under the 50% scenario is Rp19.4 billion per year (P10–P90: Rp7.6–42.6 billion). This figure represents economic output related to initial spending and subsequent transaction cycles, not additional net income for the community. Since the output value already includes the impact of direct spending, summing Rp19.4 billion and Rp9.0 billion as two separate benefits risks double-counting. Nowak & Sahli (2025) show that the relationship between imports, production linkages, and welfare resulting from tourism expansion is more complex than the simple leakage assumption.

Local government revenue (PAD) at a 50% penetration rate is reported to have a median of Rp266 million per year (P10–P90: Rp110–527 million). In the source manuscript, this figure derives from an illustrative PBJT of approximately Rp193 million and a visitor fee component of approximately Rp71 million. However, the Rp71 million cannot yet be directly categorized as local revenue because the Rp10,000 rate basis and the status of its collection have not been verified. Thus, the estimate of Rp266 million should be interpreted as a conditional PAD scenario; the PBJT component also remains dependent on the specific objects and effective rates stipulated in local regulations. The Sambas Regency Tourism Office's Performance Report notes that the 2025 PAD from the tourism sector amounts to Rp7.993 billion out of a total PAD of Rp301.165 billion; thus, the Rp266 million scenario represents approximately 3.3% and 0.09% of each respective benchmark (Tourism Office, 2026).

Sources of Uncertainty and Sensitivity Analysis

Uncertainty and sensitivity. The main results are relatively sensitive to the proportion of Aruk travelers who are indeed local (s) and the relative attractiveness of Temajuk (r), while exchange rate changes within the test range have a much smaller effect on spending values. In the comparison draw design, when $\Theta = s \times r$ is drawn uniformly, the median potential spending at p = 50% rises to Rp12.2 billion (P10–P90: Rp3.7–23.3 billion). When the spending range is limited to day trips, the median drops to Rp6.9 billion. These differences indicate that the model's output depends on the prior specification and transfer values. Therefore, the results are best used as order-of-magnitude information rather than revenue figures ready to be incorporated as budget targets. Comparing these figures with the regional budget also requires fiscal discipline. Although the illustrative PAD figure appears significant when compared to tourism-related PAD, the denominator is revenue from the entire Sambas Regency, not just Temajuk. The estimated tourism spending includes expenditures that may economically occur at untaxed businesses, informal businesses, or suppliers from outside the regency. Furthermore, regional revenue depends on compliance, oversight, and the settlement of transactions, not merely on the volume of spending. To avoid excessive optimism, policy priorities should be directed toward improving business record-keeping, identifying official tax collectors, and evaluating actual performance over a sufficiently long operational period. New PAD targets should only be set once transaction data and clear collection regulations are available.

Table 6. Single-Parameter Sensitivity at 50% Penetration (base value of Rp13.3 billion)

Parameter	Test Range Foreign	Exchange at Lower Bound (IDR billion)	Foreign Exchange at Upper Bound (IDR billion)
r (relative attractiveness)	0,5–3,0	2,7	15,9
s (local orientation share)	0,25–0,60	7,3	17,5
E (spending per tourist)	MYR 220–381	12,5	21,6
e (distance decay)	1,0–2,0	14,3	9,8
Distance from Kuching to Temajuk	117–159 km	15,7	11,5
ER (exchange rate)	Rp4.174–4.440	12,8	13,6
Pop 1 and Pop 2	See Table 1	13,3	13,3

Source: processed by the researcher

Note: δ and k do not directly affect the exchange rate. Asymmetric results because the base value is not the midpoint of the range.

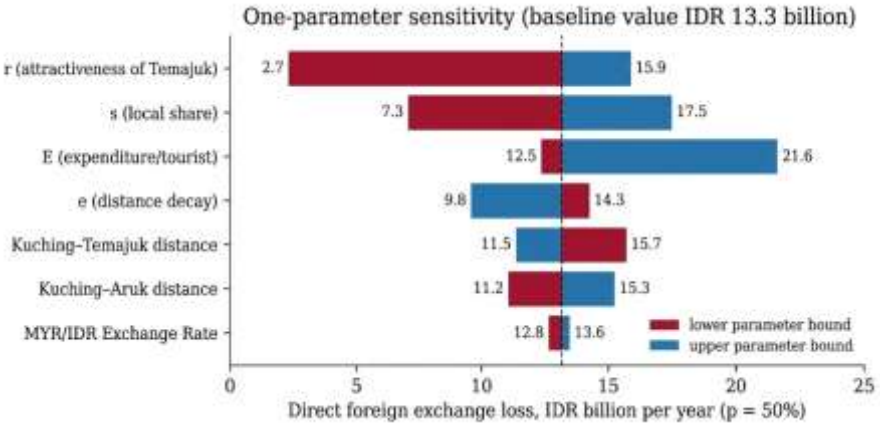


Figure 3. Sensitivity of One Parameter to Direct Foreign Exchange Loss (50% Penetration)

Source: Processed by the researcher (2026)

Discussion

Implications for the defense economy. These findings show that border barriers have potential economic consequences, but the magnitude of the benefits is not yet a sole basis for accelerating border opening. Gozgor et al. (2019) found that institutional quality and legal certainty are positively associated with inbound tourism. In the context of Temajuk, relevant recommendations include phased operations based on bilateral agreements; the readiness of immigration, customs, and quarantine officials; risk-based inspection procedures; and the separation of passenger services from freight transport. The opening of vehicle crossings should be based on the adequacy of routes, equipment, and oversight, rather than solely on projected visitor numbers.

Formal reactivation is not yet synonymous with economic function

Checkpoints that have been built but are limited to passenger crossings have the potential to b become unproductive assets. Their capital costs are sunk and therefore irrelevant to operational decisions; what is relevant are additional operational costs such as CIQ personnel, scanners, and maintenance, which are not covered in these estimates. Therefore, this article is not a cost–benefit analysis. Experience from the Russia Kazakhstan border region shows that tourism potential is realized when there is coordinated government support (Tanina et al., 2022). The absence of Malaysian travelers at Temajuk may reflect a lack of parity in service readiness, documentation, and information on the Sarawak side, although the exact cause cannot yet be determined from the available data. Accelerating operations therefore requires an assessment by comparing the range of benefits outlined above against the additional operational costs a topic for a subsequent cost–benefit analysis.

This asymmetry in bilateral readiness transforms the national border into a rigid institutional barrier (Sohn, 2014). From the perspective of border defense, the prolonged delay in the operationalization of the Temajuk PLB has hindered the transformation of the area from a vulnerable frontier to a resilient growth pole. The

economic resilience of local residents is the most fundamental layer of non-military defense. The absence of legal crossing gates forces residents' economic interactions to remain on informal paths that are vulnerable to non-procedural practices.

Customs: Facilitation and Security

As a frontline institution at the land border, the Directorate General of Customs and Excise (DJBC) through KPPBC TMP C Sintete faces a classic dilemma between facilitating the smooth flow of tourism (tourism facilitation) and enforcing fiscal border protection (border protection) (Widdowson, 2007);(Cuyvers & Zhou, 2011). The projection of around 7,100 at a 50% penetration rate (P10–P90: 3,000–13,600). At the median, the flow of about 137 tourists and 46 vehicles per weekend is not significant. However, opening the border without screening poses risks of smuggling narcotics, illegal excisable goods, and protected wildlife, while cumbersome manual inspections could deter tourists. Such a flow allows for a phased opening: monitoring can begin with travelers and their personal belongings, then be expanded to vehicles once lane layouts and scanners are in place. Evidence from ASEAN indicates that non-tariff barriers and institutional coordination determine the volume of trade flows (Thu & Thanh, 2021). Therefore, the Directorate General of Customs and Excise needs to implement risk 13 management, pre-arrival electronic declarations using QR codes, the separation of green and red lanes, and non-intrusive scanners before vehicle crossings are opened.

Cumbersome manual customs inspections risk triggering travel friction, degrading the interest of tourists in Sarawak, and reducing the calculated potential foreign exchange. On the other hand, the opening of border gates without an intelligent filtration system has the potential to create space for the entry of asymmetric threats, such as the smuggling of narcotics, psychotropics, and precursors (NPP), illegal excise goods (cigarettes and alcoholic beverages without excise stamps), prohibited and restricted goods, as well as protected wildlife. Therefore, the DJBC at PLB Temajuk needs to implement a technology-based Risk Management System, integrate the filling of the Electronic Customs Declaration (e-CD) based on QR codes before arrival, and place non-intrusive inspection x-ray scanners. By separating the green lane for general tourists and the red lane for in-depth inspections, the functions of facilitation and customs protection can operate in balance.

Monetary Sovereignty

The median foreign exchange of MYR 2.1 million per year at a 50% penetration (P10–P90: MYR 0.9–4.2 million) poses a latent risk to the country's currency sovereignty. Flowing into villages without official currency exchange outlets poses a risk of using cash ringgit in daily transactions, whereas Law Number 7 of 2011 mandates the use of rupiah in transactions within the territory of Indonesia (Law Number 7 of 2011 on Currency. State Gazette of the Republic of Indonesia Year 2011 Number 64, 2011). This risk is potential and has not been measured in this article. The mitigation includes providing official non-bank foreign exchange businesses (KUPVA BB) or bank cash

offices, as well as expanding cross-border QRIS with a Local Currency Settlement scheme so that merchants' funds are recorded in rupiah. This attention is important because tourists from Sarawak bring ringgit, which has a strong purchasing power against the rupiah (Rp4,343 per MYR), making the incentive to transact in foreign currency real. To anticipate this risk post-PLB operations, two integrated interventions are needed:

1. Provision of Official Currency Exchange Facilities: Establishing official Non-Bank Foreign Exchange Business Activities (KUPVA BB) outlets or assigning state-owned bank cash offices in the PLB Temajuk area under the supervision of Bank Indonesia and Customs.
2. Acceleration of Cross-Border Digital Payment Penetration: Encouraging the adoption of QRIS Cross-Border (Indonesia-Malaysia interconnection) through the Local Currency Settlement (LCS) scheme among all culinary traders, accommodations, and tourism services in Temajuk. Through this system, Malaysian travelers pay using their Ringgit banking applications, but the funds received by local business operators are automatically converted and deposited into Rupiah accounts, thereby closing the gap for the circulation of illegal foreign cash.

Border Diplomacy and Regional Planning

Purnama & Iswardhana (2022) indicate that the Malindo Soc-Econ Forum and the Joint Indonesia-Malaysia Forum have helped resolve border and illegal trade issues, but the development of border posts still faces shortcomings. These findings support the use of these forums to agree on a phased, limited-crossing scheme—such as weekend windows with mobile CIQ units—before permanent facilities are ready. Since the article's results are presented as a range, these figures are better suited to indicate the order of magnitude of the benefits rather than as a single, definitive figure.

Payment policies need to be positioned as part of the monetary resilience of border regions. Bank Indonesia has implemented the Indonesia–Malaysia cross-border QRIS system, enabling payments via participating apps to be converted and accepted by Indonesian merchants in rupiah (Bank Indonesia, 2025). Improving merchant financial literacy and access to formal payment service providers in Temajuk can increase transaction recording, although this study does not measure the use of cash ringgit or informal transaction practices. Furthermore, the success of tourism should be assessed based on the distribution of benefits to local businesses, not merely on visitor numbers (Dolezal & Novelli, 2022);(Cheer et al., 2019).

From an investment decision-making perspective, the costs already incurred to build the checkpoint are sunk costs and do not, in and of themselves, justify the addition of facilities. The launch of vehicle services, for example, may require inspection lanes, non-intrusive screening, maintenance, additional personnel, and coordination on the Malaysian side. The optimal operational choice must weigh the marginal benefits of each phase against its marginal costs and the impact of manageable risks. The analysis in this article does not present both sides in a balanced manner; therefore, it should

not be used to conclude that full opening is more efficient than limited opening. A phased approach also allows for an evaluation of actual demand before larger capital expenditures are approved. Thus, the economic findings serve as input for defense decisions, not as a substitute for security assessments and fiscal feasibility analyses.

Limitations

The model relies on a single calibration point that cannot be verified through open-access publications, an eight-month time horizon without seasonal adjustments, and differences in the characteristics of Aruk cross-border travelers and potential Temajuk tourists. Malaysian domestic expenditure statistics may also not accurately reflect the spending of Malaysian visitors in Indonesia. The model has not estimated additional operational costs, losses due to a shift away from domestic destinations, or the net impact on national foreign exchange earnings. Therefore, these results constitute a conditional opportunity cost analysis, not a comprehensive cost–benefit evaluation or causal evidence that PLB restrictions result in economic losses equal to the median simulation value. The formal reactivation of the Temajuk PLB has not yet been followed by full economic functionality. At a 50% penetration rate, the estimated opportunity costs have a median of Rp9.0 billion per year for tourism foreign exchange earnings (Rp3.7–17.9 billion), Rp19.4 billion for local output stimulus, and Rp266 million for potential local revenue (PAD) for Sambas Regency. These figures are contingent on the share of locally oriented cross-border travelers and Temajuk's relative attractiveness. Policy recommendations include a phased limited-crossing scheme through bilateral forums, a risk-management-based customs system, the expansion of cross-border payments in rupiah, and verification of tax and fee rates prior to their use in planning.

D. Conclusions

This study shows that the reopening of the Temajuk–Telok Melano Border Crossing Point on August 21, 2026, does not in and of itself eliminate cross-border economic barriers. Based on a gravity model calibrated against the Aruk Border Crossing Point (PLBN), the potential number of visitors under a 50% penetration scenario has a median of 7,100 people per year (P10–P90: 3,000–13,600). Hypothetically unaccounted-for tourist spending is estimated to have a median of Rp9.0 billion per year (Rp3.7–417.9 billion), accompanied by a stimulus to local gross output of Rp19.4 billion (Rp7.6–42.6 billion) and illustrative local government revenue of Rp266 million (Rp110–527 million). The deterministic baseline value of Rp13.3 billion cannot be equated with the Monte Carlo median of Rp9.0 billion. All results represent conditional scenarios, not measurable losses or guaranteed revenues that will be obtained once the facility opens. From a defense economics perspective, the primary benefit of strengthening the PLB is an increase in opportunities for legal and documented transactions without reducing the state's ability to regulate the movement of people and goods. The practical implications include the phased opening of services through Indonesia–Malaysia coordination, the implementation of risk-based customs inspections, the preparation of vehicle infrastructure in

accordance with monitoring standards, and the expansion of cross-border payment systems that generate revenue in rupiah for local merchants. Local governments need to verify the items and rates of the Border Crossing Service Fee (PBJT) and other levies before using estimates of local government revenue (PAD) in their planning. Future research should integrate open-border crossing data from both sides of the border, surveys on the purposes of visits and expenditures by Sarawak tourists, verification of distances and service capacities, as well as calculations of personnel and facility costs and potential revenue leakage. Collecting this data will enable the development of a replicable model and a more robust net benefit analysis that can serve as a sound basis for public investment decisions. Phased measurements are also necessary to distinguish increases in transactions resulting from legal border crossings from activities that merely shift routes. Thus, decisions to add facilities can be based on evidence of actual benefits and costs, rather than solely on simulated potential figures.

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F. Author Contributions

Dede Rismawan contributed to the design concept and implementation of the research, analysis of the results, and writing of the final manuscript. Ivan Yulivan and Sri Iswati were involved in planning and supervising the work, processed the data, performed the analysis, drafted the manuscript, and designed the figures. Ivan Yulivan developed the theory and verified the analytical method. Sri Iswati investigates and supervises the findings of this study. All authors discussed the results and contributed to the final manuscript.

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H. Data availability

All data generated or analysed during this study are included in this published article.

I. Declarations

Ethics approval and consent to participate

The study was approved by the Ethics Committee of the Universitas Pertahanan, West Java, Indonesia. No participants in this study.

J. Competing Interests

The authors declare no competing interests

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