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The Push-Pull Effects of Expressways: The Case of TPLEX for Baguio City, Philippines

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Abstract

This study investigates the impact of the Tarlac-Pangasinan-La Union Expressway (TPLEX) on the tourism industry of Baguio City, Philippines. By analyzing historical trends in tourist arrivals and expressway development, the study establishes a strong correlation between increased accessibility and heightened visitor influx. Findings indicate that expressway openings reduced travel time and stimulated continuous tourism growth, even beyond traditional peak seasons. These results confirm the role of expressways in overcoming the friction of distance and illustrate their push-pull effects on urban mobility. The study highlights the need for integrated planning to mitigate potential congestion and suggests further research on employment shifts and regional migration patterns.

Keywords: Expressways; Tourism; Friction of Distance; Time-Space Convergence

1. Introduction

There is a huge literature that discusses the effects of expressways in overcoming the friction of distance. This has been repeatedly demonstrated in many case studies. One of which is the situation for places that are considered tourist destinations that are experiencing huge numbers of tourist arrivals to a point where there is a growing concern among local residents due to congestion not only during vacation period but also during weekends on a regular period or season. There is a growing belief that this was attributed to the opening of the expressways that made travel between the origin and destination cities shorter. This is the subject of this paper using the case study of the TPLEX opening that made the difference to travelling between the Metropolitan Manila and Baguio City. This paper will investigate if there is indeed a correlation between the opening of the expressway, particularly the TPLEX, in the increase in the tourist arrivals in the tourist destination city (see Figure 1).

Baguio City, Philippines, often called the "Summer Capital of the Philippines," is a premier tourist destination known for its cool climate, scenic mountain landscapes, and vibrant cultural heritage. Nestled in the Cordillera Central Mountain range at approximately 1,540 meters above sea level, the city offers breathtaking views of pine-covered hills, lush gardens, and picturesque valleys.

Tourists flock to Baguio for its refreshing weather, especially during the summer months when temperatures in the lowlands soar. Baguio is also a cultural hub, home to the indigenous Cordilleran communities, whose traditions are reflected in local crafts, festivals, and cuisine. The annual Panagbenga Festival, or Flower Festival, is a major draw, featuring grand parades and street dances celebrating the city's floral abundance.

1.1 Transportation Context of Baguio City

Baguio City, located approximately 246 km north of Metro Manila, has traditionally relied on a national public road named MacArthur Highway for connectivity. Before the TPLEX development, travel between Manila and Baguio took around 6–8 hours via congested roads. The majority of visitors originated from Metro Manila and neighboring regions such as Central Luzon (north of Metro Manila) and CALABARZON (south of Metro Manila), often using intercity bus services and private vehicles. These regions including Metro Manila is the concentration of people in the country where the spread effects of development and urbanization from the capital region spillover. These transportation modes faced capacity constraints and frequent delays, especially during peak seasons (vacation and long weekends due to holidays). With the introduction of Subic-Clark-Tarlac Expressway (SCTEX) and eventually TPLEX, expressway infrastructure enabled smoother and faster access. However, a formal study

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on modal share changes is lacking. Preliminary government reports suggest that more than 70% of tourists still rely on road-based modes, with a gradual shift toward private car use due to travel time reductions and toll efficiency.

2. Scope and Objectives

This study seeks to investigate the multifaceted relationship between expressway infrastructure and regional tourism development, with a particular focus on the Tarlac-Pangasinan-La Union Expressway (TPLEX) and its influence on Baguio City. Specifically, it aims to examine the correlation between the construction and operationalization of TPLEX and the observed increase in tourist arrivals in the city. The research also assesses how enhanced accessibility and reduced travel time have reshaped tourism dynamics across the region, potentially redistributing visitor flows and altering travel behavior. Furthermore, the study explores the "push-pull" mechanisms by which expressways affect urban mobility and destination attractiveness, offering insights into how transport infrastructure can simultaneously facilitate outbound movement and stimulate inbound tourism demand.

3. Review of Relevant Literature

The development of expressways plays a critical role in shaping economic activity, tourism, and population movement in different regions. Several studies have examined the correlation between expressways and destination attractiveness, focusing on economic impacts, accessibility improvements, and demographic shifts.

Expressways are widely recognized as economic catalysts, enhancing regional accessibility and promoting investment opportunities. A study by Komori et al. (1998) applied Benefit Incidence Analysis to assess how improved transport networks influence local economies, showing that regions connected by expressways experience higher economic growth due to reduced logistics costs and increased business activities. The presence of expressways enables agglomeration effects, wherein businesses and industries cluster around key transport corridors, further stimulating economic development.

Figure 1 Map of Major Expressways in Luzon: TPLEX, SCTEX, NLEX, and SLEX

The impact of expressways on tourism is another widely studied area. Several researchers emphasize that expressway connectivity reduces travel time and costs, thereby making destinations more attractive to tourists. This

is particularly relevant for regions relying on domestic visitors, as seamless transportation networks encourage short-term travel and weekend tourism. The study by Mabazza and Tamura (2010) on toll-free expressways in Japan observed that making expressways free resulted in a higher influx of travelers, boosting local tourism-related businesses such as hospitality, food services, and leisure activities.

Figure 2 Map of the Tarlac-Pangasinan-La Union Expressway (TPLEX) with Sections and Interchanges

The expansion of expressways significantly influences population mobility and settlement patterns. The study by Allen and Sangler (1981) introduced a self-organization model to explain how expressways shape urban migration. Their model suggests that improved transport infrastructure contributes to a "push-pull effect", where people move toward urban centers due to better job opportunities, amenities, and reduced commuting costs.

4. Limitations of the Study

This study was limited by the availability and completeness of data. Tourist arrival figures were only available on an annual basis, which constrained the analysis of monthly or seasonal variations. The AADT (Annual Average Daily Traffic) data for TPLEX were not fully obtained due to limited time for data collection and coordination with concerned agencies. As a result, the study relied on partial data from selected exits and years (2020–2024), restricting the depth of correlation analysis between vehicle flow and tourist arrivals.

Additionally, the study used secondary data without accounting for other influencing factors such as fuel prices, toll rate changes, local events, and post-pandemic recovery effects. The absence of detailed travel mode and demographic data also limited behavioral insights. Future research should secure more comprehensive datasets and longer observation periods to strengthen the analysis and validate the expressway's long-term impact on regional tourism

5. Methodology

5.1 Research Design

This study employs a quantitative research approach to examine the correlation between expressway development and tourist arrivals in Baguio City. A longitudinal study design is used to analyze historical trends in tourism data and expressway developments over time. The research will utilize statistical modeling and time-series

analysis to assess the relationship between expressway expansion, accessibility improvements, traffic volume, and changes in tourist volume.

5.1.1 Data Collection

Two primary datasets will be analyzed:

1. Tourist Arrival Data – This dataset serves as the dependent variable, reflecting the number of visitors to Baguio City.
2. Expressway Data – This includes information on expressway openings, expansions, travel time reductions, toll policies, and traffic volume data to capture usage intensity and access levels. These variables will serve as independent factors in analyzing their effect on tourism dynamics.

a. Dependent Variable: Baguio City Tourist Arrivals

- Source: City Government of Baguio
- Data Type: Monthly or annual tourist arrivals
- Coverage Period: At least 10 years (to capture trends before and after major expressway developments)
- Variables Collected: Total tourist arrivals, Domestic vs. international visitors, Seasonal variations (e.g., peak and off-peak seasons)

b. Independent Variables: Expressway Infrastructure Data

- Source: Toll Regulatory Board (TRB), Expressway Operators (e.g., Private Infrastructure Development Corporation or PIDC)
- Key Expressways Considered: Tarlac–Pangasinan–La Union Expressway (TPLEX) – Primary route to Baguio
- Variables Collected: Expressway opening and expansion timelines (e.g., interchange openings), Travel time reductions from Manila to Baguio, Toll policy (toll rates or toll-free periods), Traffic volume data (e.g., Annual Average Daily Traffic per segment) – to represent actual expressway utilization, particularly during peak tourist seasons

5.2 Operationalizing the Push-Pull Framework

The concept of 'push-pull' effects in transport and tourism studies refers to two complementary forces: 'push' factors, which compel people to leave their place of origin (e.g., congestion, stress, climate), and 'pull' factors that attract them to a specific destination (e.g., cooler weather, festivals, scenic landscapes). In this study, we used the correlation between tourist arrivals and vehicle throughput at TPLEX exits, particularly Rosario, to validate this framework. Expressways reduce travel time (push from city), while Baguio's climate and culture attract (pull to periphery). The strong statistical relationship between traffic and tourism demonstrates how these effects operationalize through infrastructure.

This study confirms that expressway infrastructure such as TPLEX significantly contributes to the tourism growth of Baguio City. Findings revealed a strong correlation between Annual Average Daily Traffic at TPLEX exits—especially Rosario—and increased tourist arrivals. The expressway's travel time reductions and direct access to highland roads have operationalized the push-pull framework, where urban residents are 'pushed' from congested centers and 'pulled' toward accessible, appealing destinations. These findings are consistent with the self-organization and time-space convergence models described in prior transport studies (Allen & Sangler, 1981; Yamaguchi et al., 1990). Future studies should examine regional employment shifts and migration to deepen our understanding of expressway-induced mobility changes.

6. Results and Discussion

The series of opening the expressways initially by the addition of SCTEX (Subic Clark Tarlac Expressway) in 2008 decreased the friction of distance (or the time cost) between the Manila and Baguio corridor since the segment provided an alternative route for faster travel. The staggered opening of TPLEX (Tarlac Pangasinan La Union Expressway) in November 2013 until the Rosales interchange that moved closer the alternative route to the destination. This resulted in the continuous increase in the tourist arrival until the year 2018 when it peaked at 1,760,729 tourist arrivals (see Figure 2) along with the opening of the Binalonan interchange in the year 2016 and the Pozorrubio interchange in the year 2017 (see Figure 3). This confirms the positive correlation between the additional openings of the interchanges that are closer to the destination and the increase in the number of tourist arrivals in the destination. There was a slight decrease in the year 2019 that is a little more than the year 2017 level

for unverifiable reasons and a drop in the year 2020 when the pandemic started in spite of the opening of the Rosario interchange (the latest and the closest to the destination) that opened on 15 July 2020.

The concluding period of the pandemic in the year 2022 resulted in the dramatic increase and steep slope between 2021 and 2022 tourist arrival which reached the level slightly lower than the pre-pandemic year of 2015. The year 2023 reached the level that is slightly higher than the year 2016 and the last year 2024 reached the level that is higher than the years 2017 and 2018 levels. Upon observation, there is a tendency that it is reaching the peak year of 2019 if all other factors remain constant (see figures 2 and 3).

Figure 3 Baguio City Tourist Arrival (2011-2024)

Table 1 presents the Annual Average Daily Traffic (AADT) counts for northbound traffic at selected exits along the Tarlac–Pangasinan–La Union Expressway (TPLEX) from 2020 to 2024. The data reflects a clear upward trend in vehicle volume across the Rosario, Pozorrubio, Binalonan, and Sison exits, key interchanges for motorists en route to Baguio City via Marcos Highway and Kennon Road.

The Rosario Exit, being the last exit of TPLEX and the nearest to Baguio, recorded a dramatic increase in AADT from 250,617 in 2020 to nearly 2 million in 2024. This suggests that Rosario has become the dominant egress point for tourists and private vehicles heading to Baguio, likely due to its direct access to both Marcos Highway and Kennon Road, the two primary mountain roads leading to the city. Notably, Rosario Exit's AADT surged by over 680% in just four years, a strong indicator of post-pandemic travel recovery and growing road dependence for leisure trips to the highlands.

Similarly, traffic volumes at Binalonan Exit increased significantly from 183,005 in 2020 to 412,429 in 2024, while Pozorrubio Exit, though experiencing a dip in 2021, recovered steadily, reaching 169,036 in 2024. The upward trend at these exits reflects their strategic role as alternate approaches to the city, especially during times when Rosario becomes congested.

The Sison Exit, while still posting the lowest traffic figures among the four, displayed notable growth from 17,178 in 2020 to 148,549 in 2024, suggesting that even peripheral exits are seeing increased use. This uptick may be attributed not only to local tourism and alternate route diversions but also to the presence of popular stopover establishments in the Sison area that cater to both buses and private vehicles. These rest areas and roadside eateries serve as key breakpoints for meals, refreshments, and refueling before travelers continue their ascent to Baguio via Marcos Highway or Kennon Road. As such, Sison functions as a strategic pause point, enhancing the overall travel experience and encouraging continued usage of this exit despite it being slightly more distant from the city proper.

Table 1 TPLEX Annual Average Daily Traffic (AADT) Northbound

Toll Plaza	2020	2021	2022	2023	2024
	Northbound	Northbound	Northbound	Northbound	Northbound
Rosario Exit	250,617	798,669	1,544,612	1,878,848	1,962,804
Sison Exit	17,178	101,382	184,122	166,041	148,549
Pozzorubio Exit	531,349	113,875	141,851	161,544	169,036
Binalonan Exit	183,005	209,778	362,647	405,261	412,429

6.1 Correlation Between Vehicle Volume and Tourist Arrivals

Figure 3 illustrates the correlation between northbound vehicle volume at the Rosario Exit of TPLEX and annual tourist arrivals in Baguio City over the 5-year period from 2020 to 2024. A clear positive relationship is observed between the two variables, indicating that increases in vehicle throughput through the Rosario Exit are strongly associated with higher tourist inflows into the city.

Notably, the trend line (dotted) demonstrates a strong linear correlation, with the slope suggesting that Baguio's tourist arrivals tend to rise proportionally with the volume of vehicles entering through the Rosario Exit—recognized as the closest expressway access point to the city. This reflects how improvements in regional accessibility translate into greater tourism activity, particularly post-2020 when mobility restrictions began to ease.

The significant jump in both traffic and tourist numbers between 2021 and 2022 supports the hypothesis that expressway use is a key predictor of tourism demand. The dip in tourist arrivals in 2021 despite high traffic suggests the presence of pandemic-related travel hesitations, but the sharp rise afterward reinforces the pent-up demand for leisure travel once conditions normalized.

This correlation further validates the push-pull effects framework, where the reduction in travel time and road friction (enabled by the expressway system) "pulls" visitors to upland destinations like Baguio, especially on weekends and holidays. The Rosario Exit thus acts not only as a physical gateway but as a quantifiable mobility indicator directly tied to tourism flows.

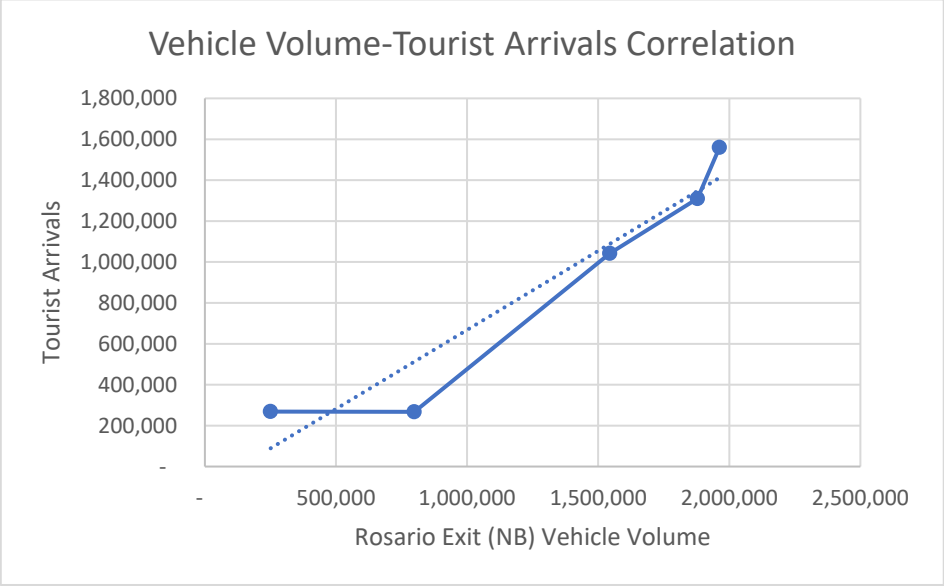

Figure 4 Vehicle Volume – Tourist Arrivals Correlation (Rosario Exit (NB)

Figure 4 illustrates the correlation between tourist arrivals in Baguio City and the northbound traffic volumes at four key TPLEX exits: Sison, Pozorrubio, Binalonan, and Rosario—from 2020 to 2024. The tourist arrivals line (yellow) is plotted against the traffic volume data for each exit to examine how closely each location aligns with visitor influx trends.

A clear pattern emerges showing that exits closest to Baguio, especially Rosario Exit, have the strongest positive correlation with rising tourist arrivals. The Rosario Exit, located at the northern terminus of TPLEX and directly feeding into Marcos Highway and Kennon Road, shows a steep upward trend aligned with Baguio's increasing tourist arrivals. This correlation affirms its role as the primary gateway to the city for private vehicles and tour

buses. The area around Rosario also features several bus stopovers, rest areas, and food establishments, making it an ideal final stop before the ascent to Baguio. These amenities likely encourage higher usage, especially for long-distance travelers.

The Binalonan Exit, also used as an alternative access point via local roads, shows moderate correlation and consistent growth in traffic volume. This supports its function as a secondary route for both regional traffic and leisure travelers, especially during congestion on Marcos Highway.

The Pozorrubio Exit, despite a strong start in 2020, exhibits a weaker and even declining correlation with tourist arrivals in the latter years. This might reflect shifting traveler preferences toward exits closer to Baguio or the opening of newer interchanges. Additionally, Pozorrubio's connectivity to the mountain roads may not be as direct or time-efficient compared to Rosario.

Sison Exit, while posting the lowest traffic volume, has shown a steady increase in use and maintains a gentle upward trend. The presence of bus and private car stopovers in the Sison area may partly explain this growth, as it serves as a rest-and-refresh point for motorists before heading to Baguio's upland terrain.

Overall, the figure confirms that proximity to Baguio and the presence of rest facilities are key factors influencing expressway exit choice. The closer the exit is to Baguio City, the more strongly its vehicle volume correlates with tourist influx—underscoring the importance of last-mile infrastructure and traveler convenience in shaping mobility behavior.

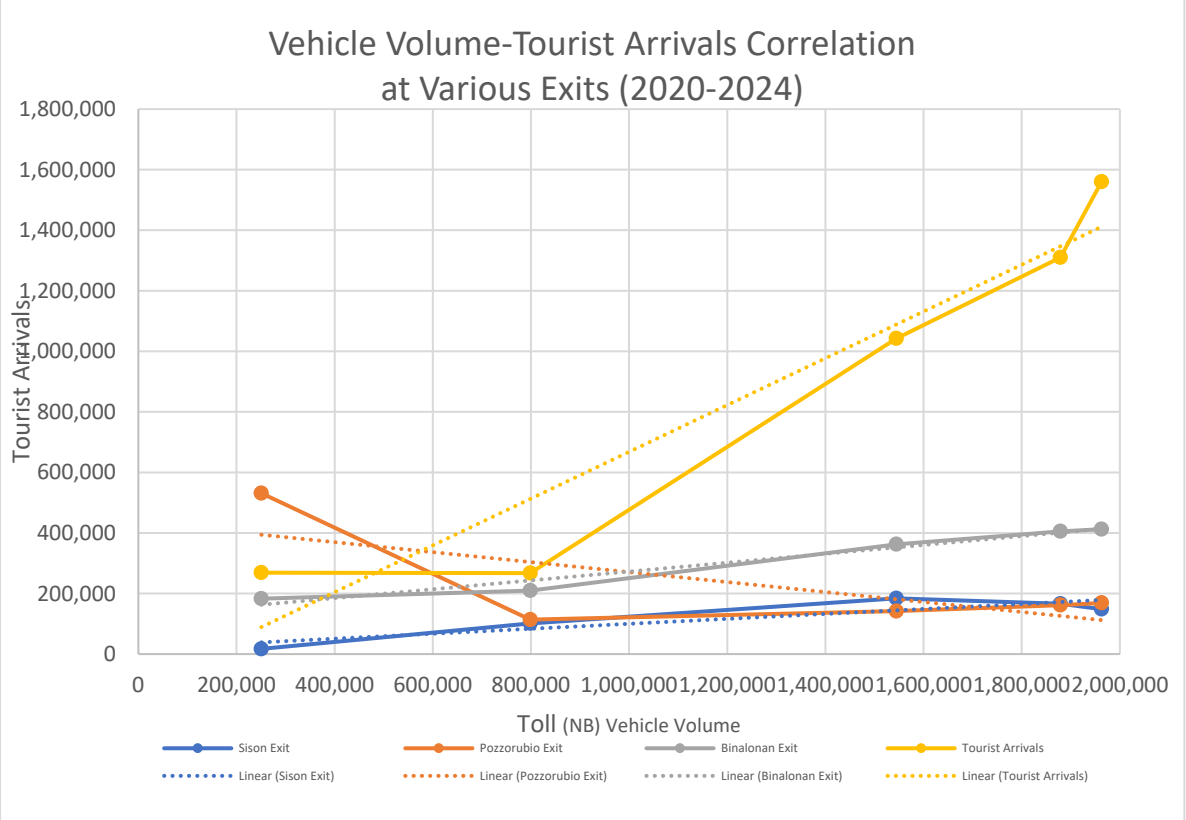

Figure 5 Vehicle Volume-Tourist Arrivals Correlation at Various Exits (2020-2024)

6.2 Travel Time

The completion of the Tarlac–Pangasinan–La Union Expressway (TPLEX) brought a substantial reduction in travel time between Metro Manila and Baguio City. Prior to TPLEX, motorists relied on the MacArthur Highway, a national road prone to congestion and frequent slowdowns due to urban settlements and mixed traffic conditions.

6.2.1 Travel Time Comparisons

Pre-TPLEX (via MacArthur Highway): Estimated travel time from Manila to Rosario, La Union (the terminus of TPLEX and gateway to Baguio) ranged between 5 to 6 hours, or longer during peak seasons.

Post-TPLEX (via Expressway): Travel time was projected to decrease to approximately 3.5 to 4 hours with the completion of the TPLEX segments, particularly between Tarlac City and Rosario.

According to the DPWH Feasibility Study conducted prior to project implementation: *"The construction of the TPLEX will reduce travel time from Tarlac City to Rosario, La Union from 3.5 hours to about 1 hour. This 2.5-hour reduction is expected to improve connectivity, reduce vehicle operating costs, and increase access to tourism and commercial centers in Northern Luzon."— DPWH Feasibility Study for the Tarlac-Pangasinan-La Union Expressway Project, 2007*

This projection emphasized the critical role of travel time savings in improving economic efficiency, encouraging tourism, and facilitating interregional movement. The study further justified user willingness to pay toll fees in exchange for faster, more reliable travel.

5.2.2 Value of Time: Users Substituting Money for Time

The expressway's success also reinforces a key behavioral insight in transport economics: travelers are willing to substitute money for time savings. By choosing TPLEX over free but slower alternatives like MacArthur Highway, motorists—especially tourists—demonstrate a clear preference for faster and safer routes. This is particularly relevant in leisure travel, where the value of time is often heightened by the limited duration of holidays or weekends.

The same feasibility study also indicated that:*"The value of time savings was a major component in the cost-benefit analysis, and was used to justify the investment through reduced travel time for private vehicles, buses, and freight carriers."*

Pre-construction feasibility studies for TPLEX projected strong time-saving and economic development benefits, especially for the northern Luzon corridor. These studies estimated:

- Increased vehicle throughput (over 20,000 vehicles/day),
- Greater efficiency in logistics and tourism travel,
- Enhanced regional competitiveness for provinces along the route.

7. Conclusion

The result of the correlation between the openings of the expressways along with the staggered openings that comes closer to the destination, and the increase in the number of tourist arrivals in next years illustrated the push from the populous national capital region where administrative, business and commerce, and employment are concentrated to the pleasure periphery that pulls them in this tourist destination. It further validates the observation and impression among the locals of the destination that the expressways made it easier for the tourists to move to this popular destination that high tourist arrivals are not only felt during holidays, and long breaks but also during weekends during ordinary weeks. It fortifies the concept of Time-Space Convergence was achieved in overcoming the friction of distance. Hence the push and pull effects were operationalized by the expressway openings.

The inclusion of employment, population changes, and gravity models that illustrate regional movement should be included in the improvement of this paper.

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