



# DOMESTIC MIGRATION PATTERNS AND THEIR IMPACT ON TRANSPORTATION CONGESTION IN THE PHILIPPINES

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## ABSTRACT

This study examines the relationship between domestic migration, economic growth, and transportation congestion in the National Capital Region (NCR) of the Philippines from the year 2012 to 2018. It utilizes a quantitative correlational research design which analyzes secondary data through an Ordinary Least Squares (OLS) regression model. The methodology involves the operationalization of Transport Congestion Index (TCI) based on vehicle density, accident rates, and Annual Average Daily Traffic. Results have indicated that Cumulative Domestic Migration and Regional GDP growth significantly increase transportation congestion, while population growth rate shows a negative relationship with congestion levels. The findings suggest that infrastructure development must address cumulative structural demand rather than just immediate population increases.

**Keywords:** *Domestic Migration, Transportation Congestion, Urban Carrying Capacity, Economic Growth, National Capital Region*

## INTRODUCTION

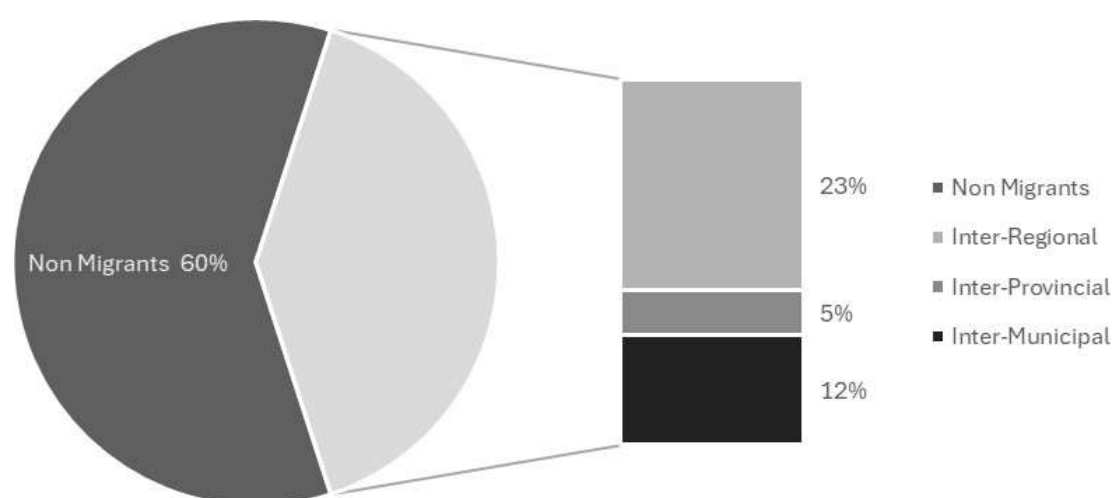
The Philippines for the longest time has been suffering from a prevailing economic issue called transportation congestion. Domestic migration patterns from provincial to urban areas is a current trend being observed due to various opportunities. Domestic migration can also add to urban congestion as the influx of migrants increases the demand for social services and puts pressure on already scarce resources. The latest TomTom index (2024) showed three Philippine cities are among the most congested; having a high congestion level, average travel time, and time lost. Davao City, Manila, and Caloocan rank 3rd, 27th, and 39th in congestion in the world while ranking 8th, 14th, and 26th in the traffic congestion index respectively. (See Table 1.0)

**Table 1.0: 2024 TomTom Traffic Index**

World Rank	City	Average Travel Time	Change From	Congestion Level %	Time Lost Per Year at Rush	Congestion World Rank
8	Davao City	32 min 59s	-30s	49%	136 Hours	3
14	Manila	32 min 10s	-30s	42%	127 Hours	27
26	Caloocan	30 min 4s	-20s	41%	111 Hours	39

Statista had also reported that in 2024 the capital city of Manila ranked the highest among Southeast Asian capitals. Changes in socioeconomic factors might result in frequent disruptions and traffic, which can significantly increase commuting time, fuel consumption, and vehicle exhaust emissions where Choudhary et al., (2022) discussed that traffic jams have a negative effect on the environment and society in terms of economic loss, disease load, and climate change. While Démurger, (2015) discussed that labor migration is typically seen as advantageous for the family that remains. Remittance transfers can improve the long-term wellbeing of households in the sourcecountry by easing budgetary limitations and increasing spending on healthcare and education. However, non-migrants, such as spouses, children, or the elderly, may also suffer as a result of the migrant's absence. For family members who do not relocate, separating families has a number of negative repercussions on social status, health, education, and the response of the labor supply. According to the National Migration Survey conducted in 2018, 46,252 have experienced migration with 40.1% being lifetime migrants; 23% being inter-regional migrants, 5% being inter-provincial migrants, 12% being inter- municipal migrants. (See Figure 1.0)

**Figure 1.0**  
2018 National Migration Data



This economic problem in the country arises and many Filipinos bear the negative effects of it. Exploring the relationship of domestic migration and how it affects urban congestion requires defining concepts, indicators, and relationships of variables.

Sokido, (2024) defined Urban congestion as characterized by a traffic volume that is greater than the road network's capacity, which results in slower travel times, longer travel durations, and traffic jams. It occurs when the supply of roads is not keeping up with the demand for traffic, which causes delays and disturbs the normal flow of traffic. Urban congestion in the country can be measured by the Transport Urban Carrying Capacity, which is defined by Guzman et al., (2021) is the maximum traffic volume that a transit system can handle without becoming congested. Understanding how well urban areas can handle rising car numbers and population densities is essential, especially in nations like the Philippines that are urbanizing quickly. The combination of domestic migration's beneficial and detrimental effects on urban congestion draws attention to a complicated situation. Migration can boost infrastructure development and economic growth, but it also makes traffic worse by increasing traffic volumes and population density. Policymakers and urban planners face a difficult task as a result of this dual effect which is juggling the positive effects of migration with the need to control its negative effects on urban systems. The sustainability of metropolitan regions is in jeopardy if these problems are not effectively addressed, which could result in increased pollution, lengthier commutes, and a worse standard of living for locals. Promoting sustainable and livable cities in the Philippines is crucial to comprehend and lessen the detrimental consequences of domestic migration on urban congestion.

Domestic migration as defined by Surve et al., (2022) which is the movement of individuals within a country from one location to another, typically driven by various factors such as economic opportunities, education, and family connections. Brown & Tousey, (2021) Established a positive relationship on how increased domestic migration can lead to economic growth in urban areas, which prompt investments in infrastructure development that alleviate congestion over time. The influx of people creates demand for services and infrastructure improvements that help manage congestion effectively. Surve et al., (2022) Established a negative relationship established is that domestic migration leads to higher population densities in urban areas, which result in increased traffic volumes and exacerbate congestion problems. The influx of migrants contributes directly to the number of vehicles on the road during peak hours.

Economic opportunities are frequently cited as reasons for migration (University of the Philippines Population Institute, 2022), there is a lack of knowledge about how particular economic issues affect migration trends, which in turn affect urban congestion. Linking economic factors to urban traffic problems and migration trends requires more thorough investigation.

Investigating the relationship between domestic migration patterns and urban congestion in the Philippines is the aim of this study, with an emphasis on the ways in which migration affects the urban carrying capacity. This study looks at the dynamics of rural-to-urban migration in order to pinpoint the main causes of these migrations and how they affect large cities' levels of traffic. "How do domestic migration patterns affect urban congestion in the Philippines, and what implications do these effects have for urban planning and transportation policy?". Through a comprehensive analysis of demographic data, transportation metrics, and policy frameworks, this research contributes valuable insights that can inform effective strategies for managing urban congestion in the context of ongoing domestic migration trends.

This study fills important research gaps in the current literature by examining the relationship between domestic migration patterns and urban congestion in the Philippines, a topic that has received little attention. A comprehensive understanding of the socio-economic elements influencing migration and their direct effects on urban mobility is provided by this research, which methodically examines how migration affects urban congestion through urban carrying capacity. It offers a fresh perspective that bridges the gap between theoretical frameworks and practical applications. In addition to deepening the appreciation of the intricacies of urban congestion, this comprehensive approach helps guide specific policy proposals meant to improve urban planning techniques and transportation networks in the Philippines' fast urbanizing regions.

This study helps address a gap in the literature by examining the relationship between domestic migration and urban congestion in the Philippines, a topic that has not been thoroughly examined and explored. The findings will contribute to the academic discourse on urbanization, migration, and transportation policy, providing a foundation for future researchers. Listed below are the various stakeholders that are identified by the researcher; these stakeholders may utilize the research to make better informed decisions.

For policymakers, the study offers insights on how migration patterns influence urban congestion and transportation systems. This can guide the development of policies to improve urban infrastructure, reduce traffic congestion, and enhance the quality of life in rapidly growing cities. For urban planners, the research highlights the need for innovative solutions to accommodate growing urban populations while maintaining efficient transportation systems. It also underscores the importance of integrating migration trends into long-term urban development strategies. On a personal level, this study contributes to the researcher's academic growth by enhancing my skills in data analysis, policy evaluation, and research methodology. It also aligns with my interest in public policy and economics, providing an opportunity to apply theoretical knowledge to a real-world problem affecting millions of Filipinos.

The relationship between Philippine urban congestion and domestic migration trends is the main subject of this study. Along with analyzing their effects on urban congestion, the study looks at the economic factors that influence domestic migration. It investigates how migration affects commuting times and traffic volume in urban transportation networks. The study only looks at internal migration; it does not include trends of foreign migration. Furthermore, it will not cover the nuanced political and cultural elements that affect migration. The researcher used secondary data sourced from different government publications, traffic indices, and scholarly studies. One of the limitations is data availability on migration and transportation for individual cities. Furthermore, due to time and resource constraints, primary data collected from migrants or urban dwellers is not included in this study. With these limitations, the study attempts to present a thorough grasp of the connection between domestic migration and urban congestion, providing information that can guide Philippine planning and policy.

This study addressed a critical research gap in holistic approaches that integrate transportation systems, land use planning, behavior of commuters, and domestic, rural- to-urban migration contexts. Promoting sustainable and livable cities in the

Philippines is crucial to comprehend and lessen the detrimental consequences of domestic migration on urban congestion.

## **Research Questions**

The study analyzed the domestic migration patterns which drive urban congestion in the NCR region, explore the impact of domestic migration on the capacity and efficiency of urban transportation systems, including vehicle density, accident rates, and annual average daily traffic, and provide evidence-based recommendations to address urban congestion and promote sustainable urban development in the context of ongoing domestic migration. Specifically it answered the following questions:

1. What is the pattern of domestic migrants which move from rural areas to NCR that cause transportation congestion for the period of December 2012 to December 2018
2. What is the pattern of economic indicators that affect transportation congestion in NCR for the period of December 2012 to December 2018?
3. What is the status of transportation congestion in NCR area using indicators of
  - a. Vehicle Density
  - b. Accident Rates
  - c. Annual Average Daily Traffic
4. What evidence-based policy recommendations can be made to manage transportation congestion in urban areas which experience domestic migration?

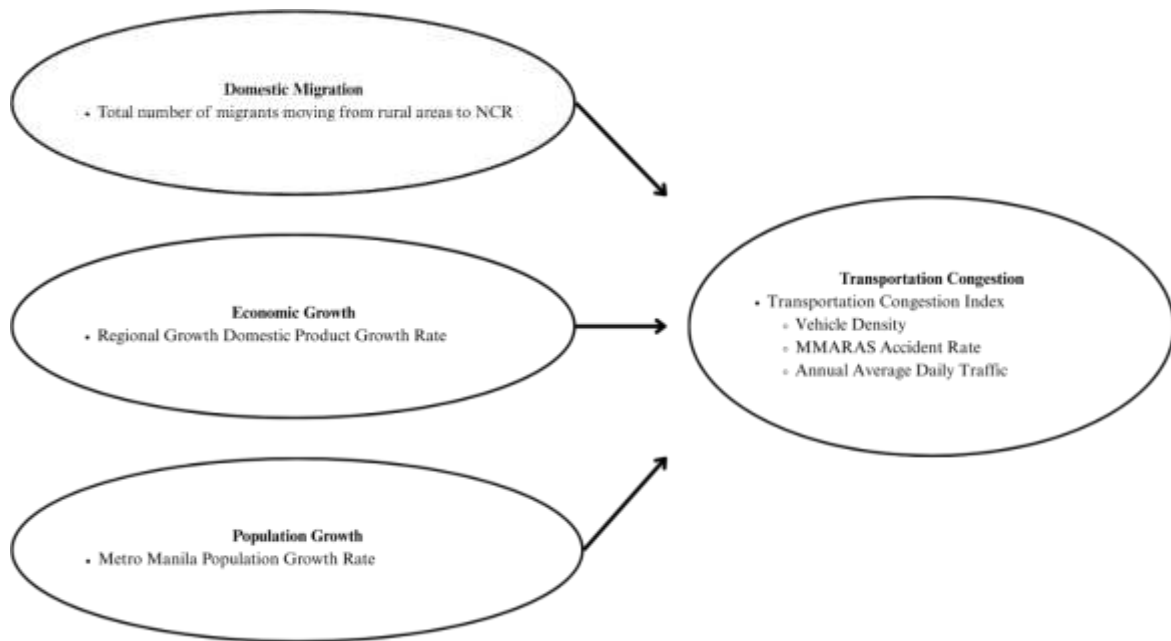
## **METHODOLOGY**

### *Proposed Operational Framework*

The study utilizes a framework which combines key findings from Lee's Push-Pull (1966) Theory, Farrell's Rapid Urban Growth Triad (2017) and Bao, et al.'s Framework on Traffic Congestion Patterns in Urban Areas (Bao, et al. 2022) to provide a synthesized and application oriented model which is tailored to the Philippine context. Serving as a basis to connect theory and empirical investigation, the proposed operational framework explains how domestic migration, economic growth, and population growth leads to urban congestion.

**Figure 2.0**

Proposed Operational Framework: Domestic Migration, Economic, Population Growth as to Transportation Congestion Framework



Domestic migration is the movement of people within a nation's borders particularly from rural areas to urban areas. This is rooted in Lee's Push pull Theory (1966) where movement is driven by the socio-economic disparities between rural and urban areas where individuals are affected by push factors such as lack of opportunities, while individuals are pulled into urban areas with the promise of more employment opportunities. Metro Manila has consistently served as the destination for domestic migration as domestic migration flows reflect inequalities and the centralization of growth in the NCR. Domestic migration is operationalized in the context of this study as the total number of migrants who move from rural areas to the National Capital Region (NCR) on a monthly basis. The arrow that connects domestic migration to urban congestion represents the hypothesis that increased domestic migration intensifies the demand on existing urban infrastructure. As individuals migrate from rural areas into the NCR, they contribute to the daily use of transportation through usage of public transit and private vehicles which raises traffic volumes and contributes to urban congestion. Metro Manila is already overstretched and the additional population influx pushes existing infrastructure past their carrying capacity.

Economic Growth is the increase in value of goods and services which is produced in a region, this is measured by the GDP. According to Myrdal's Cumulative Causation (1986) and the Endogenous growth theory (1986), they discuss that economic growth is not evenly distributed and tends to concentrate in urban areas where infrastructure, innovation and skilled labor is already present. Metro Manila has long served as an urban city with strong pull factors which draws in businesses, workers, and investment. This accelerated growth increases not only the income levels but also demand for land use and transportation infrastructure. Economic Growth is measured in the study as Regional Gross Domestic Product (RGDP) where it serves as an indicator of the



region's economic health and expansion.

The arrow which connects economic growth to urban congestion describes how expanding economies can add to urban congestion as higher incomes often lead to higher rates of private vehicle ownership and increased commercial activity which contributes to heavier traffic. Seong et al. (2025) and Duranton & Puga (2020) argue that economic growth brings prosperity through a higher quality of life; however economic growth also spurs congestion if usage surpasses the capacity of infrastructure. In the NCR, economic expansion increases the attractiveness of the region which accelerates domestic migration, land use and urban congestion.

Population growth is the increase in the number of individuals over a period of time. It is influenced by births, deaths, and migration. According to the UN's World Migration Report (2024), the population growth in urban areas is heavily shaped by domestic migration and sustained fertility rates. Delventhal et al., (2021) discusses in the demographic transition model to explain how developed nations experience lower mortality and fertility rates but still have an expanding population due to domestic migration patterns.

The arrow from Population Growth to Transportation Congestion represents a direct and compounding relationship. Population growth in the study is measured as the population growth of the NCR. Urban congestion is directly caused by population expansion, which increases demand for services, space, and transportation. According to Tsedevish et al. (2024), a growing population in metropolitan areas raises transportation volume, and utility use, frequently exceeding infrastructural capacity. This is reflected in the Urban Carrying Capacity Theory of Guzman et al. (2021), which states that systems collapse when utilization exceeds planned limitations. In this situation, population increase acts as a hidden driver of migration and economic activity in addition to making traffic worse.

### *Research Design and Strategy*

The study utilizes a quantitative research design, this approach is appropriate given the availability of extensive numerical data across a large period of time. A quantitative approach enables the study to conduct systematic investigation of observable instances through statistical, mathematical, and computational techniques. Using a quantitative approach stems from the nature of the variables that are studied in the paper, all of them being measurable and objective. Having statistical data allows for accuracy, generalizability and replicability which strengthens the empirical nature of the study

The study is correlational which focuses on determining the strength and determining if the relationship between independent and dependent variables are positive or negative. The aim is to explain how changes in domestic migration, population growth, and economic growth relate to levels of congestion in Metro Manila.

The research strategy is highly structured in order to ensure the coherence and logical alignment. The objectives, research questions, hypotheses, conceptual and operational frameworks, data collection, and statistical tools used are all interrelated. This structure is followed in order to emphasize clarity and consistency, as the

objective and problem statement identified congestion as a key issue that urban areas like Metro Manila is facing, and each part of the research process, from the selection of variables to the application of regression models were conducted in order to address the urban congestion issues directly and rigorously.

### *Research Participants and Respondents*

The study utilizes secondary data which were collected from official statistical sources with a data set spanning over 73 instances. Each variable is sourced from publicly available databases or surveys which were conducted by the Philippine Statistics Authority (PSA). Domestic migration data, which is the number of migrants moving from rural areas to the National Capital Region (NCR), is sourced from the 2018 National Migration Survey (NMS). The PSA, the University of the Philippines Population Institute, and the Philippine Institute for Development Studies collaborated to perform the NMS, which produced nationally representative data on regional internal migration movements. The Regional Gross Domestic Product (RGDP) of the NCR, which is likewise calculated and published by the PSA through the Regional Accounts of the Philippines, serves as a gauge of economic growth. As a macro-level measure of development, this data provides insights on yearly changes in the area economy. Macrotrends also provides information on population growth, as measured by yearly population statistics in the NCR. As a macro-level measure of development, this data provides insights on yearly changes of the population growth in the area.

### *Sampling Design*

The study utilizes a time series sample design which encompasses the monthly period from December 2012 to December 2018. The dependent variable and domestic migration statistics were gathered on a monthly basis; however several independent variables were only accessible through annual reports. Following conventional procedures in time series analysis as discussed by Gujarati & Porter, (2009), the study used linear interpolation to estimate the monthly values from the annual reports in order to resolve the discrepancy in data frequency the Formula used was as follows:  $\text{Interpolated Value}_t = Y_1 + \left( \frac{Y_2 - Y_1}{n+1} \right) * t$ . Aligning all the variables to a standard monthly unit ensured that the statistical analysis of the data would be more reliable and cohesive.

### *Measurement and Instrumentation*

Variables in the study were operationalized, computed and prepared for analysis, transformation of raw data into meaningful indicators were conducted using mathematical formulas and index construction. Specifically, the study uses normalized values and the derived statistics to allow for analysis of more comparable variables, regardless of the unit. Normalization and composite indices are used in urban planning and congestion analysis, where multifaceted indicators need to be consolidated into a single framework as established by the OECD, (2008).

Vehicle Density is one of the indicators utilized to approximate urban congestion, it is the number of registered vehicles in a specified area. In the study, monthly vehicle registration from the Land Transportation Office (LTO) was used; and instead of road length the density was calculated using the total land area of the NCR, which is



approximately 620  $Km^2$ . The formula is:

Equation 1

$$Vehicle\ Density = \frac{Number\ of\ Registered\ Vehicles}{Total\ Area\ of\ NCR}$$

The Variable was normalized to a range from 0 to 1 using min-max normalization as implemented by Han et al., (2012). The formula is:

Equation 2

$$Normalized\ Value = \frac{X - X_{min}}{X_{max} - X_{min}}$$

Vehicle Density serves as a proxy for potential strain on road space as Chatziioannou et al., (2023) discussed that high vehicle density correlates strongly with urban congestion level. Accidents per 1,000 Vehicles is another indicator which is based on the MMARAS accident count and monthly vehicle registration where it standardizes the frequency of accidents relative to the number of vehicles which allows it to reflect the road safety under varying levels of vehicular presence. The formula is:

Equation 3

$$Accidents\ per\ 1000\ Vehicles = \frac{Monthly\ Accident\ Count}{Registered\ Vehicles} * 1000$$

The resulting values from eq. 3 were normalized using eq. 2, normalized accident data is essential for evaluating traffic flow and the safety dimension of congestion. Road safety data is used in congestion indices to reflect the societal impact of overloaded urban systems as found in Choudhary et al's., (2022) paper.

Annual Average Daily Traffic (AADT) monthly data was normalized using eq. 2 to align with the monthly attributes of other components of the Transportation Congestion Index. AADT is a vital indicator in congestion analysis as it reflects the intensity of road usage and allows for a performance based perspective on urban congestion.

Quantifying Transportation Congestion comprehensively was done through the construction of a composite Transportation Congestion Index (TCI). The TCI is calculated as the mean of the normalized values of the three indicators discussed, this allows for a multifaceted representation of congestion as suggested in literature on Urban Carrying Capacity frameworks such as the paper of Su et al., (2019), the formula is:

Equation 4

$$TCI_t = \frac{1}{3} (Vehicle\ Density_t + Accidents_t + AADT_t)$$

This approach is validated in urban systems planning where composite indices are favored to monitor urban congestion as discussed by the OECD, (2008)

The study utilizes the cumulative number of rural to urban area migrants instead of the raw monthly domestic migration counts to capture long term build up of migration pressures. This is more aligned with the theoretical framing of Myrda's Cumulative Causation (1957) where migration is seen as a cycle over time. The formula is:

Equation 5

$$Cumulative\ Migration_t = \sum_{i=1}^t Monthly\ Migration_t$$

The index provides a more stable and interpretable representation of the gradual impact of migration on urban congestion.

### Data Analysis

The Transportation Congestion Index (TCI) is the study's dependent variable, while the population growth, cumulative domestic migration, and regional GDP are its independent factors. In regard to congestion patterns, the population statistics represent population increase, regional GDP represents economic growth success, and the cumulative migration variable is meant to be a proxy for population growth.

To establish the relationships of the variables, an Ordinary Least Squares (OLS) regression model is employed as OLS is the most fitting statistical method for identifying linear correlations between the dependent and multiple independent variables. The model is:

Equation 6

$$TCI_t = \beta_0 + \beta_1(Cumulative\ Migration_t) + \beta_2(Population\ Growth\ in\ NCR_t) + \beta_3(Regional\ GDP\ in\ NCR_t) + \epsilon_t$$

Where

- $TCI_t$  is the Transportation Congestion Index at time t,
- $\beta_0$  is the intercept,
- $\beta_1, \beta_2, \beta_3$  are the coefficients of the independent variables,
- $\epsilon_t$  is the error term.

To comply with the TCI, all variables collected are either monthly or have been interpolated to a monthly frequency as to align with the study. Testing the sensitivity and strength of connections may also be done through further model robustness checks, which include modifications like logarithmic regression.

## RESULTS

**Table 1.0 Model Regression Results**

Variable	Coefficient	t-Statistic	P-Value	Significance
Intercept	4.245e+00	2.934	0.00456	**

Cumulative Migration	2.931e-04	24.063	< 2e-16	***
Growth Rate of Regional GDP	3.450e+01	2.250	0.02769	*
Growth Rate of NCR Population	-3.234e+03	-2.905	0.00496	**

**Table 2.0 Summary of Model Fit Statistics**

Model Fit Statistics	
R <sup>2</sup>	0.90
Adjusted R <sup>2</sup>	0.89
F-Statistic	211.9
Prob	<2.2e-16
Observations	73

**Table 3.0 Summary of Hypothesis Testing Decisions**

Hypothesis	Test Variable	Coefficient Sign	P-Value	Test Statistic	Decision
H1	Cumulative Domestic Migration	Positive	< 2e-16	24.063	Reject Null Hypothesis
H2	Growth Rate of Regional GDP	Positive	0.02769	2.250	Reject Null Hypothesis
H3	Growth Rate of MM Population	Negative	0.00496	-2.905	Reject Null Hypothesis

## DISCUSSION

The variable of cumulative migration has a p-value of <2e-16 which indicates the variable is highly significant. A one-unit increase in cumulative migration is associated with an increase of 0.00029 units in the Urban Congestion Index.

The variable of Growth Rate of Regional GDP has a p-value of 0.02769 which indicates that the variable is significant. A one-unit increase in the growth rate of Regional GDP is associated with an increase of 34.5 units in the Urban Congestion Index.

The variable of Growth Rate of NCR population has a p value of 0.00496 which indicates that the variable is highly significant. A one unit increase is associated with a decrease of 3,234 units in the Urban Congestion Index.

The model demonstrates an excellent fit to the data with an R<sup>2</sup> value of 0.81. This 53 indicates that approximately 90% of the variability observed in the Transportation Congestion Index over the sample period is successfully explained by the combined effects of cumulative migration, RGDP. and population growth. Furthermore, the highly significant F-statistic of 211.9 confirm that the regression model is statistically robust and collectively relevant in predicting urban congestion

The first null hypothesis is rejected. Cumulative migration is statistically significant with

a t-value of 24.063. The coefficient is also positive which confirms that there is a direction that long term migration has a positive effect on transportation congestion.

The second null hypothesis is rejected. The Growth Rate of Regional GDP is statistically significant with a t-value of 2.250. The coefficient is also positive which confirms the hypothesized direction that the Regional GDP Growth Rate has a positive effect on transportation congestion.

The third null hypothesis is rejected. The Growth Rate of the NCR population is statistically significant with a t-value of -2.6614. The coefficient is negative, which confirms that there is a direction for NCR population growth rate and its effect on transportation congestion.

This result supports the theoretical premise of the study, especially Lee's Push-Pull Theory of migration where it suggests that migration is driven by the perceived superior economic opportunities in the NCR. This result supports the theoretical premise of the study, especially the principles of the New Economic Geography, where economic success fuels an agglomeration of industries and services. The unexpected direction challenges the application of the Urban Transport Carrying Capacity Theory which predicted a positive relationship.

## **Conclusions**

The cumulative inflow of domestic migrants from provincial areas to the NCR is the single most critical factor progressively degrading the urban transport system. The cumulative inflow of domestic migrants from provincial areas to the NCR is the single most critical factor progressively degrading the urban transport system.

Since RGDP growth is a well-established long-term contribution to TCI, economic expansion exacerbates congestion. This demonstrates that the region's transportation infrastructure cannot keep up with the demand for mobility brought on by rising economic activities.

The counterintuitive negative association between the TCI and the NCR Population Growth Rate implies that residents' adoption of fewer congestion-inducing coping techniques may mitigate basic population growth, especially in recent times. This means that rather than concentrating only on the pace of rise, strategies must address the system's cumulative structural demand.

The final OLS model offers a statistically sound and trustworthy depiction of the long-run equilibrium relationship between the TCI and its economic and demographic determinants, as evidenced by the successful confirmation of cointegration and the satisfaction of all OLS assumptions.

## **Recommendations**

Aggressive Decentralization must be put in place and can be done through creation of fully operational regional economic and academic hubs outside of the NCR with competitive infrastructure and incentives, it is advised that the National Government enact legislation and provide funding for a strategic plan. By developing sustainable

economic alternatives, this directly tackles the Push-Pull forces and lessens the need for migration.

Dynamic Congestion Pricing where it imposes changeable costs on private automobiles that enter certain high-density areas during rush hour. To control demand and enhance mobility efficiency, revenues must be openly allocated for the development and subsidization of mass public transportation systems.

Coordinated Spatial Planning where LGUs must conduct livelihood retention programs to strengthen local economies and lessen the flow of outward migration, LGUs in the NCR and adjoining areas must collaborate on regional spatial planning to minimize sprawl.

Transit-Oriented Development Incentives as it is recommended that the government provide significant incentives to developers whose projects are centered on current or future mass transport hubs. This guarantees that new residential and commercial buildings complement the current transportation system rather than interfere with it.

Data and Methodology Refinement must be done to determine which aspects are most sensitive to policy interventions, future researchers should concentrate on a disaggregated examination of the TCI components. Establishing a high-frequency Domestic Mobility Monitor is also essential for giving planners the predictive information required for infrastructure projections.

### **Compliance with Ethical Standards**

The study exclusively utilized secondary data from publicly accessible, ethically approved, and government-sanctioned data sources and no direct participants or sensitive personal data were involved. In line with ethical research practices, the data used in the study conform to the Philippine Data Privacy Act of 2013 (RA 10173), which establishes guidelines for the collection, handling, and dissemination of data. Since the data collected are published for public use, the study complies with national data sharing regulations. The structured methodological approach ensures the transparency, accountability, and integrity of data analysis throughout the research process.

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