

**Domestic Migration Patterns and Their Impact on Transportation Congestion in the
Philippines**

In Partial Fulfillment of the Requirements for
Research Economics II

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TABLE OF CONTENTS

CHAPTER 1	1
Introduction.....	1
Statement of the problem	5
Objectives of the study.....	5
Significance of the Study	6
Scope and delimitation of the study.....	7
CHAPTER 2.....	8
Transportation Congestion.....	8
Migration.....	12
Population Growth.....	15
Regional GDP	18
Transportation Expenditure	21
Policy Recommendation	24
CHAPTER 3.....	26
Lee Push-Pull Theory of Migration	26
Transportation Congestion Theory	26
New Economic Geography	27
Urban Transport Carrying Capacity Theory	27
Harris-Todaro Model of Migration.....	28
Myrdal's Cumulative Causation Theory.....	28
Endogenous Growth Theory	29
Conceptual Framework.....	31
Proposed Operational Framework	35
Assumptions.....	38
Hypotheses.....	38
Definition of Terms.....	38
CHAPTER 4.....	40
Research Design and Strategy	40
Research Participants and Respondents.....	41
Sampling Design.....	41
Measurement and Instrumentation.....	42
Research Ethics and Approaches	44
Data Analysis.....	45
CHAPTER 5.....	46
Descriptive Statistics.....	46
Stationarity Analysis.....	47

Econometric Model Diagnostics	48
Multicollinearity Check (VIF)	48
Model Validation	49
Autocorrelation Test	49
Homoskedasticity Test.....	50
Regression Results	51
Hypothesis Testing.....	52
Discussion of Findings.....	53
Summary of Findings.....	55
CHAPTER 6.....	56
Summary	56
Conclusions.....	56
Recommendations	57
Secondary References	70
Appendix.....	71

List of Figures

Figure 1.0: 2018 National Migration Data.....	2
Figure 2.0: Conceptual Timeline Narrative	30
Figure 3.0: Lee’s Push-Pull Theory of Migration Framework (Lee, 1966).....	33
Figure 4.0: Farrell’s Rapid Urban Growth Triad Framework (Farrell, 2017)	34
Figure 5.0: Bao, et al.’s Framework on Traffic Congestion Patterns in Urban Areas (Bao, et al. 2022)	35
Figure 6.0: Proposed Operational Framework: Domestic Migration, Economic, Population Growth as to Transportation Congestion Framework.....	36

CHAPTER 1

BACKGROUND OF THE STUDY

This chapter presents the Introduction, Background of the Study, Statement of the Problem, Objective of the Study, Significance of the Study, and scope and delimitations of the study

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. 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

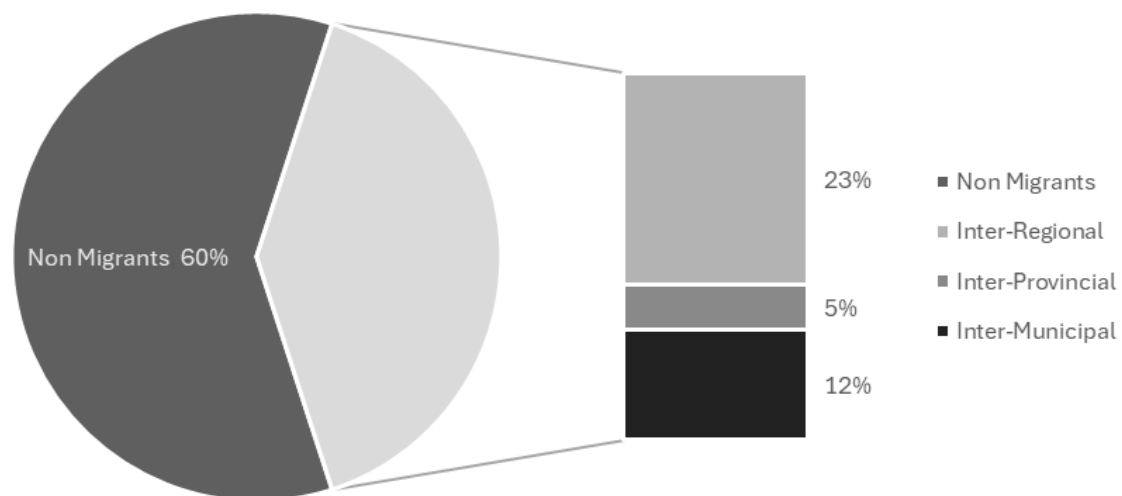
World Rank	City	Average Travel Time	Change From	Congestion Level %	Time Lost Per Year at Rush	Congestion World Rank
8	Davao City	32 min 59s	-30s	49%	136 Hours	3
14	Manila	32 min 10s	-30s	42%	127 Hours	27
26	Caloocan	30 min 4s	-20 s	41%	111 Hours	39

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 source country 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

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 our 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.

Statement of the problem

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?

Objectives of the study

The study aims to:

1. Analyze the domestic migration patterns which drive urban congestion in the NCR region

2. 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.
3. Provide evidence-based recommendations to address urban congestion and promote sustainable urban development in the context of ongoing domestic migration.

Significance of the Study

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.

Scope and delimitation of the study

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.

CHAPTER 2

REVIEW OF RELATED LITERATURE

The primary objective of this chapter is to provide a comprehensive review of the related literature, which is vital in establishing the researcher's understanding of the study. Through extensive exploration of existing sources of scholarly works, publications and government sites, the researcher aims to analyze the available information that contribute to bridge gaps in this research

Transportation Congestion

Transportation congestion is a pervasive issue in rapidly urbanizing nations like the Philippines which fundamentally stems from an imbalance between transportation supply and demand. Sokido (2024) defines urban congestion as a condition where traffic volume surpasses the road network capacity which leads to slower travel times, longer durations and traffic jams. The core problem would be that existing infrastructure is unable to accommodate the number of vehicles and commuters attempting to use it simultaneously. Guzman et al., (2021) measured urban congestion in the Philippines through Transport Urban Carrying Capacity which is the maximum traffic volume that a transit system can handle without being congested. An example of urban congestion would be the daily commute along EDSA in Metro Manila, where vehicles often crawl at a slow pace during peak hours due to the sheer volume of traffic exceeding the road's capacity. Which results in significant delays and frustration for commuters

Analyzing urban congestion involves several interconnected elements primarily rooted in spatial economics and network effects. Land use planning plays a crucial role where inefficient planning leads to urban sprawl and longer commutes where it intensifies congestion as per Ewing & Cervero, (2017). Research also emphasizes that supply and demand imbalance as a

central concept as per Lincicome, (2021); Xiao et al., (2021). Also the land use planning, transportation infrastructure and economic activities all contribute to travel patterns in the road network as discussed in the findings of Deweerdt & Fabre, (2022); Wong et al., (2020). For instance the concentration of businesses and commercial centers in Makati City which creates high demand for transportation during the rush hours. Because of high demand, disruptions like accidents can cause ripple effects which exacerbate congestion throughout the Metro Manila road network due to limited alternative routes

Several key drivers contribute to the persistent problem of urban congestion, the most notable of these are the increasing rate of vehicle ownership coupled with rapid population growth. Studies consistently identify rising vehicle ownership as a major factor as discussed by Rith et al., (2018, 2019). The increasing affordability and accessibility of vehicles have led to higher private car usage in cities which further strains already overburdened road networks as found in the article by Zurbano, (2024). Population growth and urbanization centers also play a significant role as more people migrate towards urban centers which leads to increased traffic volume which was discussed by the United Nations, (2018). Another point discussed by Choudhary et al., (2022) where he stated that changes in socioeconomic factors result in disruptions and traffic, which significantly increase commute time, consumption of fuel, and exhaust emissions. Moreover inadequate public transportation systems force more people to rely on private vehicles which worsens congestions which is discussed by Bocarejo & Urrego, (2022)

The impacts of urban congestion are multi-faceted, as they affect economic productivity, environmental quality, and the overall social well-being of urban dwellers. While the effects of urban congestion are primarily negative, congestion can paradoxically stimulate certain economic activities. Rahman et al., (2021); Shoup, (2018) discussed that when considering economic factors,

congestion leads to losses due to time wasted and an increase in the consumption of fuel; but it can also incentivize innovation in transportation services and technology. In Metro Manila, the Japan International Cooperation Agency (JICA) released a report in 2022, where it estimates that the Philippine economy loses billions of pesos annually in lost productivity due to traffic congestion. Congestion also has environmental impacts as congestion contributes to increased air pollution and greenhouse gas emissions as reported by the World Health Organization (WHO) in 2016. However, congestion also spurs demand for ride-hailing services, carpooling apps, and alternative transportation modes which creates new business opportunities and jobs. In response to congestion, policymakers may be more inclined to invest in public transportation and implement sustainable development strategies which leads to long-term benefits for the society as discussed by Guyader & Piscicelli, (2019). In the Philippine context congestion is evident as large traffic jams are present which affects fuel cost and the environment; In response policy makers have implemented projects aimed to alleviate the congestion such as the EDSA bus lanes. Alternative transportation modes have also flourished with ride hailing services being commonplace in society.

Table 2.0:

Transportation Congestion Research Gap Matrix

Author(s)	Title & Year	Limitation / Gap Identified
Bocarejo & Urrego	Impacts of improved transit systems on equity: the case of Bogota 1999–2019 (2021)	Lack of review on accessibility across income groups.
Choudhary et al.	Urban traffic congestion: its causes-consequences-mitigation (2021)	Lack of integrated approach considering multiple transport factors.
Deweerd & Fabre	The Role of Land Use Planning in Urban Transport to Mitigate Climate Change: A Literature Review (2022)	Need for more empirical validation of planning strategies in practice.
Ewing and Cerver	Travel and the Built Environment: A Meta-Analysis (2017)	Potential bias in compact development studies; lacks refined evidence.

Guyader & Piscicelli	Business model diversification in the sharing economy: The case of a mobility platform (2019)	Limited generalizability beyond single case study setting.
De Guzman & Cabrido	Estimating the Transport Urban Carrying Capacity of a City (2021)	Absence of localized vehicle density standards.
Lincicome, S.	Manufactured Crisis: 'Deindustrialization,' Free Markets, and National Security (2021)	Limited analysis of global supply chain impacts on local congestion.
Rahman et al.	Untangling Urban Traffic Congestion: A Meso-Scale Causal Analysis for Policy and Planning (2022)	Meso-level insights insufficient to explain micro-scale congestion patterns.
Rith et al..	Understanding of Determinants of Household Vehicle Ownership Level toward Urban Sustainable Transportation in Southeast Asia (2018)	Focused narrowly on density and accessibility
Rith et al..	The impact of socioeconomic characteristics and land use patterns on household vehicle ownership and energy consumption in an urban area with insufficient public transport service (2019)	Lacked policy factors.
Shoup, D.	Parking and the City (2018)	Limited to none, non-North American case studies; reform barriers underexplored.
Sokido, D.	Measuring the level of urban traffic congestion for sustainable transportation in Addis Ababa, Ethiopia, the cases of selected intersections. (2024)	Political and financial challenges limited research depth.
United Nations	2018 Revision of World Urbanization Prospects (2018)	Lack of localized urban transport solutions in global projections.
Wong et al.	Urban expansion and neighborhood commuting patterns in the Beijing metropolitan region: A multilevel analysis (2020)	Spatial focus lacks policy and infrastructure evaluation.
Xiao et al.	Understanding jobs-housing imbalance in urban China: A case study of Shanghai (2021)	Limited studies on China-specific urban commuting issues.

Urban congestion remains an issue that the Philippines faces; however existing literature reveals significant research gaps in understanding the dynamics of spatial, infrastructural, and behavioral factors that influence congestion. Studies by Choudhary et al. (2021) and Deweerdt &

Fabre (2022) have discussed the causes and consequences of congestion; however there is a gap in holistic approaches that integrate transportation systems, land use planning, and the behavior of commuters. There is a need for a more dynamic and multi-faceted framework that applies to rapidly urbanizing contexts like Metro Manila. In the Philippine setting where congestion is influenced by infrastructure, economic clustering, and socio-spatial inequality, the gap highlights the relevance of this study. It seeks to connect the dynamics between these concepts using updated indices and composite models.

Migration

Domestic migration is a significant demographic trend within the Philippines which involves the movement of people within the borders of the country, typically this phenomenon happens from rural to urban areas. The PSA, (2020) survey on National Migration Survey defined domestic migration as the movement of individuals within a country from a single location to another, this is driven by various factors such as economic opportunities, education, and family connections. Domestic migration shifts population and impacts both receiving and sending regions, an example of this would be the flow of people from provinces who search better employment opportunities in Metro Manila who seek higher wages and more job opportunities. This contributes to the growth of urban centers but may also exacerbate existing challenges

Understanding domestic migration requires analysis that considers both push and pull factors, as well the context of socio-economic status of receiving and sending regions. In Lee's Theory of Migration where he established the Push-Pull theory, it remains relevant as the theory identifies factors that compel people to leave their original home areas and factors that attract them to new areas which is further supported by de Haas, (2021). It should also be considered

that non-economic factors such as personal safety, political conflict or instability also affect migration; moreover individual agency and social networks play a crucial role in migration decisions as discussed by Braithwaite et al., (2019). The push-pull theory can be seen in the limited opportunities and inadequate social services in rural areas which drives people to seek better prospects in urban areas

Domestic migration is driven by economic disparities, educational opportunities, and family related factors. The economic factor of income differentials and employment opportunities are consistently identified as the primary drivers of migration as found by Fasani et al., (2020; Leal & Harder, (2021). Many families also send their children to study in universities located in urban areas which can lead to permanent migration; with this educational opportunities play a significant role in migration which is discussed by Ding, (2021). Reunification of families are also additional factors as individuals migrate to join family members who have already established themselves in urban areas which can be found in the discussion of Solano et al., (2020). Locally many residents tend to send their children in urban areas and once established, the family will follow which leads to permanent migration.

Domestic migration effects are complex as it can both be negative and positive for sending and receiving areas. Migration can contribute to economic growth and development in both origin and destination areas, but it can also exacerbate existing inequalities and create new challenges. In receiving areas, migration can increase the labor supply, stimulate economic activity and promote innovation as discussed by Peri & Sasahara, (2019). Another factor is remittances which are sent by migrants to their families in sending areas, this can improve living standards, increase investment in education and healthcare, and reduce poverty which is supported by the article of the World Bank, (2018). In sending areas, Rabbi, (2023) discussed

that migration results in a loss of skilled labor, reduced productivity and disruption. 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. Many rural residents already migrate to the urban areas which decreases the already strained output of our agricultural sector and reduces the possibility of promoting innovation.

Table 3.0:

Migration Research Gap Matrix

Author(s)	Title & Year	Limitation / Gap Identified
Braithwaite et al..	Refugees, Forced Migration, and Conflict: Introduction to the Special Issue (2019)	Incomplete models explaining public opinion and refugee dynamics.
de Haas, H.	A theory of migration: the aspirations–capabilities framework (2021)	Lacks empirical tests across diverse socio-economic settings.
Ding, X.	The Causal Impact of College Education on Migration in China (2020)	Long-term labor market and migration effects not examined.
Fasani et al.	The Economics of Migration: Labour Market Impacts and Migration Policies (2022)	Insufficient policy guidance for complex migration realities.
Leal & Harder	Global Dynamics of International Migration Systems Across South–South, North–North, and North–South Flows, 1990–2015 (2022)	Traditional drivers fail to fully explain South-South migration.
Peri & Sasahara	The Impact of Global Warming on Rural-Urban Migrations: Evidence from Global Big Data (2022)	Migration constraints in poorer countries overlooked.
Habbi, R.	How Does Migration Impact on Socio-economic Development of Rural Society? (2023)	Combined effect of remittances, brain drain, and culture underexplored.
Solano & Ahmad Yar	Gaps in Migration Research: Review of Migration Theories and the Quality and Compatibility of Migration Data on the National and International Level (2020)	Unaligned theories and limited data analysis.

Migration has long been studied as a demographic and economic phenomenon and there persists a critical gap in understanding the cyclical and cumulative impacts of domestic migration in developing nations. The discussions of Braithwaite et al. (2019) and de Haas (2021) emphasize that traditional theories of migration fail to capture the complex dynamics like how migration decisions are shaped by aspirations, social networks, and systemic inequalities. Solano et al. (2020) also identified limitations in existing studies, specifically the compatibility of data and theoretical models to present day scenarios. Most studies focus on international or refugee migration which leaves a research gap in domestic, rural-to-urban migration contexts as observed in the Philippines unexplored. The study addresses the research gap by analyzing domestic migration patterns in the Philippine context, and how these patterns intensify urban congestion which was not captured by previous studies.

Population Growth

Population growth is a fundamental demographic process which refers to the increase in the number of individuals residing in a specific geographic area over a period of time. The World Migration Report from the UN, (2024) defines population growth as the change in the size of a population, often expressed as a combination of migration, births, and deaths. Population Growth is vital in understanding the dynamics of urbanization. In the Philippines sustained population growth particularly in urban centers, places increasing demands on infrastructure and services.

Understanding population growth requires the analysis of factors such as migration patterns, rate of population increase, fertility rates, and mortality rates. The tool most suitable to analyze population growth is the Demographic Transition Model as it allows for the understanding of the stages of population growth and the factors that influence them as per Delventhal et al., (2021). Urban areas attract population growth due to better economic

opportunities and access to services. The model also takes into account how population growth leads to further urbanization. The Philippines is in a late stage of demographic transition with key characteristics such as declining fertility and mortality rates which leads to a larger working-age population and potential for economic growth.

Population growth is driven by multi-faceted factors such as migration, fertility rates, mortality rates, and healthcare access. Migration plays a pivotal role especially in the context of this research as individuals migrate to urban areas, the population growth is then driven by migration which is discussed by Tsedevish et al., (2024). High fertility rates also contribute to sustained population growth, this is most often seen in rural areas as found by Bongaarts, (2020). Mortality rates are another factor as advancements in healthcare contribute to population growth and increased life expectancy as per Xi et al., (2025). Understanding the key drivers of population growth help understand the role of the variable within the research

Population growth has different impacts and consequences, which affect a variety of factors such as economic development and social well-being. Population growth stimulates economic growth by increasing the supply of labor and creating demand for goods and services as found in the paper of Lei et al., (2024): however population growth also strains resources and leads to social unrest as discussed by Adaki, (2024). Peterson, (2017) discussed that larger populations lead to economies of scale, an increase in innovation and a diversification of the workforce which drives economic growth and development. On the other hand Foucher et al., (2024) argued that population growth strains resources which lead to land and water resource scarcity. Furthermore population growth is a factor in urban congestion which is discussed by Tsedevish et al., (2024) as individuals will compete for infrastructure such as housing, transportation and space in general

Table 4.0:

Population Growth Research Gap Matrix

Author(s)	Title & Year	Limitation / Gap Identified
Adaki, A.	Population Growth and Resource Scarcity: Implications for Conflict and Cooperation in Taraba State, Nigeria (2020)	Lack of review of the Integration of traditional governance into resource policy
Bongaarts, J.	Trends in fertility and fertility preferences in sub-Saharan Africa: the roles of education and family planning programs (2020)	Mechanisms reducing fertility via education/family planning unclear.
Delventhal et al.	Demographic Transitions Across Time and Space (2020)	Cultural and political factors often overlooked in transitions.
Foucher et al.	Uncontrolled deforestation and population growth threaten a tropical island's water and land resources in only 10 years (2021)	Long-term policy effectiveness against resource depletion untested.
Lei et al.	Study on the ecosystem service flow based on the relationship between supply and demand in Yangtze River Economic Belt (2022)	Sustainability under future economic pressures not fully addressed.
Peterson	The Role of Population in Economic Growth (2022)	Migration's role in fixing growth imbalances is insufficiently studied.
Tsedevis	Issues of determining the effects of migration on population growth in Ulaanbaatar (2022)	Impact on urban-rural ratios and spatial shifts needs deeper analysis.
Xi et al.	Effects of population aging on quality of life and disease burden: a population-based study	Comprehensive frameworks for health impact attribution missing.

Research on Population growth has been extensively studied; however there are still significant research gaps in understanding how urban infrastructure systems are impacted by domestic migration driven growth. As Bongaarts (2020) and Delventhal et al. (2020) discuss, the majority of research focuses on changes in fertility, mortality, and underestimates the contribution of domestic migration as a driver of population growth. Furthermore Foucher et al. (2021) noted that migration is rarely discussed in detail in connection with the long term congestion effects of uncontrolled population growth, and its strain on housing, transportation, and public service systems.

Regional GDP

Regional Gross Domestic Product (GDP) is a critical economic indicator that represents the total value of goods and services produced within a specific area during a defined period typically a year. The Philippine Statistics Authority PSA, (2024) defines Regional GDP as the aggregate value of production of all residents that produce units in a specific region, this is measured at current prices which reflect the economic output and activity in that region where it serves as the measure of economic size and performance of that region. The National Capital Region (NCR) in the Philippines has the highest Regional GDP due to the number of industries, businesses and activities of the government, which reflects the region's significant contribution to the national economy.

The analysis of Regional GDP requires the consideration of the contributions of various sectors that a region may have, these sectors include agriculture, industry and services. Considering the factors that influence economic growth, such as consumption, investment, and government spending is also another vital portion of the analysis. In the analysis of Regional GDP a sectoral approach shall be utilized where the GDP is broken into sectors from primary which include agriculture and mining, secondary which include manufacturing and construction, and tertiary which are services to understand the economic structure of a region, this approach is commonly done as shown in the paper of Budha, (2024). Variations in sector performance must also be considered when taking this approach, another factor to consider would be the inter-regional economic linkages. A region that is heavily reliant on agriculture often has a lower Regional GDP compared to a region that has a thriving manufacturing or services sector. The analysis of the Regional GDP helps understand which regions are more susceptible to urban congestion,

Factors that affect Regional GDP growth include human capital development, investment in infrastructure, and government policies. Human capital development is a factor due to education and training enhancing productivity and the competitiveness of the workforce which contributes to a higher Regional GDP as discussed by Olasehinde, (2024). Investment in infrastructure, specifically in transportation networks is another critical driver of Regional GDP growth as it facilitates trade, investment, and mobility in the various sectors of the region which is explored by Pratama et al., (2024). Government intervention such as policies which include trade liberalization, tax incentives and deregulation also stimulate economic activity where it attracts investment and boosts the Regional GDP; the spending of the government also contributes to the growth of the Regional GDP in the short run, this is supported by Rizwan & Gasmi, (2024). An example can be seen as the Philippines having Central Business Districts (CBD) where the Philippine Economic Zone Authority (PEZA) encourages foreign investors to invest into those areas which develop our work force and invest into our infrastructure.

The impacts and consequences for Regional GDP growth vary as they affect factors such as employment opportunities, income levels, and social development. Melenkina & Uzhegov, (2024) discussed that higher Regional GDP leads to increased employment opportunities, higher wages, and improved living standards for residents in the region. However (Samani et al., 2024) argued that a higher Regional GDP leads to increasing income inequality, and social disruption. High Regional GDP growth attracts investment, promotes innovation, and creates a cycle of economic development which leads to long-term prosperity and the improvement of the quality of life as discussed by Magangeni, (2024). However negative effects can be found as the high Regional GDP leads to higher income inequality, which is felt by lower-income groups as it leads to other social problems. Regional GDP growth worsens urban congestion as higher

income levels increase economic activity and leads to greater demand for transportation and housing which puts pressure on existing infrastructure which is discussed in the paper of Seong et al., (2025)

Table 5.0:

Regional GDP Research Gap Matrix

Author(s)	Title & Year	Limitation / Gap Identified
An et al.	Dynamic Interactive Effects of Technological Innovation, Transportation Industry Development, and CO2 Emissions (2023)	Regional variations in transport-related emissions underexplored.
Budha	Econometrics Analysis of Contributions of Primary, Secondary, and Tertiary Sectors in GDP of Nepal (2023)	Regional trade reliance complicates consistent GDP growth analysis.
Magangeni, L.	What are the key drivers and impediments to sustained economic growth and development in emerging markets, and how can policymakers and businesses navigate these factors to promote long-term economic prosperity and stability? (2023)	Limited cross-country comparisons for emerging economies.
Melenkina & Uzhegov	Structural Shifts in Employment in an Industrial Region: On the Issue of Raising the Standard of Living of the Population Bulletin of Perm University. Economics Series = Perm University Herald. Economy (2023)	Focus on a single region limits broader applicability.
Melnik	Legislative redistricting and the partisan distribution of transportation expenditure (2024)	Context-specific findings; lacks broader state comparisons.
Mn et al.	The Effectiveness of Unpermitted Bus Services (Pirate) Transportation Mode (2022)	Safety, regulation, and planning impacts not addressed.
Olasehinde	Enhancing Workforce Productivity Through Adult Education: A Policy Analysis (2024)	Regional variation in program success not analyzed.
Pratama et al.	The Impact of Regional Infrastructure Sector Investment on Economic Growth and Regional Inequality in East Kalimantan Province, 2012–2023 (2024)	Mechanisms linking sectoral investment to inequality are unclear.
Qian	An empirical study on the relationship between urbanization, transportation infrastructure,	Specific types of infrastructure impacts are

	industrialization and environmental degradation in China, India and Indonesia (2024)	not differentiated.
Rizwan & Gasmi	Tax Planning and Economic Activity: The Role of Tax Incentives and Corporate Investment (2024)	Long-term corporate behavior after tax breaks unexplored.
Samani et al.	Income inequality and environmental degradation in the provinces of Iran (2024)	Regional disparities limit tailored policy insights.
Sanni	Assessing the Effectiveness of Oman's Logistics Infrastructure in Facilitating Regional Trade and Economic Growth (2025)	Global risks and external trends in logistics not considered.
Seong	Beyond the Road: A Regional Perspective on Traffic Congestion in Metro Atlanta (2025)	Lack of policy intervention impacts studies.
Wang	Air pollution outcomes, land misallocation, and the transmission through urban sprawl (2023)	Narrow indices may miss broader urban pollution drivers.

Regional GDP and other economic indicators are commonly used to measure regional wealth, there is a gap in understanding how patterns of economic growth affect urban congestion. According to Budha (2024) and Magangeni (2024), while regional GDP studies frequently associate economic growth with urban development, they fail to examine how growth in revenue, private car ownership growth, and commercial activity contribute to the strain on existing infrastructure. Similarly Seong (2025) highlighted the relationship between economic growth and urban congestion is still not sufficiently comprehended, especially at a regional level in a developing nation.

Transportation Expenditure

Transportation Expenditure is the total public and private spending allocated towards transportation which includes, operation, development, and maintenance of services within a region. Melnik, (2024) defines transportation expenditure as all the monetary outlays for the purpose of transportation which includes capital investment in infrastructure, the operating costs for transportation services, and subsidies provided to transportation users and its providers. An

example would be the spending of the government on the EDSA bus lane has increased connectivity and reduced traffic congestion in the area.

Analyzing transportation expenditures should consider factors such as the allocation of funds across different modes of transportation which include road, rail, air, and water, the sources of funding, if it comes from the government, the private sector, or if it is from user fees, and the efficiency of spending. The method to analyze transportation expenditure would be to categorize by mode and purpose to assess the effectiveness of spending and its priorities utilized by Mn et al., (2022). It is also important to consider the various transportation policies put in place that contribute to increasing transportation expenditure. It is important to consider the different forms of transportation especially in the Philippines in order to have sustainable transport projects with the aim of reducing urban congestion

Transportation Expenditure is driven by population growth, economic development, urbanization, and innovation. Qian, (2024) discussed that population growth and urbanization increase the demand for transportation infrastructure and services which leads to higher transportation expenditure. It is also discussed that economic development generates both passenger and freight traffic which adds strain to the transportation infrastructure. Another factor that drives transportation expenditure would be technological innovation where An et al., (2024) established that technological innovation leads to higher transportation expenditure.

Transportation expenditure has a variety of effects where it affects economic growth, accessibility, and social equity. Sanni, (2025) established that higher transportation expenditures stimulates economic growth by creating jobs, improving productivity, and facilitating trade and investment. Furthermore, increased investment in transportation expenditure would improve accessibility, reduce travel times, and enhance the competitiveness of business and industries

which would lead to prosperity and sustainable growth. However Wang et al., (2023) argued that the increase in transport expenditure would also lead to urban sprawl, social inequality, and environmental issues. The various possible effects are to be considered when investments are made in order to align with current goals and if it would support policies currently put in place.

Table 6.0:

Transportation Expenditure Research Gap Matrix

Author(s)	Title	Limitation / Gap Identified
Melnik	Legislative redistricting and the partisan distribution of transportation expenditure (2024)	Focused only on Ohio; broader spending patterns unexplored.
Mn et al.	The Effectiveness of Unpermitted Bus Services (Pirate) Transportation Mode (2022)	Impacts on regulation, safety, and urban planning not assessed.
Qian	An empirical study on the relationship between urbanization, transportation infrastructure, industrialization and environmental degradation in China, India and Indonesia (2024)	Insufficient distinction of transport modes' environmental effects.
Sanni	Assessing the Effectiveness of Oman's Logistics Infrastructure in Facilitating Regional Trade and Economic Growth (2025)	External economic shocks' impact on transport infrastructure not analyzed.

Transportation expenditure is often reviewed through the lens of economic investment efficiency however there is a gap in exploring the connection between spending trends and urban congestion. Previous literature analyze the distribution of funding across various modes of transportation but they fail to assess whether the spending leads to the reduction of urban congestion as according to Melnik (2024) and Mn et al. (2022). Furthermore Sanni (2025) pointed out that if expenditure is misallocated it may lead to the contribution towards urban congestion.

Policy Recommendation

In the context of transportation studies, policy recommendations are evidence-based strategies proposed to influence decision makers to reduce congestion through institutional

action. Yu & Bae (2016) defined policy recommendations as actionable statements which are derived from systematic analysis aimed at challenges faced by the public whilst He, et al. (2021) emphasized that integrated modal strategies as critical for reshaping urban mobility. A study conducted by Lanigt, et al (2025) analyzed how congestion-charging proposals in baguio were crafted through studies of revenue usage and public sentiment, furthermore the study of Zulueta, et al. (2024) reviewed modern jeepney designs in Manila and how they emphasized environmental benefits, route rationalization and engagement with stakeholders. Thus, policy recommendations bridge empirical insight with pragmatic solutions. In the Philippine context, jeepney modernization program proposals included technical standards, fare systems, and GPS monitoring which were based on stakeholder analysis, which makes them implementable recommendations rather than being just theories.

Evaluation of transport policy recommendations involves the assessment of feasibility, cost-benefit, public sentiment, and institutional capability. Lee & Hur (2017) highlighted that the determinants of pricing success are political will, equity and update, furthermore in their study they discussed how impact fees improved travel time, air quality, using quantitative data. In another study by Jalota, et al. (2023) they conducted analysis through development of schemes through the study of congestion pricing and revenue refunding, formulating policy recommendations that maximize efficiency and reducing wealth inequality. In the Philippine context, the study of Cueto, et al. (2021) incorporated logistic modeling, qualitative stakeholder interviews, and quantitative survey data to evaluate the feasibility of modernization program feasibility. These studies establish that effective analysis of policy recommendations combines technical modeling and institutional insights; where the lack of multi-layered evaluation risks failure due to a lack of stakeholder buy-in or poor fit in with existing infrastructure and systems.

Transport policy recommendations are driven by demand created by domestic migration, road capacity limits, and vehicle dependency. A study conducted by Gatarin (2021) linked domestic migration to rising traffic delays in Metro Manila, this is further supported by Kucharski, et al. (2020) in their review of the Lewis-Mogridge position and it demonstrates how road expansion induces further demand. This is backed by PIDS (2015) reports in which they estimate that congestion costs billions of pesos' per day and that regulation of public transportation can reduce travel times by approximately 20%. These studies highlight that policy recommendations must directly respond to demographic pressures and demand dynamics while aligning with institutional reforms and public readiness.

Well designed, evidence-based policy recommendations measurably reduce transport congestion and promote sustainable modal shifts. Reports by the OECD (2019) establish that effective policy recommendations led to reduction of tunnel traffic, increase in travel speeds, improvement of air quality, and increase in bike-sharing which acknowledges broader modal shifts. Furthermore Lanigt, et al (2025) found out that when revenues funded transport upgrades, it led to improved driver behavior, whilst Zulueta, et al. (2024) showed that effective policy recommendation led to efficiency improvement and strengthened stakeholder cooperation. These findings confirm that policy recommendations that are built upon empirical evidence and tailored to local contexts significantly alleviate congestion and foster sustainable transportation systems. Institutions in the Philippines can leverage similar policies to achieve tangible goals of improvement.

CHAPTER 3

THEORETICAL FRAMEWORK

This chapter presents the Theoretical Framework, Conceptual Framework, Operational Framework, Statement of Assumptions and Hypothesis and Definition of Terms

Lee Push-Pull Theory of Migration

Migration occurs due push and pull factors which influence an individual's decision to relocate from their residence of origin. Lee's Push-Pull Theory of Migration stated that individuals migrate based on factors that push them out of their residence of origin or pull them towards a new location. De Haas, (2021) discussed in his framework that economic disparity between rural and urban areas is the primary driver of migration as people who seek better wages also seek better living standards. The Philippines faces rapid urbanization in its metro areas which is largely fueled by rural migrants who seek better livelihoods. Data from the Philippine Institute of Development Study (PIDS) show that internal migration flows are directed toward urban centers which in turn contribute to the strain on infrastructure systems. This theory highlights how migration is a response to economic and social imbalances as it directly contributes to the influx of people who already reside in urban areas.

Transportation Congestion Theory

Domestic migration contributes to transportation congestion by driving growth in urban areas which alters spatial development and increases travel demand, if left unchecked it may overwhelm existing infrastructure. Urban Spatial Structure Theory by Alonso, (1964) explains that concentration due to migration leads to spatial imbalances, where urban areas become highly congested due to the lack of decentralization and uneven land use planning. This spatial clustering increases the demand along transport corridors which are unable to keep up with the

demand. A theory that compliments this is the Urban Systems Theory by Batty, (2013) where it emphasizes that cities operate as interlinked sub systems; where an increase in population from migration strains transportation systems. Additionally the Mobility Transition Theory by Zelinsky, (1971) establishes that individuals that migrate shift their mobility preferences from walking and public transport toward private vehicles and motorcycles which increases road use in the city. Together these theories explain how domestic migration effects result in transportation congestion, the theoretical lens validates the inclusion of migration as a driving variable and supports the study's focus.

New Economic Geography

The concentration of economic activities drives migration and congestion upwards which creates a cycle of growth and spatial inequality. New Economic Geography (NEG) , which was termed by Krugman in 1991, argued that as businesses and different industries cluster in urban areas, they generate agglomeration economies which benefit from shared infrastructure and labor markets. This clustering attracts additional workers which increases migration into urban areas. Duranton & Puga, (2020) discussed that urban economic clusters lead to an increase in productivity but also have a positive relationship to congestion due to heightened commuter demand. Metro Manila serves as a good example where job seekers from provinces relocate for better opportunities which adds to traffic congestion. While agglomeration fuels economic growth, it also places significant stress on urban infrastructure which requires the government to respond with targeted and land-use policies to mitigate congestion.

Urban Transport Carrying Capacity Theory

Urban areas have the limited ability to accommodate transportation demand before congestion ultimately overwhelms existing infrastructure. Urban Transport Carrying Capacity

Theory established that when traffic volume exceeds the capacity of the transport system of the city, inefficiencies such as economic losses, travel delays occur. Guzman & Cabrido, (2021) confirmed that transport networks in the Philippines struggle to satisfy the needs that come with rapid urbanization which ultimately leads to severe congestion. This is particularly relevant in Metro Manila as major roads operate beyond the designed capacity which results in daily traffic jams and bottlenecks. This theory highlights the need for sustainable urban mobility solutions which includes mass transit investment and improved urban planning.

Harris-Todaro Model of Migration

People will migrate to urban areas despite congestion due to expected economic benefits regardless of risks that they may face. The Harris-Todaro Model of Migration establishes that migration decisions are based on the possibility of employment in urban areas. This means that even in congested cities with high unemployment and where overpopulation is rampant, migrants will still be willing to relocate. Zheng & Yang, (2016) further supported that rural-to-urban migration still occurs in developing countries, despite the worsening of urban conditions. In the Philippines, rural migrants still continue to relocate despite urban areas experiencing a large volume of informal settlements and heavy traffic congestion as the rural migrants anticipate better economic opportunities. The model suggests that if rural opportunities were improved, migration rates would decrease, therefore reducing urban congestion.

Myrdal's Cumulative Causation Theory

The cumulative causation theory (1986) establishes that economic development is a cycle of regional advantages which causes inequality between rural and urban areas. Paredes-Orozco (2019) found that in Mexico, the migration to the U.S. is a cycle due to the established social networks, regardless of the immigration policies put into place. This indicates that cumulative

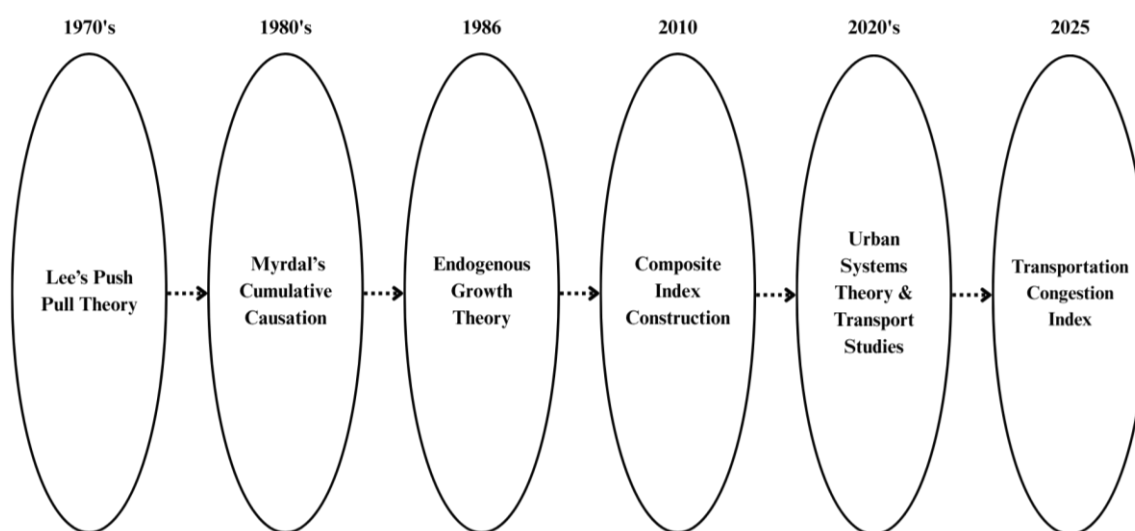
causation is still a relevant concept in migration patterns. In Metro Manila, the concentration of economic opportunities attracts individuals to migrate from rural areas. Domestic migrants then establish communities and they create networks that facilitate further migration which adds to urban congestion and strains existing infrastructure

Endogenous Growth Theory

Internal factors like knowledge, labor, and innovation drive long-term economic development as discussed in the endogenous growth theory. Apostol et al. (2021) applied this theory in the review of ASEAN which includes the Philippines and the findings revealed that urbanization and human capital significantly impact GDP per capita which underscores the role of internal factors in economic growth. The accumulation of skilled labor and innovation in urban areas fosters economic growth which makes urban areas attract migrants who seek job opportunities. This cycle contributes to urban congestion which highlights the unintended consequences of the dynamics of endogenous growth.

Figure 2.0:

Conceptual Timeline Narrative



The conceptual evolution of the study begins with classical migration theory with Lee's Push-Pull Theory (1966) which lays the groundwork for understanding the forces that compel individuals to migrate from their place of origin and those that attract them to new locations. The theory is relevant in the Philippines, where regional inequalities and the concentration of services in Metro Manila increase the rate of domestic migration, as reinforced by contemporary literature such as de Haas (2021) and Surve et al. (2022).

The timeline incorporates economic theories such as Myrdal's Cumulative Causation (1986) and the Endogenous Growth Theory (1986), which emphasize the cycle of regional development. These theories discuss why economic opportunities and the effects of agglomeration accumulate in urban areas like NCR. As economic development migrants and innovation, existing infrastructures become overburdened, especially the absence of decentralizing development in rural regions. These frameworks establish why domestic migration is embedded within broader structural and spatial inequalities.

The timeline progresses to Urban Transport Carrying Capacity Theory by Guzman et al. (2021) and Farrell's Rapid Urban Growth Triad (2017), both of which provide the theoretical and analytical basis to understand how migration and economic growth manifest in urban areas. These frameworks focus on how urban infrastructure fails to meet the thresholds and results in urban congestion and inefficiencies. This progression finally accumulates to the operationalization of the Transportation Congestion Index (TCI), which is a composite indicator tailored for the Philippine context. The TCI integrates vehicle density, accident rates, and Annual Average Daily Traffic (AADT) which are quantifiable measures of strain on infrastructure to provide an analytical output which reflects the culmination of domestic migration pressures, economic growth dynamics, and urban planning constraints. The timeline outlines the academic

process of ideas and supports the methodological and conceptual convergence as seen in the discussions in the present study.

Conceptual Framework

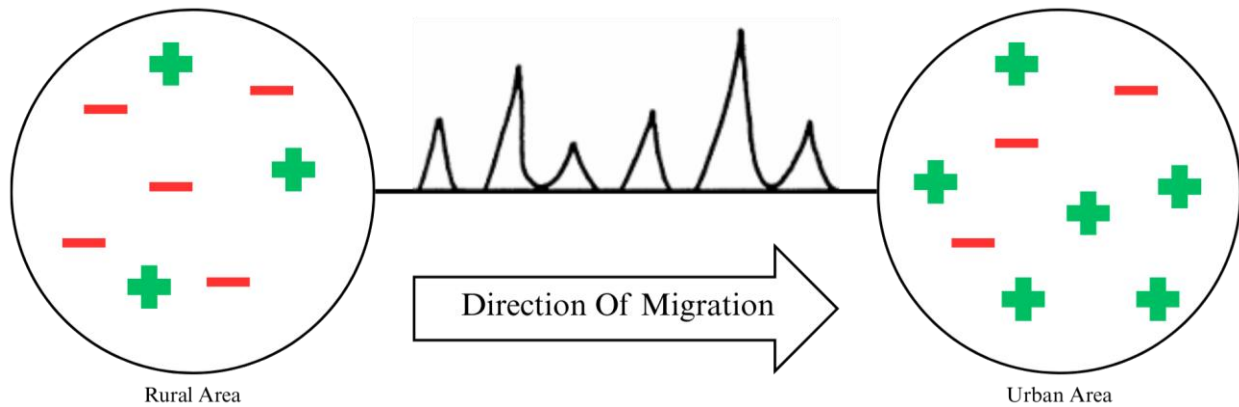
The study utilizes a conceptual framework that integrates the concepts of domestic migration and the urban and economic consequences that follow. The conceptual framework serves to visually and analytically connect the theoretical components of the study, which helps visualize how the variables interact with one another within the research. In this study, the framework draws from established models, to provide comprehensive understanding on how domestic migration influences urban congestion in the Philippine context.

Figure 3.0 explains the causes and directional flow of domestic migration where it identifies the economic, social, and infrastructural disparities between rural and urban areas which drive individuals to migrate. Figure 4.0 analyzes the effect of domestic migration on urban congestion and economic performance, specifically on how population growth interacts with infrastructure capacity. While Figure 5.0 explores how spatial and temporal factors that may be caused by domestic migration shape congestion.

Utilizing these models allows the study to construct a coherent narrative which begins with domestic migration drivers and extends toward the result of urban congestion as a result. The following figures and explanations outline how each framework contributes to the research design and further discuss the nature of the variables within the study.

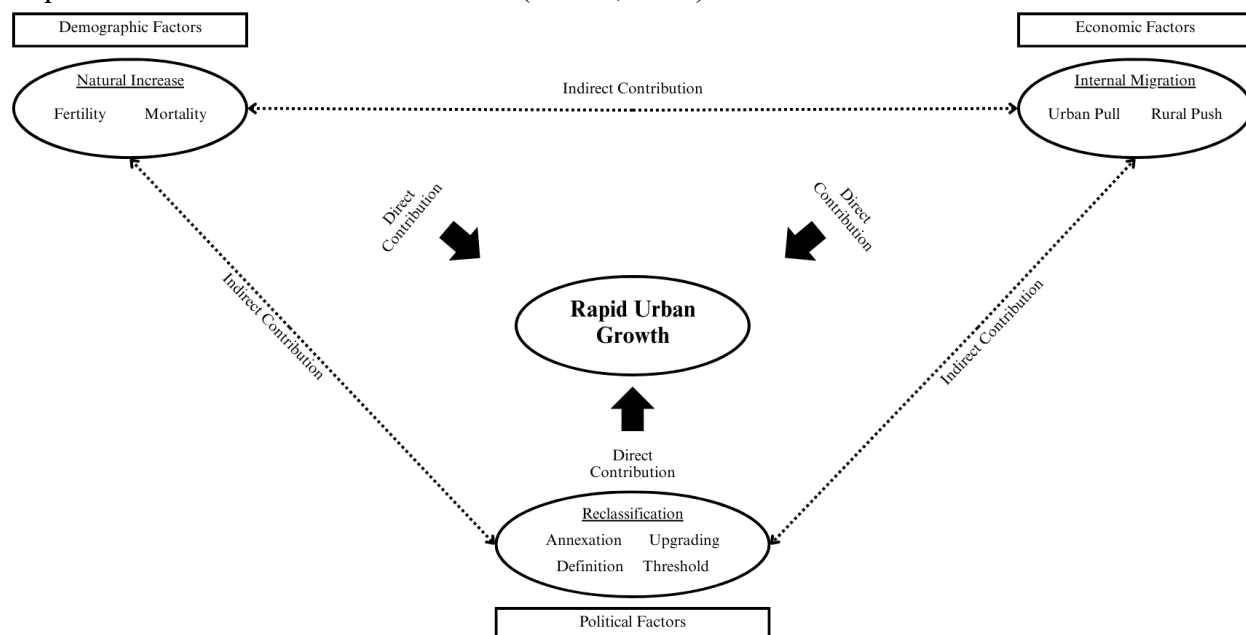
Figure 3.0:

Lee's Push-Pull Theory of Migration Framework (Lee, 1966)



Lee's Push Pull Theory allows the study to interpret the motivation for domestic migration. As shown in figure 3.0, migration is understood as a function that is influenced by push factors from the area of origin such as poverty, unemployment, and lack of access to basic services, and pull factors from the destination such as more employment opportunities, better education, and higher perceived quality of life. These factors influence the decision-making of individuals or households on whether to migrate or not.

In the framework, the convergence of push and pull factors lead to migration toward urban centers. In some cases intervening obstacles such as distance, cost, and social networks or personal factors mediate whether individuals or households decide to migrate. Nevertheless, Lee's framework helps establish why migration originates which sets the stage for understanding its effects further in the study

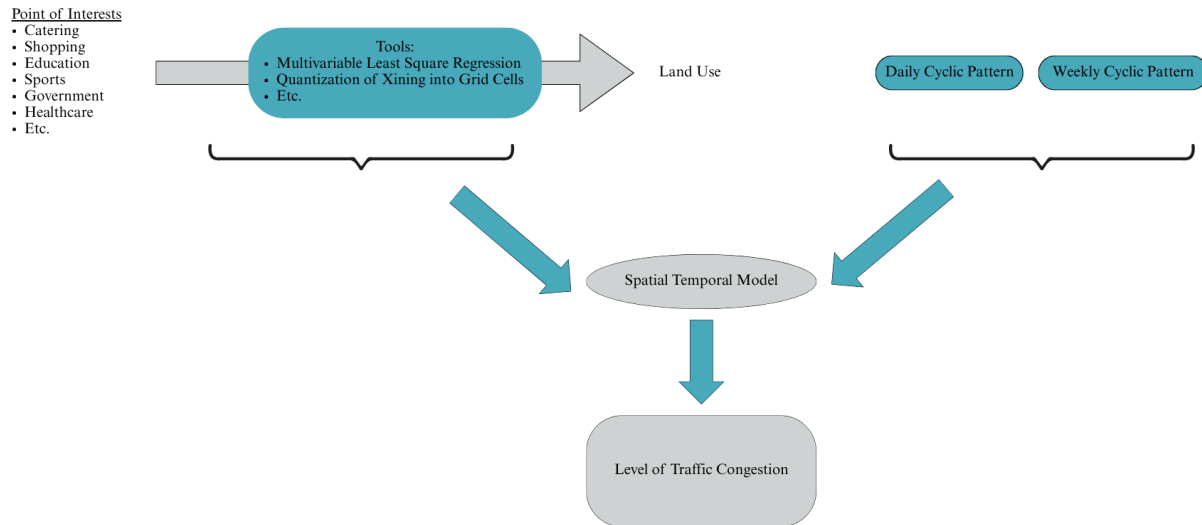
Figure 4.0:**Rapid Urban Growth Triad Framework (Farrell, 2017)**

Illustrated in Figure 4.0, the Rapid Urban Growth Triad Framework from Farrell, (2017) further supports Lee's theory by focusing on the urban consequences of domestic migration. The model conceptualizes the relationship economic factors, demographic factors, and political factors, where domestic migration increases the density of the population in a short period whereas without proportional improvements in infrastructure or if there is delay in public service, it will result in informal development, spatial inequality, and urban congestion

The framework shows that strains on the infrastructure systems such as road networks, public transportation lead to inefficient services, traffic congestion, and a lower quality of life. However the Triad also highlights the potential for policy interventions such as decentralization, investment in infrastructure, and sustainability programs to enable inclusive growth within society.

Figure 5.0:

Bao, et al.'s Framework on Traffic Congestion Patterns in Urban Areas (Bao, et al. 2022)



In Figure 5.0, the framework on traffic congestion patterns in urban areas from Bao, et al. (2022) it discusses that urban areas are affected by spatial and temporal factors which shape traffic congestion. The spatial factors encompass the physical design of the urban environment which directly influences how individuals navigate urban areas. Meanwhile, temporal factors further complicate temporal factors as traffic patterns can vary dramatically based on time and or special events. Consideration of these factors is important for urban planners to optimize land use and transportation systems.

The frameworks relates back to Lee's Push-Pull Theory and Farrell's Rapid Urban Growth Triad by highlighting how spatial factors such as land use and transportation networks can attract or repel individuals to migrate and how urban growth and congestion patterns are affected by domestic migration trends,

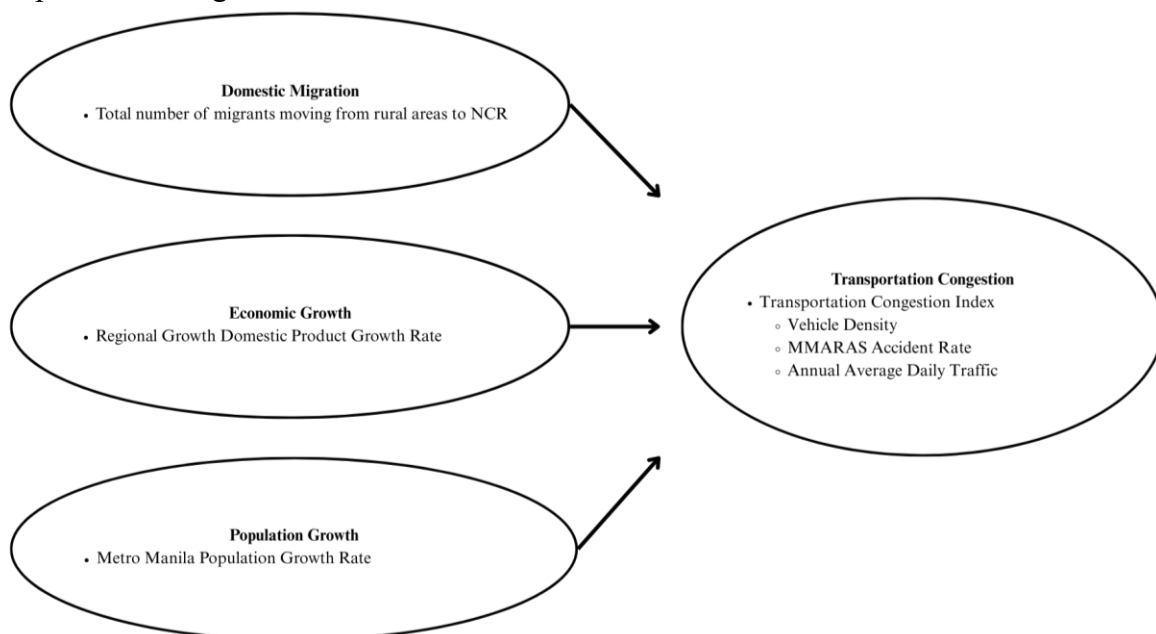
Together these conceptual frameworks trace a complete path, from the motivation to migrate to the urban and economic impacts that stem from domestic migration. In doing so, they serve as the theoretical and visual foundation for the analysis

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 6.0:

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.

Assumptions

This research makes the assumption that domestic migration is driven by economic opportunity, and that when infrastructure development falls behind, transportation congestion is the result. Agglomeration economies initially boost economic growth, but if left unchecked, traffic and population increase might negate these gains. Government actions affect migration patterns by either increasing urban density through infrastructure growth or reducing congestion through decentralized development.

Hypotheses

H_{01} : There is no significant relationship between domestic migration and urban congestion in the Philippines.

H_{02} : Domestic migration has no significant positive or negative effect on urban congestion.

H_{03} : There is no significant relationship between economic indicators and urban congestion in the Philippines.

H_{04} : Economic indicators have no significant positive or negative effect on urban congestion.

Definition of Terms

Agglomeration Economies - The economic benefits that arise when businesses and industries cluster in cities, increasing efficiency according to Duranton & Puga, (2020)

Carrying Capacity - The maximum population an urban area can support before inefficiencies emerge as tackled by Guzman & Cabrillo, (2021)

Domestic Migration - The domestic movement of individuals from rural areas to urban areas, often influenced by economic opportunities as established by Lee, (1966)

Economic Growth - The expansion of economic activities measured through productivity, GDP and employment rates as defined by Krugman in the paper of Duranton & Puga, (2020)

Government Response - Infrastructure initiatives, urban planning, and policy changes targeted at reducing congestion caused by migration as explored by Shang et al., (2024)

Transportation Congestion - The overabundance of traffic, and service demands on municipal infrastructure that surpasses the carrying capacity of the region as discussed by Guzman & Cabrido, (2021)

CHAPTER 4

METHODOLOGY

This chapter offers a comprehensive overview of the research methodology, detailing the specific tools and methods employed to analyze data necessary for generating findings related to the research topic. It covers aspects such as research design and strategy, participants and respondents, sampling methodology, measurement and instrumentation, research procedures and data collection, ethical considerations in research, as well as data analysis and diagnostic tests.

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 Km². The formula is:

$$\text{Vehicle Density} = \frac{\text{Number of Registered Vehicles}}{\text{Total Area of NCR}} \quad (1)$$

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:

$$\text{Normalized Value} = \frac{X - X_{\min}}{X_{\max} - X_{\min}} \quad (2)$$

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:

$$\text{Accidents per 1,000 Vehicles} = \frac{\text{Monthly Accident Count}}{\text{Registered Vehicles}} * 1000 \quad (3)$$

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 the formula is:

$$TCI_t = \frac{1}{3}(\text{Vehicle Density}_t + \text{Accidents}_t + \text{AADT}_t) \quad (4)$$

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:

$$\text{Cumulative Migration}_t = \sum_{i=1}^t \text{Monthly Migration}_i \quad (5)$$

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

Research Ethics and Approaches

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.

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:

$$TCI_t = \beta_0 + \beta_1(\text{Cumulative Migration}_t) + \beta_2(\text{Pop Growth in NCR}_t) + \beta_3(\text{Regional GDP in NCR}_t) + \epsilon_t \quad (6)$$

Where

- TCI_t is the Transportation Congestion Index at time t ,
- β_0 is the intercept,
- $\beta_1, \beta_2, \beta_3$ are the coefficients of the independent variables,
- ϵ_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.

CHAPTER 5

RESULTS, ANALYSIS, AND DISCUSSION

This chapter describes the statistical methods used in the study, the data analysis and the interpretation of the findings. The gathered results enable the researcher to address the stated problem statements and draw a conclusion.

Descriptive Statistics

This section summarizes the statistical properties of the variables utilized in the regression analysis which provides the foundational context for the dataset of the study.

Summary Statistics

Table 7.0

Summary Statistics of Variables Included in the Model

Variable	Mean	Standard Error	Median	Standard Deviation	Minimum	Maximum
Transportation Congestion Index	0.50709	0.02292	0.52110	0.19587	0.10390	0.87160
Cumulative Migration	1136.30	74.4899	1111	636.442	31	2081
Growth Rate of RGDP of NCR	0.00494	0.00005	0.00494	0.00077	0.00548	0.00601
Growth Rate of NCR Population	0.00129	0.00002	0.00131	0.00015	0.00132	0.00133

The Transportation Congestion Index (TCI), which is the dependent variable, exhibits a mean of 0.50. Furthermore, the median value is higher than the mean which is 0.521 suggesting the distribution is slightly left-skewed. Additionally, the standard deviation of value of 0.196 with a minimum of .104 and maximum of .872.

The Independent variable of Cumulative migration, exhibited a mean of 1136.30 and a close median of 1111. Furthermore, the variable has a standard deviation value of 636.442 with a minimum of 31 and a maximum of 2081.

The variable of Growth Rate of Regional GDP of NCR has a mean of 0.00494 and a median of 0.00494. Furthermore, the variable has a standard deviation value of 0.00077 with a minimum of 0.00548 and a maximum 0.00601.

The variable of growth rate of the NCR Population has a mean of 0.00129 and a median of 0.00131. Furthermore, the variable has a standard deviation value of 0.00015 with a minimum of 0.00132 and a maximum 0.00133.

Stationarity Analysis

Before running the Ordinary Least Squares (OLS) regression, the assumption of stationarity for all variables was tested using the Augmented Dickey-Fuller (ADF) test. The purpose of this test is to determine if the mean, variance, and autocovariance remain constant over time.

Table 8.0:

Augmented Dickey-Fuller (ADF) Test Results for Time Series Stationarity

Variable	Dickey-Fuller Test Statistic	p-value	Conclusion
Transportation Congestion Index	-3.45	0.05	Stationary
Cumulative Migration	-1.28	0.86	Non-Stationary
Growth Rate of Regional GDP of NCR	-3.47	0.59	Non-Stationary
Growth Rate of NCR Population	-3.53	0.04	Stationary

The test results indicate that only 2 of the four variables are statistically stationary, which are the Growth Rate of NCR population with a p-value of 0.04 and the Transportation Congestion Index with a p-value of 0.05, hence we reject the null hypothesis of a unit root. In contrast, cumulative migration with a p-value of 0.86 and the Growth Rate of Regional GDP of NCR with a p-value of 0.59 are categorized as non-stationary, hence failing to reject the null hypothesis of a unit root.

These variables contain underlying stochastic trends, which indicate that standard OLS regression may produce spurious correlation. The mixed integration status indicates that an Engle-Granger Cointegration Test must be run as established by Engle & Granger (1987) to prove that the non-stationary variables share a common, stable, long-run equilibrium relationship which would validate the usage of an OLS regression model.

Econometric Model Diagnostics

This section presents the results of post-estimation diagnostic tests performed on the Model to ensure the reliability and validity of the OLS estimation. These tests check for violations of key assumptions, which include multicollinearity, autocorrelation, homoskedasticity, and normality.

Multicollinearity Check (VIF)

Multicollinearity occurs when independent variables are highly correlated with each other which leads to inflated standard errors and unreliable t-statistics. The Variance Inflation Factor (VIF) test was used to detect the presence of severe multicollinearity among the independent variables. A score below 5.0 is acceptable

Table 9.0

Variance Inflation Factor (VIF) Scores for Multicollinearity Check

Variable	VIF	Conclusion
Cumulative Migration	1.09	Acceptable
Growth Rate of RGDP of NCR	1.14	Acceptable
Growth Rate of NCR Population	1.08	Acceptable

The VIF scores for all independent variables are all significantly below the threshold of 5.0. This indicates that correlation among predictors is low, establishing that the model is free from multicollinearity, and that the coefficient estimates are stable and reliably measured.

Model Validation

Table 10.0

The Augmented Dickey-Fuller test

Variable	Dickey-Fuller Test Statistic	p-value	Conclusion
Regression Model Residuals	-3.6699	0.03	Stationary

The Augmented Dickey-Fuller test was applied to the residuals of the model in order to justify the validity of the model. The test resulted in a Dickey-Fuller statistic of -3.6699 with a p-value of 0.03364, indicating the rejection of the null hypothesis of a unit root. These results indicate that the variables are cointegrated and the model captures a valid long-run equilibrium.

Autocorrelation Test

The Breusch-Godfrey Test was conducted to formally assess whether the error terms were correlated over time.

Table 11.0

Breusch-Godfrey Test for Autocorrelation in Residuals

Test Value	p-value
LM = 1.87	0.17

The Breusch-Godfrey Test resulted with a LM statistic of 1.87 and a p-value of 0.17, this result would result in failure of rejecting the null hypothesis, establishing that there is no autocorrelation.

Homoskedasticity Test

The Breusch-Pagan test was conducted to assess the assumption of homoskedasticity, which assumes that the variance of the errors is constant across all the independent variables.

Table 12.0

Breusch-Pagan Test for Homoskedasticity

Test Value	Degrees of Freedom	p-value
6.34	3	0.09

The Breusch-Pagan test resulted in a p-value of 0.09 which confirms that the variance of the residuals are constant, which satisfies the assumption of homoskedasticity in the model.

Normality Test

The Shapiro-Wilk test was performed to verify the assumption that the residuals are normally distributed.

Table 13.0

Shapiro-Wilk Test for Normality of Residuals

Test Value (W)	p-value
0.97	0.09

The p-value of 0.09 is greater than the 0.05 significance level. This indicates that the residuals follow a normal distribution which satisfies the normality assumption.

Regression Results

The final econometric model was estimated using Standard OLS Errors.

Table 14.0

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	**

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.

Table 15.0

Summary of Model Fit Statistics

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

The model demonstrates an excellent fit to the data with an R² value of 0.81. This 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

Hypothesis Testing

The hypotheses stated in Chapter 3 are formally tested against the results of the OLS regression model.

Table 16.0

Summary of Hypothesis Testing Decisions

Hypothesis	Test Variable	Coefficient Sign ($\hat{B}$)	P-Value	Test Statistic (t-value)	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

Analysis of Hypothesis

Hypothesis 1 (H1: Cumulative Migration)

The 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

Hypothesis 2 (H2: Regional GDP Growth Rate)

The 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

Hypothesis 3 (H3: NCR Population Growth Rate)

The 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.

Discussion of Findings

The discussion synthesizes the results of the econometric model, demonstrates that cumulative migration, regional economic growth, and the population rate are all statistically significant determinants of the Urban Congestion Index.

Impact of Cumulative Domestic Migration

The findings confirm a significant positive relationship between the cumulative amount of migrants and transportation congestion. Cumulative Migration emerged as the strongest predictor and the positive coefficient indicates that a long term increase in the amount of migrants is associated with a proportional increase in the Transportation Congestion Index.

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. The concentration of people and demand for urban services and transportation would become the cause of the increased congestion. Furthermore, Myrdal's cumulative causation theory further explains that the influx of migrants attracts more people which continuously strains the region's existing infrastructure which would lead to an increase in transportation congestion.

Impact of Regional GDP Growth Rate

The findings confirm a significant positive relationship between the growth rate of regional GDP and transportation congestion.

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. This concentration drives the demand for commerce, movement of goods and people, which translates economic growth into higher transportation demand. This is also in line with the Endogenous Growth Theory, where investment in human capital and physical capital would drive sustained output. However, if the demand exceeds the capacity of the existing network, growth would contribute to congestion in the long run.

Impact of Population Growth Rate

The findings confirm a significant negative relationship between the growth rate of NCR population and transportation congestion, which suggest an increase in population growth is associated with a long run decrease in transportation congestion.

The unexpected direction challenges the application of the Urban Transport Carrying Capacity Theory which predicted a positive relationship. The negative relationship is likely attributable to complex, unmodeled spatial and policy feedback mechanisms.

Summary of Findings

The study successfully established the integrity and validity of the model through diagnostic testing as the Augmented Dickey-Fuller test confirmed the presence of cointegration, the Variance Inflation Factor analysis confirmed freedom from multicollinearity, the Breusch-Godfrey test indicated no autocorrelation, the Breusch-Pagan test revealed that there is no heteroscedasticity, and the Shapiro-Wilk test confirmed that the residuals are normally distributed.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

This chapter contributes of the study, followed by the conclusion and recommendations of the researcher for future researchers

Summary

This study used an OLS model validated by cointegration analysis to examine the long-term effects of cumulative domestic migration, regional economic growth, and population growth rate on the Transportation Congestion Index in the National Capital Region (NCR). The model demonstrated great explanatory power and statistical robustness. It was discovered that each of the three independent variables was statistically significant. According to the data, the most potent positive driver of long-term congestion is cumulative domestic migration, albeit the regional GDP growth rate also has a beneficial impact. Contrary to expectations, the NCR Population Growth Rate was found to be negatively linked with the. This finding was taken as proof of urban decentralization or the rapid efficacy of policy feedback loops that control traffic in response to population pressure.

Conclusions

With the conducted research methodologies and analysis of results from the gathered data and information, the following conclusions are found:

1. 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.
2. 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 activity.

3. 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.
4. 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

With the stated conclusions that the study has arrived with, the following recommendations are suggested for the further development of research with regards to transportation congestion studies.

1. 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.
2. 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.

3. 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.
4. 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.
5. 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.

References

- Adaki, A. (2024). Population Growth and Resource Scarcity: Implications for Conflict and Cooperation in Taraba State, Nigeria. *Journal of Environmental Science and Economics*, 3, 128–145. <https://doi.org/10.56556/jescae.v3i3.1016>
- Air pollution levels rising in many of the world's poorest cities. (2016). Retrieved March 9, 2025, from <https://www.who.int/news/item/12-05-2016-air-pollution-levels-rising-in-many-of-the-world-s-poorest-cities>
- Alonso, W. (1964). *Location and Land Use. Toward a General Theory of Land Rent*. Cambridge: Harvard University Press. <http://dx.doi.org/10.4159/harvard.9780674730854>
- An, K., Wang, X., Wang, Z., Zhao, H., Zhong, Y., Shen, J., & Ren, X. (2024). Dynamic Interactive Effects of Technological Innovation, Transportation Industry Development, and CO2 Emissions. *Sustainability*, 16, 8672. <https://doi.org/10.3390/su16198672>
- Apostol, M., Enriquez, H. A., Sumaway, O., & Navarrete, A. F. (2022). Innovation Factors and its Effect on the GDP Per Capita of Selected ASEAN Countries: An Application of Paul Romer's Endogenous Growth Theory. *International Journal of Social and Management Studies*, 3(2), Article 2. <https://doi.org/10.5555/ijosmas.v3i2.124>
- Bao, Zhikang, Yifu Ou, Shuangzhou Chen, and Ting Wang. (2022). "Land Use Impacts on Traffic Congestion Patterns: A Tale of a Northwestern Chinese City." *Land* 11(12), 2295. <https://doi.org/10.3390/land11122295>
- Batty, Michael. (2013). *The New Science of Cities*. MIT Press.
- Bocarejo, J. P., & Urrego, L. F. (2022). The impacts of formalization and integration of public transport in social equity: The case of Bogota. *Research in Transportation Business & Management*, 42, 100560. <https://doi.org/10.1016/j.rtbm.2020.100560>

- Bongaarts, J. (2020). Trends in fertility and fertility preferences in sub-Saharan Africa: The roles of education and family planning programs. *Genus*, 76, 32.
<https://doi.org/10.1186/s41118-020-00098-z>
- Braithwaite, A., Salehyan, I., & Savun, B. (2019). Refugees, forced migration, and conflict: Introduction to the special issue. *Journal of Peace Research*, 56(1), 5–11.
<https://doi.org/10.1177/0022343318814128>
- Brown, J., & Tousey, C. (2021). How the Pandemic Influenced Trends in Domestic Migration across U.S. Urban Areas. *The Federal Reserve Bank of Kansas City Economic Review*.
<https://doi.org/10.18651/ER/v106n4BrownTousey>
- Brueckner, J. K. (2000). Urban sprawl: Diagnosis and remedies. *International Regional Science Review*, 23(3), 267-279.
- Budha. (2024). Econometrics Analysis of Contributions of Primary, Secondary, and Tertiary Sectors in GDP of Nepal. *Journal of Nepalese Management and Research*, 6, 129–141.
<https://doi.org/10.3126/jnmr.v6i1.72090>
- Chatziioannou, I., Nikitas, A., Tzouras, P. G., Bakogiannis, E., Alvarez-Icaza, L., Chias-Becerril, L., Karolemeas, C., Tsigdinos, S., Wallgren, P., & Rexfelt, O. (2023). Ranking sustainable urban mobility indicators and their matching transport policies to support liveable city Futures: A MICMAC approach. *Transportation Research Interdisciplinary Perspectives*, 18, 100788. <https://doi.org/10.1016/j.trip.2023.100788>
- Choudhary, A., Gokhale, S., Kumar, P., Pradhan, C., & Sahu, S. K. (2022). Urban traffic congestion: Its causes-consequences-mitigation. *Research Journal of Chemistry and Environment*, 26(12), 164–176. <https://doi.org/10.25303/2612rjce1640176>

- Cueto, Geoffrey L., Francis Aldrine A. Uy, and Keith Anshilo Diaz. (2021). “Exploratory Data Analysis of Electric Tricycle as Sustainable Public Transport Mode in General Santos City Using Logistic Regression.” arXiv. <https://doi.org/10.48550/arXiv.2104.08182>
- de Haas, H. (2021). A theory of migration: The aspirations-capabilities framework. *Comparative Migration Studies*, 9(1), 8. <https://doi.org/10.1186/s40878-020-00210-4>
- Delventhal, M. J., Fernández-Villaverde, J., & Guner, N. (2021). NBER Working Paper Series.
- Démurger, S. (2015). Migration and families left behind. *IZA World of Labor*.
<https://doi.org/10.15185/izawol.144>
- Deweerd, T., & Fabre, A. (2022). The Role of Land Use Planning in Urban Transport to Mitigate Climate Change: A Literature Review. *Advances in Environmental and Engineering Research*, 3, 1–1. <https://doi.org/10.21926/aeer.2203033>
- Ding, X. (2021). College education and internal migration in China. *China Economic Review*, 69, 101649. <https://doi.org/10.1016/j.chieco.2021.101649>
- Duranton, G., & Puga, D. (2020). The Economics of Urban Density. *Journal of Economic Perspectives*, 34(3), 3–26. <https://doi.org/10.1257/jep.34.3.3>
- Ewing, R., & Cervero, R. (2017). “Does Compact Development Make People Drive Less?” The Answer Is Yes. *Journal of the American Planning Association*, 83(1), 19–25.
<https://doi.org/10.1080/01944363.2016.1245112>
- Farrell, Kyle. (2017). “The Rapid Urban Growth Triad: A New Conceptual Framework for Examining the Urban Transition in Developing Countries.” *Sustainability* 9(8), 1407.
<https://doi.org/10.3390/su9081407>

- Fasani, F., Llull, J., & Tealdi, C. (2020). The economics of migration: Labour market impacts and migration policies. *Labour Economics*, 67, 101929.
<https://doi.org/10.1016/j.labeco.2020.101929>
- Foucher, A., Evrard, O., Rabiet, L., Cerdan, O., Landemaine, V., Bizeul, R., Chalaux-Clergue, T., Marescaux, J., Debortoli, N., Ambroise, V., & Desprats, J.-F. (2024). Uncontrolled deforestation and population growth threaten a tropical island's water and land resources in only 10 years. *Science Advances*, 10, eadn5941.
<https://doi.org/10.1126/sciadv.adn5941>
- Galor, O. (2012). The Demographic Transition: Causes and Consequences. *Cliometrica*, 6(1), 1–28. <https://doi.org/10.1007/s11698-011-0062-7>
- Gatarin, Gina. (2023). “Beating the Traffic: Civil Society Participation in Transport Reforms and Innovations in Metro Manila, Philippines,” 143–158. https://doi.org/10.1007/978-981-19-8726-7_9
- Guo, L., & Liu, Y. (2022). Urban-Industrial Development and Regional Economic Growth in a Developing Country: A Spatial Econometric Approach. *Sage Open*, 12(2), 21582440221102425. <https://doi.org/10.1177/21582440221102425>
- Guyader, H., & Piscicelli, L. (2019). Business model diversification in the sharing economy: The case of GoMore. *Journal of Cleaner Production*, 215, 1059–1069.
<https://doi.org/10.1016/j.jclepro.2019.01.114>
- Guzman, M. P. D., Jr, C. A. C., & Tabangin, D. R. (2021). Estimating the Transport Urban Carrying Capacity of a City.
- Han, J., Kamber, M., & Pei, J. (Eds.). (2012). *Front Matter*. In *Data Mining (Third Edition)* (pp. i–v). Morgan Kaufmann. <https://doi.org/10.1016/B978-0-12-381479-1.00016-2>

- He, Brian Yueshuai, Jinkai Zhou, Ziyi Ma, Ding Wang, Di Sha, Mina Lee, Joseph Y. J. Chow, and Kaan Ozbay. (2021). “A Validated Multi-Agent Simulation Test Bed to Evaluate Congestion Pricing Policies on Population Segments by Time-of-Day in New York City.” *Transport Policy* 101, 145–161. <https://doi.org/10.1016/j.tranpol.2020.12.011>
- Hidalgo, D., & Rodriguez, D. A. (2014). The challenge of sustainable urban transport in Latin America. *Journal of Public Transportation*, 17(1), 1-22.
- Jalota, Devansh, Kiril Solovey, Karthik Gopalakrishnan, Stephen Zoepf, Hamsa Balakrishnan, and Marco Pavone. (2023). “When Efficiency Meets Equity in Congestion Pricing and Revenue Refunding Schemes.” *arXiv*. <https://doi.org/10.48550/arXiv.2106.10407>
- Kucharski, Rafał, Arkadiusz Drabicki, Jan Paszkowski, and Andrzej Szarata. (2020). “Lewis–Mogridge Points: A Nonarbitrary Method to Include Induced Traffic in Cost-Benefit Analyses.” *Journal of Advanced Transportation* 2020, 3096260. <https://doi.org/10.1155/2020/3096260>
- Lall, S. V., Zhang, J., & Deichmann, U. (2006). Spatial externalities in the public sector: A case study of the impact of transportation investments in India. *Journal of Development Economics*, 81(2), 400-421.
- Langit, Ericka Renee, Samantela, Sandra, Devanadera, Ma, & Agaton, Casper. (2025). Acceptability of The Proposed Congestion Charging System in The Central Business District of Baguio City, Philippines. *CSID Journal of Infrastructure Development*, 8(1), 4–19. <https://doi.org/10.7454/jid.v8.i1.1178>
- Leal, D., & Harder, N. (2021). Global dynamics of international migration systems across South–South, North–North, and North–South flows, 1990–2015. *Applied Network Science*, 6. <https://doi.org/10.1007/s41109-020-00322-x>

- Lee, E. S. (1966). A theory of migration. *Demography*, 3(1), 47–57.
<https://doi.org/10.2307/2060063>
- Lei, M., Ma, G., Yu, F., Tang, Z., Yang, W., Zhou, Y., & Peng, F. (2024). Study on the ecosystem service flow based on the relationship of between supply and demand in Yangtze River Economic Belt. *Frontiers in Earth Science*, 12.
<https://doi.org/10.3389/feart.2024.1432037>
- Levinson, D. M. (2009). The end of traffic congestion. *Transportation Research Part A: Policy and Practice*, 43(1), 13-20.
- Lincicome, S. (2021). Manufactured Crisis: “Deindustrialization,” Free Markets, and National Security. Cato Institute. <https://www.jstor.org/stable/resrep28730>
- Lucas, R. E., & Rossi-Hansberg, E. (2002). On the internal structure of cities. *Econometrica*, 70(3), 1019-1058.
- Magangeni, L. (2024). What are the key drivers and impediments to sustained economic growth and development in emerging markets, and how can policymakers and businesses navigate these factors to promote long-term economic prosperity and stability?"
- Melenkina, S. A., & Uzhegov, A. O. (2024). Structural Shifts in Employment in an Industrial Region: On the Issue of Raising the Standard of Living of the Population. *Bulletin of Perm University. Economics Series = Perm University Herald. Economy*.
<http://economics.psu.ru/index.php/econ/article/view/11>
- Melnik, W. (2024). Legislative redistricting and the partisan distribution of transportation expenditure. *Economics of Governance*, 25, 1–29. <https://doi.org/10.1007/s10101-024-00308-w>

- Mn, H., Asli, N., & Mz, R. (2022). The Effectiveness of Unpermitted Bus Services (Pirate) Transportation Mode. *Journal of Asian Scientific Research*, 12(2), Article 2.
<https://doi.org/10.55493/5003.v12i2.4512>
- Myrdal, G. (1957). *Economic theory and under-developed regions*. London: Duckworth.
- OECD. (2019). “Evaluating the Impact of Urban Road Pricing on the Use of Green Transport Modes.” https://www.oecd.org/en/publications/evaluating-the-impact-of-urban-road-pricing-on-the-use-of-green-transport-mode_ddaa6b25-en.html
- Olasehinde, T. (2024). *Enhancing Workforce Productivity Through Adult Education: A Policy Analysis*.
- Paredes-Orozco, G. (2019). The limits to cumulative causation revisited: Urban-origin Mexico–US migration in an era of increased immigration restrictions. *Demographic Research*, 41, 815–846. <https://doi.org/10.4054/DemRes.2019.41.28>
- Peri, G., & Sasahara, A. (2019). The Impact of Global Warming on Rural-Urban Migrations: Evidence from Global Big Data (SSRN Scholarly Paper No. 3368018). Social Science Research Network. <https://papers.ssrn.com/abstract=3368018>
- Peterson, E. W. F. (2017). The Role of Population in Economic Growth. *Sage Open*, 7(4), 2158244017736094. <https://doi.org/10.1177/2158244017736094>
- Prado, D. (2023). The Impact of Regional Differences and Household Characteristics on Total Income: An Analysis of Variations and Correlations.
<https://doi.org/10.13140/RG.2.2.34980.86404>
- Pratama, F., Fitriadi, F., & Gaffar, E. (2024). The Impact of Regional Infrastructure Sector Investment on Economic Growth and Regional Inequality in East Kalimantan Province,

- 2012–2023. *International Journal of Economics, Commerce, and Management*, 2, 44–52.
<https://doi.org/10.62951/ijecm.v2i1.354>
- Qian, L. (2024). An empirical study on the relationship between urbanization, transportation infrastructure, industrialization and environmental degradation in China, India and Indonesia. *Environment, Development and Sustainability*, 1–27.
<https://doi.org/10.1007/s10668-024-05773-1>
- Rabbi, R. (2023). How Does Migration Impact on Socio-economic Development of Rural Society? 1, 11.
- Rahman, Md. M., Najaf, P., Fields, M., & Thill, J.-C. (2021). Traffic congestion and its urban scale factors: Empirical evidence from American urban areas. *International Journal of Sustainable Transportation*, 15. <https://doi.org/10.1080/15568318.2021.1885085>
- Rith, M., Doi, K., Gue, I. H., Fillone, A., Soliman, J., Mayol, A. P., Lopez, N. S., Ubando, A., & Biona, J. B. M. (2018). Understanding of Determinants of Household Vehicle Ownership Level toward Urban Sustainable Transportation in Southeast Asia – A Case Study in Metro Manila. 2018 IEEE 10th International Conference on Humanoid, Nanotechnology, Information Technology, Communication and Control, Environment and Management (HNICEM), 1–5. <https://doi.org/10.1109/HNICEM.2018.8666265>
- Rith, M., Fillone, A., & Biona, J. B. M. (2019). The impact of socioeconomic characteristics and land use patterns on household vehicle ownership and energy consumption in an urban area with insufficient public transport service – A case study of metro Manila. *Journal of Transport Geography*, 79, 102484. <https://doi.org/10.1016/j.jtrangeo.2019.102484>
- Rizwan, U., & Gasmi, S. (2024). Tax Planning and Economic Activity: The Role of Tax Incentives and Corporate Investment. <https://doi.org/10.13140/RG.2.2.26667.66089>

- Sadigov, R. (2022). Rapid Growth of the World Population and Its Socioeconomic Results. *The Scientific World Journal*, 2022, 8110229. <https://doi.org/10.1155/2022/8110229>
- Samani, H., Rouzbahani, M., Dalvandi, H., & Sadeghi, R. (2024). Income inequality and environmental degradation in the provinces of Iran. *Environmental Health Engineering and Management*, 11, 25–30. <https://doi.org/10.34172/EHEM.2024.04>
- Sanni, B. (2025). Assessing the Effectiveness of Oman’s Logistics Infrastructure in Facilitating Regional Trade and Economic Growth.
- Seong, J., Lee, S., Cho, Y., & Hwang, C. (2025). Beyond the Road: A Regional Perspective on Traffic Congestion in Metro Atlanta. *ISPRS International Journal of Geo-Information*, 14, 61. <https://doi.org/10.3390/ijgi14020061>
- Seoulsolution. (2017). “Reduction of Car Travel: Transportation Demand Management (TDM).” Seoul Solution. <https://www.seoulsolution.kr/en/content/6535>
- Shang, W.-L., Song, X., Chen, Y., Yang, X., Liang, L., Deveci, M., Cao, M., Xiang, Q., & Yu, Q. (2024). Congestion and Pollutant Emission Analysis of Urban Road Networks Based on Floating Vehicle Data. *Urban Climate*, 53, 101794. <https://doi.org/10.1016/j.uclim.2023.101794>
- Shoup, D. (2018). *Parking and the City*. <https://doi.org/10.4324/9781351019668>
- Small, K. A. (2012). *The economics of urban transportation* (2nd ed.). Routledge.
- Sokido, D. L. (2024). Measuring the level of urban traffic congestion for sustainable transportation in Addis Ababa, Ethiopia, the cases of selected intersections. *Frontiers in Sustainable Cities*, 6. <https://doi.org/10.3389/frsc.2024.1366932>

- Solano, G., Ahmad Yar, A. W., & Bircan, T. (2020). Gaps in Migration Research. Review of migration theories and the quality and compatibility of migration data on the national and international level.
- Su, Y., Xue, H., & Liang, H. (2019). An Evaluation Model for Urban Comprehensive Carrying Capacity: An Empirical Case from Harbin City. *International Journal of Environmental Research and Public Health*, 16(3), 367. <https://doi.org/10.3390/ijerph16030367>
- “The Cost of Metro Manila Traffic Congestion.” (n.d.). Accessed July 6, 2025.
<http://www.pids.gov.ph/details/the-cost-of-metro-manila-traffic-congestion>
- Tsedevish, O., Enkh-Amgalan, S., & Shugatai, A. (2024). Issues of determining the effects of migration on population growth in Ulaanbaatar. *Proceedings of the Mongolian Academy of Sciences*, 63, 10–20. <https://doi.org/10.5564/pmas.v63i03.3403>
- Vuchic, V. R. (2017). *Urban transit: Operations, planning, and economics* (2nd ed.). Hoboken, NJ: John Wiley & Sons.
- Wang, Y., Fan, J., Liu, D., Fu, J., Ding, L., & Zhang, J. (2023). Air pollution outcomes, land misallocation, and the transmission through urban sprawl. *Journal of Environmental Management*, 345, 118730. <https://doi.org/10.1016/j.jenvman.2023.118730>
- Wong, C., Zheng, W., & Qiao, M. (2020). Urban expansion and neighbourhood commuting patterns in the Beijing metropolitan region: A multilevel analysis. *Urban Studies*, 57(13), 2773–2793. <https://doi.org/10.1177/0042098019884254>
- Xi, J.-Y., Liang, B.-H., Zhang, W.-J., Yan, B., Dong, H., Chen, Y.-Y., Lin, X., Gu, J., & Hao, Y.-T. (2025). Effects of population aging on quality of life and disease burden: A population-based study. *Global Health Research and Policy*, 10(1), 2.
<https://doi.org/10.1186/s41256-024-00393-8>

- Xiao, W., Li, H., & Wei, Y. D. (2021). Understanding jobs-housing imbalance in urban China: A case study of Shanghai. JSTOR. <https://www.jstor.org/stable/48646191>
- Yu, Sang-Gyun, and Gi-Mok Bae. (2016). “The Relationship Between Congestion Pricing and In-vehicle Crowding Level in Public Transport.” *Journal of Korean Society of Transportation* 34(6), 510–522. <https://doi.org/10.7470/jkst.2016.34.6.510>
- Zelinsky, Wilbur. (1971). “The Hypothesis of the Mobility Transition.” *Geographical Review* 61(2), 219. <https://doi.org/10.2307/213996>
- Zheng, Z., & Yang, G. (2016). Internal Migration in China: Changes and Trends (pp. 223–237). https://doi.org/10.1007/978-3-319-24783-0_14
- Zulueta, Tricia Mae T., Ardivin Kester S. Ong, Josephine D. German, Ma Janice J. Gumasing, and Jenn Christzel D. Chico. (2024). “Implications of the Progression to Sustainable Public Transportation: An Insight into Modern Jeepney Shift from the Philippines.” *Sustainability* 16(10), 3912. <https://doi.org/10.3390/su16103912>

Secondary References

- PSA. (2020). *Migration Decisions—2018 National Migration Survey*. <https://library.psa.gov.ph/cgi-bin/koha/opac-retrieve-file.pl?id=01e1e27cc1e4880baf51379163a8e431>
- OECD. (2008, August 21). *Handbook on Constructing Composite Indicators: Methodology and*

- User Guide*. OECD. https://www.oecd.org/en/publications/handbook-on-constructing-composite-indicators-methodology-and-user-guide_9789264043466-en.html
- PSA. (2024). *GRDP* | *Philippine Statistics Authority*. <https://rssocar.psa.gov.ph/car-grdp>
- UN. (2024). *Interactive World Migration Report 2024*. Retrieved March 10, 2025, from <https://www.iom.int/wmr/interactive>
- United Nations. (2018). *2018 Revision of World Urbanization Prospects*. United Nations; United Nations. <https://www.un.org/en/desa/2018-revision-world-urbanization-prospects>
- World Bank. (2018). *Open Knowledge Repository*. <https://openknowledge.worldbank.org/entities/publication/9eb130a1-8551-517a-b362-7d921fd75bdd>
- Zurbano, J. E. (2024, April 13). Private cars main reason for huge traffic in metro. Manila Standard. <https://manilastandard.net/?p=314435542>

Appendix

Appendix A

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 -20 s 41% 111 Hours 39

Appendix B

Author(s)	Title & Year	Limitation / Gap Identified
Bocarejo & Urrego	Impacts of improved transit systems on equity: the case of Bogota 1999–2019 (2021)	Lack of review on accessibility across income groups.
Choudhary et al.	Urban traffic congestion: its causes-consequences-mitigation (2021)	Lack of integrated approach considering multiple transport factors.
Deweerd & Fabre	The Role of Land Use Planning in Urban Transport to Mitigate Climate Change: A Literature Review (2022)	Need for more empirical validation of planning strategies in practice.
Ewing and Cerver	Travel and the Built Environment: A Meta-Analysis (2017)	Potential bias in compact development studies; lacks refined evidence.
Guyader & Piscicelli	Business model diversification in the sharing economy: The case of a mobility platform (2019)	Limited generalizability beyond single case study setting.
De Guzman & Cabrido	Estimating the Transport Urban Carrying Capacity of a City (2019)	Absence of localized vehicle density standards.
Lincicome, S.	Manufactured Crisis: ‘Deindustrialization,’ Free Markets, and National Security (2021)	Limited analysis of global supply chain impacts on local congestion.
Rahman et al.	Untangling Urban Traffic Congestion: A Meso-Scale Causal Analysis for Policy and Planning (2022)	Meso-level insights insufficient to explain micro-scale congestion patterns.
Rith et al..	Understanding of Determinants of Household Vehicle Ownership Level toward Urban Sustainable Transportation in Southeast Asia (2018)	Focused narrowly on density and accessibility
Rith et al..	The impact of socioeconomic characteristics and land use patterns on household vehicle ownership and energy consumption in an urban area with insufficient public transport service (2019)	Lacked policy factors.

Shoup, D.	Parking and the City (2018)	Limited to none, non-North American case studies; reform barriers underexplored.
Sokido, D.	Measuring the level of urban traffic congestion for sustainable transportation in Addis Ababa, Ethiopia, the cases of selected intersections. (2024)	Political and financial challenges limited research depth.
United Nations	2018 Revision of World Urbanization Prospects (2018)	Lack of localized urban transport solutions in global projections.
Wong et al.	Urban expansion and neighborhood commuting patterns in the Beijing metropolitan region: A multilevel analysis (2020)	Spatial focus lacks policy and infrastructure evaluation.
Xiao et al.	Understanding jobs-housing imbalance in urban China: A case study of Shanghai (2021)	Limited studies on China-specific urban commuting issues.

Appendix C

Author(s)	Title & Year	Limitation / Gap Identified
Braithwaite et al..	Refugees, Forced Migration, and Conflict: Introduction to the Special Issue (2019)	Incomplete models explaining public opinion and refugee dynamics.
de Haas, H.	A theory of migration: the aspirations–capabilities framework (2021)	Lacks empirical tests across diverse socio-economic settings.
Ding, X.	The Causal Impact of College Education on Migration in China (2020)	Long-term labor market and migration effects not examined.
Fasani et al.	The Economics of Migration: Labour Market Impacts and Migration Policies (2022)	Insufficient policy guidance for complex migration realities.
Leal & Harder	Global Dynamics of International Migration Systems Across South–South, North–North, and North–South Flows, 1990–2015 (2022)	Traditional drivers fail to fully explain South–South migration.
Peri &	The Impact of Global Warming on Rural-	Migration constraints in poorer

Sasahara	Urban Migrations: Evidence from Global Big Data (2022)	countries overlooked.
Habbi, R.	How Does Migration Impact on Socio-economic Development of Rural Society? (2023)	Combined effect of remittances, brain drain, and culture underexplored.
Solano & Ahmad Yar	Gaps in Migration Research: Review of Migration Theories and the Quality and Compatibility of Migration Data on the National and International Level (2020)	Unaligned theories and limited data analysis.

Appendix D

Author(s)	Title & Year	Limitation / Gap Identified
Adaki, A.	Population Growth and Resource Scarcity: Implications for Conflict and Cooperation in Taraba State, Nigeria (2020)	Lack of review of the Integration of traditional governance into resource policy
Bongaarts, J.	Trends in fertility and fertility preferences in sub-Saharan Africa: the roles of education and family planning programs (2020)	Mechanisms reducing fertility via education/family planning unclear.
Delventhal et al.	Demographic Transitions Across Time and Space (2020)	Cultural and political factors often overlooked in transitions.
Foucher et al.	Uncontrolled deforestation and population growth threaten a tropical island's water and land resources in only 10 years (2021)	Long-term policy effectiveness against resource depletion untested.
Lei et al.	Study on the ecosystem service flow based on the relationship between supply and demand in Yangtze River Economic Belt (2022)	Sustainability under future economic pressures not fully addressed.
Peterson	The Role of Population in Economic Growth (2022)	Migration's role in fixing growth imbalances is insufficiently studied.
Tsedevish	Issues of determining the effects of migration on population growth in Ulaanbaatar (2022)	Impact on urban-rural ratios and spatial shifts needs deeper analysis.
Xi et al.	Effects of population aging on quality of life and disease burden: a population-based study	Comprehensive frameworks for health impact attribution

		missing.
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Appendix E

Author(s)	Title & Year	Limitation / Gap Identified
An et al.	Dynamic Interactive Effects of Technological Innovation, Transportation Industry Development, and CO2 Emissions (2023)	Regional variations in transport-related emissions underexplored.
Budha	Econometrics Analysis of Contributions of Primary, Secondary, and Tertiary Sectors in GDP of Nepal (2023)	Regional trade reliance complicates consistent GDP growth analysis.
Magangeni, L.	What are the key drivers and impediments to sustained economic growth and development in emerging markets, and how can policymakers and businesses navigate these factors to promote long-term economic prosperity and stability? (2023)	Limited cross-country comparisons for emerging economies.
Melenkina & Uzhegov	Structural Shifts in Employment in an Industrial Region: On the Issue of Raising the Standard of Living of the Population Bulletin of Perm University. Economics Series = Perm University Herald. Economy (2023)	Focus on a single region limits broader applicability.
Melnik	Legislative redistricting and the partisan distribution of transportation expenditure (2024)	Context-specific findings; lacks broader state comparisons.
Mn et al.	The Effectiveness of Unpermitted Bus Services (Pirate) Transportation Mode (2022)	Safety, regulation, and planning impacts not addressed.
Olasehinde	Enhancing Workforce Productivity Through Adult Education: A Policy Analysis (2024)	Regional variation in program success not analyzed.
Pratama et al.	The Impact of Regional Infrastructure Sector Investment on Economic Growth and Regional Inequality in East Kalimantan Province, 2012–2023 (2024)	Mechanisms linking sectoral investment to inequality are unclear.
Qian	An empirical study on the relationship between	Specific types of

	urbanization, transportation infrastructure, industrialization and environmental degradation in China, India and Indonesia (2024)	infrastructure impacts are not differentiated.
Rizwan & Gasmi	Tax Planning and Economic Activity: The Role of Tax Incentives and Corporate Investment (2024)	Long-term corporate behavior after tax breaks unexplored.
Samani et al.	Income inequality and environmental degradation in the provinces of Iran (2024)	Regional disparities limit tailored policy insights.
Sanni	Assessing the Effectiveness of Oman's Logistics Infrastructure in Facilitating Regional Trade and Economic Growth (2025)	Global risks and external trends in logistics not considered.
Seong	Beyond the Road: A Regional Perspective on Traffic Congestion in Metro Atlanta (2025)	Lack of policy intervention impacts studies.
Wang	Air pollution outcomes, land misallocation, and the transmission through urban sprawl (2023)	Narrow indices may miss broader urban pollution drivers.

Appendix F

Author(s)	Title	Limitation / Gap Identified
Melnik	Legislative redistricting and the partisan distribution of transportation expenditure (2024)	Focused only on Ohio; broader spending patterns unexplored.
Mn et al.	The Effectiveness of Unpermitted Bus Services (Pirate) Transportation Mode (2022)	Impacts on regulation, safety, and urban planning not assessed.
Qian	An empirical study on the relationship between urbanization, transportation infrastructure, industrialization and environmental degradation in China, India and Indonesia (2024)	Insufficient distinction of transport modes' environmental effects.
Sanni	Assessing the Effectiveness of Oman's Logistics Infrastructure in Facilitating Regional Trade and Economic Growth (2025)	External economic shocks' impact on transport infrastructure not analyzed.

Appendix G

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

Appendix H

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

Appendix I

$$\text{Accidents per 1,000 Vehicles} = \frac{\text{Monthly Accident Count}}{\text{Registered Vehicles}} * 1000$$

Appendix J

$$UCI_t = \frac{l}{3}(\text{Vehicle Density}_t + \text{Accidents}_t + \text{AADT}_t)$$

Appendix K

$$\text{Cumulative Migration}_t = \sum_{i=1}^t \text{Monthly Migration}_i$$

Appendix L

$$UCI_t = \beta_0 + \beta_1(\text{Cumulative Migration}_t) + \beta_2(\text{Birth Rate in NCR}_t) + \beta_3(\text{Regional GDP in NCR}_t) + \epsilon$$