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# **Infrastructure Investment, Disruption, and Tourism Response: Short-Run Associations of Infrastructure Across New Zealand's Regions**

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## Abstract

This thesis examines the short-run association between infrastructure investment and regional tourism outcomes in New Zealand. While existing research has largely focused on individual infrastructure sectors, particularly transport, relatively little work has examined multiple infrastructure categories within a unified empirical framework or explored these relationships at the regional level in a small, high-income economy. This study addresses that gap by analysing how different forms of infrastructure investment are associated with tourism activity across New Zealand's sixteen regions.

The empirical analysis draws on a region-year panel dataset combining three dimensions: regional economic and demographic conditions, infrastructure capital expenditure across transport and energy sectors, and measures of tourism activity. This structure allows the analysis to exploit both cross-regional variation and temporal dynamics, while remaining attentive to the constraints imposed by short and uneven regional time series.

Methodologically, the study adopts a parsimonious dynamic panel specification estimated over the pre-pandemic period from 2012 to 2019. The model focuses on short-run adjustments in tourism activity, measured by changes in commercial accommodation guest nights, while controlling for persistence, lagged infrastructure investment, regional economic conditions, and common year-specific shocks. Given data limitations and the observational nature of the setting, the analysis is descriptive in nature and does not seek to identify causal effects.

The results indicate that short-run associations between infrastructure investment and tourism outcomes are modest and heterogeneous across infrastructure categories. Airport capital expenditure exhibits a negative but statistically imprecise association with guest nights at a one-year horizon, consistent with temporary disruption during major airport upgrade cycles. At the same time, airport investment is positively associated with international tourism electronic card spending, suggesting that improvements may be linked to shifts in visitor composition or spending intensity rather than immediate increases in visitor volumes. Public transport investment is negatively associated with short-run international tourism expenditure, while road and energy infrastructure display limited and statistically imprecise associations within the same time frame. Robustness checks using alternative specifications yield qualitatively similar patterns but highlight sensitivity to model structure and functional form.

Overall, the findings emphasise the timing-dependent and category-specific nature of infrastructure-tourism relationships in New Zealand. Rather than generating uniform or immediate tourism gains, infrastructure investment appears to interact with tourism activity through transitional dynamics and sector-specific channels. These results underscore the importance of cautious interpretation when evaluating short-run tourism

responses to infrastructure investment and highlight the need for longer time horizons and richer data to assess longer-term impacts.

**Keywords:** Infrastructure investment; regional tourism; panel data; tourism economics; New Zealand.

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## 1. Introduction and Motivation

Tourism has long been recognised as an important contributor to regional development, particularly in economies endowed with strong natural, cultural, and geographic assets. In New Zealand, the sector contributes significantly to national GDP, supports employment, sustains small enterprises, and enhances the economic resilience of peripheral regions. The infrastructure that underpins this activity includes airports, roads, public transport, and essential utilities. While digital and other forms of infrastructure are relevant conceptually, the empirical analysis focuses on major physical infrastructure categories for which consistent regional data are available.

In recent years, the interaction between infrastructure and tourism has attracted renewed attention in both academic and policy debates, particularly in the context of regional equity and post-pandemic economic recovery. Well-functioning infrastructure can reduce travel frictions, enhance destination competitiveness, and support longer and higher-spending visits (Zhang & Xiao, 2014; Seetanah, 2011). Yet, this relationship is neither uniform nor automatic. In some regions, investment produces substantial tourism gains, while in others it remains disconnected from local tourism ecosystems or fails to yield measurable results. This unevenness highlights the need for context-specific and multi-sectoral analyses.

The present study examines how infrastructure investment is associated with regional tourism patterns in New Zealand. The analysis draws on a multi-dimensional dataset organised around three broad pillars: (1) **economy and demographics**, including population, GDP per capita, and regional GDP; (2) **infrastructure**, covering capital expenditure across transport, energy, and public investment areas; and (3) **tourism activity**, measured through guest nights, occupancy, visitor spending, including international electronic card transactions. This framing enables the study of tourism as part of an integrated regional system rather than an isolated outcome.

New Zealand offers a particularly relevant case study due to its decentralised governance, geographic dispersal, and reliance on both nature-based attractions and international visitor markets. While destinations such as Queenstown and Rotorua attract high tourist volumes and concentrated infrastructure spending, other regions remain underserved or lack integration with broader tourism networks.

This research considers whether infrastructure investment is associated with tourism outcomes in relatively weaker regions, while recognising that the empirical analysis is descriptive rather than causal. Much of the existing literature focuses on national-level aggregates or examines single infrastructure types, most commonly roads or airports (Khadaroo & Seetanah, 2007; Yang & Wong, 2012). Studies addressing multiple sectors simultaneously, or exploring sub-national outcomes in small, high-income economies, remain limited.

The motivation for this thesis is both empirical and policy-relevant. Empirically, it contributes to the tourism economics literature by employing a regionally disaggregated, multi-sectoral approach. From a policy perspective, the findings may inform infrastructure investment decisions in settings where tourism is increasingly expected to support regional economic transitions. This is particularly salient as New Zealand faces growing pressure to reconcile environmental constraints, fiscal limits, and the evolving role of tourism in regional development.

The empirical strategy is based on a regional panel dataset covering the pre-pandemic period. By combining indicators across the three pillars with tourism metrics such as guest nights, visitor spending, and tourism's contribution to regional GDP, the study investigates regional and temporal variation in outcomes. Particular attention is directed at whether infrastructure investment in underperforming regions is associated with measurable differences in tourism outcomes, and whether certain sectors have a more catalytic influence than others. The modelling approach, detailed in the following chapters, focuses on short-run relationships and does not attempt to identify long-run causal effects.

Overall, this research aims to support an improved understanding of how infrastructure investment and regional tourism performance interact in New Zealand. In a governance environment where responsibilities for planning, funding, and delivering infrastructure are dispersed across national and regional entities, identifying spatial associations between infrastructure investment and tourism outcomes is important. By adopting a multi-sectoral and regionally grounded approach, the study seeks to provide evidence that is academically robust and relevant for the design of future infrastructure and regional development strategies.

## **2. Literature Review**

### **2.1 Revisiting the Conventional Link Between Infrastructure and Tourism**

The conventional perspective in tourism economics has often emphasised a positive relationship between infrastructure provision and tourism growth. As core systems such as roads, airports, and utilities are expanded or upgraded, destinations may become more accessible, visitor experiences may improve, and tourism inflows may rise. This foundational view has influenced both policy and academic discourse on tourism development for decades, particularly in contexts where limited physical accessibility constrains tourism activity.

Recent contributions to the literature, however, have highlighted a more complex and contingent relationship. Expanding infrastructure does not automatically translate into tourism growth; rather, observed effects depend on the type of infrastructure, the characteristics of the host region, and the absorptive capacity of the wider tourism

system. Several studies document instances in which mismatches between infrastructure investment and tourism readiness, for example, new airports in regions with underdeveloped accommodation capacity, have produced limited or even negative outcomes (Zhang & Xiao, 2014; Seetanah, 2011).

A further dimension is the risk of over-investment. Using Chinese provincial data, Yan et al. (2022) identify an inverted U-shaped relationship, where returns on infrastructure investment rise at first but decline and potentially reverse beyond a certain saturation point. This insight is relevant for New Zealand, where infrastructure expenditure often serves multiple policy objectives, including regional development and service delivery, in addition to tourism promotion. In such contexts, isolating tourism-specific impacts requires careful empirical design and context-sensitive interpretation.

At the same time, the literature has shifted away from treating infrastructure as a homogeneous category. Zhao et al. (2025) propose a useful typology that distinguishes between traditional infrastructure (e.g., roads, bridges), technological infrastructure (e.g., broadband, ICT systems), and livelihood infrastructure (e.g., healthcare, cultural centres). Their findings suggest that livelihood infrastructure can exert a stronger influence on tourism outcomes than capital-intensive or technologically advanced projects, particularly in regional areas where quality-of-life considerations are central to sustaining both residents and visitors.

Traditional transport infrastructure thus remains essential, but its effectiveness increasingly depends on integration with broader place-based investments. Emerging forms of infrastructure, including smart systems and digital tools, appear to yield tourism benefits primarily when layered onto a stable base of conventional services. In this sense, infrastructure relates to tourism not merely through physical accessibility, but also by shaping regional identity, social cohesion, and the lived experiences of visitors and residents alike.

The empirical evidence from this thesis is broadly consistent with the nuanced patterns documented in the wider literature. Specifically:

- **airport investment exhibits differentiated associations across tourism indicators**, with short-run construction-related disruptions reducing visitor volumes (guest nights) but lagged airport investment associated with higher international tourism expenditure;
- **public transport investment shows negative short-run associations with international spending**, consistent with studies that emphasise disruption effects and potential misalignment between commuter-focused infrastructure and visitor needs;
- **road and energy infrastructure display weak or statistically imprecise associations**, in line with findings that these categories often influence tourism indirectly or over longer horizons.

These results echo the broader literature's view that infrastructure-tourism relationships are heterogeneous, timing-dependent, and sensitive to regional context. They suggest that infrastructure associated with tourism outcomes may require complementary investments, coordinated planning, and alignment with regional tourism strategies to achieve measurable short-run benefits.

## **2.2 Seasonal, Regional, and Symbolic Dimensions of Infrastructure**

Infrastructure's influence on tourism is not static; it interacts with seasonality, geography, and symbolic meaning in ways that complicate conventional assumptions about capacity and access. In many peripheral or less-developed regions, the mere presence of infrastructure does not guarantee sustainable or consistent tourism flows. Airports and road networks may exist, but without stable year-round demand their utility can remain constrained. Santana et al. (2024), in a study of North Iceland, found that improvements in air connectivity had limited effect in the absence of complementary tourism infrastructure such as adequate accommodation capacity, skilled labour, and diversified products. They describe this broader set of conditions as "extended capacity," emphasising that the effectiveness of physical assets is contingent on their integration with softer, seasonal, and institutional dimensions of destination readiness.

This perspective is particularly relevant for New Zealand, where many regions face pronounced seasonality and uneven demand. Tourism activity often concentrates in the summer months and in iconic destinations, leaving smaller regions with infrastructure that is underutilised or financially unsustainable for much of the year. In such contexts, investments can appear misaligned with tourism outcomes unless analysed through a temporal lens. The critical issue is not simply whether infrastructure exists, but whether it supports tourism patterns that are durable, inclusive, and regionally balanced.

Geographic fragmentation adds further complexity. In sparsely populated or dispersed territories, infrastructure can assume symbolic and strategic roles that extend beyond its functional utility. For example, in the Faroe Islands, subsea tunnels have not only improved transport efficiency but also reshaped inter-island connectivity, opening previously isolated communities to both residents and visitors (Chan Santana et al., 2024). Comparable dynamics are evident in New Zealand's South Island, where road investments have enabled access to remote areas such as the West Coast and Fiordland. These interventions, however, have not been uniformly beneficial. In some cases, infrastructure originally designed for freight or logistics has inadvertently stimulated tourism flows without sufficient planning for visitor management or community readiness.

These mismatches can generate significant tension. While new infrastructure may stand as a visible marker of development, the planning processes underpinning it are often opaque or disconnected from tourism realities. Communities may find themselves

unprepared for the scale or type of visitation that follows enhanced connectivity, particularly when infrastructure intersects with fragile ecosystems, limited-service provision, or culturally sensitive landscapes. This highlights the importance of aligning infrastructure investment with tourism planning in a more coordinated and anticipatory manner, ensuring that physical expansion is matched by local capacity and community engagement.

The patterns emerging from the New Zealand panel dataset are broadly consistent with several of these themes. Short-run infrastructure associations are modest and heterogeneous, suggesting that the presence of infrastructure alone is insufficient to generate immediate tourism gains. The negative short-run association with airport investment on guest nights, for example, reflects transitional disruption rather than expanded seasonal capacity, while the positive relationship with international expenditure is consistent with changes in spending intensity that may become more evident after initial construction phases. Similarly, public transport investment shows short-run negative associations with tourism spending in the level-based models, consistent with the idea that infrastructure works may disrupt local mobility before their longer-term benefits are realised. For road and energy infrastructure, the absence of strong short-run associations aligns with the literature's view that these categories influence tourism indirectly or over longer horizons.

Together, these insights highlight the need to analyse infrastructure not only as a physical asset but also as part of a broader regional system shaped by seasonality, geographic fragmentation, and the symbolic and strategic meanings attached to development. This broader perspective is essential for understanding why infrastructure-tourism relationships vary across New Zealand's regions and why short-run associations may be limited even when long-run potential appears substantial.

### **2.3 Planning, Prioritisation, and the Role of Decision Tools**

A recurring concern in the literature is the absence of robust frameworks to guide infrastructure prioritisation in tourism contexts. Skare et al. (2025) emphasise that investment decisions are often made without systematic tools to evaluate funding feasibility, spatial impact, or alignment with strategic tourism objectives. In response, their study develops a hybrid model that combines expert judgment with algorithmic weighting to assess proposals on criteria such as tourism growth potential, accessibility improvements, and visitor satisfaction outcomes. Although technical in its design, this approach underscores a broader challenge: infrastructure projects relevant to tourism are frequently selected based on historical patterns, political influence, or general development agendas, rather than being grounded in evidence of tourism-specific needs.

This issue is particularly salient in New Zealand, where infrastructure decision-making is distributed across multiple levels of government and often must balance overlapping

objectives, ranging from freight and logistics to community services and tourism development. In the absence of a data-driven evaluation framework, regions with strong tourism potential but weak baseline connectivity may remain overlooked. Skare et al.'s findings suggest that the most effective outcomes are achieved when investment targets areas with high tourism value but limited accessibility, where marginal gains from improved connectivity are greatest.

More broadly, the literature cautions against standardised or one-size-fits-all approaches. The effectiveness of infrastructure depends on context, timing, scale, and the presence of complementary systems such as service quality, labour capacity, and regulatory coordination. Infrastructure planning, therefore, must be conceptualised not only as a technical process but as a strategic one, embedding tourism-related considerations at the outset. Failing to integrate these considerations risks delivering capital-intensive projects that underperform relative to expectations or leave existing bottlenecks unresolved.

Patterns emerging from the panel dataset indicate that observed infrastructure expenditure is not consistently associated with short-run tourism outcomes. The empirical models indicate that expenditure across most categories, including roads and energy, shows limited association with annual tourism indicators within the one-year horizon examined. The exceptions, such as airport investment (negative for visitor volumes but positive for international expenditure), appear to reflect transitional disruption or sector-specific dynamics rather than systematic prioritisation targeting tourism needs.

These findings are consistent with capital allocation being shaped by broader development logics, such as resilience upgrades, population-serving investment, or multi-sector infrastructure cycles, than by tourism potential per se. While tourism outcomes may benefit indirectly once projects are completed, the short-run patterns observed in the data do not suggest coordinated prioritisation mechanisms of the type recommended in the decision-tool literature. This reinforces the value of frameworks that integrate tourism planning into infrastructure appraisal more explicitly, ensuring that regions with strong tourism potential and limited accessibility are not overlooked in future investment cycles.

## **2.4 Emerging Tensions: Sustainability, Digitalisation, and Perception**

Infrastructure development increasingly intersects with how destinations are perceived, experienced, and represented, extending beyond its functional roles of accessibility and efficiency. A growing body of literature highlights the visual and symbolic dimensions of infrastructure, particularly energy infrastructure projects. Generation and network developments are commonly framed within national sustainability agendas. Yet, in practice, such developments may disrupt the aesthetic or experiential qualities that underpin tourism appeal (Tverijonaite et al., 2023). The central tension lies not in the

infrastructure itself, but in how its presence aligns, or conflicts, with established destination identities.

In several contexts, energy infrastructure has altered landscapes in ways that diminish qualities such as remoteness, natural purity, and silence, all of which are integral to nature-based and wilderness tourism. While some European destinations have adapted branding strategies to incorporate renewable energy as part of a narrative of ecological responsibility and modernisation, others have resisted integration, citing concerns over visual intrusion and cultural incompatibility. These divergent responses underline the role of perception and identity in mediating tourism outcomes, even when infrastructure investments serve broader societal goals.

A parallel dynamic is evident in the domain of digital infrastructure. Mobile networks, data platforms, and app-based services increasingly shape how visitors navigate, engage with, and evaluate destinations. Unlike transport or energy assets, such infrastructure is less visible but has become central to competitive positioning. Sun et al. (2024) provide evidence that investment in ICT systems can significantly enhance tourist arrivals and spending, particularly in regions seeking to rebrand themselves as “smart” destinations. However, the rollout of digital infrastructure is uneven. Regions with limited fiscal or technical capacity may struggle to develop and maintain such systems, even when endowed with strong natural or cultural resources. This unevenness risks reinforcing spatial disparities, as destinations unable to adapt to rising digital expectations, particularly those of younger and international travellers, lose competitiveness in an increasingly data-driven tourism economy.

Patterns emerging from the New Zealand dataset suggest that energy distribution capital expenditure does not exhibit clear links with tourism volumes and may, in the short-run, be associated with lower international tourism expenditure. While the empirical models do not capture perceptual or symbolic dimensions directly, the negative association between lagged energy capital expenditure and TECT is consistent with the literature’s emphasis on transitional disruption and broader context-dependent channels, and the potential misalignment between renewable energy development and tourism identity in environmentally distinctive regions. Similarly, the uneven distribution of digital and ICT-related infrastructure across New Zealand’s regions, although not explicitly measured in the dataset, may contribute to regional disparities in tourism competitiveness. These tensions underscore the importance of integrating sustainability objectives, digital strategy, and destination identity within infrastructure planning processes, ensuring that investments support rather than undermine the tourism narratives that regions seek to project.

## **2.5 Evidence from Case Studies: Bundled Investments and Missed Opportunities**

Empirical studies from diverse contexts demonstrate that infrastructure investment need not always be large-scale or technologically sophisticated to generate measurable

improvements in tourism outcomes. Modest but well-timed interventions, particularly when bundled across modes, can significantly reshape destination competitiveness. Lahura and Sabrera (2023), analysing the Kuelap archaeological site in Peru, applied a synthetic control approach to show how a combined investment in a cable car system and an airport upgrade led to a sharp increase in visitor numbers. The intervention not only reduced access frictions but also altered perceptions of the site's reachability. At the same time, the study highlighted short-term costs, as visitation declined temporarily during construction, underscoring the potential for disruption even when long-term benefits are substantial.

These findings reinforce a broader insight: tourism potential is often constrained not by destination appeal, but by absent or misaligned infrastructure. Costea et al. (2017), examining Romania, report that rich cultural and heritage assets, including UNESCO-listed towns, remain underexploited due to persistent gaps in airport, rail, and port connectivity. Similarly, Zerouali Ouariti and Jebrane (2020) show that in Marrakesh, growth in tourist nights closely tracked phases of coordinated infrastructure improvement, particularly when multiple systems were upgraded in parallel. Such examples illustrate that infrastructure can function as a foundational enabler of tourism competitiveness rather than a secondary support system. Its absence can delay or even negate the economic potential of destinations with otherwise strong assets.

Evidence also suggests that infrastructure quality interacts with market segmentation. Khadaroo and Seetanah (2007), using panel data from Mauritius, found that visitors from Europe and the United States exhibited greater sensitivity to infrastructure standards than those from regional markets. This indicates that infrastructure strategies must be calibrated to the expectations of target demographics: destinations seeking to attract high-spend or long-haul tourists face more stringent requirements than those relying on closer, lower-spend markets.

Comparable patterns are visible in Spain, where long-term policy has deliberately reinforced the match between infrastructure provision and tourism intensity. Regions such as Catalonia, Andalusia, and the Balearic and Canary Islands consistently outperform others in terms of airport density, intermodal integration, and network access (Hrushka et al., 2021). These outcomes reflect not chance, but deliberate policy alignment. The result is a reinforcing cycle in which infrastructure both responds to and sustains tourism flows over time, creating a path-dependent dynamic of investment and visitation.

The empirical patterns emerging from this thesis suggest several parallels with the international evidence. In contexts where investment is tourism-relevant, particularly in airport infrastructure, display clearer short-run behavioural responses in tourism expenditure, even if visitor volumes experience transitional declines during construction phases. Public transport expenditure, by contrast, shows negative associations with international tourist spending, reflecting its primary orientation toward resident mobility

rather than visitor-facing services. Road and energy infrastructure show weaker and less consistent relationships, mirroring global findings that such investments exert diffuse, long-horizon associations rather than immediate tourism impacts. These patterns indicate that in New Zealand, as elsewhere, the effectiveness of infrastructure depends not only on the scale of investment but also on coordination across sectors and alignment with the needs and expectations of different visitor segments.

## **2.6 Methodological Approaches and Gaps in Tourism: Infrastructure Research**

The ways in which scholars have examined the infrastructure-tourism relationship vary considerably across contexts, with methodological choices often shaping the conclusions drawn. A large share of early research relied on descriptive case studies or cross-sectional comparisons of destinations, highlighting correlations between infrastructure quality and tourism flows without controlling for unobserved heterogeneity (Khadaroo & Seetanah, 2007). While useful for illustrating broad patterns, such approaches provide limited insight into causal relationships or temporal dynamics.

Over the past decade, more sophisticated econometric techniques have been introduced. Time-series analyses, for example, have been applied in national settings to capture the long-run co-movement between infrastructure expansion and tourism growth (Seetanah, 2011). However, these approaches often aggregate data to the country level, obscuring important differences across regions. The consequence is a body of work that tends to overemphasise national-level elasticities while overlooking subnational heterogeneity.

Panel data methods have been adopted in some contexts, particularly in studies of transport infrastructure and tourism in Europe and Asia (Hrushka et al., 2021; Yan et al., 2022). These designs allow researchers to exploit both temporal and cross-sectional variation, thereby controlling for unobserved, region-specific characteristics. Yet even here, limitations persist. Many studies restrict their focus to a single infrastructure sector, such as airports or highways, rather than considering multiple sectors in combination. Others concentrate on large emerging economies or heavily touristed regions, limiting generalisability to smaller, high-income economies such as New Zealand.

Another recurring gap lies in the treatment of infrastructure as a homogeneous category. As Zhao et al. (2025) note, distinguishing between transport, digital, and livelihood infrastructure alters the estimated associations on tourism. However, few empirical studies integrate these categories within a single framework. Likewise, temporal aspects, such as whether investments yield immediate or lagged effects, are rarely incorporated into models.

Taken together, the literature suggests that while methodological progress has been made, notable gaps remain. Regional-level, multi-sector analyses remain scarce, particularly in small advanced economies where geography and governance structures

create unique dynamics. This study addresses these shortcomings by constructing a panel dataset for New Zealand's regions and applying a parsimonious dynamic specification, motivated by an autoregressive distributed lag (ARDL)-type specification, with time fixed effects and lag structures suited to a short regional panel. In doing so, it responds directly to the need for more granular, context-sensitive approaches that account for both regional and temporal variation in the infrastructure-tourism relationship. The empirical strategy in this thesis responds to these constraints by implementing a conservative dynamic panel specification that borrows the error-correction structure of ARDL models but is estimated as a single-equation difference model with lagged levels and time fixed effects, without attempting to recover long-run equilibrium parameters

## **2.7 Synthesis and Relevance for New Zealand**

A recurring theme across the literature is that infrastructure functions not only as an enabler of tourism but also as a strategic signal. It reflects policy priorities, indicates the types of visitors a destination seeks to attract, and shapes the kinds of experiences it aims to deliver. Whether through bundled investments in peripheral regions, digital systems embedded in urban tourism zones, or renewable energy projects intersecting with scenic landscapes, infrastructure increasingly carries symbolic as well as functional weight. This dual role complicates how its value is assessed and how interventions are designed.

Earlier assumptions that infrastructure growth would automatically generate tourism growth have been replaced by more nuanced perspectives. Contemporary studies reveal a layered and uneven relationship, where spatial, institutional, and social contexts shape outcomes as much as technical provision. Modest improvements in certain regions may yield significant gains, while large-scale investments can underperform when disconnected from service capacity, governance arrangements, or destination identity. Effectiveness is therefore embedded not just in engineering and finance, but in systems of coordination, community readiness, and visitor perception.

A second theme is that tourism-relevant infrastructure must increasingly be future-oriented. It must respond simultaneously to environmental imperatives, such as climate resilience, and to evolving visitor expectations. Younger and more mobile travellers often expect sustainability, digital integration, and inclusivity to be integral to the tourism experience, while others continue to prioritise comfort and accessibility. These heterogeneous expectations make infrastructure planning both more complex and more urgent. Strategies that overlook such diversity risk obsolescence or misalignment with market realities.

For New Zealand, the literature reviewed here points to several implications. Regional disparities in tourism flows, varied destination identities, and ongoing tensions between

tourism growth and community capacity underscore the need for infrastructure policy that serves multiple objectives simultaneously. Infrastructure must enhance accessibility, support economic resilience, reinforce place identity, and promote spatial equity. In this context, the regionally disaggregated, panel-based approach adopted in this thesis is well suited to documenting differentiated associations of airport, road, public transport, and energy investments across regions. It also enables the analysis of temporal dynamics, specifically whether capital expenditure in lagging or underserved regions produces measurable tourism gains.

As New Zealand navigates infrastructure priorities in a post-pandemic and climate-conscious environment, evidence of this kind can inform more adaptive, targeted, and integrated tourism planning. It highlights the importance of recognising regional diversity, coordinating across infrastructure sectors, and aligning investment with evolving visitor expectations and community capacities.

### **3. Data and Methodology**

#### **3.1 Introduction**

The robustness of any empirical investigation depends heavily on the quality of its data and the methodological framework applied. In a study that examines the relationship between infrastructure investment and regional tourism activity in New Zealand, this challenge is particularly pronounced given the multi-sectoral nature of the research and the diversity of regional contexts in New Zealand. Constructing a dataset that is both comprehensive and comparable across time and space was therefore a critical first step in this thesis.

To capture the interplay between infrastructure and tourism, the research draws upon multiple datasets encompassing a wide range of variables, including regional capital expenditure on infrastructure, demographic and economic indicators, and tourism activity measures. Together, these dimensions provide the foundation for a region-year panel covering New Zealand's sixteen regions. While the assembled databook spans 2005-2024 for most series, the econometric analysis uses restricted estimation windows and subsamples where required by outcome availability and the inclusion of lags, which necessitate consecutive observations.

Developing this dataset required navigating several methodological challenges. Although the intended coverage spans 2005-2024, gaps in availability, inconsistent reporting standards across agencies, and periodic changes in data collection practices introduced discontinuities that needed to be reconciled. These decisions, and their potential implications for the analysis, are documented in detail later in this chapter to ensure transparency and reproducibility.

The datasets were primarily sourced from well-established public and government institutions, including Stats NZ, the Ministry of Business, Innovation and Employment (MBIE), the New Zealand Transport Agency (NZTA), and the Commerce Commission. Additional data were obtained from the published financial statements of regional airport operating companies, given the absence of a unified database for airport capital expenditure. All sources were systematically reshaped into a panel format, organised by region and year, to enable subsequent econometric estimation.

This chapter therefore serves three purposes: first, to provide an overview of the datasets and their sources; second, to describe the procedures employed for their extraction, transformation, and aggregation; and third, to highlight the assumptions and adjustments applied in order to construct a coherent time-series panel. For ease of reference, a summary table is included at the end of the section to consolidate the key attributes of each dataset.

### **3.2 Overview of Datasets**

In line with the objectives of this thesis, datasets were compiled to capture three broad themes that together shape the infrastructure-tourism relationship: (1) demographic and economic indicators, (2) infrastructure investment, and (3) tourism activity. This tripartite structure ensures that both demand-side and supply-side factors are adequately represented and that the regional variation across New Zealand is meaningfully captured. The aim was not only to assemble descriptive indicators but also to construct a panel dataset suitable for econometric analysis of regional disparities and temporal dynamics. This structure is carried through into the empirical analysis, which models tourism outcomes as a function of both regional economic conditions and sector-specific infrastructure investment.

Given the fragmented nature of data availability in New Zealand, the process of dataset assembly required the application of proxies and informed assumptions in order to maintain consistency across regions and over time. These adjustments are documented explicitly in the databook and are acknowledged as limitations. Where feasible, their implications are evaluated through sensitivity analyses, and they are revisited in the interpretation of results. Nevertheless, by drawing from official statistical agencies, regulatory disclosures, and financial reports, the resulting dataset provides a sufficiently comprehensive foundation for addressing the research questions posed in this thesis.

#### **3.2.1 Economic and Demographic Indicators**

Demographic indicators serve as the baseline for normalising and contextualising tourism and infrastructure statistics. Annual mid-year population estimates were obtained from Stats NZ's Infoshare platform, providing consistent coverage for all sixteen regions from 2005 onwards. Population data are essential for constructing per capita

measures (such as GDP per capita or guest nights per capita), which allow for more accurate comparisons across regions of varying size. A known limitation is that population estimates are periodically revised following each national census, resulting in minor retroactive adjustments to historical figures. Despite this, the data remain robust and widely regarded as reliable for longitudinal analysis.

Regional Gross Domestic Product (GDP) data, also sourced from Stats NZ's Infoshare, provide measures of economic output for the 2005-2024 period. This dataset is central to evaluating how infrastructure investment and tourism activity align with broader patterns of regional economic performance. A caveat is that GDP estimates for certain smaller regions, such as Tasman and Nelson, are reported in combined form to maintain statistical quality. Similarly, Canterbury's figures include the Chatham Islands. While these aggregations slightly constrain the granularity of regional analysis, they reflect standard practices within the New Zealand statistical system and are consistent with prior empirical research.

### **3.2.2 Infrastructure Investment Data**

Infrastructure investment data formed the core of this study, as understanding how capital expenditure flows into different sectors and regions is essential to evaluating its influence on tourism and wider economic outcomes. For this purpose, four categories of infrastructure were considered: airports, roads, public transport, and energy distribution networks. Together, these provide a representative cross-section of both transport and utility investments that underpin regional accessibility and competitiveness.

Airport investment figures were compiled manually from the annual reports of individual airport operating companies, as no unified national database of airport capital expenditure exists. This process involved identifying relevant line items, typically asset renewals, expansions, or capacity upgrades, from financial disclosures. For smaller airports, historical disclosures were sometimes incomplete; in these cases, budgeted or committed capital expenditure was used as a carefully documented proxy. Gisborne Airport presented a particular challenge, as its operator, Eastland Group, also manages non-airport assets such as ports and energy infrastructure. In such instances, expenditure attributable specifically to the airport had to be inferred from segmented disclosures, and the associated caveats are noted explicitly in the databook.

Road and public transport expenditure data were obtained from the New Zealand Transport Agency's (NZTA) open data portal. These datasets are pre-aggregated at the regional level and include funding from both central and local government. Coverage spans the period 2005-2024 and incorporates investment in state highways, local roads, and public transport infrastructure. While comprehensive and consistent, the figures are reported in nominal terms and not adjusted for inflation, a limitation addressed in later robustness checks. As such, subsequent analysis will account for this limitation,

particularly in long-run comparisons where real expenditure values may be more meaningful.

Energy infrastructure data were sourced from regulatory disclosures published by the Commerce Commission. Electricity distribution businesses (EDBs) are legally required to report annual infrastructure investment, which enabled regional mapping of expenditure. Each EDB was assigned to its primary service area to construct a region-level series. The main limitation of this dataset is that it captures only distribution-related investment, excluding generation and transmission assets. Nevertheless, given the reliability and transparency of these disclosures, the resulting series provides a credible and internally consistent proxy for regional energy infrastructure investment.

Overall, while each category presents unique challenges in terms of data availability and scope, the combined dataset provides a sufficiently broad and reliable basis to evaluate the linkages between infrastructure investment and regional tourism activity.

### 3.2.3 Tourism Activity Data

To capture the dynamics of tourism across New Zealand's regions, multiple datasets were compiled to reflect both demand-side activity and its contribution to regional economies. Five main indicators were selected: **guest nights, accommodation occupancy rates, guest nights per capita, international tourist electronic card transactions, and tourism expenditure relative to regional GDP**. Collectively, these measures provide both scale (volume of visitors) and intensity (tourism relative to local population or economy), enabling a multidimensional view of tourism performance.

Guest nights and accommodation occupancy rates were obtained from *Stats NZ's Accommodation Survey*. These data cover all major categories of commercial accommodation (e.g., hotels, motels, holiday parks), providing a consistent and long-term measure of tourism demand. A key limitation is the exclusion of informal accommodation providers such as Airbnb, whose relevance increased markedly during the 2010s and early 2020s. Nevertheless, the dataset remains the most comprehensive official source for standardised measures of commercial guest activity.

Guest nights per capita were taken from the *MBIE Regional Economic Activity Tool (REAT)*, which directly reports this ratio. This metric is useful as it controls for population size, allowing more meaningful comparisons across regions of different scales. However, availability is restricted to more recent years (from 2020 onward), meaning long-run consistency is limited.

Tourism expenditure as a share of regional GDP, along with international tourist electronic card spending, were drawn from the *MBIE Tourism Evidence and Insights Centre dashboard*. These datasets highlight the economic weight of tourism relative to local economies and provide insight into expenditure patterns. A major discontinuity

arises around 2020, when MBIE shifted from the *Monthly Regional Tourism Estimates (MRTEs)* to the more limited *Tourism Electronic Card Transactions (TECTs)* dataset. While TECT provides reliable information on card-based spending, it omits cash transactions and some online payments, which introduces a structural break relative to the pre-2020 MRTE series. Consequently, pre- and post-2020 series are not fully comparable, and this limitation will be taken into account when interpreting expenditure trends.

Despite such caveats, the chosen datasets collectively cover a wide time span (2005-2024 for most indicators) and all sixteen New Zealand regions. When integrated, they allow the analysis to capture both long-term trajectories and recent structural changes in regional tourism dynamics.

Where an indicator is available only for a shorter period or contains structural breaks, it is retained for descriptive context but is not necessarily used in the core ECM estimation.

### 3.2.4 Summary of Data Sources

The assembled datasets span all sixteen New Zealand regions and, for most variables, cover close to two decades of annual observations. Together they capture the core elements of the infrastructure-tourism relationship: regional economic conditions, multiple categories of infrastructure capital expenditure, and a suite of tourism indicators that reflect both visitor volumes and spending.

Table 1 summarises the key attributes of each dataset, including the variables used, their sources, temporal coverage, and regional scope. This provides a consolidated overview of the data landscape that underpins the empirical analysis and clarifies the main limitations that are later revisited in robustness checks.

*Table 1: Summary of Datasets and Key Attributes*

<b>Dataset Category</b>	<b>Variable</b>	<b>Data Source</b>	<b>Years Covered</b>	<b>Regions Covered</b>
Demographic	Population Estimates	Stats NZ (Infoshare)	2005-2024	All 16 NZ regions
Economic	Regional GDP	Stats NZ (Infoshare)	2005-2024	All 16 NZ regions
Infrastructure	Airport CAPEX	Airport Reports	Annual 2005-2023	All 16 NZ regions
Infrastructure	Road & Public Transport CAPEX	NZTA Dashboard	Funding 2005-2024	All 16 NZ regions
Infrastructure	Energy Distribution CAPEX	Commerce Commission	2008-2023	All 16 NZ regions

Dataset Category	Variable	Data Source	Years Covered	Regions Covered
Tourism	Guest Nights Accommodation Occupancy Rates	& Stats (Accommodation Survey)	NZ 2005-2024	All 16 NZ regions
Tourism	Guest Nights per Capita	MBIE Economic Tool	Regional Activity 2020-2024	All 16 NZ regions
Tourism	Tourism Spend as % of Regional GDP	MBIE Dashboard	Tourism 2009-2020	All 16 NZ regions
Tourism	International Electronic Card Spend (TECT)	MBIE Dashboard	Tourism 2021-2024	All 16 NZ regions

*Note: Most datasets are comprehensive and span all 16 New Zealand regions. However, there are some caveats worth noting. The population and GDP data from Stats NZ include minor post-census revisions and, in some cases, smaller regions have been combined (e.g., Tasman and Nelson). Airport CAPEX data rely on budgeted or committed figures when actuals weren't available. Road and public transport funding figures from NZTA are nominal and not adjusted for inflation. Energy CAPEX data reflect only distribution, excluding generation and transmission. The accommodation dataset from Stats NZ omits informal providers such as Airbnb. In the tourism datasets, TECT data exclude cash or bank card transactions, and guest nights per capita data are only available from 2021 onward. Tourism spend as a share of regional GDP is available only until 2020, after which it was replaced by the TECT series. The econometric models reported later use restricted pre 2020 windows and smaller region samples where required by lag structure and consecutive observations.*

### 3.3 Analytical Approach

With the datasets prepared and summarised above, the analysis proceeds by specifying an econometric framework that is compatible with the structure of the regional panel and the time-series properties of the key variables. The data combine cross-regional variation in infrastructure investment with annual movements in tourism outcomes, but the panel is short, unbalanced, and characterised by intermittent missing observations across several regions and variables. These features impose meaningful constraints on the class of models that can be estimated reliably and inform the analytical choices adopted in this study.

Tourism activity and macroeconomic variables are typically persistent, and preliminary diagnostics suggest that the series may exhibit mixed orders of integration. In this setting, static level-based panel regressions can be difficult to justify, particularly when the distinction between short-run adjustment and longer-run relationships is of interest. To address this concern, the empirical analysis is based on a parsimonious dynamic specification motivated by the ARDL framework and implemented in an error-correction form. This formulation models annual changes in tourism outcomes while allowing

lagged levels of the dependent variable and key regressors to enter the specification, thereby allowing short-run dynamics to be modelled while retaining a partial adjustment mechanism through lagged levels.

Given the short and unbalanced nature of the regional panel, and mixed diagnostic evidence on persistence across variables, the analysis adopts a parsimonious dynamic specification in first differences with selected lagged levels. This structure is intended to capture short-run adjustment dynamics and persistence while remaining feasible given the limited time dimension of the data.

Importantly, the inclusion of lagged levels is not interpreted as evidence of a long-run equilibrium relationship, nor is a formal panel ARDL or cointegration framework estimated. Instead, all coefficients are interpreted conservatively as short-run conditional associations. Diagnostic unit-root results are reported in Appendix C.

In principle, panel ARDL models can be estimated using pooled mean group or related estimators. However, the short and uneven time dimension of the regional data, together with limited runs of consecutive observations once lags are introduced, renders formal panel ARDL estimators impractical in this context without substantial loss of regional coverage. Instead, the analysis implements a feasible reduced-form error-correction model estimated using within-panel methods. This approach preserves a larger share of the available data while retaining the core structure of the ARDL framework.

The main specification includes year fixed effects to control for shocks common to all regions in a given year, such as nationwide macroeconomic conditions, changes in international travel demand, and sector-wide developments affecting tourism. By contrast, the preferred specification does not include region fixed effects, meaning that time-invariant regional characteristics are not differenced out. This choice reflects a deliberate trade-off. Year effects absorb common shocks that would otherwise confound regional tourism movements in a short panel. At the same time, the preferred specification does not difference out time-invariant regional characteristics, which places limits on identification and motivates a conservative interpretation of coefficients. As a result, the estimates are interpreted as conditional associations within an error-correction framework, rather than as causal effects net of all forms of unobserved regional heterogeneity.

To limit the influence of exceptional shocks associated with the COVID-19 period, the core results are estimated on a sample restricted to 2012-2019, avoiding pandemic-period distortions. This restriction focuses the analysis on typical short-run dynamics between infrastructure investment and tourism activity under more stable conditions and avoids conflating infrastructure effects with the unprecedented collapse and recovery in tourism demand observed during the pandemic. Alternative fixed-effects structures, including pooled specifications, region fixed effects only, and two-way fixed

effects, are estimated as sensitivity checks to assess how coefficient magnitudes and precision vary with the fixed-effects structure in a short panel.

The dependent variable is specified as the annual change in the logarithm of guest nights, capturing short-run growth in tourism activity. Explanatory variables enter both in lagged levels and in first differences, consistent with the error-correction formulation. Infrastructure investment is included with lag structures intended to reflect the delayed influence of capital expenditure on tourism outcomes, while remaining parsimonious given the limited time dimension. Controls for regional economic conditions are included to account for broader demand-side influences. Standard errors are reported in a manner consistent with panel estimation in small samples, and inference is treated cautiously where coefficient precision is limited.

Overall, the analytical approach prioritises internal consistency, transparency, and empirical feasibility. Rather than imposing highly parameterised models that the data cannot support, the study adopts a restrained specification that reflects the constraints of the regional panel while still allowing an explicit distinction between short-run adjustment and longer-run relationships. The resulting estimates provide a conservative benchmark for assessing the association between infrastructure investment and regional tourism outcomes in New Zealand.

### **3.4 Descriptive Statistics**

A descriptive overview of the regional panel provides context for the econometric strategy and highlights structural features of New Zealand's tourism and infrastructure landscape. The data display substantial variation across regions and over time, with pronounced differences in tourism scale, economic structure, and the timing of capital investment. These features motivate a panel approach and support the use of lag structures for capital expenditure, given that infrastructure projects are typically implemented over multiple years and may affect tourism outcomes with delay. Table 2 summarises key variables for the assembled dataset, while Appendix B presents region-level figures illustrating underlying dispersion.

Tourism activity is highly uneven across regions. Guest nights average just over 3 million per region-year but display a wide distribution, indicative of the dominance of a small number of gateway and high-amenity regions. Measures of tourism intensity reinforce this pattern: guest nights per capita range from very low levels in large, diversified regions to extremely high levels in sparsely populated destination regions. Accommodation occupancy rates show similar heterogeneity, with some regions operating close to capacity during peak months and others maintaining ample spare capacity. International tourism expenditure, measured through electronic card transactions, is even more skewed, with a small number of regions accounting for the majority of international spending each year. The divergence between visitor volumes and visitor spending echoes

established differences in market composition across regions. These dynamics are clearly illustrated in Figures B1-B4.

A further defining feature of the dataset is the magnitude of dispersion across variables, as reflected in the standard deviations. For several tourism indicators, the standard deviation is large relative to the mean, indicating marked cross-regional heterogeneity. Guest nights, for example, have a mean of 3.06 million but an SD of 1.85 million, underscoring the dominance of a few high-volume destinations alongside structurally smaller regions. International TECT expenditure exhibits even greater variability, with an SD (NZD 238 million) exceeding the median by a wide margin, consistent with the strong concentration of international spending in gateway regions such as Auckland and Queenstown. Tourism expenditure as a share of regional GDP shows similar dispersion, with an SD of 6.67 percentage points relative to a mean of 12.3 percent, reflecting stark differences in economic dependence on tourism. Comparable patterns appear in the infrastructure series. Airport CAPEX, with an SD nearly three times its mean and more than 25 times its median, exemplifies the project-driven nature of capital cycles. Public transport CAPEX displays even higher dispersion, reflecting the dominance of Auckland and Wellington in national transport investment. Road and energy expenditures exhibit more moderate but still substantial variability, reinforcing the view that infrastructure investment across New Zealand is episodic, uneven, and heavily shaped by region-specific priorities. These large standard deviations indicate substantial cross-regional heterogeneity and time variation. In a short annual panel, such dispersion can be informative but also highlights the need for cautious interpretation when model precision is limited.

Infrastructure investment also displays distinct patterns of concentration and cyclicity. Airport and public transport capital expenditure are characterised by infrequent but large spikes, reflecting major upgrade cycles in a handful of regions, while remaining minimal elsewhere. By contrast, road maintenance expenditure is more evenly distributed, whereas road improvement and energy distribution investment exhibit intermediate patterns, combining moderate dispersion with occasional large projects. The lumpy nature of CAPEX, especially in airports and metropolitan public transport, provides a strong rationale for using lagged specifications to capture implementation timelines and reduce contemporaneous noise. These features are documented in Figures B5-B9.

The economic and demographic variables reveal similarly pronounced regional asymmetries. Population ranges from fewer than 40,000 residents in the smallest regions to nearly 1.8 million in the largest, while regional GDP spans more than an order of magnitude. GDP per capita is more compressed but still shows meaningful variation that has implications for tourism capacity, spending profiles, and infrastructure needs. These factors reinforce the importance of controlling for year specific shocks and broader macro conditions when interpreting annual tourism movements.

Taken together, the descriptive evidence highlights three empirical regularities that guide the subsequent modelling:

1. Strong heterogeneity across regions in tourism scale, tourism intensity, and economic composition.
2. Project driven and highly skewed infrastructure investment patterns, particularly for airports and metropolitan public transport.
3. Clear temporal discontinuities, including the COVID period, which motivate restricting the core estimation sample to 2019 and emphasising year effects in the preferred specifications.

These features establish the empirical context for the year-effects error correction models reported in Chapter 4. Summary statistics are reported in Table 2, with supporting regional figures in Appendix B. Where the econometric estimation uses restricted windows or reduced region samples due to lag structure and missingness, this is reported explicitly alongside the relevant model outputs.

*Table 2: Summary statistics for key variables (region-year panel)*

*(all monetary values in NZD; CAPEX in millions; GDP in millions; occupancy in proportions)*

#### **Tourism variables**

<b>Variable</b>	<b>N</b>	<b>Mean</b>	<b>Std. dev.</b>	<b>Min</b>	<b>Median</b>	<b>Max</b>
Guest nights (thousand nights)*	91	3,057	1,847	880	2,301	7,434
Guest nights per capita (days)	74	9.0	6.7	1.5	6.6	39.2
Occupancy rate	165	43%	10%	24%	40%	70%
International TECT (NZD million)	87	164.2	238.6	4.4	70.4	1,175.8
Tourism expenditure / regional GDP (% , ppts)	106	12.32	6.67	4.50	10.35	29.90

#### **Infrastructure variables (CAPEX, NZD million)**

<b>Variable</b>	<b>N</b>	<b>Mean</b>	<b>Std. dev.</b>	<b>Min</b>	<b>Median</b>	<b>Max</b>
Airport CAPEX	165	20.09	57.66	0.00	2.10	409.96
Public transport CAPEX	165	73.78	192.87	0.16	6.76	1,223.67
Road maintenance CAPEX	165	132.79	125.39	3.65	93.21	712.63
Road improvement CAPEX	165	120.79	165.30	0.02	40.59	708.21
Energy distribution CAPEX	165	81.00	117.23	0.00	37.39	916.91

#### **Economic and demographic variables**

Variable	N	Mean	Std. dev.	Min	Median	Max
Population	165	340,551	418,256	32,400	204,600	1,797,300
GDP per capita (NZD)	165	55,279	12,553	30,816	54,326	92,776
Regional GDP (NZD million)	165	21,040	28,937	1,433	10,173	157,281

## 4. Results

### 4.1 Empirical model and estimation strategy

This chapter examines the relationship between regional infrastructure investment and tourism activity in New Zealand using a dynamic panel specification applied to annual regional data. The primary outcome variable is the annual change in the logarithm of guest nights in commercial accommodation,  $\Delta \ln(\text{GuestNights}_{i,t})$ , which captures short-run movements in tourism activity at the regional level. Guest nights are used as the core dependent variable because they provide the most consistent coverage across regions and years once lag structures are introduced, relative to alternative tourism indicators.

The empirical analysis focuses on the pre-pandemic period and is estimated over the 2012-2019 window. Restricting the sample to this period avoids the structural break associated with COVID-19 and limits the influence of crisis-driven collapses and recoveries in tourism demand. Because the model includes lagged regressors and the underlying panel is unbalanced, the effective estimation sample is further restricted to regions with sufficient consecutive observations to support the specified lag structure.

The estimation adopts a parsimonious dynamic specification motivated by an autoregressive distributed lag (ARDL)-type specification. In practical terms, the preferred specification is a single-equation dynamic panel in first differences with one lag of the dependent variable, lagged levels of airport capital expenditure and controls, and common year fixed effects. This design mirrors the short-run adjustment component of panel ARDL models but does not estimate pooled long-run coefficients or a full pooled mean group structure. The model is implemented in first differences with lagged levels included to capture persistence in tourism activity and delayed associations between infrastructure investment and tourism outcomes, while remaining feasible in a short annual panel. The baseline equation estimated for region  $i$  in year  $t$  is:

$$\begin{aligned}
\Delta \ln(\text{GuestNights}_{i,t}) &= \phi \ln(\text{GuestNights}_{i,t-1}) + \beta_1 \ln(\text{AirportCAPEX}_{i,t-1}) \\
&+ \beta_2 \ln(\text{AirportCAPEX}_{i,t-2}) + \gamma \ln(\text{GDP}_{i,t-1}) + \delta_1 \Delta \ln(\text{AirportCAPEX}_{i,t}) \\
&+ \delta_2 \Delta \ln(\text{GDP}_{i,t}) + \lambda_t + \epsilon_{i,t}
\end{aligned}$$

Here,  $\Delta$  denotes the first difference operator. The coefficient  $\phi$  captures dynamic dependence in guest nights through the inclusion of the lagged level of the outcome. The coefficients  $\beta_1$  and  $\beta_2$  capture delayed associations between airport investment and tourism activity, while  $\gamma$  captures the association with lagged regional GDP in levels. Airport capital expenditure enters at both one- and two-year lags to reflect the project-based nature of airport investment and the possibility that capacity expansions and upgrades affect tourism with delay. The first-difference terms in airport CAPEX and GDP allow for short-run co-movements between changes in infrastructure spending, broader economic conditions, and tourism growth.

The baseline specification includes year fixed effects,  $\lambda_t$ , which absorb shocks common to all regions in a given year, including nationwide macroeconomic conditions, changes in international travel demand, and sector-wide developments affecting tourism. In a short regional panel, such common shocks account for a substantial share of the variation in tourism outcomes, and controlling explicitly for year effects is important for isolating conditional associations at the regional level. The model is estimated using a fixed-effects panel estimator with time effects, and coefficient estimates are reported with their corresponding standard errors from the panel estimator.

The coefficients are interpreted as conditional associations within a dynamic framework rather than as causal effects. Infrastructure investment decisions may respond to anticipated tourism demand or broader regional development strategies, and unobserved factors may influence both investment and tourism outcomes. While the dynamic specification addresses persistence and the timing of lagged responses, it does not fully resolve potential endogeneity concerns. For this reason, the empirical results are presented as evidence on the direction, timing, and stability of associations between airport investment and regional tourism growth under a conservative specification that emphasises control for common year effects.

To assess the sensitivity of the findings to alternative treatments of unobserved heterogeneity, supplementary models are estimated using pooled specifications, region fixed effects only, and two-way fixed effects (region and year). These alternative specifications are reported as robustness checks and are not treated as preferred models. The next section presents the main estimation results based on the time fixed-effects specification, followed by a discussion of robustness and sensitivity to alternative model structures.

## 4.2 Main Estimation Results

Table 3 reports the main estimates from the time fixed effects specification of the dynamic model described in Section 4.1, estimated on the restricted 2012-2019 sample. The dependent variable is the annual change in log guest nights,  $\Delta \ln(\text{GuestNights}_{i,t})$ . The regressors include the lagged level of guest nights, one- and two-year lags of airport capital expenditure in levels, lagged GDP in levels, and contemporaneous first differences in airport CAPEX and GDP. Year effects are included throughout to absorb

shocks common to all regions in a given year. The estimation sample is necessarily smaller than the full dataset because the inclusion of lags and first differences require consecutive observations, and the regional panel is unbalanced.

In terms of magnitude, the estimated airport CAPEX coefficients are small in economic terms in the preferred time-effects specification. The one-year lag of airport CAPEX is  $-0.002$ , implying that a 10% increase in airport capital expenditure in year  $t-1$  is associated with approximately a 0.02 percentage point lower growth in guest nights in year  $t$  (because the dependent variable is  $\Delta \ln$ ). The two-year lag is  $0.004$ , which implies a 10% increase in CAPEX in year  $t-2$  is associated with about a 0.04 percentage point higher growth in guest nights in year  $t$ . The contemporaneous change term ( $d\_lnacap = -0.006$ ) corresponds to roughly a 0.06 percentage point reduction in guest-night growth for a 10% increase in CAPEX within the same year. Taken together, these magnitudes suggest that, conditional on common year shocks, airport investment is not associated with economically large short-run movements in regional tourism volumes within a one- to two-year horizon.

The estimated coefficients on airport capital expenditure are small in magnitude in the preferred time fixed-effects specification. This contrasts with studies that document economically meaningful positive effects of transport infrastructure on tourism using long-run or stock-based measures. For example, Khadaroo and Seetanah (2007), using a cross-country panel and indicators of transport infrastructure availability, report positive and statistically significant associations between infrastructure and international tourist arrivals. Their estimates reflect long-run relationships operating through accumulated infrastructure capacity rather than short-run investment flows. By comparison, the present analysis focuses on annual changes in tourism activity and uses contemporaneous and lagged capital expenditure, which captures project-level investment cycles rather than completed infrastructure stock. The small magnitudes estimated here are therefore consistent with the short-run nature of the specification and do not contradict evidence of positive long-run infrastructure effects reported elsewhere (Khadaroo and Seetanah, 2007).

The results in Table 3 indicate limited evidence of stable short-run associations between airport investment and guest nights within the time fixed effects framework. The lagged airport CAPEX terms are statistically imprecise, with opposite signs across the first and second lags, and the contemporaneous change in airport CAPEX is negative and statistically imprecise. Taken together, the airport investment coefficients do not provide robust support for an immediate or delayed relationship with guest nights in the preferred time effects model.

Lagged GDP enters with a negative coefficient and is the closest term to conventional significance in the main specification. The negative sign suggests that, within this restricted sample and conditional on the included dynamics and common year shocks, higher lagged regional GDP is associated with weaker subsequent growth in guest nights in this specification. This result should be interpreted cautiously and viewed as a conditional association rather than a structural demand relationship. With time fixed effects only, the identification relies on variation that is not absorbed by year dummies,

and the short, unbalanced structure limits the precision with which macroeconomic controls can be separated from tourism dynamics. In this setting, coefficient signs and magnitudes are informative as descriptive associations rather than structural demand relationships.

The lagged dependent variable term is small and statistically insignificant in the time fixed effects estimates. This implies that, once year effects and the included covariates are accounted for, the model does not detect a strong persistence pattern operating through the lagged level of guest nights in this specification, with persistence largely absorbed by common national tourism cycles. This outcome reinforces the interpretation that common shocks and the limited effective sample account for a substantial share of the variation in the data once the model is restricted to the pre-pandemic window and to regions with sufficient consecutive observations.

Overall, Table 3 highlights an important empirical reality for this dataset. When the main specification is constrained to time fixed effects and lags are introduced in a short, unbalanced regional panel, the estimates naturally become less precise and evidence of infrastructure-related effects on guest nights weakens materially. The results therefore serve as a conservative benchmark: they describe the direction and timing of conditional associations that remain after controlling for year specific shocks, but they do not provide strong statistical support for short-run guest night responses to airport capital expenditure in the preferred specification.

The absence of strong short-run responses is consistent with evidence from transport infrastructure studies showing that major investment projects tend to generate effects that materialise over longer horizons and are unevenly distributed across regions (Pereira and Andraz, 2010).

The next section reports sensitivity checks under alternative fixed effects structures to show how the estimates change when regional heterogeneity is absorbed more directly, while maintaining the same dynamic structure and sample restrictions.

*Table 3: Dynamic Time Fixed Effects Estimates*

**Dependent variable:**  $\Delta \ln(\text{Guest Nights})$

**Sample:** 2012-2019 (pre-COVID), restricted regional panel

<b>Variable</b>	<b>Coef</b>	<b>Std. Err.</b>	<b>t</b>	<b>p</b>
lag(ln_guest, 1)	0.004	0.010	0.360	0.721
lag(ln_acap, 1)	-0.002	0.004	-0.553	0.585
lag(ln_acap, 2)	0.004	0.004	0.949	0.351
lag(ln_gdp, 1)	-0.065	0.034	-1.924	0.065
d_lnacap	-0.006	0.004	-1.558	0.131
d_lngdp	0.274	0.241	1.138	0.265

*Note: The preferred specification includes year effects only; region fixed effects are examined separately in Section 4.3 as sensitivity checks*

### **4.3 Robustness Checks and Additional Evidence**

The main results in Section 4.2 are based on a dynamic specification with time fixed effects only. This choice reflects the short and unbalanced nature of the regional panel and the strong co-movement in tourism outcomes across regions, particularly in the pre-pandemic period. While this structure provides a conservative benchmark, it is important to assess whether the estimated associations are sensitive to alternative treatments of unobserved heterogeneity.

To this end, the same dynamic specification is re-estimated under three alternative panel structures: pooled ordinary least squares, region fixed effects only, and two-way fixed effects combining region and year effects. In all cases, the dependent variable, lag structure, sample window (2012-2019), and variable definitions are held constant. Differences across specifications therefore reflect only the treatment of unobserved heterogeneity rather than changes in model design or data coverage.

The pooled specification, which ignores both region-specific and time-specific unobserved effects, yields coefficients that differ substantially from the preferred model. In particular, lagged guest nights and airport capital expenditure display weak and unstable associations, while lagged GDP remains negative and statistically significant. Given the strong evidence of common national shocks and structural differences across regions, these pooled estimates are unlikely to provide a credible representation of regional tourism dynamics and are included solely for reference.

Introducing region fixed effects alone absorbs all time-invariant regional characteristics but leaves national shocks uncontrolled. Under this specification, coefficient estimates weaken markedly and lose statistical precision across all regressors. Lagged guest nights, airport investment, and GDP are no longer distinguishable from zero, suggesting that, in a short panel, absorbing region-specific heterogeneity without controlling for common year effects removes a large share of the remaining identifying variation.

The two-way fixed effects specification, which controls simultaneously for region and year effects, produces the most structured set of coefficients. In this model, the lagged level of guest nights enters with a negative and statistically significant coefficient, indicating mean reversion in tourism activity once both forms of unobserved heterogeneity are absorbed. Notably, the second lag of airport capital expenditure is positive and statistically significant, while the first lag remains negative and imprecise. This pattern is consistent with short-run disruption followed by delayed adjustment.

However, the two-way fixed effects model also substantially reduces effective variation in the data. With a small number of regions and limited consecutive time observations in an unbalanced panel, absorbing both region and year effects increases the risk of over-parameterisation and unstable estimates. For this reason, and in line with supervisory

guidance, the two-way specification is not treated as the main model despite yielding sharper coefficients for some regressors.

Taken together, the sensitivity analysis highlights a clear trade-off. Simpler specifications fail to control adequately for common shocks, while more restrictive specifications impose heavy demands on a short panel. The time fixed effects model adopted in Section 4.2 strikes a conservative balance by controlling for dominant national influences while preserving sufficient variation for estimation. The fact that some dynamic patterns, particularly the delayed association between airport investment and tourism activity, emerge more clearly in the two-way specification provides supportive but not definitive evidence of timing effects.

Accordingly, the results are best interpreted as conservative short-run associations whose estimated signs and magnitudes are sensitive to how unobserved heterogeneity is handled in a short, unbalanced regional panel. This reinforces the need for caution in causal interpretation and underscores the empirical constraints inherent in regional tourism data with limited time depth.

#### **4.4 Summary of Empirical Findings**

This chapter has examined the short-run relationship between regional infrastructure investment and tourism activity in New Zealand using a dynamic panel framework estimated over the pre-pandemic period. The analysis focused on commercial accommodation guest nights as the primary outcome measure, given its relatively consistent availability across regions once lag structures were imposed. The empirical strategy emphasised parsimony and transparency, reflecting the short and unbalanced nature of the regional panel.

Across the preferred specifications with time fixed effects, the results point to limited and generally weak short-run associations between infrastructure investment and regional tourism growth. The lagged level of guest nights enters the model with a small and statistically insignificant coefficient, indicating that persistence in tourism activity is largely absorbed by common year-level factors rather than by region-specific adjustment dynamics over this short horizon.

Airport capital expenditure exhibits no statistically robust association with guest nights in the main specification, whether measured at one-year or two-year lags. Point estimates vary in sign across lags but remain imprecise, suggesting that any short-run impact of airport investment on visitor volumes is modest relative to the dominant influence of national tourism cycles and common demand shocks. While alternative specifications with more restrictive fixed-effects structures reveal patterns consistent with short-run disruption followed by delayed adjustment, these results are sensitive to model structure and are therefore treated as supplementary rather than conclusive.

Lagged regional GDP displays a consistently negative association with short-run changes in guest nights, reaching marginal statistical significance in the preferred

model. This pattern likely reflects cyclical or compositional factors rather than a direct causal mechanism linking regional income growth to short-run tourism demand.

Overall, the empirical evidence does not support the presence of strong or immediate tourism volume responses to infrastructure investment within a one- to two-year window. Instead, the findings suggest that short-run tourism dynamics in New Zealand are dominated by common national shocks, macroeconomic conditions, and broader demand-side factors rather than by contemporaneous or near-term regional capital expenditure. Where infrastructure effects do emerge, they are small in magnitude and sensitive to specification choices, underscoring the difficulty of identifying short-run impacts in regional panels with limited time depth.

These results highlight an important distinction between short-run associations and longer-run structural effects. The absence of clear short-run responses does not imply that infrastructure investment is unimportant for tourism performance, but rather that its benefits are unlikely to materialise immediately or be captured within narrow annual windows. This distinction motivates the discussion in the next chapter, which situates the empirical findings within the broader literature on infrastructure timing, tourism adjustment processes, and regional development in small open economies.

## **5. Discussion**

The empirical analysis reveals a set of short-run associations between infrastructure investment and regional tourism activity in New Zealand that are modest in magnitude and sensitive to model structure. Taken collectively, the results suggest that short-run tourism dynamics are dominated by common national forces rather than immediate responses to regional capital expenditure. Where infrastructure-related patterns do emerge, they are consistent with transitional adjustment processes rather than rapid or uniform tourism responses.

A central feature of the results is the limited short-run association between airport capital expenditure and visitor volumes, as measured by changes in commercial accommodation guest nights. In the preferred specification with time fixed effects, neither one-year nor two-year lagged airport investment exhibits a statistically robust relationship with guest-night growth. This finding is consistent with the operational reality of large airport projects, which typically unfold over multiple years and are designed to deliver capacity or quality improvements that materialise gradually rather than within a narrow annual window. In the short run, construction activity, temporary capacity constraints, or service reconfiguration may offset any positive demand-side effects, leaving net visitor volumes largely unchanged within the short-run horizon examined.

At the same time, the broader pattern observed across alternative specifications suggests that airport investment may be associated with delayed adjustments rather than immediate volume responses. In particular, more restrictive fixed-effects structures point to a possible sequence in which short-run disruption is followed by later adjustment. While these patterns are sensitive to specification and therefore not treated

as conclusive, they are consistent with international evidence documenting transitional effects around major aviation infrastructure projects. The New Zealand context, characterised by relatively small regional markets and high dependence on international air connectivity, is likely to amplify such timing effects.

The negative association between lagged regional GDP and short-run changes in guest nights is another notable result. This pattern should not be interpreted as evidence that stronger regional economic conditions reduce tourism demand. Rather, it likely reflects compositional and cyclical effects, whereby periods of stronger economic activity coincide with shifts in travel behaviour, accommodation choice, or the relative importance of business versus leisure travel. In a short panel dominated by national shocks, such correlations are best interpreted as conditional associations rather than structural relationships.

More broadly, the absence of strong short-run responses across most infrastructure variables highlights the difficulty of identifying immediate tourism impacts from capital expenditure in regional data. Infrastructure investment is inherently lumpy, project-based, and forward-looking, whereas tourism activity responds rapidly to macroeconomic conditions, airline capacity decisions, exchange rate movements, and global demand shocks. In New Zealand, these national and international forces generate substantial co-movement across regions, which is captured by the year fixed effects and leaves limited residual variation attributable to region-specific investment cycles in the short run.

The results also underscore the importance of distinguishing between different dimensions of tourism performance. Visitor volumes, as proxied by guest nights, are shaped by accommodation capacity, seasonality, and supply-side constraints, whereas expenditure-based measures reflect visitor mix, length of stay, and spending intensity. Although this study ultimately prioritises guest nights due to data availability and consistency constraints, the contrast observed in earlier exploratory models suggests that infrastructure investment may influence the value of tourism activity differently from its volume. This distinction is particularly relevant for airport infrastructure, which can alter the composition of arrivals even when total visitor numbers change little in the short run.

Taken together, the findings point to a cautious but coherent interpretation. Infrastructure investment does not appear to generate immediate and sizeable increases in regional tourism activity within a one- to two-year horizon. Instead, its role is more plausibly understood as shaping longer-run capacity, connectivity, and visitor experience, with short-run dynamics dominated by transitional disruption and national-level demand conditions. The modest and heterogeneous associations identified in this study are therefore consistent with the timing and transmission mechanisms emphasised in the broader infrastructure and tourism literature.

These observations have important implications for both empirical work and policy interpretation. From an empirical perspective, they highlight the limits of short regional panels for identifying dynamic infrastructure effects and the importance of conservative

model specification. From a policy perspective, they caution against expecting rapid tourism payoffs from infrastructure spending and reinforce the need to evaluate such investments over longer horizons and across multiple dimensions of tourism performance, including both visitor volumes and expenditure.

## **6. Conclusion**

This thesis examined the short-run relationship between regional infrastructure investment and tourism activity in New Zealand, with particular emphasis on airport capital expenditure and its association with short-run changes in commercial accommodation guest nights. Using an annual regional panel and a dynamic specification estimated with time fixed effects, the analysis was designed to assess near-term adjustment dynamics rather than long-run causal impacts. This framing reflects both the structure of the available data and the inherently gradual nature of infrastructure investment cycles.

The empirical results indicate that short-run associations between infrastructure investment and regional tourism activity are generally weak and imprecisely estimated once common national shocks are controlled for. In the preferred specification, which controls for year-specific effects, neither one-year nor two-year lagged airport capital expenditure exhibits a statistically robust relationship with short-run growth in guest nights. This suggests that, within a narrow one- to two-year horizon, regional variation in airport investment does not translate into immediate changes in visitor volumes once national tourism cycles and macroeconomic conditions are taken into account.

These findings are economically plausible. Major airport projects are typically large, multi-year undertakings whose effects on capacity, connectivity, and service quality materialise gradually. In the short run, construction activity, operational disruption, and transitional adjustments may offset any demand-side benefits, resulting in muted net effects on visitor volumes. At the same time, tourism demand in New Zealand is highly sensitive to national and international forces, including global economic conditions, airline capacity decisions, and exchange rate movements, which generate strong co-movement in tourism activity across regions. The prominence of year effects in the estimated models highlights the extent to which these common shocks dominate short-run tourism dynamics.

The analysis also underscores the methodological challenges of identifying infrastructure-tourism linkages in short regional panels. Once lag structures are introduced, effective sample sizes fall sharply, limiting statistical power and increasing sensitivity to specification choices. More restrictive fixed-effects structures further absorb variation that may reflect slow-moving infrastructure impacts. As a result, the absence of strong short-run effects should not be interpreted as evidence that infrastructure investment is unimportant for tourism performance, but rather as an indication that its influence is unlikely to be captured within a one- to two-year window using annual regional data.

From a policy perspective, the results caution against evaluating infrastructure projects based on expectations of rapid tourism gains. Infrastructure intended to support tourism may deliver its primary benefits over longer horizons, through improved capacity, resilience, and visitor experience, rather than through immediate increases in visitor numbers. Short-run assessments conducted during construction or early operational phases may therefore understate the longer-term contribution of such investments.

While the scope of the analysis is constrained by data availability and time coverage, the study provides a transparent and empirically grounded account of short-run dynamics between infrastructure investment and regional tourism activity in New Zealand. Future research would benefit from longer time horizons, higher-frequency data, and project-level information that distinguishes between construction, completion, and operational phases. Such extensions would allow a clearer assessment of longer-run impacts and regional heterogeneity. Within its intended scope, however, this thesis contributes to the evidence base on infrastructure and tourism by clarifying the limits of short-run effects and highlighting the dominant role of national shocks in shaping regional tourism outcomes.

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## Appendix A: Supplementary Empirical Material

This appendix provides supporting material for the empirical analysis presented in Chapter 4. The purpose is to document additional model variants and sensitivity checks that were estimated during the analysis but are not treated as core results. These supplementary specifications are included for transparency and to clarify the robustness boundaries of the empirical findings, rather than to introduce alternative preferred estimates.

As discussed in Chapter 4, the main analysis relies on a dynamic specification with time fixed effects, estimated over the 2012-2019 period, using regional guest nights as the primary tourism outcome. This specification was selected because common national shocks account for a substantial share of variation in tourism activity in New Zealand, while the short and unbalanced nature of the regional panel limits the feasibility of absorbing multiple layers of fixed effects without excessive loss of identifying variation.

### A1: Alternative treatments of unobserved heterogeneity

To assess the sensitivity of the results to alternative treatments of unobserved heterogeneity, the same dynamic regression equation was also estimated under pooled specifications, region fixed effects only, and two-way fixed effects (region and year). These variants use the same sample window, lag structure, and set of regressors as the main model, but differ in how unobserved regional and temporal factors are controlled.

Across these alternative specifications, coefficient magnitudes and statistical significance vary noticeably. In particular, specifications that absorb both region and year effects simultaneously tend to produce more pronounced coefficients on lagged variables, but at the cost of substantially reduced effective variation and precision in a short panel. Conversely, pooled and region-only specifications weaken dynamic structure and yield less stable estimates.

These patterns reinforce the rationale for treating the **time fixed-effects model as the preferred specification**, rather than as one option among several. The supplementary estimates confirm that results are sensitive to how common shocks and regional heterogeneity are handled, which is expected given the data constraints, and underscore the need for cautious interpretation of short-run associations.

### A2: Interpretation boundaries and model limitations

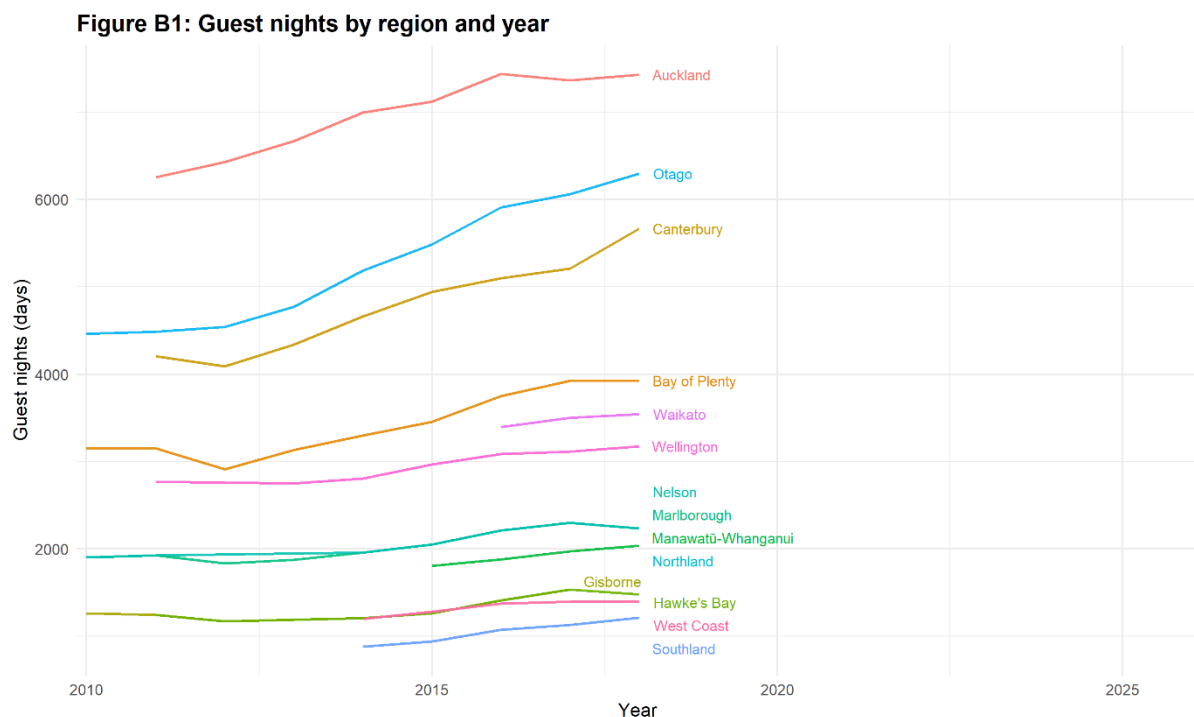
The supplementary models reported in this appendix are not intended to establish causal relationships or to identify long-run structural effects. Instead, they illustrate how dynamic associations between infrastructure investment and tourism activity respond to alternative modelling choices within a constrained data environment.

Two limitations are particularly relevant. First, the inclusion of lagged dependent variables in a short panel reduces the number of usable observations and amplifies sensitivity to missing data patterns across regions. Second, absorbing both region and year fixed effects can over-parameterise the model relative to the available time dimension, leaving little residual variation to identify dynamic responses.

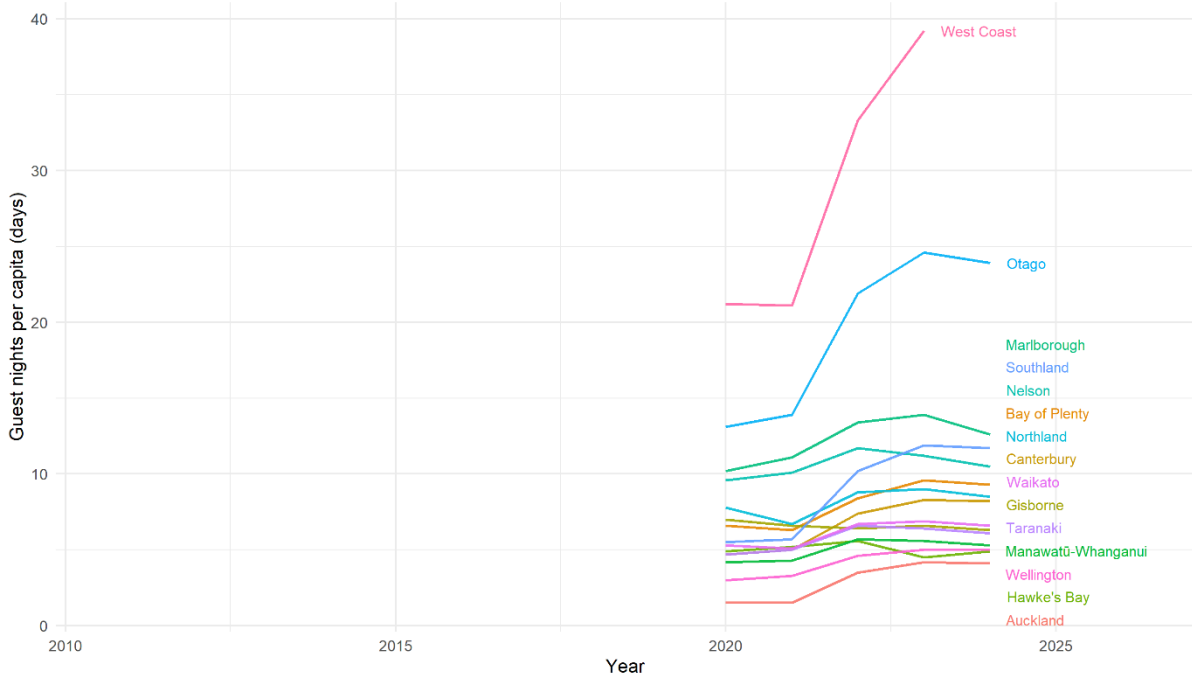
For these reasons, the appendix results are interpreted strictly as contextual evidence that supports the modelling decisions adopted in Chapter 4. The substantive discussion and policy interpretation in the thesis are based exclusively on the main time fixed-effects specification, which provides the most internally consistent balance between control for common shocks and empirical feasibility.

## Appendix B: Regional Profiles and Descriptive Figures

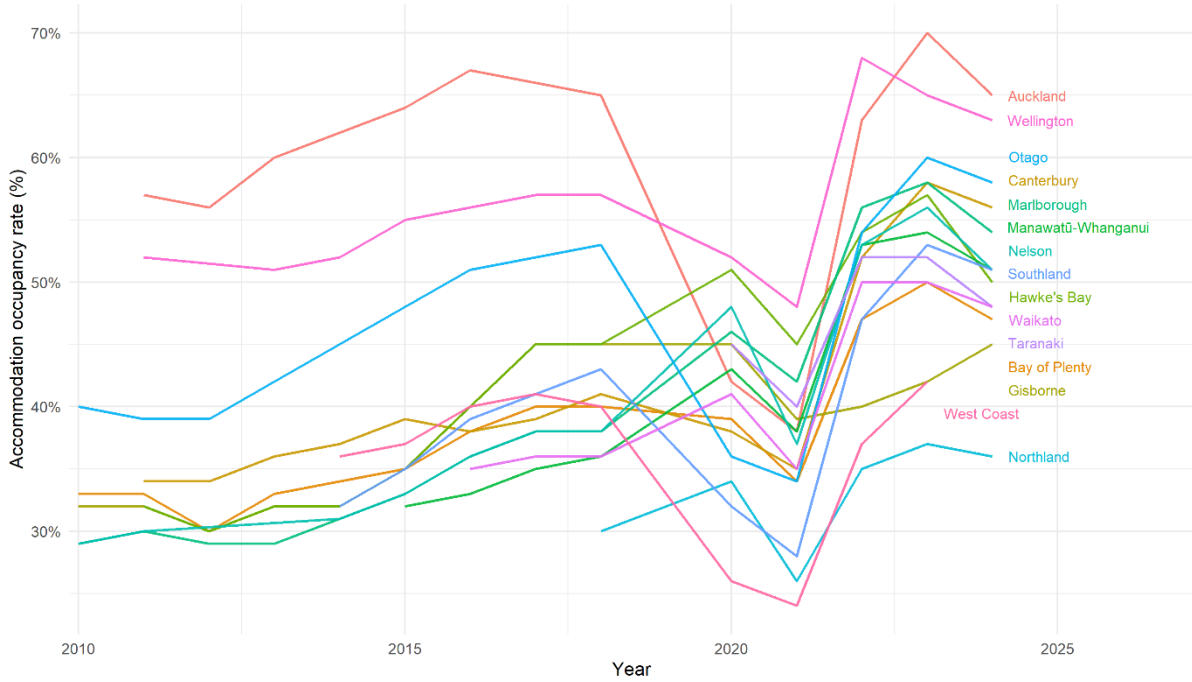
Appendix B presents region-level figures that complement the descriptive statistics in Chapter 3. These plots document the substantial dispersion across New Zealand’s regions in tourism activity, infrastructure investment, and related economic indicators. They provide visual evidence of the heterogeneity that motivates the fixed-effects modelling strategy and illustrate the lumpy, project-driven nature of capital expenditure across infrastructure categories.



**Figure B2: Guest nights per capita by region and year**



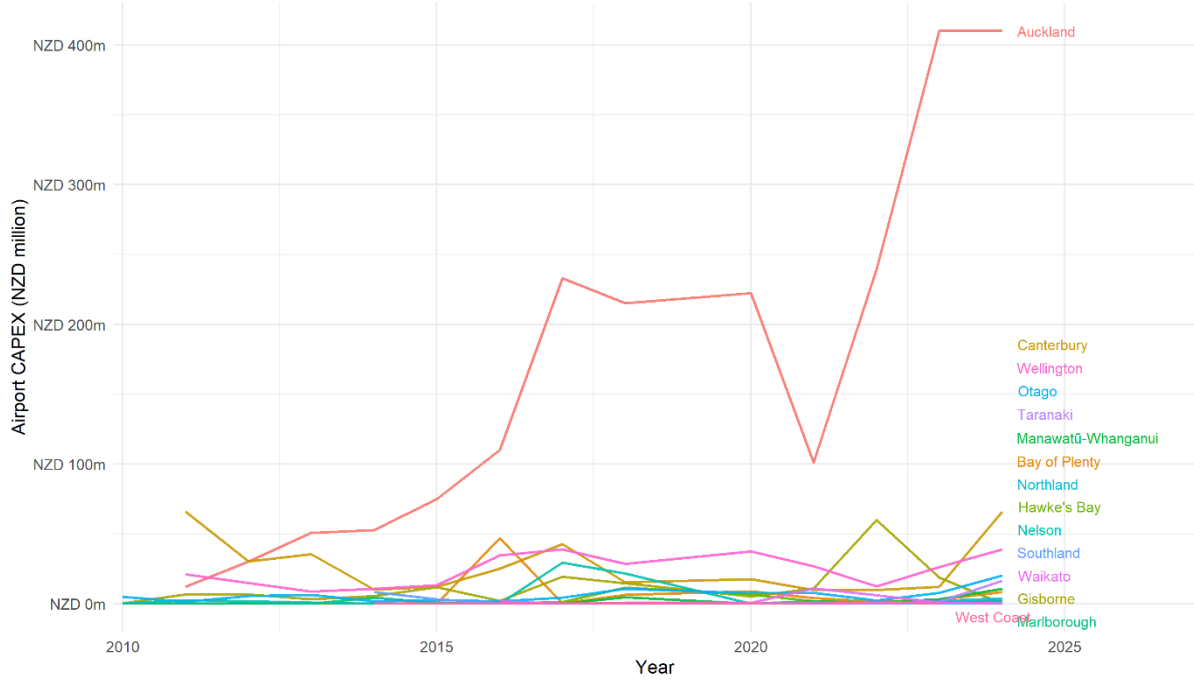
**Figure B3: Accommodation occupancy rates by region and year**



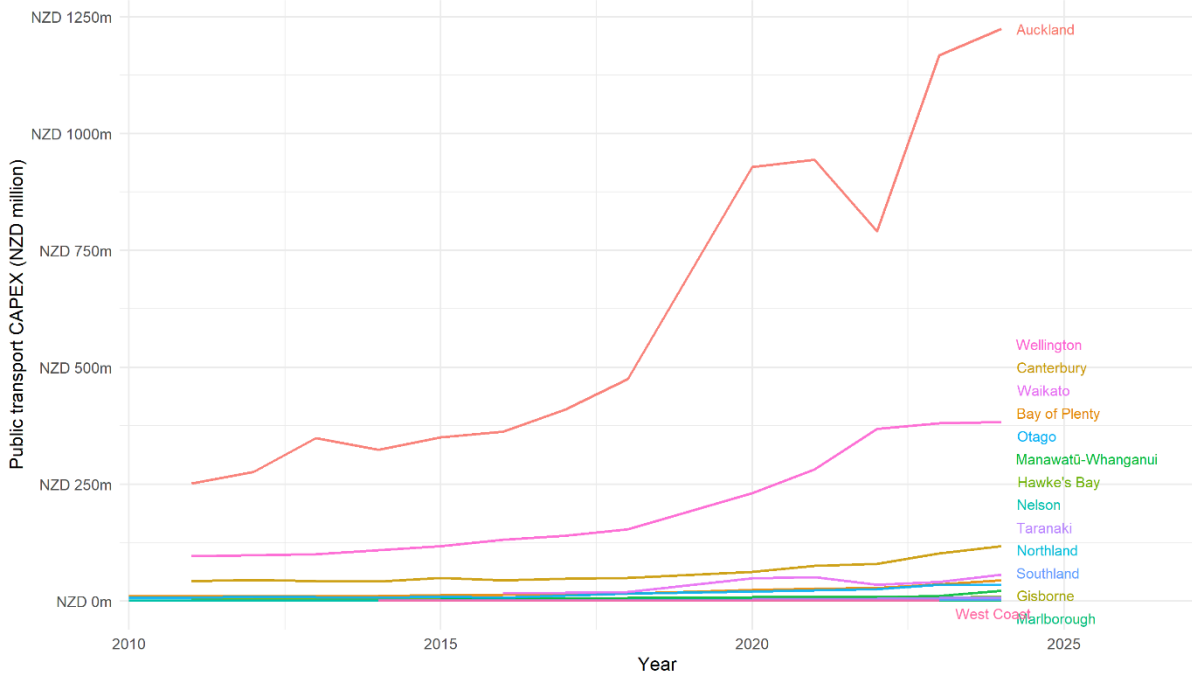
**Figure B4: International tourism electronic card transactions (TECT) by region and year**



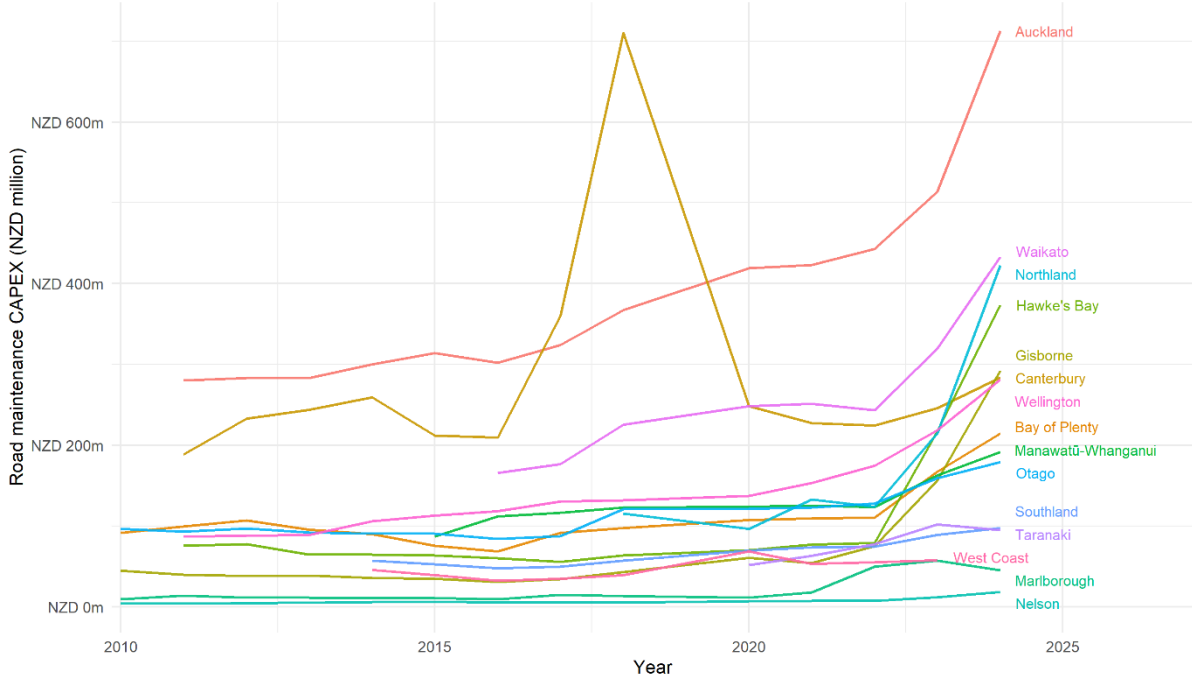
**Figure B5: Airport capital expenditure by region and year**



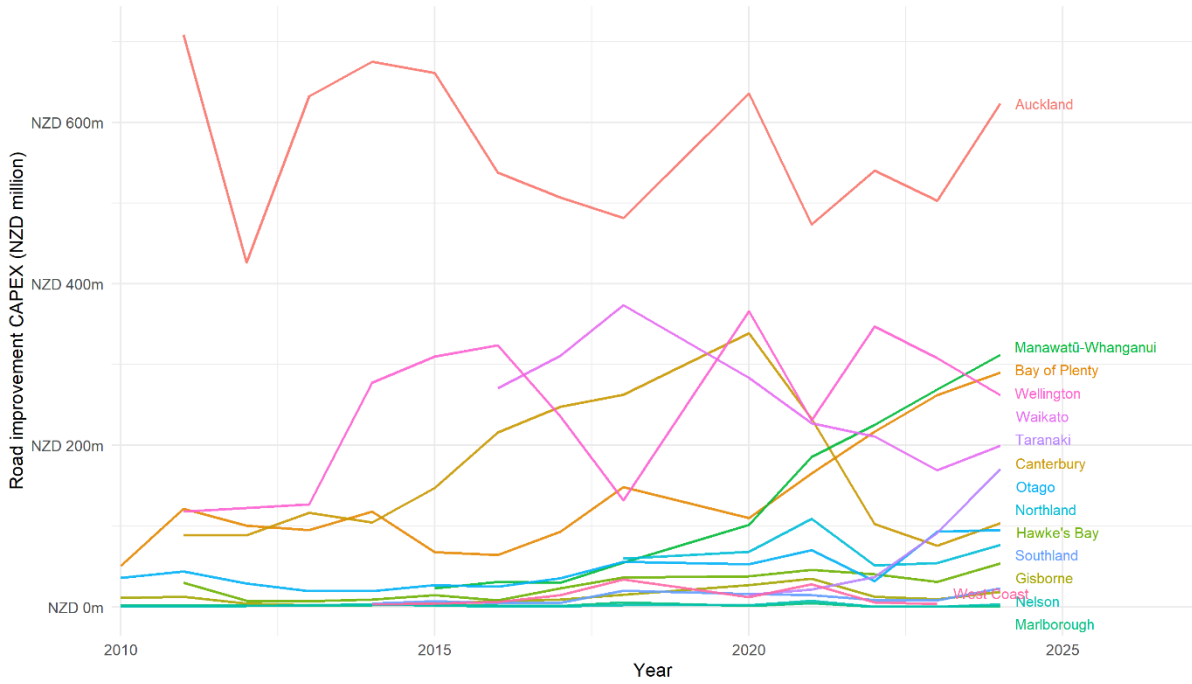
**Figure B6: Public transport capital expenditure by region and year**



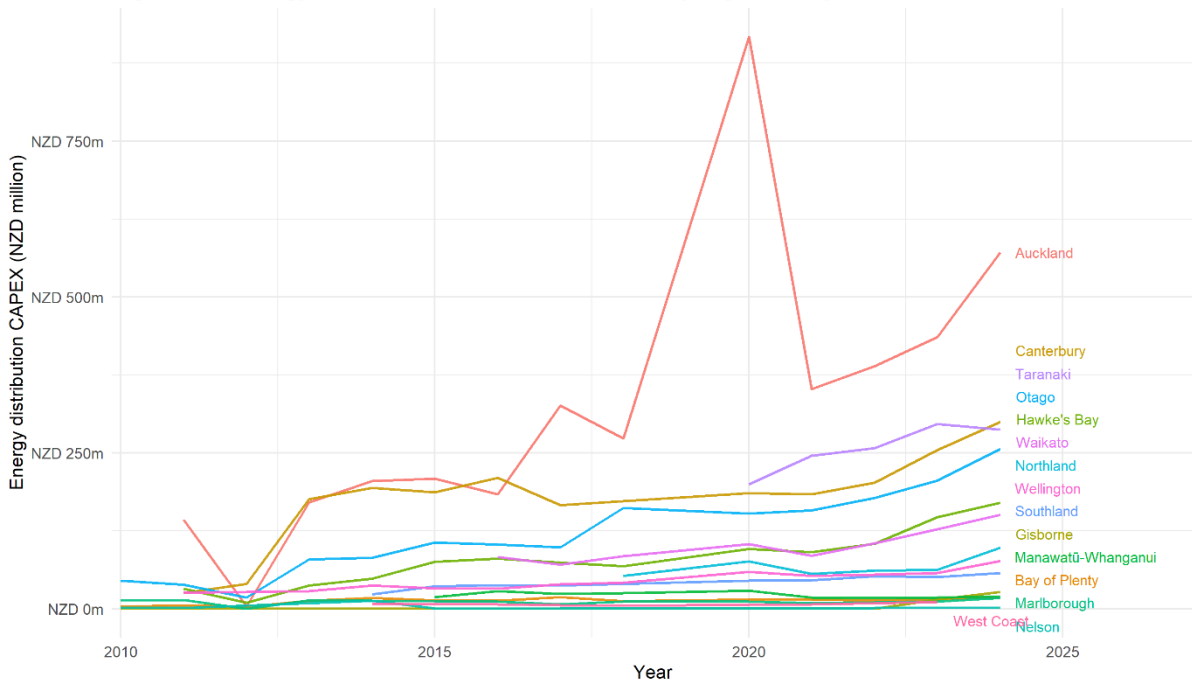
**Figure B7: Road maintenance capital expenditure by region and year**



**Figure B8: Road improvement capital expenditure by region and year**



**Figure B9: Energy distribution capital expenditure by region and year**



**Appendix C: Panel Unit Root Tests**

This appendix reports diagnostic unit-root checks for the main variables used in the empirical analysis. The purpose of these tests is to document the time-series properties of the regional data rather than to establish formal conditions for long-run modelling.

The regional panel used in this study is short and unbalanced, with limited consecutive observations for several regions once lag structures are imposed. As a result, standard panel unit-root procedures such as Levin-Lin-Chu (LLC), Im-Pesaran-Shin (IPS), and conventional Fisher-type panel tests could not be implemented reliably across all variables and regions due to insufficient time depth and missing observations.

Given these constraints, Augmented Dickey-Fuller (ADF) tests were conducted separately for each region and variable where sufficient observations were available. The resulting p-values were then combined using a Fisher-type statistic to provide a summary indication of unit-root behaviour across regions. This approach has been used in applied regional studies where conventional panel unit-root testing is infeasible due to short time dimensions.

Table 4 reports the number of regions included in each test, the Fisher combined statistic, and the associated p-value. The results should be interpreted cautiously, as the power of unit-root tests is inherently limited in short regional time series.

*Table 4: Combined ADF Panel Results (Fisher Statistic)*

*(p-values refer to the Fisher combined test of the ADF p-values across regions)*

<b>Variable</b>	<b>Regions Included</b>	<b>Fisher Statistic</b>	<b>Fisher p-value</b>
ln_guest_nights	9	38.45	0.0034
ln_tect	0	-	-
ln_airport_capex	14	32.02	0.274
ln_pt_capex	13	6.86	0.9999
ln_road_maint_capex	13	20.92	0.746
ln_road_impr_capex	13	31.96	0.194
ln_energy_capex	13	54.03	0.0010
ln_gdp_pc	13	19.68	0.807
ln_pop	13	17.51	0.893

Taken together, the Fisher-type panel unit root tests provide mixed evidence on stationarity. Guest nights and some infrastructure series reject the unit-root null at conventional levels, while other variables remain highly persistent and do not clearly reject. Given the short, unbalanced regional panel and limited test power, the analysis does not treat these statistics as definitive classifications of  $I(0)$  or  $I(1)$  processes. Instead, they motivate the adoption of a parsimonious dynamic specification in first differences with lagged levels and common year effects, which resembles an autoregressive distributed lag (ARDL) structure. Within this framework, coefficients are interpreted as short-run associations rather than long-run equilibrium relationships, and no formal claims of cointegration or causal effects are made.