Bay of Plenty: Settlement and agglomeration impacts

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Background

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Agglomeration: How the Bay of Plenty should respond

Within the Bay of Plenty, there has been a considerable shift in population in recent years. The main shift has been from Kawerau, Opotiki and Whakatane in the east of the region, to Tauranga and the Western Bay of Plenty district in the west of the region. To a lesser extent, there has also been a shift of population from Rotorua to Tauranga and its surroundings.

The shift of population into and around the region's major urban centre is positive in an economic sense – at least in theory. Agglomeration in and around Tauranga is likely to result in increased productivity and increased incomes. Increased incomes will boost employment, and this will lead to further population growth.

In perfect market conditions, growth in and around Tauranga ought to benefit everywhere in the region through a process of factor price equalisation. Increasing labour, land and other costs in Tauranga ought to encourage activity to shift to lower cost locations, so that, over time, these factor costs tend to even themselves out. This should make all location equally attractive from a living and working point of view. However, inefficient allocations of resources by the free market (market failures) means that the above equalisation process does not necessary happen, resulting in some locations being more/less attractive than others in terms of cost and general liveability. Mitigating this market failure may require a policy response or intervention from central and/or local government.

A parallel research study by BERL[1] has highlighted the risk of co-existing labour and skills shortages in Tauranga and enduring levels of high unemployment in some other parts of the region. BERL recommended a strategic response because these co-existing problems are unlikely to resolve themselves.

In short, agglomeration in and around Tauranga is likely to benefit the region as a whole economically, but the benefits are unlikely to be evenly distributed if current trends are allowed to continue. For example, skilled workers from east of the region are likely to depart for Tauranga resulting in a low skill, low wage economy in eastern Bay of Plenty.

It would, however, be too simplistic to only consider the economic aspects of agglomeration. The social consequences of agglomeration need to be assessed as well, not least because they can have their own economic impact.

In the absence of population growth at regional level that is sufficient to ensure that nowhere actually loses population, agglomeration will mean that some localities will experience population decline. It is clear that this has happened in Kawerau and Opotiki.

Evidence indicates that, when towns lose population, public service delivery in those towns can be scaled back. However, there comes a point when effective and efficient delivery cannot be sustained. If this happens the Bay of Plenty will need to address the challenge of ensuring that these towns have access to public services from neighbouring towns or cities with a larger population base. The cessation of service delivery is likely to encourage people who are able to relocate to do so. Typically, the people most able to relocate will be those with skills and experience that are in demand in the labour market. They will also tend to be people who have the ability to contribute to their communities through their involvement in social and cultural activities.

[1] Analysis of Bay of Plenty employment and skills. (Augsut 2014)

The risk is that, when towns start to decline, they can enter a downward spiral from which it is difficult to recover. The people in those towns who have "get-up-and-go" might literally get up and go, leaving behind people who are less skilled and experienced, and less able to contribute socially. In other words, there is a risk of loss of social cohesion. In the absence of policy action to combat the loss of social cohesion, towns that have started to decline might cease to be capable of recovery.

In terms of the possible strategic response, the evidence suggests that the region is likely to need to address three main areas.

First, and consistent with the recommendations arising from the analysis of employment and skills, decision makers in the region may wish to consider action to ensure that labour and skills shortages do no hold back the growth of the economically buoyant districts; and that less economically buoyant or struggling districts are supported to perform more strongly or to transform their economies. Priority areas for action could include:

1. Facilitation of greater educational attainment
2. Support for enterprise development
3. Attraction of inward investment into the region
4. Encouragement for older workers to remain in the workforce and for women to return to the workforce.

In general, evidence suggests that the above actions are likely to have the maximum impact if they focus on involving the relatively disadvantaged groups in the workforce (i.e. younger people, Maori and those with no/low qualifications) across the region, and on the relatively deprived localities.

Second, an emerging issue to consider is how to ensure that social cohesion is not reduced. This is particularly the case for towns in the region where population has declined which is likely to have an impact on the quality and availability of public services, which in turn impacts on social cohesion. Expanding the use of ICT could be the key to enhanced service delivery. Equally, there is a case for support for cultural and sporting organisations that constitute a significant part of the social fabric of any community.

Third, the Bay of Plenty may need to develop strategies to identify where it needs to work on a trans-regional and national basis to ensure that the region's potential to contribute to economic and social wellbeing beyond its borders is recognised and exploited. This is increasingly becoming evident as the region's dominant urban centre increasingly becomes part of an urban hierarchy that encompasses the upper North Island The government has recently adopted a new approach to promoting regional development, and this features an emphasis on inter-regional issues as well as intra-regional issues.

Agglomeration in the Bay of Plenty

The above strategic responses are based on an analysis of urban settlement and agglomeration theory and associated impacts and implications for the Bay of Plenty. It is complemented by analysis of employment and skills in the Bay of Plenty, undertaken by BERL.

This report summarises the urban settlement agglomeration theory. The theory summarised is then placed in the context of the Bay of Plenty, with trends and implications highlighted. This report is supported by a review of agglomeration theory and applied agglomeration research findings from urban centres in Australasia.

Contents

Tables

Figures

1 Urban settlement, agglomeration and the Bay of Plenty

This section summarises urban settlement and agglomeration theory and the associated impacts. Urban settlement and agglomeration theory are then placed in the context of the Bay of Plenty.

1.1 Urban settlement and agglomeration theory

1.1.1 Urban settlement

In any geographic space, there is a settlement hierarchy. Settlement hierarchies are a way of representing the role settlements play in a region or country, based largely on population size and services available. Higher positions in the hierarchy reflect larger populations, greater availability of services, and a wider sphere of influence. Conversely, lower positions in the hierarchy have lower populations and draw on the services and amenities of higher level settlements.

Position in a settlement hierarchy can also depend on the sphere of influence. This includes how far people will travel to use the services in a settlement. For example, if people are willing to travel further to the particular settlement for services, the settlement becomes more important and ranks higher in settlement hierarchy.

Every region has 'Central Place' settlements. These settlements provide services to surrounding areas. They increase in population size as they provide, and require, higher levels of commercial, private and social services for the population of lower level settlement populations in the region.

As a result of this increase in population, the larger Central Places have the option of expanding their urban area, either at the extensive or intensive margin. At the extensive margin, they can occupy a larger land area at about their existing low density level of residents per hectare. Alternatively they can intensify, occupy the same or similar land area and increase residential density and density of workplace employment. The sum of residential density and workplace employment density is termed urban density.

The process of increasing a centre's urban population along with urban density is called agglomeration.

1.1.2 Agglomeration

Agglomeration is typically used to describe the benefits that flow to firms and economies from locating in areas that have a higher density of economic activity. It is based on the premise that economic efficiencies arise through increased labour market interactions, linkages between suppliers, and from knowledge spillovers.

Agglomerated economies are the benefits received by third parties when businesses and people are located in a dense urban setting. Hazledine, Donovan and Bolland (2013) outline that these benefits can occur at four different levels:

- **Internal to individuals/households**: individuals gain from wider job opportunities and better amenity.
- **Internal to firms**: firms gain from larger labour markets, and from economies of scale generated by access to effectively larger accessible output markets

- **Internal to industries**: technological (knowledge) spillovers; better choice of intermediate inputs; larger skilled labour pool.
- **Internal to the city**: scale of local markets and the more efficient provision of infrastructure, public administration and amenity.

Further, agglomeration can also increase social cohesion in an area, with people most able to relate being those with skills and experience that are in high demand in the labour market. These migrants attracted also tend to be people who have the ability to contribute significantly to their communities through their involvement in social and cultural activities.

While increased urban density and form can lead to economies of scale and result in agglomeration benefits, there are also costs. These can include increased traffic congestion, pollution, waiting times and constrained access to production facilities and resources. This means that there is an optimal size and density for settlements and regions.

In perfect market conditions, growth agglomeration in a large city or district should benefit the wider region through a process of factor price equalisation. Increasing labour, land and other costs in large city or districts should encourage activity to shift to lower cost locations, so that, over time, these factor costs tend to even themselves out. This should make all locations in the region equally attractive from a living and working point of view. However, market failures mean that the equalisation process does not necessarily happen, and it may require a policy response from central and local government to compensate. Auckland is a current example of where such a market failure occurs, with housing in South Auckland not as attractive as suburban areas. This has in turn resulted in housing affordability issues in suburban Auckland.

Increased urban density and agglomeration has flow on impacts for settlements at lower levels of the settlement hierarchy. When higher level settlements grow, they are better able to supply higher level services to lower level settlements and thus help lower level settlement maintain and attract population and businesses. Conversely, when increased urban density and agglomeration does not occur at higher levels, lower levels in the settlement hierarchy face reduced provision of services and thus find it more difficult to maintain and attract people and businesses.

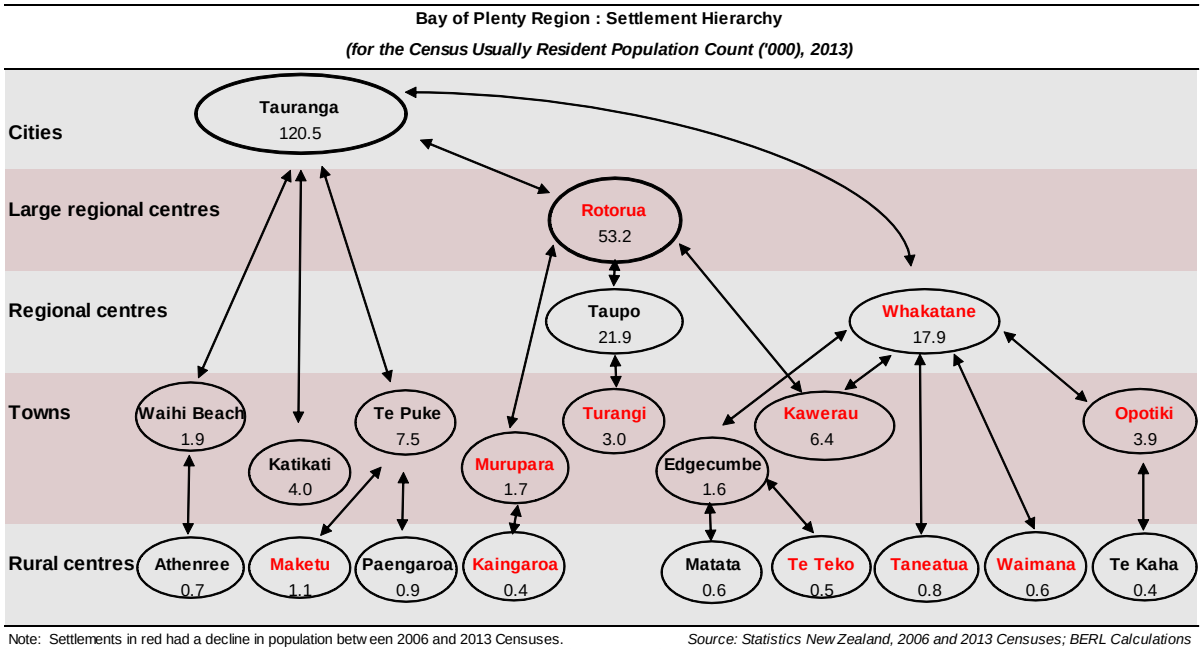
1.2 Urban settlement, agglomeration and the Bay of Plenty

1.2.1 Urban settlement

To gain a better understanding of how urban settlement and agglomeration plays out in the Bay of Plenty, it is useful to look at the settlement hierarchy in the region.

For the purpose of this report it is useful to consider a simple classification of settlement hierarchy according to urban population. Using the population levels from the recent 2013 Census, and our knowledge of geographic linkages, Figure 1.1 outlines Bay of Plenty settlements in a hierarchy as at 2013.

Figure 1.1: Bay of Plenty region settlement hierarchy, 2013



Note: Settlements in red had a decline in population between 2006 and 2013 Censuses. *Source: Statistics New Zealand, 2006 and 2013 Censuses; BERL Calculations*

This classification shows that:

- Tauranga is the only city in the region and has direct links to five other settlements including two of the three large or regional centres (Rotorua and Whakatane);
- Rotorua would be classified as a large regional centre/small city;
- Taupo, and Whakatane would be classified as regional centres;
- Katikati, Te Puke, Murupara, Turangi, Edgecumbe, Kawerau, Waihi Beach and Opotiki would all be classified as towns;
- Most rural centres like Maketu, Paengaroa, Kaingaroa, Matata, Te Teko, Taneatua, Waimana and Te Kaha would be classified as rural centres. The geography of the region suggests that smaller centres also play key roles. For example, Whakatane also has five links and towns such as Te Puke and Edgecumbe each appear to support two smaller rural centres (Maketu and Paengaroa, and Matata and Te Teko respectively).

Within the Bay of Plenty, there has been a considerable shift in population in recent years (red lettering in Figure 2.2 indicates population decline between 2006 and 2013). The main shift in population has been away from Kawerau, Opotiki and Whakatane in the east of the region, and towards Tauranga and the Western Bay of Plenty district in the west of the region. To a lesser extent, there has also been a shift of population away from Rotorua. Net migration from outside the region has largely driven these population trends although internal migration has also had an impact.

As previously mentioned, centres at the lower levels of the settlement hierarchy typically rely on settlements at the next layer up in the settlement hierarchy to maintain and attract populations. When the population at a higher level in the hierarchy falls, the provision of services available to the lower levels of the hierarchy are often reduced, making it more difficult for settlements at the lower level to attract and retain residents. The shift of population away from Whakatane between 2006 and 2013 and the decline in population in Kawerau and Opotiki outlined above are examples of this.

Hierarchy and effective service provision

Higher positions in the hierarchy generally reflect larger populations within their boundaries and their surrounding areas. Settlements at higher positions therefore provide a greater availability of services, and have wider connections or sphere of influence. In fact the hierarchy can show effective patterns of service provision so that people in the countryside and in the smaller, lower-order settlements can access higher level services at a single higher-level settlement.

This is achieved by ensuring that secondary level services of different types being provided to a number of primary settlements (or villages in this classification), are all located in the same (secondary) settlement or town. In the past there has been the political temptation to scatter secondary services among a number of primary settlements. To overcome this and provide much more effective access to the full range of secondary services at one place, the settlement hierarchy concept was adopted in planning service provision in settlements in developing countries in the 1970s.

In the Bay of Plenty region, the education allocation largely follows the hierarchy, with rural centres or villages all having one or two primary schools while the Towns have a number of primary schools and at least one secondary school to serve their own and the hinterland population. Rotorua and Whakatane have a number of secondary schools as well as a tertiary education or training institution. Tauranga has a large secondary school population, presumably attracting students from the Western Bay of Plenty, and also tertiary training.

At the higher level of health provision, New Zealand hospitals are classified progressively as sub-acute, secondary, and tertiary. The hospitals in Bay of Plenty reflect their places in the national settlement hierarchy with Tauranga, Rotorua and Whakatane having Secondary hospitals, and Opotiki and Taupo, Sub-acute hospitals.

Generally, social service provision is consistent with effective access for people up and down the settlement hierarchy.

Provision of public transport is growing in the Bay of Plenty, and as populations grow and people move to settlements up the hierarchy for higher level services this increase in demand will hopefully drive the expansion of the public transport services.

Identifying a hierarchy shift in New Zealand

It is also useful to know the types of conditions or attributes that may enable a settlement to move from their present hierarchy level to a higher one. In New Zealand, a recent example of this is provided by BERL (1997) in Napier City.

Napier-Hastings had a large economic and population expansion as a result of upgrading the flood control scheme in the Heretaunga Plains Hawke's Bay. The upgraded scheme was found to enable agricultural and horticultural production systems that significantly expanded the economy and increased total population in the area from about 70,000 people to over 115,000. This lifted the level of professional service required and available in the Napier-Hastings area from that of a typical New Zealand 'hinterland city', like Palmerston North, to a level similar to Dunedin or Hamilton. Not only are there chartered accountants and conveyancing lawyers there now, but also some specialists, e.g. tax accountants, commercial lawyers. This change implies a shift to a higher level on the hierarchy.

The greater population and the larger business base was shown to result in an expansion of the economy and an increase in services and thus in the unit rental for commercial space by 30 percent above the norm for 'hinterland cities'.

1.3 Urban form and agglomeration in the Bay of Plenty

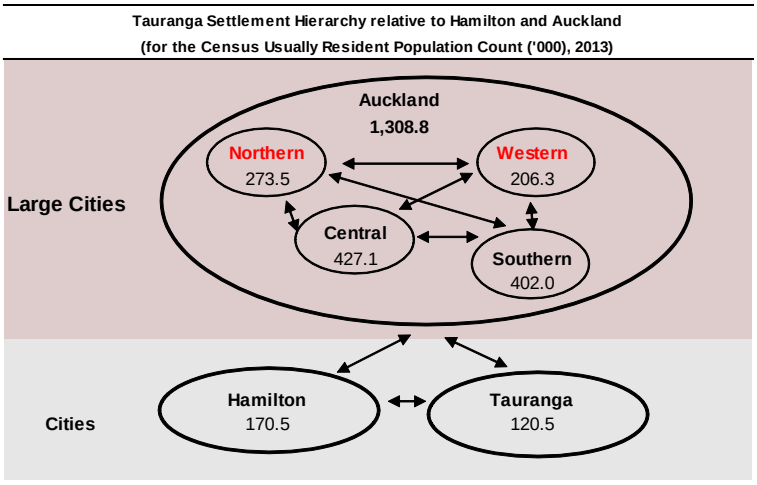
Figure 1.1 highlights the inter-relationships of particular settlements in the Bay of Plenty and the impact that changes in population in settlements can have. For example, expansion in the rural centres in eastern Bay of Plenty is likely to place a greater demand on Whakatane for increased higher level services than may currently be available.

Our analysis, and our understanding of the region and urban form leads us to believe that two settlements within the Bay of Plenty region – Tauranga City and Rotorua District - could realise the benefits of an agglomerated economy, with these benefits filtering down across the region.

Tauranga

Tauranga City is clearly the largest settlement in the Bay of Plenty region. Looking at the region in isolation however only tells part of the story as within close geographic distance to the Bay of Plenty region are Hamilton City and Auckland. Both of these areas are larger than Tauranga City and compete with cities like Tauranga to attract people, firms, industry and larger amenity. This is particularly the case with Auckland, which is almost 11 times larger than Tauranga. Figure 1.2 outlines this relationship.

Figure 1.2: Tauranga settlement hierarchy relative to Hamilton and Auckland, 2013



Source: Statistics New Zealand, 2006 and 2013 Censuses; BERL Calculations

Note: Settlements in red had a decline in population between 2006 and 2013 Censuses.

The relationship between these two larger cities and Tauranga can be shown in health, education, research facilities and airports. For example, while Tauranga has a Secondary hospital, Hamilton has a larger 'Tertiary (type I)' hospital and Auckland has an even larger 'Tertiary (type II) hospital. Similarly, in regards to air travel, Tauranga has a regularly frequented domestic airport while Hamilton, and particularly Auckland, have large domestic and international airports.

Put simply, Tauranga is an agglomerating economy that is within close proximity to larger agglomerating economies. Whilst Tauranga grew at a faster rate than both Hamilton and Auckland between 2006 and 2013, it is likely that many 'tier 1' services, such as medical and legal, will only be available in New Zealand in the three main urban areas – Auckland, Wellington and Christchurch.

In many instances replicating these services in Tauranga City may lead to decreased economies of scale and reduce overall national productivity. In some instances provision of some of these services may bring about increased resident and business satisfaction which could counter the reduced economies of scale. The City Council has a role in both scenarios. For example, where the

economies of scale argument is strong, the Council may wish to examine how residents and business in Tauranga could have the best possible access to high level services from surrounding regions. This could include improved infrastructure and transportation links with Auckland and Hamilton.

While Tauranga's location relative to Auckland could be considered a disadvantage in terms of attracting industries to the area, it can be considered an advantage in terms of accessing labour and increasing population. Indeed, 2013 Census data shows that compared to five years earlier (2008), there was a net inflow of people from Auckland to Tauranga City.

In term of tertiary education, Tauranga City currently does not have a large university like Hamilton or Auckland, meaning it is unlikely to attract large numbers of people moving to the area to undertake tertiary study. Tauranga does however have a number of other tertiary education organisations (e.g. Wananga and polytechnic) which service the needs of the surrounding economies. The potential exists for some of these tertiary education organisations to 'specialise' in particular areas, which may result in an inward flow of students and businesses in the specialist areas to move to Tauranga.

Rotorua

The population of Rotorua declined from 2006 to 2013. Rotorua has, behind Tauranga City, one of the highest population densities in the Bay of Plenty Region. Rotorua's unique amenities and attractions to tourists mean that it is able to take advantage of localisation agglomeration in the accommodation, hospitality and retail services industries. Further, the District's traditional industries of forestry and wood processing have resulted in human capital clustering around these industries in Rotorua's main urban areas.

Like many tourism dominated areas, Rotorua's population declined between 2006 and 2013. Between 2006 and 2013 the Global Financial Crisis (GFC) had a negative impact on the tourism, hospitality and retail related industries. With a large portion of Rotorua's employment related to these industries, it is possible that the GFC resulted in a decline in employment in these areas, which in turn led to people leaving Rotorua District to look for employment elsewhere in the region, in Hamilton or in Auckland. Census data appears to support this hypothesis.

Further, while Rotorua does not have the large scale population volume to be considered a large urban settlement, its location lends itself to becoming a service hub for surrounding areas, particularly for those services that support the forestry and wood processing industries.

1.4 Implications for the Bay of Plenty

There are some potential implications for the Bay of Plenty region in terms of increasing urban density and achieving the benefit of agglomeration economies. These are briefly outlined below:

- Transportation will be a significant enabler in the future to ensure that the main centres can feed into the secondary and smaller centres within the region. In the context of Tauranga, this also includes ensuring that there are good transportation linkages with Auckland and Hamilton to ensure that higher level services located in these areas can be accessed and that Tauranga can access labour from these areas. For Rotorua, improving transportation flows also has implications for attracting tourists, increasing tourism and related demand, and generating economic growth.
- Rotorua is likely to benefit from 'localisation' agglomeration economies. This means that agglomeration will occur in a few industries, particularly those related to tourism and retail

trade, as well as forestry and wood processing. Research shows that these industries, in times of economic growth, will attract additional services industries and thus generate further economic growth. However, in an economic downturn, it is likely that specialisation, particularly in the forestry and wood processing areas, will result in higher levels of unemployment. This threat could be partially mitigated by encouraging further diversification of industry employment in Rotorua by developing infrastructure and establishing Rotorua as a 'hub' for the central North Island.

- Tauranga is likely to benefit from 'urbanisation' agglomeration economies. Employment in Tauranga occurs across a range of sectors, particularly in the service sector. Research shows that this can lead to greater flows of human capital and lead to higher wage rates. One challenge for Tauranga will be how it taps into the potential of young people situated in the east of the region, where job growth is expected to be not as strong as the rest of the region. To be successful, this cannot be done through the provision of employment alone and should be supported through the provision of transport between the east (living) and west (working) as well as improving education infrastructure in Tauranga. Secondly, improving Tauranga's transportation and infrastructure is a key challenge in terms of increasing its linkages with the upper North Island, and resulting in increased economic, employment and population growth, Finally, further amenity improvement in Tauranga District is likely to attract people from outside the region and internationally so that the full benefits of urban form can be realised.
- There are constraints to the amount of agglomeration economies that the Bay of Plenty region can receive. Given the region's proximity to Auckland, and to a lesser extent Hamilton, there will be some levels of tertiary agglomeration (e.g., tertiary II hospitals and international airports) that Tauranga, and indeed the wider region, are unlikely to benefit directly from. Where this is the case, the region should look at provision of appropriate infrastructure and or transportation support that can be provided so that people and firms within the Bay of Plenty region can enjoy the benefits of these services.
- Given dynamics within the region combined competition for people and business across the upper north island, Bay of Plenty decision makers need to be aware of decisions that are being made at a sub-regional and inter regional level that could have an impact of agglomeration in the region. Ideally Bay of Plenty would also be able to influence decisions that are being made at these levels.

Finally, it should be noted that the Bay of Plenty, in common with other regions, faces a challenge in making the case for new infrastructure and transportation projects, which are critical to realising the benefits of agglomerated economies. It is widely acknowledged that standard cost-benefit analysis can often mask the costs and benefits of agglomeration. This should be borne in mind when cost benefit analyses of infrastructure projects are evaluated.

Appendix A Theory and empirical research

To inform this report BERL undertook a short review of urban settlement theory and associated impacts. This appendix:

- Discusses modern economic theory on urban settlement and agglomeration as well as key drivers; and
- Summarises key empirical impacts of agglomeration.

1.5 Modern economic theory on agglomeration

Agglomeration theory has evolved over time and will continue to evolve, although the central tenets of the agglomeration theory - that it leads to efficiency and productivity gains - remains unchanged.

The following outlines traditional and modern economic agglomeration theory.

Traditional economic theory

Agglomeration theory was first introduced by Alfred Marshall in the late 19th and early 20th century to explain the tendency of firms and workers to locate near each other. It is built on the premise that economic efficiencies will arise through labour market interactions, linkages between suppliers, and from knowledge spillovers. The theory suggests that the congregation of businesses and workers in a geographic area will reduce business costs. This reduction in business costs will provide incentives for businesses and workers to cluster together in cities.

Different microeconomic mechanisms are used to explain the existence of agglomeration in urban areas. Agglomeration theory suggests that improvements in efficiency/productivity can be obtained through the three types of micro-foundations based on sharing, matching and learning mechanisms outlined by Marshall (Gill and Kharas 2007):

- **Sharing mechanisms:** Broadening the market for input suppliers, allowing them to take advantage of internal economies of scale in production. Benefits include the sharing of indivisible goods and facilities, sharing the gains from variety, sharing the gains from individual specialisation, and sharing risk.
- **Matching mechanisms:** Expanding the availability of the range of skills required by employers to facilitate better matching to their distinctive needs. Benefits include improving the quality of matches and improving the chances of matching.
- **Learning mechanisms:** Accelerating the spillover of knowledge and enabling workers and entrepreneurs to share their learning. Benefits include knowledge generation, knowledge diffusion, and knowledge accumulation.

Modern economic theory

While the main tenets of traditional agglomeration theory still stand, agglomeration theory has been built on over the years, resulting in two main forms of agglomeration theory: localisation and urbanisation (Henderson, 2003, Venables, 2004):

- Localisation theory outlines that economic benefits arise from a larger number of firms in the **same** industry being locating in the same geographic area.

- Urbanisation theory outlines that economic benefits arise from a larger number of firms in **different** industries being locating in the same geographic area.

Table 1.1 summarises the key economic theories that sit within the areas of localisation and urbanisation.

Table 1.1: Modern agglomeration economic theory[2]

Type	Theory	Example of theoretical benefit
Localisation	"Shopping"	Shoppers are attracted to places where there are many sellers.
	"Adam Smith" specialisation	Outsourcing allows both the upstream input suppliers and downstream firms to profit from productivity gains because of specialization.
	"Marshall" labour pooling	Workers with industry-specific skills are attracted to a location where there is a greater pool of labour.
	"Marshall-Arrow-Romer" learning by doing	Reductions in costs that arise from repeated and continuous production activity over time and which spill over between firms in the same place.
Urbanisation	"Jane Jacobs" innovation	The more different things are done locally, the more opportunity there is for observing and adapting ideas from others.
	"Marshall" labour pooling	Workers in an industry bring innovations to firms in other industries; Workers with industry-specific skills are attracted to a location where there is a greater concentration, with the benefit arising from the diversity of industries in one location.
	"Adam Smith" division of labour	Similar to '"Adam Smith" specialisation', the main difference being that the division of labour is made possible by the existence of many different buying industries in the same place.
	"Romer" endogenous growth	The larger the market, the higher the profit; the more attractive the location to firms, the more jobs there are; the more labour pools there, the larger the market—and so on.

However, there has also been an increasing realisation that there are constraints to agglomeration and that agglomeration does not always result in positive spillovers and increased economic growth. Chatterjee (2003) suggests that while employment density is important, other factors such as availability of natural resources, state and local government economic policies, and proximity to other areas are also important.

[2] Source: Adapted from The World Bank (2009).

Further, while agglomeration can lead to increased economic growth, Crawford (2006) outlines that there is a limit to the benefits of agglomeration. After this limit is reached, theory states that there can be diminishing returns of scale. For example, there is a point where increased demands on road transport, leading to things such as traffic congestion, and other physical infrastructure can impact negatively on overall productivity levels.

1.6 Key agglomeration impacts

The impact of agglomeration has been measured in a variety of ways since Marshall first outlined his theoretical framework in the 1920s. As a result, there is a growing body of evidence of the impacts of agglomeration. This section provides a brief summary of key agglomeration impacts and discusses ways of measuring the economic impacts of agglomeration.

1.6.1 Agglomeration impacts

The majority of empirical literature of the impacts of agglomeration focuses on the linkage between economic productivity and the concentration of activity (Marè and Graeme, 2010). Rosenthal and Strange (2004) outline it is difficult to clearly identify the source of agglomeration impact. In identifying the key empirical impacts of agglomeration, we first focus on the linkage between productivity and urban density and then look at the impact of increasing urban density on agglomeration.

1.6.2 Agglomeration impacts on productivity

Productivity impacts

A number of empirical studies, in New Zealand and internationally, have been undertaken to try and quantify the strength of the relationship between economic productivity and the concentration of activity. Table 1.2 summaries some of the key findings from these studies in terms of elasticity.

Table 1.2: Strength of the relationship of agglomeration effects on labour productivity

Author	Location	Elasticity	Comment
Williamson, Paling & Waite (2008)	Auckland, NZ	0.3	This study uses an approach developed in London to examine the economic impacts of the Auckland Cross-rail project. As part of the Study, the link between employment density and average earnings in Auckland is examined using 2001 Census data.
Marè and Graeme (2009)	Auckland, NZ	0.7	This study used microdata from Statistics New Zealand's Prototype Longitudinal Business Database to examine the correlation between productivity and employment density in Auckland City. Overall, this study identified that localisation effects appear stronger than urbanisation, with productivity being more strongly related to own-industry density than to overall density.

Ciccone & Hall (1996)	US States	0.6	This study uses 1988 US State level data on gross output and country level data on employment density and average income to examine the correlation between productivity and employment density.
Ciccone (2002)	European Union	0.5	Using a similar methodology to Ciccone & Hall (1996), Eurostat regional data for the late 1980s was used from five countries.

The findings presented in the above table are a small cross section of the empirical studies that have been undertaken on the correlation between urban density and productivity. Graeme (2005) and Williamson, Paling and Waite (2008) have undertaken more comprehensive reviews of empirical studies:

- Looking at a number of empirical studies on agglomeration elasticities and the correlation between productivity and concentration, Graeme concludes that the elasticity impact is between 0.01 and 0.10. This means that if employment density doubled, productivity would increase by between 1 and 10 percent.
- In a similar analysis of different studies, Williamson, Paling & Waite (2008) put the elasticity level between 0.03 and 0.06. Simply put, if employment density doubled, productivity would increase by between 3 and 6 percent.

In addition to the above, BERL has also examined available data on the link between employment density and labour productivity in thirteen New Zealand cities[3].

Figure 1.3: Productivity versus density (2013)

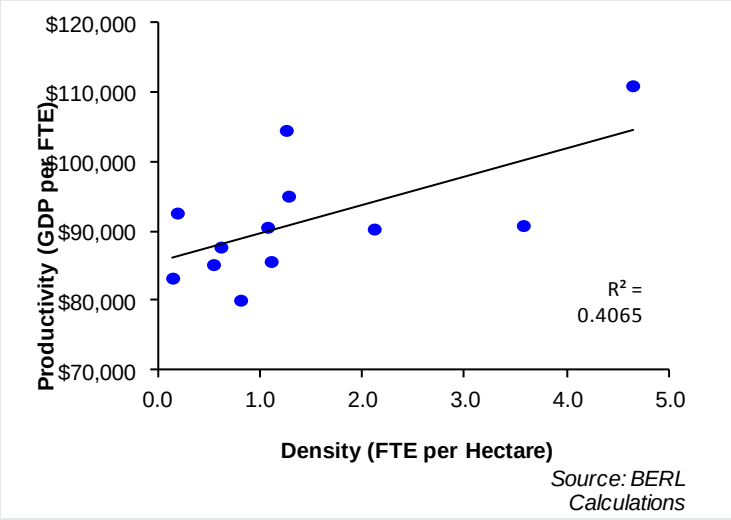


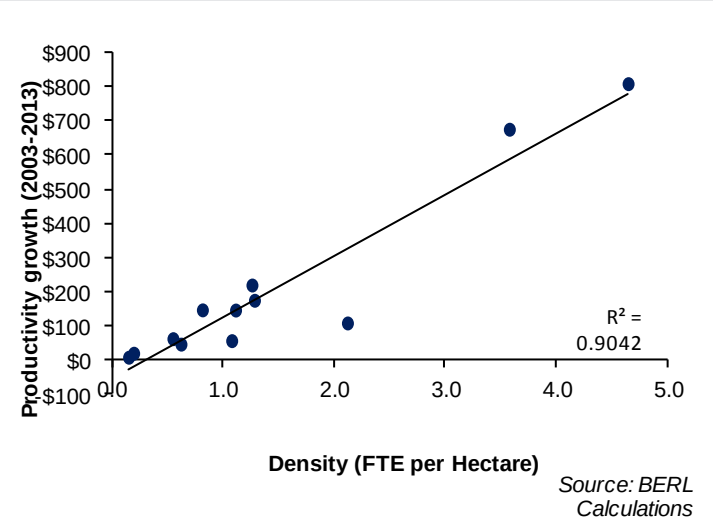
Figure 1.3 shows the relationship between the level of labour productivity (as measured in terms of GDP per FTE) and density (as measured by FTEs per hectare). A simple regression confirms a positive correlation between density and labour productivity although the explanatory power of this regression is not particularly strong with an R^2 of 0.41[4].

[3] Note the following analysis excludes Hamilton City as an outlier.

[4] R^2 measures the linear relationship between two different sets of variables. When R^2 is 0.0, there is no relationship between the two sets of variables. When R^2 is 1.0, there is a direct relationship between two different sets of variables.

Figure 1.4 below shows the relationship between the growth in labour productivity (measured as the change in GDP per FTE between 2003 and 2013) and density (as measured by FTEs per Hectares). Again, a simple regression confirms a positive relationship, but in this case between density and labour productivity growth, with the explanatory power of this regression rising to an R^2 of 0.90.

Figure 1.4: Productivity growth versus density, 2003-2013



Source: BERL Calculations

Figure 1.4 indicates that, based on past trends, increasing the density of population of a New Zealand city is likely to lead to increased productivity growth in the area.

Identifying and understanding the productivity linkages that are internal to firms and industries

Identifying and understanding the different potential causes of these productivity advantages remains a challenge as most studies are highly selective in terms of scope and geographic coverage (Rosenthal and Strange, 2004). The vast majority of studies focus on a defined agglomerated economy, making it difficult to accurately assess the wider impact of a regional agglomerated economy in terms of spillover benefits to other regions. Table 1.3 summarises a selection of empirical evidence on the correlation between agglomeration and productivity in terms of factors that impact on productivity.

Table 1.3: Understanding the linkage between agglomeration and productivity

Component	Impact	Evidence	Applicability in NZ
Increasing Urban Density	Increased wages	Gaeser and Marè (2001) examined longitudinal data on employment and wages in US cities and found that living in a dense urban area is associated with a wage premium of 25 percent. Conley, Flyer and Tsiang (2003) draw on data from Malaysia and find that there are significant human capital spillovers operating within travelling times of 90 minutes. They find that a reduction in travel time by 30 minutes increases wage by approximately 5 percent. Rosenthal and Strange (2005) use US Census data to find that an addition of 100,000 workers within five miles of a city increases wages by 1.5 percent. Coombes, Duranton and Gobillon (2005), drawing on wages and worker characteristics in France between 1976 and 1996 found that wages would increase by three percent if employment density were doubled.	High
Localisation: Increasing Industry specialisation	Indeterminate impact on employment and productivity growth	Henderson (1999), drawing on US empirical studies concludes that it is difficult to generalise about the overall impact of specialisation that are associated with specialisation, noting that some industries will experience positive effect while others will experience negative effects. Glaser, Kallal Scheinkman & Shleifer (1992) examine the determinants of employment growth over a thirty year period in 170 US cities and find that industry specialisation by 10 percentage points reduced employment growth by 0.1 percent. Coombes (2000), looking at industry employment data from France between 1984 and 1993 found that specialisation had a slightly negative effect on the majority of industries within the manufacturing sector.	Medium
	Increased wages	Wheaton and Lewis (2002) investigate the impact of occupation and specialisation in the US on wage. Controlling for various variables, they find that a doubling of occupation specialisation increases wages by 4 percent while increasing industry specialisation increases wages by 3	High

Component	Impact	Evidence	Applicability in NZ
		percent. Glaser, Kallal Scheinkman & Shleifer (1992), examined payroll and employment data between 1956 and 1987 and found that specialisation had no effect on wage growth.	
	Increased unemployment	Simon (1988) examined the relationship between a city's level of specialisation and the unemployment rate. In this study, unemployment rates were found to be greater in cities with higher degrees of specialisation. A more recent study by Basile, Girardi, Mantuano and Pastore (2011) looking at local labour systems in Italy between 2004 and 2008 assert that specialisation exerts a negative role on unemployment dynamics.	Medium
Urbanisation: Increasing firm diversity	Increased productivity	Marè and Timmins (forthcoming), drawing on Statistics New Zealand business demography data between 1987 and 2003 found that 'local diversity' of industry mix has a positive effect on productivity. Marè and Timmins estimated that a decline in local diversity over a decade would reduce productivity by approximately 1 percent. Coombes (2000) concluded that industry diversity had a positive impact on diversity in France between 1984 and 1993. Drawing in data from the US, Henderson (1999) .concludes that for high tech industries, diversity has a positive impact on employment growth. This build on early work undertaken by Henderson (1997), where a permanent one standard deviation decrease in employment reduces employment by a minimum of 2 percent and a maximum of 42 percent.	High
Localisation / Urbanisation: Increased knowledge spillover	Increased patents	Rosenhall and Strange (2004) outline that the increases in productivity associated with knowledge transfer are poorly understood. Jaffe, Trajtenberg and Henderson (1993) examined patent citations and firm location in the US and found that citations were approximately 5 to 10 times more likely to come from the same municipal area when compared to control patents.	Medium

Component	Impact	Evidence	Applicability in NZ
		Varga (2000), examining US and UK data, concludes that the concentration of high technology employment turns out to be the most important agglomeration factor promoting knowledge spillovers from universities. Moretti (2004) finds that human capital spillovers human capital spillovers in agglomerated economies. These are found to be stronger between industries that are close in terms of input-output linkages, technologically similarity, and patent links.	
Localisation / Urbanisation: Increased Competition	Reduced productivity	Studies undertaken by Romer (1986) and Glaser, Scheinkman & Shleifer (1992) show that increase competition in a local market leads to decreased productivity as businesses are unable to protect their intellectual property as safely as they are subject to increased staff turnover to competitors.	Low

1.7 Impact of density and agglomeration in urban centres

1.7.1 Increasing population and urban density

The New Zealand Treasury (2003) notes that while New Zealand's size will not enable widespread urbanisation economies of agglomeration to occur, there are areas where urban agglomeration can be sustained. It therefore makes sense to examine some of the key things that New Zealand policy makers and central and local government can do to increase urban density and drive agglomeration. To do this, cities need to grow their population.

German and US research shows that there are two main ways to drive population size and urban density – through labour market conditions and through increased levels of amenity. Amenity can mean different things to different people, with amenity commonly being used to describe a desirable feature of an area or place. In this report, we use the term amenity to cover the following domains (Economist Intelligence Unit, 2011):

- Stability: crime, threat of unrest, terror etc
- Healthcare: public and private
- Culture and environment: climate, culture and sport, religious, food etc
- Education: public and private mainly
- Infrastructure: Transport: road, public transport, regional or international links; housing, services.

Exogenous drivers or investments, such as effective public transport systems and complementary urban development and interventions increase the amenity of an area and can result in increased population, and thus the employment density in a central city as well as in the urbanised area overall. As a result, urban centres can progress up the levels of the settlement hierarchy. This view is further advanced by Marè (2010) who outlines that urban settlements that have superior accessibility, infrastructure and amenity are more likely to experience the benefits of agglomeration and reduced transaction costs through ease of contact with suppliers and customers.

Increased amenity levels in an area can increase inward migration by encouraging existing residents to stay, past residents who have emigrated to return and by attracting new immigrants. This process has recently been researched in Germany in a comparison of whether amenities impact on migration and account for differences in cities' demographic development (Buch, Hamann, Niebuhr and Rossen, 2013). Looking at the mobility of workers in German cities between 2000 and 2007 this research finds that amenity have an impact on the net migration rate.

1.7.2 Applied research findings on amenity, urban centres and agglomeration in Australasia

In recent years a number of applied research projects have been completed looking at the relationship between amenity, urban form and agglomeration. The majority of this research focuses on public transport, roading and infrastructure as a form of amenity. This research focuses on the premise that reducing travel times increases the number of workers available to employers while at the same time brings a greater range of employment opportunities within reach of households. Table 1.4 highlights key recent applied research findings from projects completed across Australasia.

Table 1.4: Applied research findings on amenity, urban centres and agglomeration in Australasia

Relationship between amenity and agglomeration outcomes	**Evidence**
Transportation impact on agglomeration, labour	Kernohan and Rognlien (2011) outline that the NZ Transport Agency (NZTA) commissioned Steer Davies Gleave to develop a wider economic impacts appraisal methodology for New Zealand based on existing practical approaches and the latest academic evidence. Part of this work included a case study on the overall likely value of the proposed Auckland Waitemata Crossing. This case study found that that project would be worth $106 million in net present value (2010 prices) terms. They found that agglomeration accounts for the largest component of the total impacts with a total impact of $72m in net present value. This impact is equivalent to an increase of 22.3 percent on the standard valuation. Labour supply impacts were the next most significant impact at $21.7m net present value (6.7 percent uplift) and imperfect competition impacts were worth $13m net present value (4 percent uplift).
Major Transport infrastructure investment on land values, employment and population	Focusing on the benefit of extensions to the length of Auckland's Northern Motorway, Grimes and Liang (2008) focus on changes in land values to measure the gross benefits of a major transport infrastructure investment. They find that there are large effects on land values near new exits of the motorway, as well as employment and population increases. Overall they calculate a benefit cost ration in excess of six.
Public transportation and productivity	Hazeldine and Douglas (2013) studied the 'Central Connector', a system of interlinked on-street side bus lanes in the corridor connecting Newmarket to Auckland's CBD, and the double tracking of the Waikanae railway line in Wellington. They identified the additional 'agglomerated economies' productivity benefit arising from the increased commuter flows and the partial reallocation of parking spaces in the CBD were 3 to 19 percent the size of conventional transportation benefits.
Transport accessibility and density	Examining a range of variables in the Auckland Region, Ascari Partners and Richard Paling Consulting (2007) find that there is a link between transport accessibility and employment density.
Transport infrastructure, density and productivity	In 2013, SGS examined the impact of the Melbourne City Rail Loop, completed in the 1980's. While the overall impact of the City Rail Loop could not be identified over a 30 year period, SGS presents scenarios of the productivity benefit ranging from $3.18 billion (assuming that no jobs were lost from Melbourne but simply redistributed across Melbourne) to $10.42 billion (assuming that the City Loop facilitated 74,000 jobs which would not have located in Melbourne otherwise). In the scenario that created a benefit of $10.42 billion, $9.21 billion came from gross valued added arising from having an extra 72,000 employed in Melbourne. The other $1.21 billion came from improvements in the

	relative accessibility of particular locations which have been impacted by the project. In the scenario that created a $3.18 billion benefit by redistributed jobs across Melbourne, increased productivity by $1.27 billion and, by dispersing jobs across Melbourne away from the CBD has a significant impact on all jobs in Melbourne.
Transport infrastructure and GDP	In the early 2000's BERL was contracted to assess the economic and strategic importance of the Eastern Transport Corridor in Auckland. As part of this work BERL (2004) assessed that the attributable increase in GDP per annum attributable to the Eastern Transport Corridor would be in the $1 billion to $1.5 billion. This was based on the view that industrial transport would increase by 130 percent by 2030 and result in increased volume, quality, value, and technology of industry.
Transport infrastructure, GDP, employment and wider economic benefits.	In Australia, Eddington (2008) looked at traditional cost-benefit analysis but also included assessment of the flow-on effects of transport infrastructure development on the Melbourne and Victorian economies (such as changes in GDP and employment). It also includes calculation of wider economic benefits. Eddington found that the net present value of 'traditional measured benefits' was calculated at $11.1 billion. Additional wider economic benefits were assessed as totalling $3.3 billion (adding around 35 per cent to conventional transport-user benefits). The most important of these benefits was attributed to agglomeration effects and to greater labour supply.

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