Urban Transport Governance and Inclusive Development in Korea

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Foreword

Urban transport can play a significant role in promoting inclusive growth in cities by facilitating and broadening access to socio-economic opportunities. In Korea, as in other OECD countries, there is scope for making urban transport more inclusive and more sustainable, both from a financial and an environmental point of view.

This report analyses the relationship between urban transport and inclusive development in Korea. While Korean cities have different public transport needs and capacities, the report finds that urban public transport is not equally accessible to different social groups. In this context, both central and local governments are moving away from a concept of mobility focused on high-speed, individual car-based transport towards a notion of transport as an enabler of access to opportunities. First, it looks at how Korea is shifting the main focus of transport from cars towards passengers and pedestrians. It discusses opportunities and challenges posed by current urban transport arrangements – including chronic deficits in urban public transport systems – and proposes options for improving urban transport governance. Second, the report uses advanced data analysis and space syntax methods to examine how accessibility to public transport shapes inclusiveness in Korean metropolitan areas. Third, it analyses public transport in four selected Korean cities (Seoul, Suwon, Changwon and Sejong), which offer interesting insights into how public transport policies can be tailored to local socio-economic profiles and urban landscapes.

While Korea's car-centred development model is now reaching its limits, cities have different public transport needs and capacities. Large cities typically enjoy an outstanding public transport system, although they also face important financial constraints. Moreover, urban public transport is not equally accessible to all social groups. Getting urban transport right could help Korea contribute to the Sustainable Development Goal and help implement the New Urban Agenda put forward at the UN Habitat III Conference.

The findings and recommendations contained in this report build on discussions with a diverse range of researchers, policy makers and civil servants in Korea during an OECD study mission in July 2016. The report combines empirical research with an assessment of policies and governance structures. The empirical work is based on detailed regional and Census micro data and digital maps of all Korean roads with public transport networks, as well as private datasets published online for wider public use.

This report was prepared as part of the programme of work of the OECD Regional Development Policy Committee. The committee seeks to help governments enhance well-being and living standards in all types of regions, from cities to rural areas, and to improve the contribution of regions to national performance and to more inclusive and resilient societies.

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Acronyms and abbreviations

A-S-I	Avoid-shift-improve
BIS	Bus Information System
BRT	Bus rapid transit
CNG	Compressed natural gas
CNT	Center for Neighborhood Technology
CNTP	Comprehensive National Territorial Plan
CO_2	Carbon dioxide
CRTM	Regional Consortium of Transport *Consorcio Regional de Transportes*
CTA	Chicago Transit Authority
DRT	Demand-responsive transit
EDS	Economic Development Strategy (London)
EV	Electric vehicle
FUA	Functional urban area
GDP	Gross domestic product
GIS	Geographic information system
GLA	Greater London Authority
GPS	Global positioning system
GRDP	Gross regional domestic product
ITF	International Transport Forum
ITS	Intelligent Transport System
KDI	Korea Development Institute
KOSIS	Korean Statistical Information Service
KOSTAT	Korea National Statistical Office
KOTI	Korea Transport Institute
KOTSA	Korea Transportation Safety Authority
KRW	Korean won
KSCC	Korea Smart Card Corporation
KTX	Korea Train Express
LAI	Location Affordability Index
MOI	Ministry of Interior
MOLIT	Ministry of Land, Infrastructure and Transport

MOSF	Ministry of Strategy and Finance
MOU	Memorandum of Understanding
MRA	Amsterdam Metropolitan Area *Metropoolregio Amsterdam*
MTS	Mayor's Transport Strategy (London)
NO_x	Nitrogen oxides
O/D	Origin/destination
OLS	Ordinary least square
PFS	Preliminary feasibility study
PIMAC	Public and Private Infrastructure Investment Management Center
PM	Particulate matter
PPP	Public-private partnership
RDF	Reassessment of demand forecast
RMV	Rhein-Main Transport Association *Rhein-Main Verkehrsverbund*
ROI	Return on investment
RRS	Regular revenue sharing
RSD	Revenue sharing for decentralisation
RSF	Reassessment study of feasibility
SDG	Sustainable Development Goal
STIF	Île-de-France Transport Authority *Syndicat des transports d'Île-de-France*
TfL	Transport for London
TIMS	Taxi Information Management System
TL3/TL4/TL5/TL6	Territorial Level 3/4/5/6
TOD	Transit-oriented development
TOPIS	Transport Operation and Information Service
TPCM	Total Project Cost Management
UCL	University College London
UVF	Frankfurt Urban Environs Authority *Umlandverband Frankfurt*
WHO	World Health Organisation

Executive summary

Main findings

- Transport has played a major role in Korea's rapid urbanisation and economic boom. In stark contrast with several countries around the world, Korea has combined rapid urbanisation (82.2% in 2013 according to the Korea Statistical Office) with a steep rise in gross domestic product (GDP) per capita (more than twice the average growth rate across the OECD between 2005 and 2014). Massive investment in transport infrastructure has driven this development pattern, primarily by improving road connectivity between the largest cities.
- Korea's car-centred model is now reaching its limits. Even though car ownership rates are still comparatively modest, Korea has the second-highest vehicle density in the OECD, more than three times the OECD average (190.3 vs. 61 vehicles per kilometre in 2014). Congestion costs have risen steadily in Korea and represented 2.2% of national GDP in 2015 – around two-thirds of such costs accrued from urban roads. Korea registers the longest commuting time among OECD countries. Congestion also fuels pollution: Korea is home to four of the five OECD metropolitan areas with the highest level of particulate matter concentration in 2013 (Cheongju, Seoul, Incheon, and Jeonju).
- Getting urban transport right in Korea could help the country implement the New Urban Agenda put forward at the UN Habitat III Conference. Both central and local governments in Korea are moving away from a concept of mobility focused on high-speed, individual car-based transport to a new notion of transport as an enabler of access to opportunities. This could also help Korea achieve the Sustainable Development Goals (SDGs), such as Target 11.2 – access to safe, affordable, accessible and sustainable transport systems for all by 2030 – notably by expanding public transport.
- Korean cities have different public transport needs and capacities. Among the largest cities, the modal share of public transport (as defined by the percentage of total trips made via public transport, mostly bus and rail) ranges between 28.5% in Daejeon and 52.4% in Seoul, compared with a national average of 35.8%. Modal shares also differ within cities between the urban core and the periphery.
- Urban public transport is not equally accessible to all social groups. Analysis shows that, in many large cities, income levels do not seem to influence access to public transport (calculated in terms of the ratio of population that lives within walking distance to bus stops or train or subway stations), whereas in other areas, people with lower incomes tend to live further away from bus stops. Also, women tend to live in areas with lower bus accessibility. This might reflect the relative lack of economic opportunities for women: Korea registers the widest wage gap

between men and women among OECD countries (36.6%, more than twice the OECD average gap of 15.5% in 2013).

- The elderly tend to live both close to bus stops and in areas that have many school-age children. A possible explanation may be that many elderly are unable to drive or to walk, thus tend to locate closer to bus stops, and school-age children have similar needs for commuting to education facilities. Both the elderly and school-age children are unlikely to own a car or to be able to drive one. Part of the elderly might live with their children and grandchildren for financial reasons (according to a survey of Korean housing welfare, 13.2% of households included both elderly and their grandchildren in 2010, up from 12.7% in 2007 and higher than 6.6% on average in European Union (EU) countries in 2008).
- The Ministry of Land, Infrastructure and Transport (MOLIT) is in charge of both urban policy and transport policy. This, coupled with a sophisticated public investment management system (Total Project Cost Management, TPCM) system, allows Korea to assess upfront the long-term impacts and risks of public investment in transport. This good practice is well aligned with the *OECD Recommendation on Effective Public Investment Across Levels of Government*.
- Ambitious reforms in urban public transport have helped improve service delivery and user convenience. First, Korea has managed to harmonise its public transport fare-collection system nationwide, so that citizens can ride any public transport network in Korea with a single mobility pass. Second, Korea has built sophisticated urban transport management systems using "big data" (high-volume, high-velocity datasets that traditional processing systems cannot easily exploit). Third, major cities in Korea have increased the use of public-private partnerships in the bus sector.
- However, urban transport systems face important financial and institutional constraints in Korea. Urban public transport services in Korea tend to run large chronic deficits. At the same time, the share of central government in total subnational government revenue in Korea is well above the OECD average (61.6% vs. 37.3% in 2013).

Key recommendations

- Integrate urban transport planning in broader metropolitan development strategies. Both central and local governments are focusing on reducing reliance on cars and promoting public transport and soft mobility (such as cycling and walking). Such a vision could be implemented by clearly aligning the transport strategy with the broader long-term economic planning framework (e.g. assessing the impact of transport policy on economic, social and environmental goals).
- Develop a monitoring tool that bundles transport and housing costs together. Measuring combined transport and housing costs in a given location could help better inform citizens' locational choices and implement more coherent policies. The Korean government has started to move in this direction, for example by promoting "Happy Housing" policies to provide public rental housing located close to public transport or to job opportunities, specifically for young residents.
- Continue to monitor and evaluate urban transport performance. Measuring and communicating successful performances in urban transport policies on a regular

basis – such as MOLIT's evaluation of local governments in terms of public transport and sustainable transport – can help build public support for necessary reforms. It is also critical to engage stakeholders effectively in the design of urban transport policies.

- Strengthen partnerships among local governments and across different levels of government on mutually agreed objectives and a fair distribution of costs (e.g. investment, operation and maintenance). Local governments need more sustainable financial resources for ensuring more inclusive urban transport. Introducing financial disincentives to make car use less attractive, particularly in high-density urban areas, can also help promote public transport use and upgrade the vision of urban transport as an enabler of economic, environmental and social opportunities.

Assessment and recommendations

Urban transport has played a major role in Korea's rapid urbanisation and economic boom.

Korea has combined rapid urbanisation (82.2% in 2013 according to the Korea Statistical Office) with a steep rise in gross domestic product (GDP) per capita (more than twice the average growth rate across the OECD between 2005 and 2014). This stands in stark contrast with several countries in the world (including Colombia and Senegal, for example). Massive investment in transport infrastructure has driven this development pattern, primarily by improving road connectivity between the largest cities. Korea devoted 6.6% of its total public investment to transport infrastructure in 2015 (even though this share represents a drop from 8.2% in 2006). For about four decades until the early 2000s, transport investment was tilted towards road infrastructure to support the development of export-oriented heavy industries in the largest cities. The investment mix has changed over time, and in 2015, roads and railways accounted for around 45% and 33% of total traffic-related public investment, respectively. Korea's motorisation rate (number of cars per 1 000 residents) relative to its income level remains below the OECD average and is among the lowest in the OECD, which can help prevent further congestion and promote environmental sustainability. However, given its high population density, Korea has the second highest vehicle density in the OECD, more than three times the OECD average (190.3 vs. 61 vehicles per kilometre in 2014).

New challenges require urban transport to be not only economically efficient, but also environmentally sustainable and socially inclusive.

Such a car-centred model is now reaching its limits. According to estimates from the Korea Transport Institute (KOTI), congestion costs have risen steadily in Korea, and represented 2.16% of national GDP in 2015 – around two-thirds of such costs accrued from urban roads. Korea registers the longest commuting time among OECD countries and ranks third lowest among 38 countries in terms of work-life balance according to the OECD Better Life Index. Congestion also puts a drag on Korea's sustainable development potential, notably by fuelling pollution. Four of the five OECD metropolitan areas with the highest level of particulate matter concentration are located in Korea in 2013 (Cheongju, Seoul, Incheon, and Jeonju).

Getting urban transport right in Korea could therefore help the country implement the New Urban Agenda put forward at the UN Habitat III Conference, and contribute to achieving the Sustainable Development Goals (SDGs), such as Target 11.2 – access to safe, affordable, accessible and sustainable transport systems for all by 2030 – notably by expanding public transport. Both central and local governments in Korea are moving

away from a concept of mobility focused on high-speed motorised transport toward a notion of transport as an enabler of access to opportunities.

Many cities in Korea are shifting towards public transport.

Large, densely populated cities around the world typically have both greater needs and larger resources in terms of public transport systems. However, there can be large differences across cities within the same country. Among the largest cities in Korea (Seoul and the six cities classified as "metropolitan cities" in the Korean territorial framework), the modal share of public transport (as defined by the percentage of total trips made via public transport, mostly bus and rail) ranges from 28.5% in Daejeon to 52.4% in Seoul, compared with a national average of 35.8%. Modal shares also differ within cities between the urban core and the periphery. Such a core-periphery gap is particularly large in the capital area (Seoul, Incheon and Gyeonggi), Gwangju and Busan, while it is slightly lower in Daegu, Daejeon and Ulsan. Several cities have taken initiatives to foster greener transport, by inhibiting car use or promoting alternative modes. Seoul implemented a congestion charge in two urban tunnels as early as 1996, although so far it remains the only city that has done so in Korea. Sejong, which was planned and created by the central government as an alternative administrative hub to the capital, adopted aggressive "road diet" policies to discourage car use (e.g. narrow driving lanes, little or no parking space in buildings) and combined them with strong investment in the supply of public transport (e.g. drastic increase in the number and frequency of buses, introduction of bus-rapid transit [BRT]). Suwon experimented with a car-free neighbourhood during an entire month (the Eco-Mobility Village in September 2013), which helped change residents' behaviour even after the experiment ended. In 2008, Changwon established the first public bike-sharing system in Korea (called Nubija), which is still expanding after the central government merged the city with the neighbouring Masan and Jinhae in 2010. Such encouraging initiatives offer interesting insights and could be further developed in other parts of Korea.

How can accessibility to urban public transport be measured in Korea with regard to inclusiveness?

Even where available, however, urban public transport is not equally accessible to all social groups. While accessibility can take different forms, the present research focused on measuring physical accessibility to urban public transport by calculating how long it takes for residents to walk to a bus stop or to a train station. After exploiting the GIS maps of all roads, bus stops, train and subway stations in Korea at an extremely granular scale through population grids, it was possible to calculate the ratio of residents who live within a 10-minute walking distance from a bus stop or train/metro station in total Territorial Level 5 (TL5) population (as an indicator of "accessibility") and the ratio of people who live farther than a 30-minute walking distance (as an indicator of "inaccessibility"). Such indicators of accessibility and inaccessibility were then regressed against a set of socio-economic indicators (notably related to income, age and gender) to analyse to what extent public transport is both accessible and inclusive in Korean cities.

In some cases, urban public transport is more accessible to the rich and to men in Korea.

A first, unsurprising result is that the areas that are the most densely populated and offer better economic and educational opportunities enjoy greater accessibility to buses and trains. Higher income individuals also tend to live closer to public transport (bus stops). However, there are major differences across Korean cities and regions in terms of inclusiveness of public transport. In some large cities (including Seoul, Incheon, Daejeon, Ulsan and Busan), the transport system shows a high degree of inclusiveness with respect to income, as there is no systematic difference in access to public transport across income groups. In other areas (such as Daegu, Gyeonggi and some other provinces), people with lower incomes tend to live further away from bus stops. This may be in part related to the difficulty of providing public transport in those areas where population density is lower. Interestingly, there is also a strong positive correlation between bus accessibility and the ratio of men in TL5 population throughout Korea. Conversely, women tend to live in areas with lower bus accessibility, which are less densely populated and have fewer firms (thus fewer job opportunities).

Women's lower accessibility to buses may reflect a deeper, underlying aspect of the Korean society – the relative lack of economic opportunities for women compared to men. High accessibility areas are likely to offer more expensive housing than elsewhere, which only higher income people can afford. Income is directly linked with the status of employment. The employment rate of women in Korea was 49.9%, whereas the one for men was 71.1% in 2015. This gap has barely changed in ten years. Likewise, the wage gap between men and women in Korea is 36.6%, the widest gap among OECD countries, more than twice the OECD average gap of 15.5% in 2013. Evidence also shows that roughly a quarter of total households in Korea are single households (either a man or a woman living alone), which may underlie the gender gap observed in accessibility to public transport.

Some demographic groups such as the elderly and school-age children also enjoy better access to urban public transport in Korea.

Looking at specific age groups, the analysis found that the elderly tend to live close to bus stops, in high-income areas. What affects this age group is particularly relevant considering that Korea's population ageing is projected to be the fastest in the OECD area, with projections showing that by 2050 Korea will have the third oldest population (only behind Japan and Spain). In Korea as a whole, and in a number of Territorial Level 3 regions (TL3) – especially Gangwon, but also Gyeonggi, Gwangju, Gyeongnam, Jeju and Chungbuk) –, there was a significantly positive correlation between the ratio of the elderly in TL5 population and bus accessibility.

Intriguingly, the elderly also tend to live in areas that have many school-age children. This pattern was consistent from elementary school students to middle and high school students. A possible explanation may be that many elderly are unable to drive or to walk, thus tend to locate closer to bus stops, and school-age children have similar needs for commuting to education facilities. Both the elderly and school-age children are unlikely to own a car or to be able to drive one. Part of the elderly might live with their children and grandchildren for financial reasons (according to a survey of Korean housing welfare, 13.2% of households included both elderly and grandchildren members in 2010, up from 12.7% in 2007 and higher than 6.6% on average in European Union (EU) countries

in 2008). Elderly poverty might contribute to this pattern. Korea has the highest rate of elderly poverty by far among OECD countries (49.6% of Koreans aged 65 or more lived below the poverty line as of 2012, a staggering almost four times the OECD average of 12.6%).

Further analysis through "space syntax" techniques, which overlays public transport networks with urban street networks in a selection of Korean cities, helped identify a number of areas within these cities where lower income residents were likely to be disconnected from economic and social opportunities (e.g. old north-eastern part of Seoul, several areas within Busan due to its fragmented topography, the new centre in the Special City of Sejong).

The legal and institutional framework provides a solid basis for designing urban public transport in Korea.

Korea has the advantage that a single ministry – the Ministry of Land, Infrastructure and Transport (MOLIT) – is in charge of both urban policy and transport policy. MOLIT prepares both a 20-year strategic plan for the development of the entire territory, including urban areas (the Comprehensive National Territorial Plan, or CNTP, currently in its 4th edition), and a 5-year Public Transport Master Plan (currently in its 2nd edition, 2012-16). Based on these national frameworks, each city government establishes both a city master plan and a local public transport plan over the same time span.

This planning scheme also fits in a sophisticated public investment management system, called the Total Project Cost Management (TPCM) system, which combines close monitoring from the Ministry of Strategy and Finance and independent expert assessment in three phases (*ex ante*, intermediate and *ex post* assessment). The TPCM applies to projects – including transport projects – that are implemented by central or local governments (or private actors relying on public funding), have a construction period of two years or longer, and incur costs of at least KRW 50 billion (about USD 47.5 million) in the case of civil engineering projects or at least KRW 20 billion (about USD 19 million) in the case of architectural projects. Such a system is well aligned with the *OECD Recommendation on Effective Public Investment Across Levels of Government* and has been acknowledged as a good practice, particularly in terms of assessing upfront the long-term impacts and risks of public investment.

Ambitious reforms in the governance of urban public transport have helped improve service delivery and user convenience.

Three examples of key reforms in the governance of urban public transport in Korea can illustrate the considerable potential for improving service delivery and user convenience: the introduction of a semi-public bus operating system, the harmonisation of the fare-collection system and the use of big data in urban public transport management systems.

First, major cities in Korea have introduced a unique type of public-private partnership model in the bus sector. Korea has a very particular system in which private bus operators hold quasi-monopolistic rights on the routes once they have obtained a license. However, the law also provides for exceptional measures in case of financial deficits. In the 1990s, public subsidies were introduced to compensate for the swelling deficits of private bus operators and counter the deterioration of service quality. In 2004, Seoul was the first city to adopt a semi-public bus operating system, later replicated in five out of Korea's six

metropolitan cities (only Ulsan did not follow suit). The new system is a form of gross cost contract, in which the city government fully compensates private operators for their operation costs under the condition that the private operators share their authority over routes with the city government. While this reform came at a considerable cost, it is estimated to have substantially increased bus ridership and improved safety. In Seoul, the bus reform was combined with a wider set of urban renewal strategies, such as the replacement of an elevated highway with a multi-purpose waterfront (Cheonggyecheon).

Second, Korea has managed to harmonise its public transport fare-collection system nationwide. Originally launched in 2004 by the city of Seoul and later expanded by MOLIT to cover almost the entire country, a single mobility pass allows users to ride any public transport network in Korea and benefit from discounts when they transfer from one mode to another. MOLIT worked on testing relevant technologies, building nationally standardised infrastructures, as well as building consensus among subnational governments and private card companies. Finally, a series of Memoranda of Understanding were signed with all the 17 TL3-level subnational governments and public transport operators in 2013. The "One Card, One Pass" can be easily purchased and recharged, and today it is accepted in all buses, subways, taxis, trains, inter-city buses, express buses, toll gates and even major retailers.

Third, Korea has capitalised on its strong IT uptake to build sophisticated urban transport management systems using big data. A shining example is the Transport Operation and Information Service (TOPIS), which was launched by the city of Seoul in 2004 and has inspired similar endeavours in other cities both domestically and abroad. TOPIS tracks all vehicles in the city in real time by processing a massive flow of data coming from cameras, sensors, GPS systems and fare-collecting devices. It also collects information from the Korea Meteorological Administration, the Seoul Metropolitan Police Agency and information provided by citizens to prevent natural disasters, react quickly to accidents, reorient traffic in case of street protests, among others. The public can access the collected information via smart phone apps, the TOPIS website and digital information boards in stations. Other cities are also running or building similar information systems, most notably Suwon's Urban Safety Integrated Center, which provides multi-sectoral monitoring on traffic, crime and natural disasters. MOLIT plans to expand the system to 80 additional subnational jurisdictions by 2021 and a Taxi Information Management System (TIMS) is also expected to be completed in 2018 across 157 subnational governments.

Nonetheless, urban transport systems face important financial and institutional constraints in Korea.

While urban public transport services in Korea are generally well developed and fast, they also tend to run large chronic deficits. Cities in Korea, as in other OECD countries, are grappling with a variety of financial challenges in the urban transport sector, both in the short term and in the long term – including the long-term cumulated costs of infrastructure repair and maintenance, and the need to make urban transport affordable for the most vulnerable users (such as the lower income groups, the elderly and the disabled). This financial burden is particularly salient in Korea where local governments have a relatively low fiscal autonomy to start with. Although the 1988 Local Finance Act was amended several times (in 2005, 2009 and 2011) to enhance fiscal decentralisation, the share of central government in total subnational government revenue in Korea remained well above the OECD average (61.6% vs. 37.3% in 2013). According to the Act on the

Management of Grants, the national government provides grants to cover part or all of the costs of traffic-related investments in cities and provinces. In general, these are earmarked, discretionary and matching grants. Costs are shared in accordance with predetermined ratios or lump sums, applied identically across all local jurisdictions.

Adopting a holistic approach to urban transport as part of a broader metropolitan development strategy is essential.

An important aspect of rethinking the governance of urban transport systems in Korea is how to help the latter better serve economic, social and environmental objectives by promoting a holistic approach. In particular, both central and local governments are focusing on reducing reliance on cars and promoting public transport and soft mobility. Implementing such a vision requires developing a transport strategy within a broader long-term economic planning framework. For example, Transport for London (TfL) – the transport authority for the Greater London Authority – has been successful in designing economically driven transport policies, which are well aligned with demographic and employment dynamics and effectively promote public and non-motorised transport modes.

Developing a measurement and monitoring tool that bundles transport and housing costs together could also be particularly useful in Korean cities. For example, in the United States, a federal government initiative called the US Partnership for Sustainable Communities has aimed to develop more sustainable communities by integrating transport, housing and energy policies. Recognising that housing and transport costs account for almost half the average household's budget, a Location Affordability Index (LAI) was developed to provide estimates of the percentage of a family's income dedicated to the combined cost of housing and transport in a given location and help inform people's locational choices as well as better target public investment. The Korean government has also started to move in this direction, for example by promoting "Happy Housing" policies to provide public rental housing located close to public transport or to job opportunities specifically for young residents (e.g. newlyweds, university students or workers in their first year of employment).

Enhancing monitoring and evaluation of urban transport performance can help build public support.

Finally, it is critical to better identify citizen needs by engaging stakeholders effectively in the design of urban transport policies. For example, Suwon set up a Civil Transport Evaluation Committee, which brings together 150 representatives (e.g. members of non-governmental organisations, traffic experts, citizens and youth) to collaborate on formulating the city's urban transport vision for 2030. Measuring and communicating successful performances in urban transport policies on a regular basis – such as MOLIT's evaluation of local governments in terms of public transport and sustainable transport – can also help increase trust in the capacity of Korean central and local authorities to deliver concrete improvements in people's daily life and build public support for necessary reforms.

Towards more efficient, sustainable and inclusive urban transport in Korea.

Korea has already demonstrated its capacity to implement ambitious governance reforms to improve urban transport service delivery, as illustrated by the introduction of the semi-public bus operating system in several cities and the harmonisation of fares throughout the country. Strengthening partnerships among local governments and across different levels of government on mutually agreed objectives, and a fair distribution of costs could help address chronic financial constraints in Korean urban transport systems. Introducing financial disincentives to make car use less attractive, particularly in high-density urban areas, also constitutes a powerful tool. A shared, forward-looking vision of urban transport as an enabler of economic, environmental and social opportunities will play a key role in upgrading growth and well-being in Korean cities.

Chapter 1.

Towards a more effective governance of urban transport in Korea

This chapter describes how transport helped shape Korea's fast-paced urbanisation and how improving transport governance could contribute to building more efficient, sustainable and inclusive cities in Korea. First, it shows that Korea's priorities for urban transport are shifting from car-centred towards people-centred mobility, as illustrated both in central and local government strategies. Second, it discusses opportunities and challenges in Korea's current institutional and financial arrangements for urban transport. Finally, it offers insights on four proposed options for strengthening urban transport governance in Korea.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

Introduction

Cities and cars have historically grown together in Korea, one of the most urbanised and fastest expanding economies in the OECD. Together with the gradual shift of public investment focus from roads to other modes of transport, urban mobility systems – both between and within Korean cities – have played a major role in supporting national prosperity and are today generally seen as modern, reliable and efficient. However, urban transport in Korea is currently under strain, as in many other OECD countries. New demands are challenging its capacity to deliver not only economically efficient performances, but also environmentally sustainable and socially inclusive outcomes. Getting urban transport right in Korea can help the country meet the Sustainable Development Goals (SDGs) – notably Target 11.2 – and implement the New Urban Agenda put forward at the UN Habitat III Conference. Both central and local governments in Korea are moving away from a focus on motorised transport toward a notion of mobility that puts people first. While this attempt is aligned with the OECD/International Transport Forum approach, which promotes transport as an enabler of access to opportunities, achieving this goal requires rethinking the governance of urban transport (ITF, 2016).

This chapter is organised in three parts. First, it assesses the main trends in urban transport in Korea, in light of the country's rapid urbanisation and growth. Second, it analyses the opportunities and challenges in the governance of urban transport in Korea in terms of the legal, institutional and financial arrangements currently in place. Finally, it discusses four main options for strengthening the governance of urban transport in Korea.

Urban transport in Korea: In search of a new paradigm

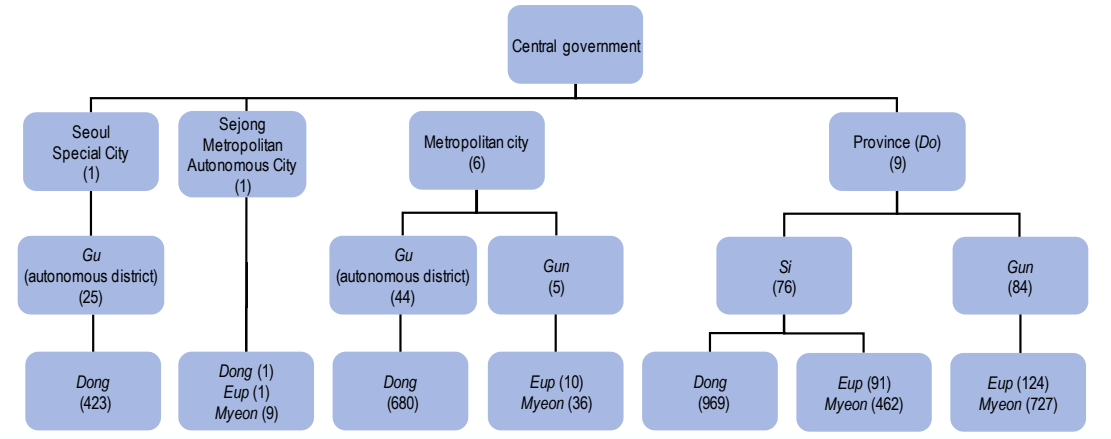
Korea combined rapid urbanisation and fast growth

Urbanisation is one of the most striking features of Korea's "Miracle on the Han River", as the country's record economic growth has sometimes been coined. In stark contrast with many countries around the world that have urbanised without necessarily catching up economically, Korea has combined rapid urbanisation with a steep rise in gross domestic product (GDP) per capita relative to the United States (Figure 1.2). Today, Korea ranks among the most urbanised and the fastest growing countries in the OECD. While the urbanisation rate may vary according to the methodology used, it remains high in Korea. In 2013, the urbanisation rate in Korea was 82.2% according to the Korea Statistical Office. According to the OECD territorial classification, which classifies Territorial Level 2 (TL2) regions into three categories (predominantly urban, intermediate and predominantly rural), population living in predominantly urban areas in Korea represents 69.6% of total population, the fourth highest among OECD countries and far above the OECD average of 46.4%[1] (Figure 1.3). On the economic growth front, Korea's real GDP grew at more than twice the average growth rate across the OECD between 2006 and 2015 (3.5% vs. 1.4%).[2] Institutional reforms also supported this move with the introduction of a specific tier of cities called "metropolitan cities" in the Korean territorial framework in 1995, with the aim to equip the largest cities with adequate resources (Box 1.1).

Box 1.1. **The creation of "metropolitan cities" in Korea**

Cities in Korea are classified into two tiers. The upper-tier cities (Territorial Level 3, TL3) include cities with a special status, such as Seoul and Sejong, as well as six metropolitan cities. These cities are on the same footing as provinces, whereas the lower-tier cities (TL4) are under provincial jurisdiction. There are no legally established prerequisites to upgrade a city from the lower tier to the upper tier, but past practices indicate that a population of at least 1 million inhabitants, a strong economic base and autonomous administrative capacity are commonly required. The latest upgrade was granted to Ulsan in 1997.

Figure 1.1. **Territorial framework in Korea**



Source: OECD (2014b), *Compact City Policies: Korea: Towards Sustainable and Inclusive Growth*, http://dx.doi.org/10.1787/9789264225503-7-en.

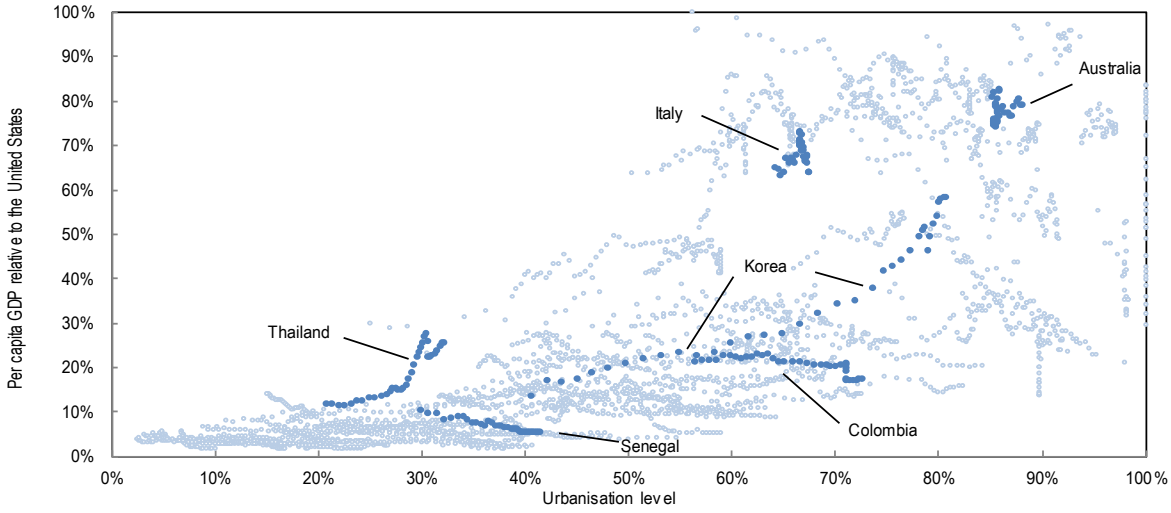
The main benefit of being upgraded to a metropolitan city is the expansion of local tax base and greater fiscal independence. The tax base of TL4-level local governments is confined to 6 tax items, whereas an upgrade to a metropolitan city will double the number of autonomous taxes to 12, as a result of a transfer of tax powers from provincial jurisdictions (Ahn, 2016). While metropolitan cities are equally eligible to shared tax and grants from the national government, they no longer receive provincial shared tax and grants. Besides, administrative procedures for general planning and budgeting are substantially shortened, facilitating more efficient and timely delivery of public goods and services.

Recently, in November 2016, the mayor of Changwon submitted a motion to obtain approval from the National Assembly for an upgrade. Changwon argues that its population, land mass and economic intensity are comparable to those of metropolitan cities, and the mounting demand for complex urban services cannot be met with limited fiscal and functional autonomy. However, the proposal was the subject of a hot dispute with the provincial assembly of Gyeongnam (the province to which Changwon is currently subordinated), because Changwon's independence would mean that the province will lose over one-third of its population and gross regional domestic product (GRDP). Amidst this political uncertainty, the agenda will have to pass several committees of the Assembly before getting introduced to the general meeting (Yun, 2016).

Sources: Author's own elaborations drawing from Ahn, G.W. (2016), "Changes in fiscal structures following Changwon's administrative elevation: Impacts on the vertical tax revenue distribution"; Yun, S.H. (2016), "Changwon's elevation to a metropolitan city, will it pass the National Assembly?", www.ohmynews.com/NWS_Web/View/at_pg.aspx?CNTN_CD=A0002261775 (in Korean).

Figure 1.2. **Korea is an outstanding example of urbanisation combined with economic development**

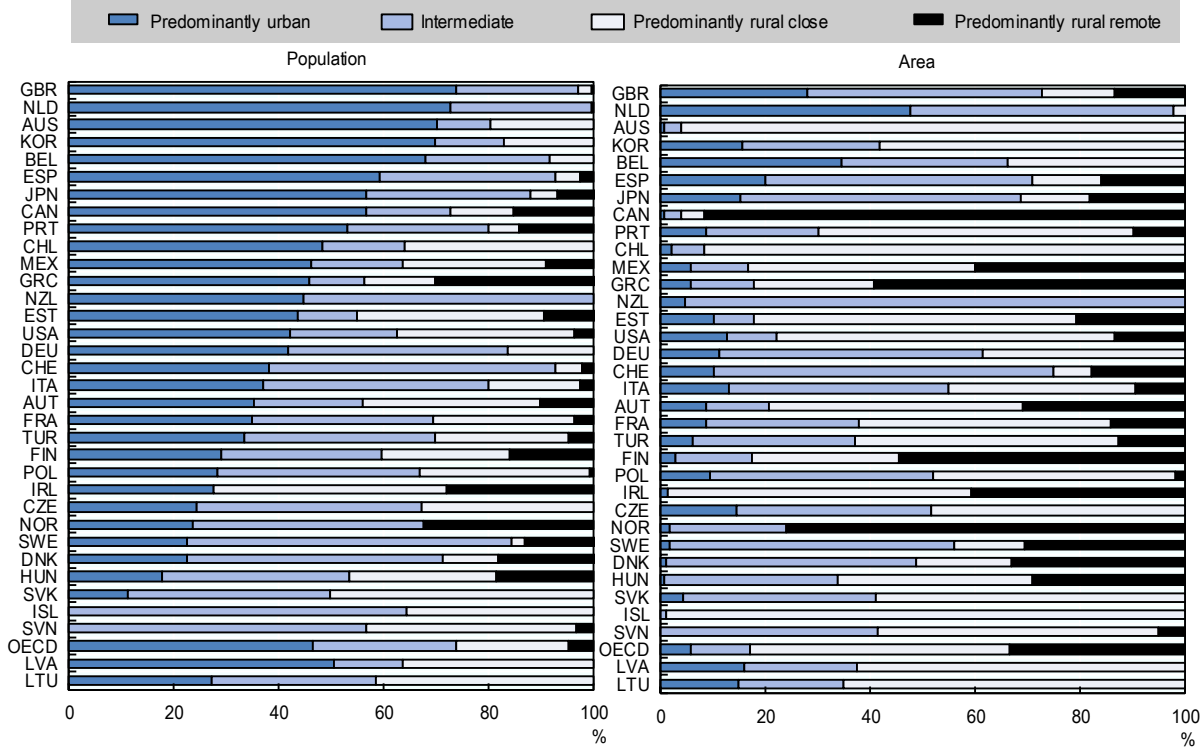
Annual observations of country GDP per capita (relative to the United States) and share of urban population, 1970-2013



Source: OECD (2015a), *The Metropolitan Century: Understanding Urbanisation and Its Consequences*, http://dx.doi.org/10.1787/9789264228733-en.

Figure 1.3. **Korea is one of the most urbanised countries in the OECD**

Percentage of population living in each type of region, 2014



Source: OECD (2016b), *OECD Regions at a Glance 2016*, http://dx.doi.org/10.1787/reg_glance-2016-en.

Urban transport is well developed but often remains car-dependent

Korea's rapid urbanisation and development went hand in hand with massive investment in transport infrastructure, primarily to improve connectivity between the largest cities. But before its economic takeoff, much of its transport infrastructure was destroyed during the Korean War (1950-53). The government launched an extensive railway reconstruction programme between 1953 and 1960. However, the relatively lower cost of roads (USD 0.012 per km of motorway vs. USD 0.129 per km of high-speed railway, according to KOTI estimates in 2008)[3] made the case for shifting the focus from railways to roads starting from the late 1960s, in order to meet the growing demand of industry for mass traffic infrastructure. The completion of the Gyeongbu Expressway in 1970 established a fast northwest-south-east corridor between Korea's two largest cities, Seoul and Busan, passing through Daejeon and Daegu. Several expressways were also built between major cities over the following years. During the 1970s, the government promoted heavy chemical industries and export-oriented growth through large-scale investment in ports and their road and railway connections to the hinterland. It also increased the supply of roads by creating a Special Account for Traffic Facilities in 1993, setting aside fuel tax revenues to finance the construction of new transport infrastructure, notably roads (Box 1.2). The share of railways in transport-related public investment shrank drastically from 60.6% during the first Economic and Social Development Plan (1962-66) to only 14.5% by the late 1990s, whereas the share of roads jumped from 17.2% to 64.6% over the same period (Figure 1.4).

Box 1.2. **Public funding for transport investment in Korea**

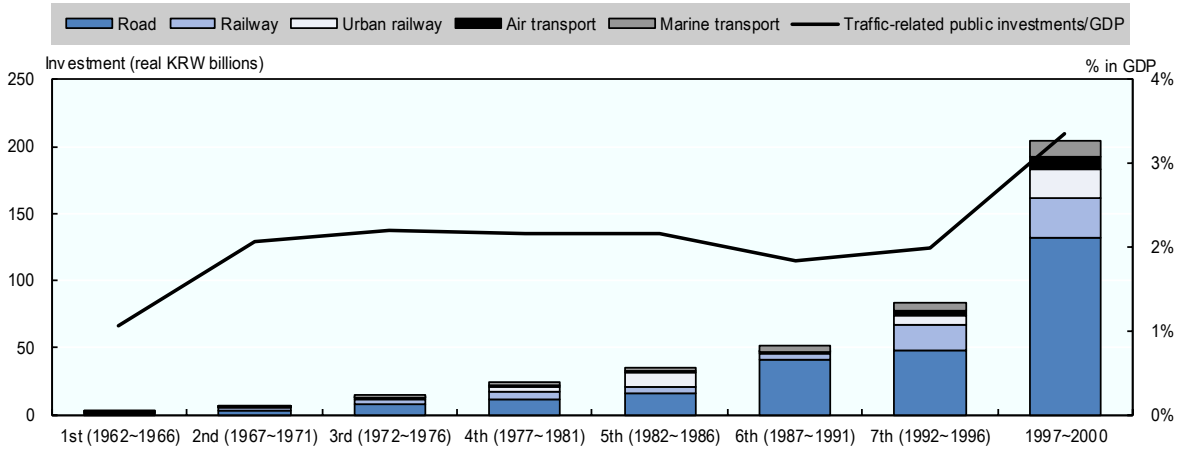
The main source of revenue for public investment in transport infrastructure in Korea is the Traffic/Energy/Environment Tax (originally called Traffic Tax), which is levied on gasoline and diesel consumption. This special-purpose tax was first introduced in 1993, originally as a sunset law with automatic termination ten years later. However, it was extended four times, most recently in November 2015. The current extension is valid until 2018.

Around 80% of the tax revenues currently flow into the transport sector, while the remaining 20% is distributed to the environment (15%), energy (3%) and balanced regional development (2%). The share allocated to the transport sector is then distributed to separate accounts for roads (43-49%), railways (30-36%), harbours (7-13%), airports (below 7%) and traffic system management (below 10%), following the provisions of the Act on Special Accounts for Traffic Facilities. In 2015, as much as 67% of the budget for road investments came from this tax alone, surpassing all other sources combined, such as general account transfers and vehicle special consumption tax revenues.

While the tax offers a major and stable source of funding for transport infrastructure, it has also raised a debate about the efficiency of its use and its sustainability over time. Critics have argued that tax revenues should serve general purposes and support new needs in sectors other than transport, such as environment, energy and social welfare. This is the reason why it was decided, in 2007, that tax revenues would also serve the environment and energy sectors. It is also debated whether the dominance of a single revenue source against the backdrop of increasing fuel efficiency and the emergence of eco-vehicles is putting the sustainability of transport financing at risk. It has therefore been suggested that cultivating alternative sources of transport financing should be a priority.

Source: adapted from MOLIT (2016a), "Current state of the Traffic/Energy/Environment Tax" (in Korean) www.molit.go.kr/USR/policyData/m_34681/dtl.jsp?id=331.

Figure 1.4. **Annual public investment in transport and share of GDP in Korea, 1962-2000**



Notes: GDP and investment values are inflation-adjusted, using 2000 as the base year. The periods on the x axis correspond to the seven 5-year economic development plans, which were first launched in 1962 and terminated in 1997.

Sources: Author's own elaborations based on data from Park, J.H. (2012), *A Case Study on the Legal Framework and Financing of Transport Infrastructure*, http://archives.kdischool.ac.kr/bitstream/11125/4217/1/36%20English_A%20Case%20Study%20on%20the%20Legal%20Framework%20and%20Financing%20of%20Transport%20Infrastructure.pdf; Kostat (2016a), *Consumer Price Inflation Database*, http://kosis.kr.

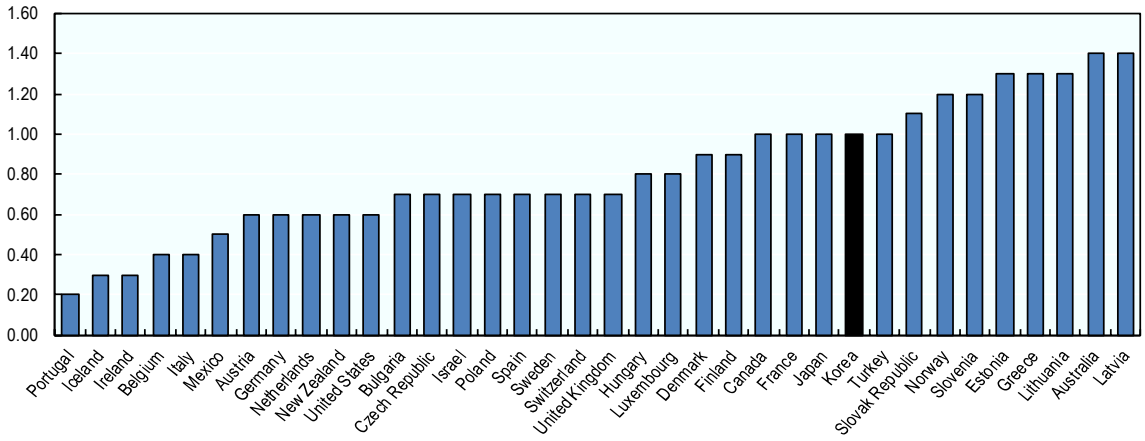
Today, Korea still invests a relatively high share of its GDP in roads and railways compared with other OECD countries (Figure 1.5). However, more recently, the share of its total public investment devoted to transport infrastructure decreased from 8.2% to 6.6% between 2006 and 2015. Railways – and especially high-speed railways – have also gradually surfaced back as an alternative response to car-centred development and to the side effects of the latter, such as congestion and environmental degradation.[4] The high-speed Korea Train eXpress (KTX), first inaugurated in 2004, handled 42.3% of total rail traffic in 2010. In comparison, motorways absorbed 46.7% of total road traffic in the same year (Park, 2012). These figures illustrate Korea's strong demand for high-speed mobility both in rail and road traffic.

Despite an exponential boom in the absolute number of cars, Korea has maintained a relatively low level of motorisation relative to its income level. Against the backdrop of strong urbanisation, the number of cars per resident increased by 49% between 2000 and 2010 (MOLIT, 2016b). It is also consistent with the results of recent OECD research, which showed a strong positive relationship between the amount of developed land per capita and the number of cars per 100 residents (see Annex 1.A2).[5] However, Korea's motorisation rate is below what many European countries, the United States and Canada registered at comparable income levels (Figure 1.6). It also remains one of the lowest in the OECD (Figure 1.7). This is likely the result of a comparatively efficient public transport system, coupled with population densities that allow for widespread use of public transport, which indicates bus and rail hereinafter except some cases including the national public transport master plan in Table 1.1. Korea's low motorisation rate relative to its income level bodes well for its capacity to prevent further congestion and to enhance ecological sustainability.

By contrast, Korea displays the second highest vehicle densities in the OECD area (190.3 vehicles per kilometre), more than three times the OECD average (61 vehicles per kilometre) (Figure 1.8). With a relatively moderate yet evident urban sprawl pattern,

Figure 1.5. **Infrastructure investment in roads and railways in OECD countries**

% of GDP, 2014

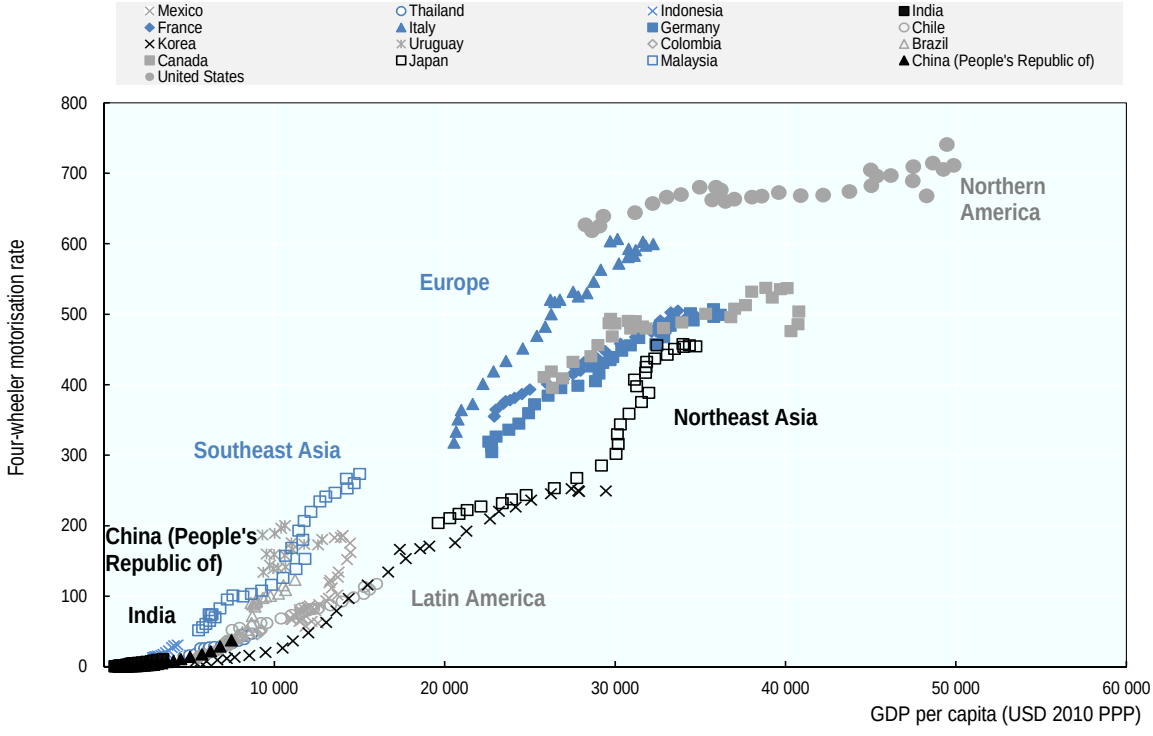


Note: The data include road, rail, and waterways where available.

Source: OECD (2016c), "Infrastructure investment" (indicator), http://dx.doi.org/10.1787/b06ce3ad-en.

Figure 1.6. **Korea shows a comparatively low level of motorisation relative to income, 2000-13**

Four-wheeler motorisation relative to per capita income, selected countries

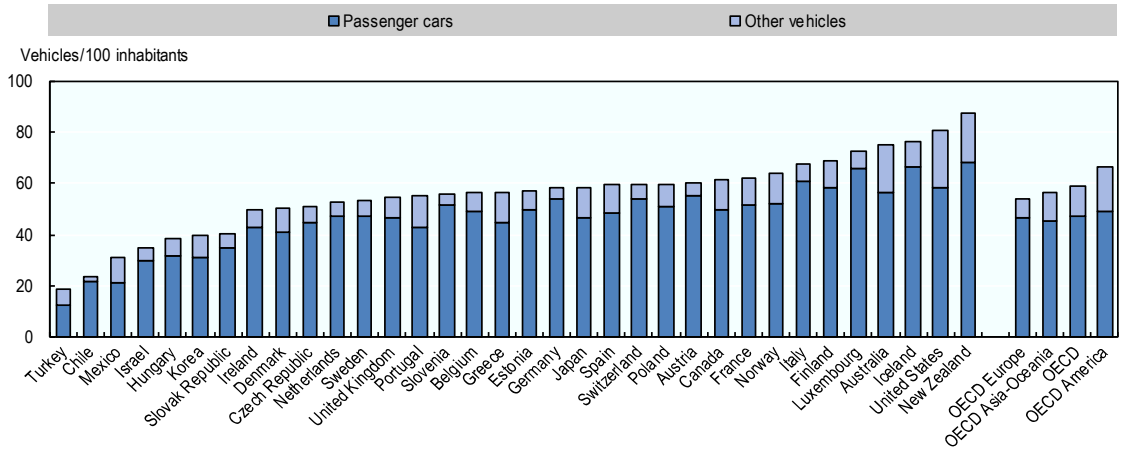


Source: OECD/ITF (2015), *ITF Transport Outlook 2015*, http://dx.doi.org/10.1787/9789282107782-en.

Korea currently registers the longest commuting time among OECD countries (Figures 1.9 and 1.10). Urban residents also have a longer average commuting time than

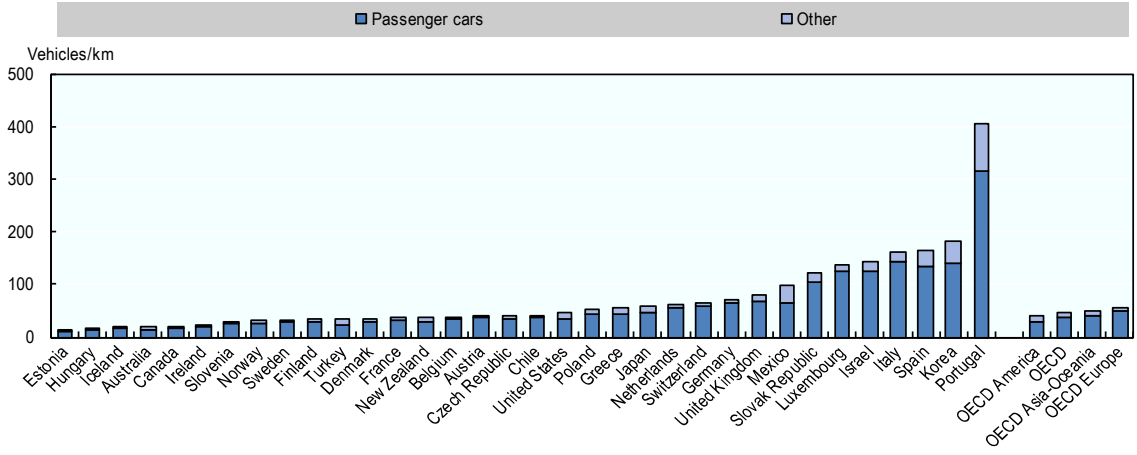
non-urban residents.[6] Korea's acute urban road congestion contributes to eroding citizens' well-being by harming work-life balance, for which Korea ranks the third lowest among 38 countries according to the OECD Better Life Index (OECD, 2016d). Long commutes

Figure 1.7. **Motor vehicle ownership in OECD countries, 2014 or latest available year**



Source: OECD (2015b), "Road traffic, vehicles and networks", http://dx.doi.org/10.1787/9789264235199-17-en.

Figure 1.8. **Motor vehicle density per network length in OECD countries, 2014 or latest available year**



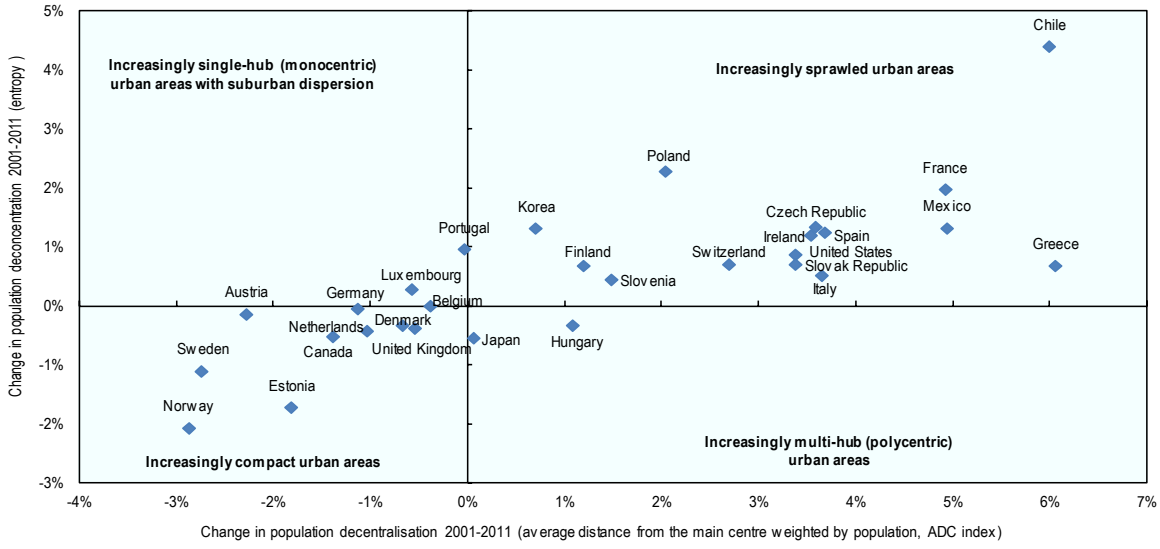
Source: OECD (2015b), "Road traffic, vehicles and networks", http://dx.doi.org/10.1787/9789264235199-17-en.

can also stymie economic growth and productivity. According to KOTI estimates, congestion costs have been rising steadily in Korea and represented 2.16% of national GDP in 2015 – around two-thirds of such costs accrued from urban roads (Figure 1.11). Likewise, congestion puts a drag on Korea's sustainable development potential by fuelling pollution. Four of the five OECD metropolitan areas with the highest level of particulate matter air pollution in 2013 are located in Korea, i.e. Cheongju, Seoul, Incheon, and Jeonju (OECD, 2016e). Curbing road congestion and promoting greener types of mobility in Korea could therefore play a fundamental role in helping the country contribute to achieving the Sustainable Development Goals (SDGs) – such as Target 11.2,

which aims to provide access to safe, affordable, accessible and sustainable transport systems for all by 2030, notably by expanding public transport.

Figure 1.9. **Urban population in Korea is both deconcentrating and decentralising**

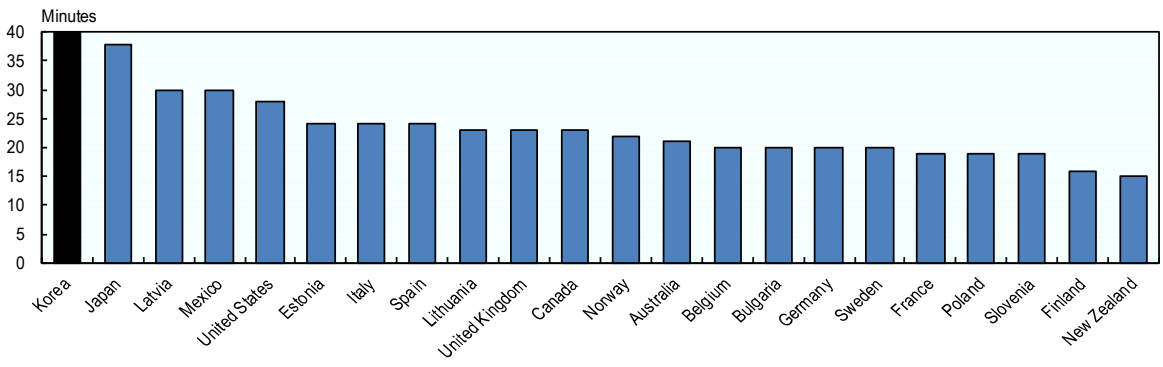
Change in population deconcentration and decentralisation, 2001-11



Source: Veneri, P. (2015), "Urban spatial structure in OECD cities: Is urban population decentralising or clustering?", http://dx.doi.org/10.1787/5js3d834r3q7-en.

Figure 1.10. **Average commuting time in a selection of OECD and non-OECD countries**

Average minutes spent travelling to work, per weekday

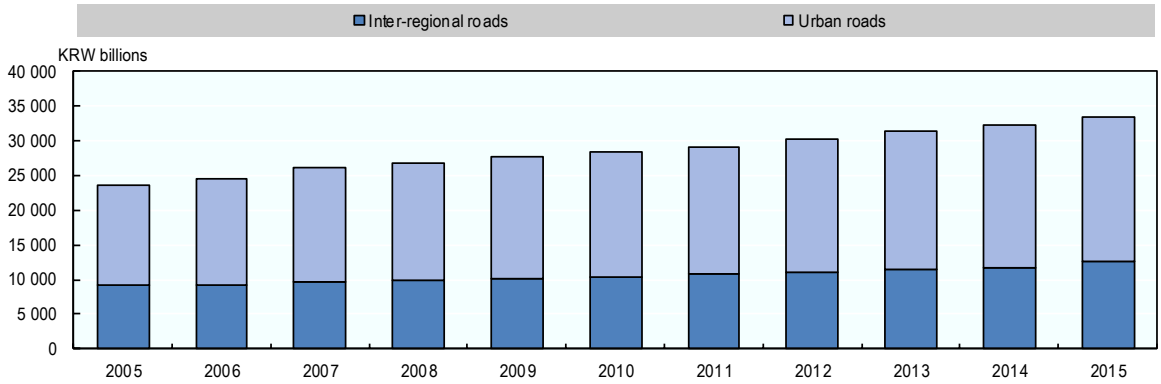


Source: adapted from OECD (2016f), "Family indicators", *OECD Social and Welfare Statistics* (database), http://dx.doi.org/10.1787/efd30a09-en.

Large cities in Korea typically rely more on public transport (especially bus and rail) than the rest of the country. However, this modal share varies widely across and within cities. The share of public transport in metropolitan cities ranges from 28.5% in Daejeon to 52.4% in Seoul, compared with a national average of 35.8% (Figure 1.12). Among the largest cities, only Seoul (20.7%) and to a lesser extent Busan (30.9%) and Incheon (34.0%) register a lower share of cars than the national average (34.5%) in 2010 (Figure 1.13). Modal shares also differ within cities between the urban core and the

periphery. The gap in modal shares between the urban core and the periphery (commuting zone) is much wider in the capital area (Seoul, Incheon and Gyeonggi), Gwangju and Busan than in Daegu, Daejeon and Ulsan (Figure 1.14).

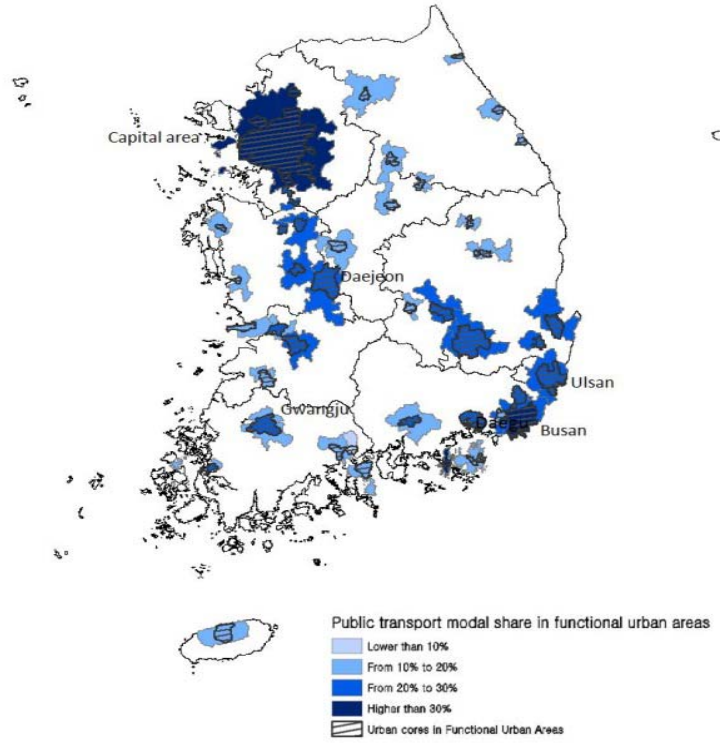
Figure 1.11. **Congestion costs from urban roads in Korea, 2005-15**



Notes: "Congestion costs" measure the comprehensive costs resulting from road congestion when the speed drops below the standard velocity, such as time loss and increase of vehicle operation costs. "Urban roads" refer to the intra-city roads located in Seoul and six metropolitan cities (Busan, Daegu, Incheon, Gwangju, Daejeon and Ulsan).

Source: adapted from KOTI (2016a), "Trends of traffic congestion costs", *National Index System*, www.index.go.kr/potal/main/EachDtlPageDetail.do?idx_cd=1248.

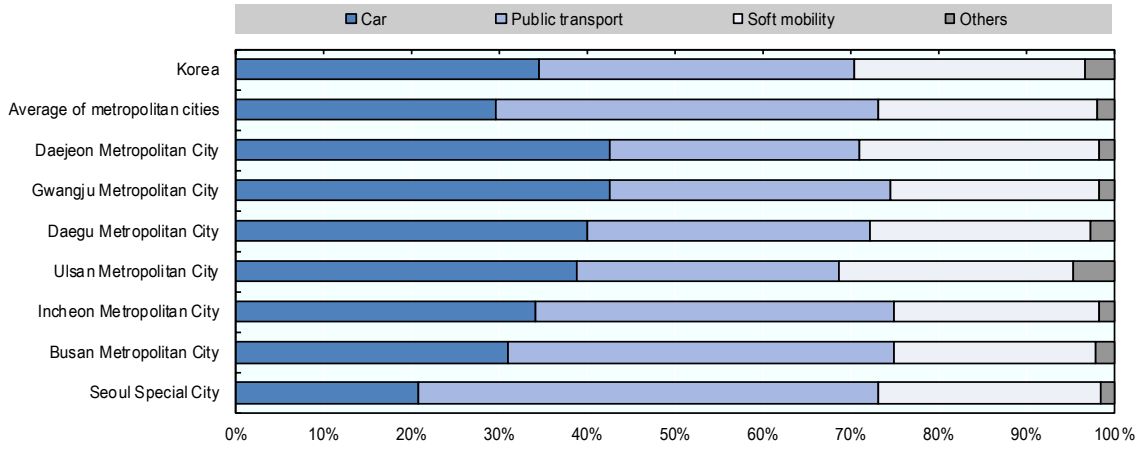
Figure 1.12. **Share of public transport in functional urban areas in Korea in 2015**



Note: The boundaries of Functional Urban Areas were based on 2010 Korean Census data.
Source: Authors' own elaborations based on data provided by MOLIT (unpublished) based on National Statistics Office (2016b), 2010 Population Census Database, http://kosis.kr/; KOTI (2016a), "O/D data 2015", *Korea Transport Database*, Korea Transport Institute, www.ktdb.go.kr/www/selectBbsNttView.do?key=45&bbsNo=2&nttNo=2970; and OECD (2012), *Redefining "Urban": A New Way to Measure Metropolitan Areas*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264174108-en.

Figure 1.13. **Modal share in large cities in Korea, 2010**

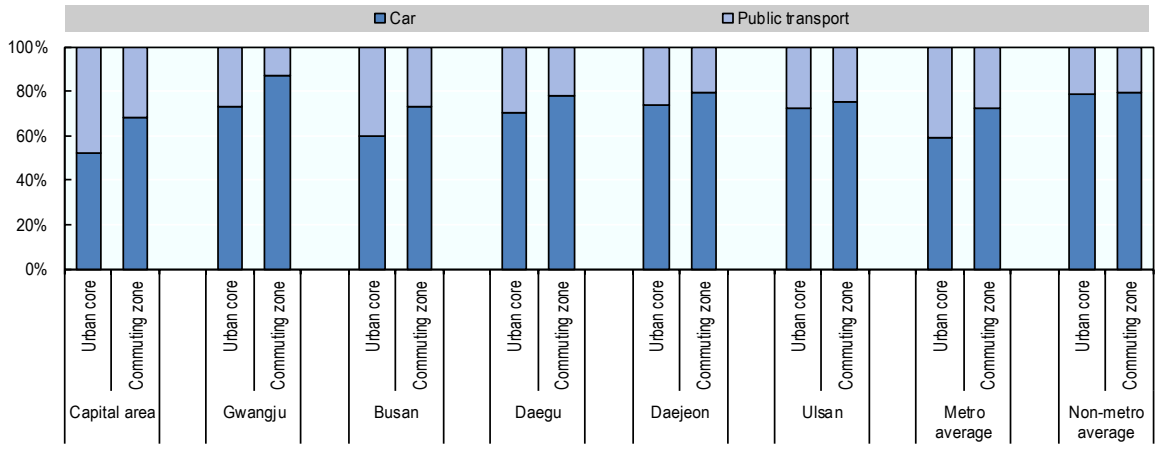
Percentage of commuters



Note: "Car" includes private vehicles and taxis; "public transport" includes bus, train and subway; "soft mobility" includes walking and bicycle.

Source: Authors' own elaboration based on Kostat (2016b), *2010 Population Census Database*, http://kosis.kr.

Figure 1.14. **Modal shares in urban core and commuting zone in metropolitan areas in Korea**



Notes: This graph shows metropolitan cities in Korea as defined in the OECD classification of Functional Urban Areas (FUA). The capital area as defined in the OECD classification groups Seoul, Incheon and Gyeonggi together. The FUAs have been sorted from the largest to the smallest gap between the urban core and the commuting zone in terms of modal share.

Sources: Authors' own elaborations based on Kostat (2016b), *2010 Population Census Database*, http://kosis.kr; KOTI (2016b), "O/D data 2015", *Korea Transport Database*, www.ktdb.go.kr/www/selectBbsNttView.do?key=45&bbsNo=2&nttNo=2970; and OECD (2012), *Redefining "Urban": A New Way to Measure Metropolitan Areas*, http://dx.doi.org/10.1787/9789264174108-en.

Who plans and funds urban transport in Korea?

An extensive legal and institutional framework for urban transport

With the parallel advent of economic prosperity and infrastructure expansion, Korea has endowed itself with a solid legal and institutional framework for spatial planning and transport, notably for urban areas. Under the overall Framework Act on National Land,

the National Transport System Efficiency Act (Box 1.3) is supported by a number of acts that apply specifically to each mode of transport (such as the Road Act, the Urban Railroad Act, the Aviation Act, the Harbour Act and the Framework Act on Logistics Policy). Within this legal framework, a thorough and complex hierarchy of plans is currently in place to design and implement urban transport investments in Korea (Figure 1.15). National level plans set the overall orientations with which subnational level plans (at metropolitan, city, county and district level) must align.

Box 1.3. **The National Transport System Efficiency Act of Korea**

The National Transport System Efficiency Act was enacted in 1999 to improve the efficiency of transport governance by aligning land, marine and air transport policies, as well as managing the life cycle of investment, from planning to evaluation. The act provides the legal basis for the establishment of many key national transport plans, such as the Mid-Term Traffic Facility Investment Plan, the Multi-Modal Transit Center Development Master Plan and the Intelligent Transportation System Master Plan. The prescriptions of the act revolve around the following five domains:

1. Intensification of seamless traffic connections. The act makes it compulsory to establish a five-year transport connectivity improvement plan, which is expected to identify key traffic hubs and improve connectivity between large-scale flows of logistics or passengers.
2. Development of multi-modal transit centres. In order to promote systematic development of transit centres, the Multi-Modal Transit Center Development Master Plan is established every five years. The plan incorporates development strategies of multi-modal transit centres at national, regional and local levels.
3. Efforts for wider adoption of intelligent transportation systems (ITS). In the past, the ITS were largely confined to road and car traffic management, and thus opportunities to improve inter-sectoral synergies through these technologies have been lost. The ITS Master Plan lays the groundwork for sectoral ITS plans as well as local ITS plans, which altogether aim to facilitate all-inclusive smart traffic management.
4. R&D on traffic technologies. Through a five-year national plan, efforts to develop advanced traffic technologies will be made at the national level.
5. Creation of the National Traffic Committee. The major responsibility of the committee is to deliberate on the suitability and funding availability of traffic-related plans designed under the act and other laws.

Source: Authors' own elaboration drawing on MOI (2016), "Transportation", *National Archives*, www.archives.go.kr/next/search/listSubjectDescription.do?id=009252.

Importantly, the responsibility for both transport policy and urban policy in Korea lies within a single ministry, the Ministry of Land, Infrastructure and Transport (MOLIT). Korea is actually one of the few OECD countries where a single ministry is reported to lead regional, urban and rural policy (Figure 1.16). In principle, this institutional setting could help facilitate policy co-ordination for effective urban transport. MOLIT is in charge of preparing a long-term strategic plan for the development of the entire territory, encompassing all types of areas. The Comprehensive National Territorial Plan (CNTP), currently in its 4th edition (2000-20) and last revised in 2011, establishes a 20-year vision for territorial development and serves as overarching guidance for other high-level sectoral plans, including the National Traffic Network Plan. Urban transport features

Figure 1.15. **Transport planning framework in Korea**

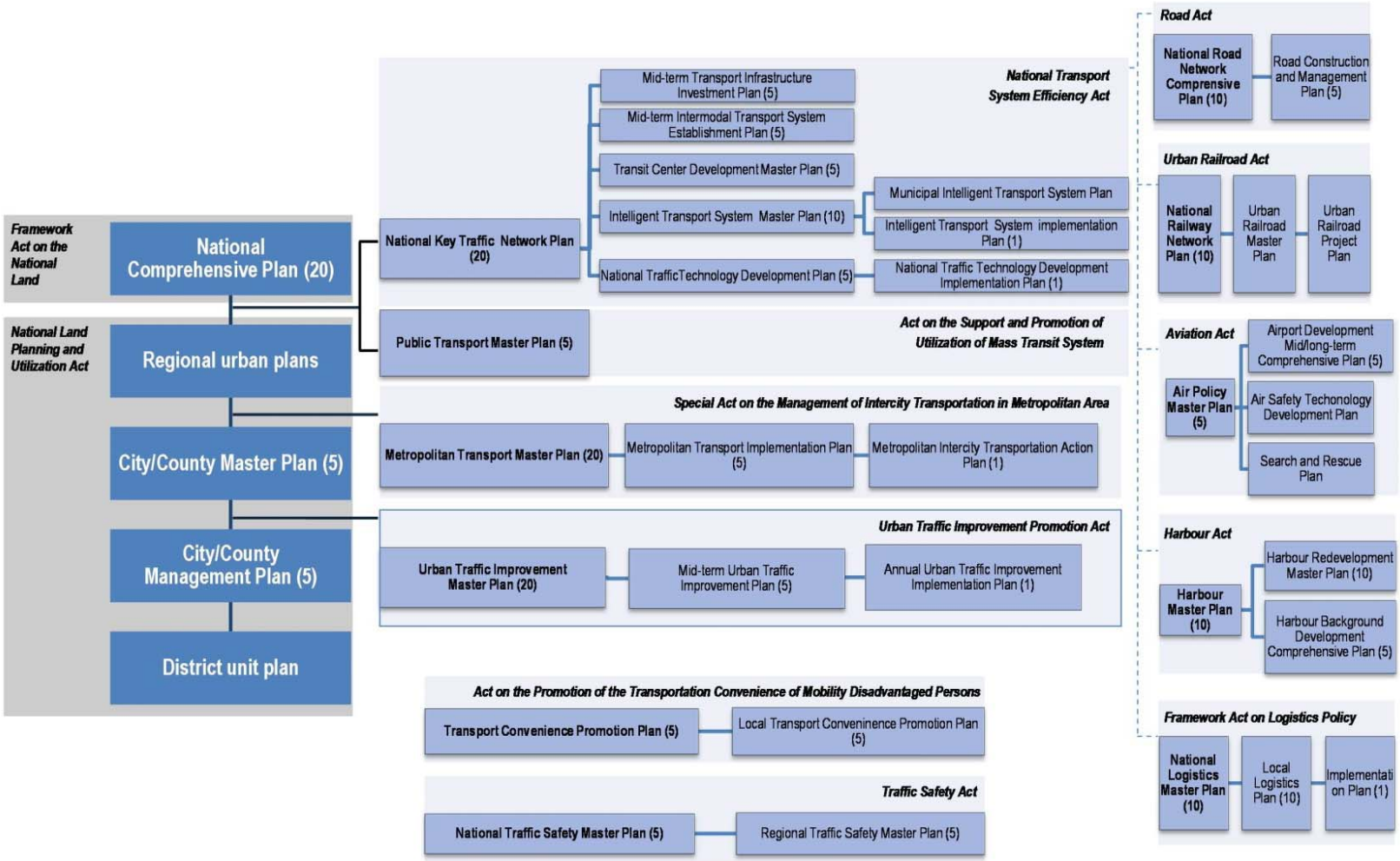
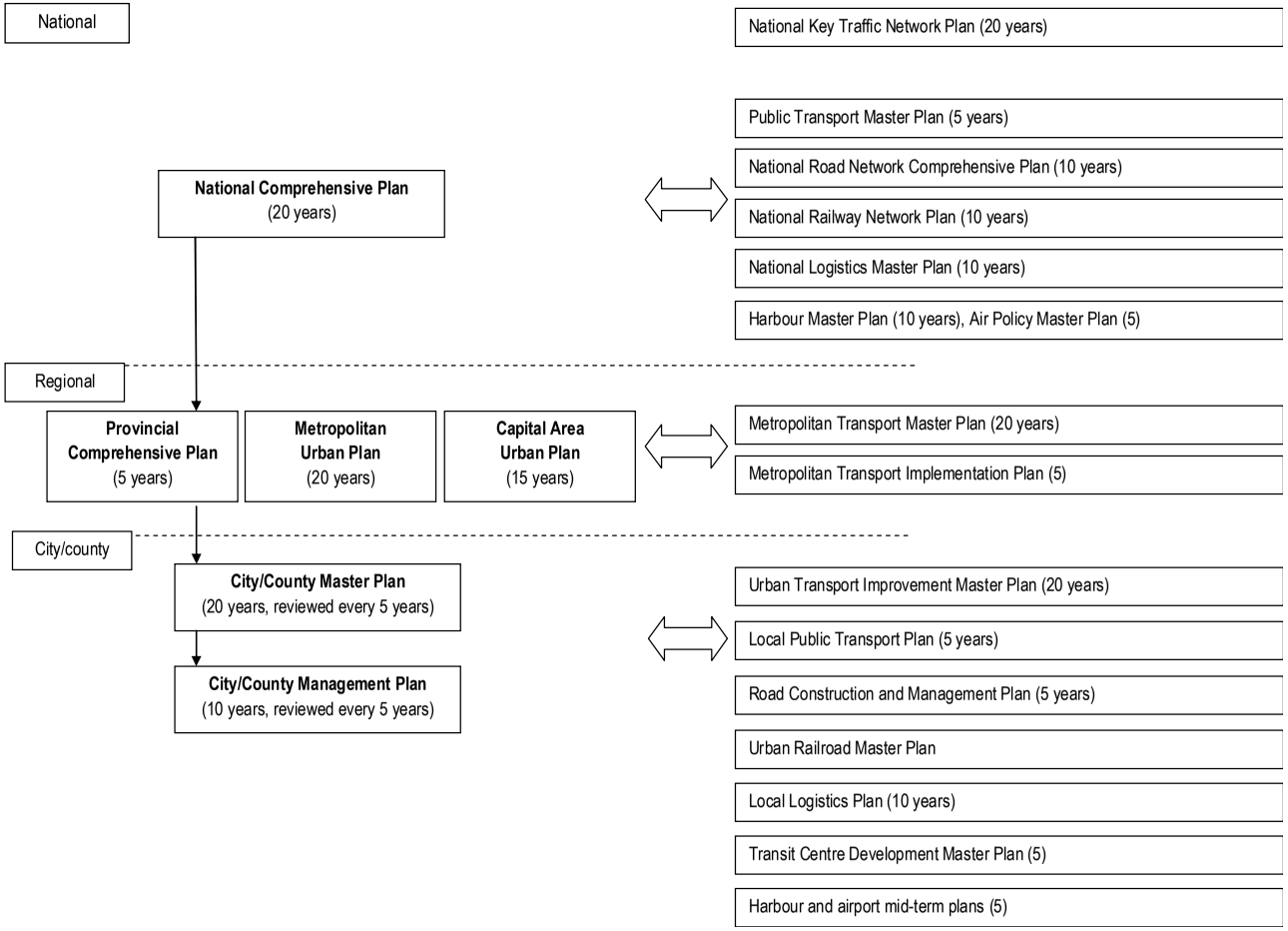


Figure 1.15. **Transport planning framework in Korea** (*continued*)



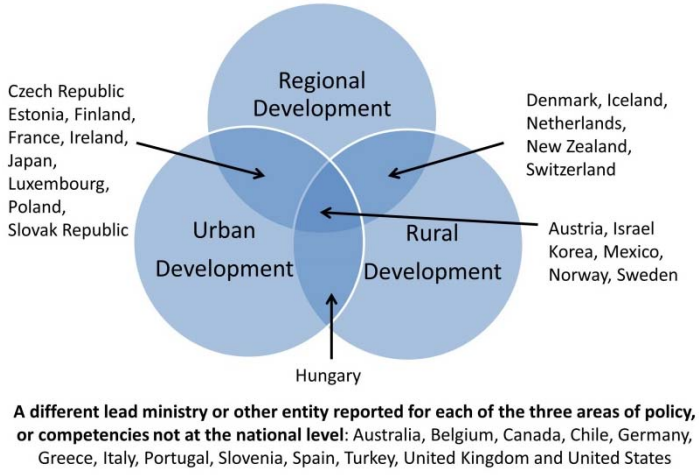
Note: Numbers within brackets refer to the time span of each plan. Plans for which the time span has not been specified have a flexible planning period.

Source: Authors' own elaboration drawing on diverse law provisions available at National Law Information Center, www.law.go.kr.

prominently in the CNTP and the National Traffic Network Plan. This is in line with the practice of many OECD countries, which generally classify urban transport as their top priority in national urban policy (Figure 1.17).

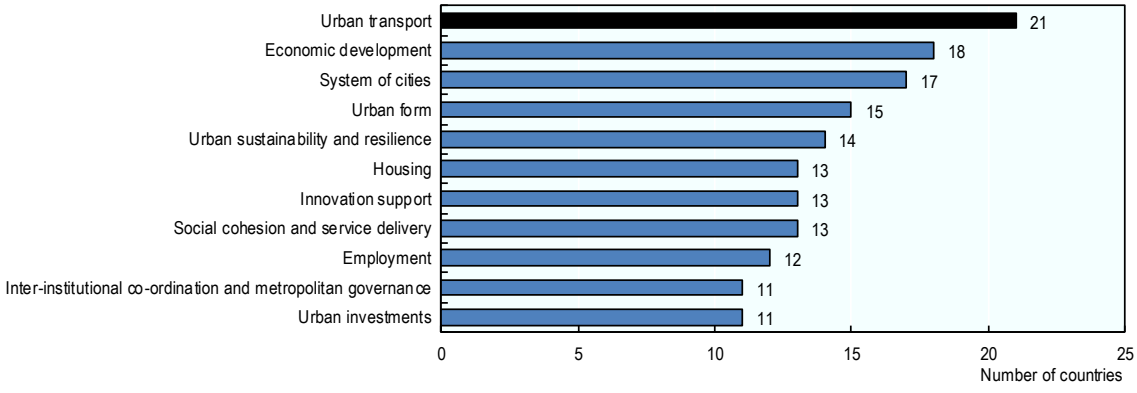
Figure 1.16. **Regional, rural and urban development ministries/entities at national level in OECD countries**

Reported lead ministries or entities across three policy fields



Source: OECD (2016g), *OECD Regional Outlook 2016*, http://dx.doi.org/10.1787/9789264260245-en and based on self-reported responses by countries to the OECD Regional Outlook Survey (2015).

Figure 1.17. **Transport ranks as the first priority for national urban policy**



Source: Adapted from OECD (2016g), *Regional Outlook 2016*, http://dx.doi.org/10.1787/9789264260245-en.

While MOLIT holds the main responsibility for planning and building transport infrastructure, Korea has also developed a sophisticated public investment management system that combines close monitoring from the Ministry of Strategy and Finance and independent expert assessment. This public investment management system applies to large-scale transport infrastructure investment decisions and is organised in three phases: *ex ante*, intermediate and *ex post* assessment (Box 1.4). The Korean public investment management system is well aligned with the *OECD Recommendation on Effective Public Investment Across Levels of Government* (Figure 1.18). It has been acknowledged as a

good practice, particularly as an illustration of Principle 4: "Assess upfront the long-term impacts and risks of public investment" (OECD, 2014a).

Box 1.4. **Public investment management system in Korea**

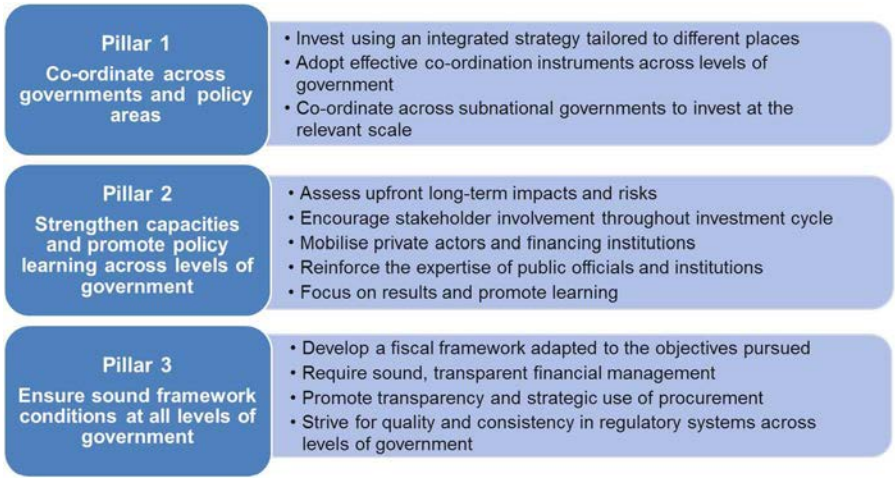
Large-scale road investment falls under the Total Project Cost Management (TPCM) system, which was introduced in 1994. Through the TPCM, the Ministry of Strategy and Finance (MOSF) monitors expenditure on large-scale projects in order to curb cost overrun throughout the entire project cycle, from planning to the completion of construction. The TPCM applies to projects that are: implemented by central or local governments (or private actors relying on public funding), have a construction period of two years or longer, and incur costs of at least KRW 50 billion (about USD 47.5 million) in the case of civil engineering projects or at least KRW 20 billion (about USD 19 million) in the case of architectural projects. Under the TPCM, the project is not allowed to increase construction size through design modification (unless it is inevitable), construction costs are not interchangeable between project phases or between construction units, and any project adjustment deemed inevitable must be subject to consultation between the ministry in charge of the project and the MOSF.

Large-scale road investment projects are subject to *ex ante* assessment through the Preliminary Feasibility Study (PFS), which was introduced in 1999 despite strong resistance from line ministries. The MOSF is responsible for conducting the PFS and it is evaluated by the PIMAC within the KDI (Public and Private Infrastructure Investment Management Center within the Korea Development Institute), an independent evaluation authority established in 2005. All new large-scale projects with total costs of at least KRW 50 billion (about USD 47.5 million) are subject to a PFS (save for a few exceptions). Line ministries are required to submit a project proposal to the MOSF two years before the project. The procedure is organised in three phases, based on interactions between the line ministry, the MOSF and PIMAC: 1) the line ministry selects PFS candidate projects and submits them to the MOSF, which selects projects in consultation with a PFS committee; 2) PIMAC conducts the PFS (through a team composed of external and internal experts); 3) the MOSF makes the investment decision. The PFS includes three types of analysis, each of which is then weighted: 1) economic analysis (e.g. cost-benefit analysis, sensitivity analysis, financial analysis), with a weight of 40-50%; 2) policy analysis (e.g. consistency with higher level plans, project risks in terms of financing and environmental impact, project-specific evaluation items), with a weight of 25-35%; and 3) balanced regional development analysis (e.g. "regional backwardness index" analysis, regional economic impact), with a weight of 20-30%. A multi-criteria decision-making technique, called "analytic hierarchy process", is adopted to combine the quantitative and qualitative elements of the evaluation and give the final score. The mid-term and final PFS reports are discussed by the MOSF, line ministries, PIMAC, and field specialists from the public and private sectors. PIMAC reports are made available to the public online. If the project is found feasible, the line ministry in charge conducts a more detailed feasibility study.

The TPCM was reinforced through the introduction of two additional procedures for intermediate assessment: the Reassessment Study of Feasibility (RSF) and the Reassessment of Demand Forecast (RDF). First, the RSF was introduced in 1999 for projects that fall under PFS coverage but did not go through a PFS for some reason; projects whose costs increased by more than 20% of the cost endorsed by the MOSF at the initial stage of the project; projects for which the demand forecast has decreased by 30% or more; or projects for which the National Assembly or the Board of Audit and Inspection requests an RSF. The RSF focuses on finding alternatives for adjusting the cost and size of the project. It helps prevent line ministries from deliberately underestimating project costs in the planning stage and prevents project costs from escalating once the project has been initiated. Second, the RDF was introduced in 2006 to prevent overestimation of demand. The RDF is conducted either by the MOSF (through the KDI) if the total project costs are over KRW 50 billion (about USD 47.5 million) or by line ministries if total project costs are below that threshold. RDFs have mostly been conducted on small- and medium-scale road projects so far. RDFs can be conducted at any stage throughout the project cycle when a substantial decrease of demand is anticipated or more than five years have elapsed since the latest demand forecast has been conducted.

Source: OECD (2016h), *Road Infrastructure, Inclusive Development and Traffic Safety in Korea*, http://dx.doi.org/10.1787/9789264255517-en.

Figure 1.18. **OECD Recommendation on Effective Public Investment Across Levels of Government**



Source: OECD (2014a), *Effective Public Investment Across Levels of Government: Principles for Action*, www.oecd.org/effective-public-investment-toolkit/Effective-Public-Investment-Brochure.pdf.

A generally efficient and forward-looking public transport system

Following the Korean government's focus on shifting from a car-centred development to a more sustainable, people-centred mobility paradigm, the Public Transport Master Plan (elaborated by MOLIT every five years and currently in its second edition, 2012-16) provides a specific strategic framework for the development of urban public transport networks. Based on this national framework, each city government establishes a local public transport plan over the same time span. The current Master Plan takes 2009 as the base year and puts forward long-term prospects and goals for 2030. The national goal is to increase the modal share of public transport by 11 percentage points between 2009 and 2030 (Table 1.1). To achieve this target, the Master Plan requests different levels of commitment at subnational level depending on the type of city (based on various criteria such as population size and urban functions).

The following section discusses three examples of key reforms that have been initiated in the sector of urban public transport in Korea and could contribute to achieving this goal: the introduction of a semi-public bus operating system, the harmonisation of the fare-collection system and the use of big data in urban public transport systems.

Ambitious local reforms in the governance of urban bus systems

Major cities in Korea, starting with Seoul, have implemented ambitious reforms to improve their public transport services, particularly in the bus sector. The Korean bus system used to run in a pure free-market mechanism until the 1990s, when public subsidies were first introduced to compensate for the swelling deficits of private operators. The role of the public sector remained confined to the distribution of licenses for the routes and the establishment of tariff ranges, while the private sector continued to be the direct service provider and owner. The current Passenger Vehicle Transport Business Act grants private businesses quasi-monopolistic rights on the routes, once a license is obtained, although it provides guidelines on temporary licencing for low-profit routes or those with uneven levels of demand. As a result, private operators continued to lose profitability and many cities in Korea grappled with a deterioration of service quality and the redesign (if not elimination) of the least profitable bus routes, regardless of public

needs. The urban bus sector also suffered from frequent strikes of drivers protesting against their overly competitive and poor working conditions. Faced with the rise of economic and social tension, most metropolitan cities in Korea have switched towards a public-private partnership model (see Figure 1.19, and Tables 1.2 and 1.3 on the different operating models and their characteristics).

Table 1.1. **Public transport modal share goals for Korea and its cities**

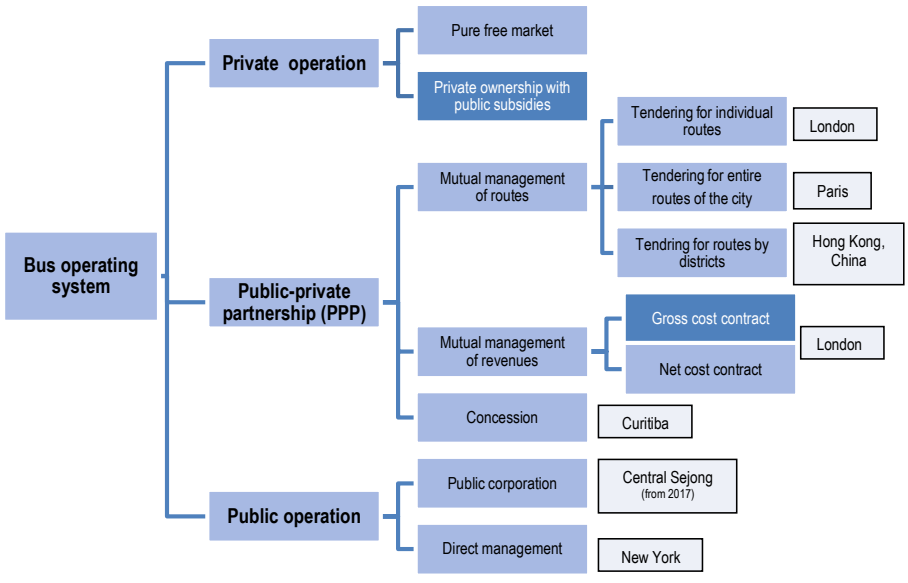
In %

			2009	2016		2030	
				Prospects	Goal	Prospects	Goal
Korea			40.9	41.3	47	41.8	52
Metropolitan city area	A group	Economic principal city (with a population over 1 million)	54.2	54.06	60	63.62	73
		Local principal city (with a population over 1 million)	28.92	29.23	35	43.06	53
	B group	Self-sufficient city	44.26	44.69	50	45.68	55
		Satellite city	31.43	34.28	40	42.82	52
Non-metropolitan city area	C group	Tourism city	21.89	21.89	27	33.46	43
	D group	Industry city	28.23	27.83	33	40.58	50
	E group	Urban/rural mixed city	28.96	29.48	35	37.15	47
	F group	Agricultural city	27.60	25.39	30	27.31	37

Notes: In this plan, the Ministry of Land, Infrastructure and Transport includes taxis in public transport. Cities in A group include special/metropolitan cities and those hosting provincial governments; cities in B group are mainly those located within the commuting zones of the A group cities; cities in C group are characterised by the presence of touristic attractions or national parks; cities in D group have industrial complexes on site; cities in E group show mixed features of both urban and rural communities; F group bundles together cities with a population under 100 000.

Source: Adapted from MOLIT (2011), "2nd Public Transport Master Plan" (in Korean), www.molit.go.kr/USR/I0204/m_45/dtl.jsp?idx=8118.

Figure 1.19. **Different types of bus operating systems**



Note: * Korea's two dominant models are shaded in dark blue.

Source: Authors' own elaborations drawing on Mo, C.H., J.Y. Park and D.J. Kim (2007), "Assessment and improvement strategy for bus quasi-public operating system".

Table 1.2. **Competencies and tools in different bus operating systems**

	Public	Route tendering	Mutual management of revenues	Private ownership with subsidies	Pure market mechanism
Need to renew the license	No	Yes	No	No	No
Ownership of routes	Public	Public	Private	Private	Private
Authority to modify routes	Public	Public	Public	Private	Private
Public subsidies	Yes	Yes	Yes	Yes	No
Public operation	Yes	No	No	No	No

Source: Korean Public Service and Transport Workers' Union (2015), "Policy discussion for the introduction of a pure public bus operation system".

Table 1.3. **Advantages and challenges of different bus operating systems**

	Private operation	Public operation	Public-private partnership
Advantages	– Least financial burden for the government in terms of administrative costs and subsidies – Swift and flexible response to customer needs through constant effort to maintain market competitiveness	– Complete public control over routes and tariffs – Planning of urban transport in a way to maximise social welfare of the public – Stable provision of service, including to the less profitable areas or users	– Possibility to strengthen the advantages of each system, making up for the weaknesses (guarantee of public welfare and efficiency of private operation)
Challenges	– Risk of jeopardising social equity as unprofitable routes are discarded – Absence of public authority to intervene in route planning with long-term goals, such as enhancement of intermodal connections and modal share increase of public transport	– Low sensitivity to market demand – Potential inefficiency due to political influence on decision making – Requires advanced administrative and fiscal capability	– Possibility to intensify the downside of each system (bureaucratism and extreme pursuit of private benefits)

Source: Authors' own elaborations drawing on Lee, C.G., Y.S. Kim and D.H. Lee (2015), "Research on efficient introduction of quasi-public bus operating system in Gyeonggi-do", www.ggc.go.kr/get/bbs/30/83/38/1.

In 2004, Seoul was the first city to adopt a semi-public bus operating system, which has been widely documented as a best practice of urban public transport reform (Box 1.5) (Lee, 2014).[7] Since then, five out of the six metropolitan cities in Korea have followed suit (all except Ulsan). The semi-public bus operating system is a unique type of public-private partnership developed in Korea, mostly comparable to the gross cost contract in terms of its revenue management method (see Figure 1.19). Under this scheme, private operators are guaranteed the full compensation of operation costs, regardless of the number of passengers, under the condition that they share authority over routes with the city government. All revenues flow into a joint revenue management committee, and are distributed to each company according to the number of kilometres travelled and the number of vehicles. While the system ensures a stable supply of public transport services, by nature it does not provide any motivation for private operators to improve their services and raise revenues. Well-designed reward and sanction mechanisms therefore need to be put in place to control service quality and minimise budget leakages.

Box 1.5. **Key factors of success in the bus reform in Seoul**

While it is difficult to measure accurately the effects of the reform, the example of Seoul is internationally recognised as a success. Some of the most striking achievements over the past decade include the following: the number of annual users rose from 1 462 million to 1 606 million; the average speed picked up from 18.1 km/h to 19.5 km/h; the on-time arrival rate increased from 87.3% to 91.6%; and the number of bus accidents decreased by almost a third from 1 944 to 709 (Kim, 2016).

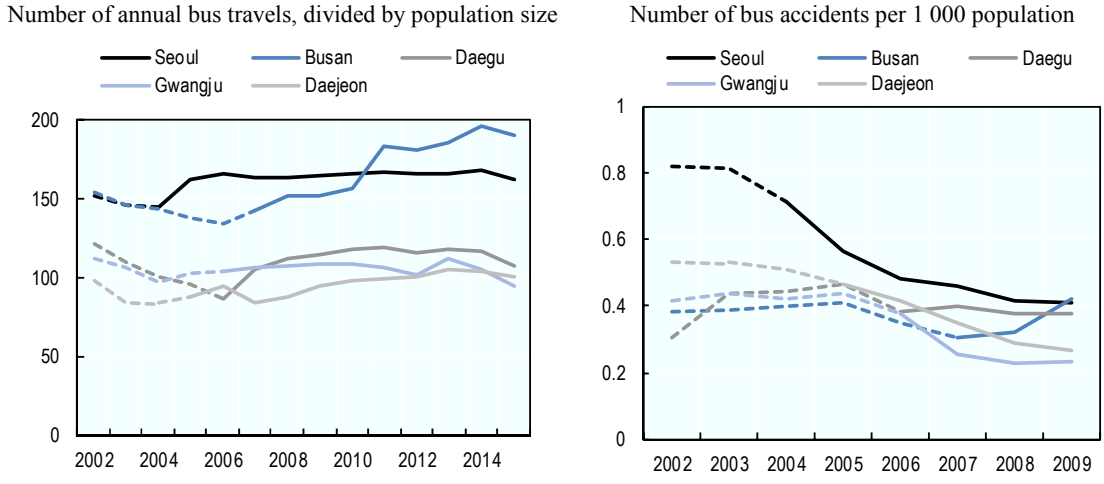
Key factors of success when comparing Seoul to other cities include:

- **Seoul went through a clear goal-setting process.** The city identified two policy objectives to achieve through the reform: reinforcing the role of the public sector and offering a stable supply of the bus service. The city also undertook a thorough analysis of various alternatives to determine which model was the most suitable in its unique urban context.
- **Conflicts with private operators and labour unions were minimised.** The initial plan was to adopt an individual route tendering system, but it ran against strong opposition from various interest groups, as the authority regarding routes would have been entirely handed over to the public sector. To avoid high social costs and make the reform acceptable to the stakeholders, the city government proposed a compromise, a system mixed with mutual revenue management on existing routes and route tendering on new routes. As a result, private companies retain the ownership on the routes that are already acknowledged as their private property while the city government has a say in their planning and revenue management. In exchange, if private operators have a deficit will be compensated through public subsidies. Conversely, the city government owns newly created routes and puts them into a bidding process for a six-year license over the route. This scheme means that the city government has a limited authority over the majority of routes, whereas it commits to pouring in an enormous amount of funding. However, the city chose to exercise political flexibility to make its agenda acceptable to the society without aggravating conflicts.
- **An effective incentive system was put in place.** In order to make up for the lack of natural incentives for profit maximisation in the semi-public operating system, all six cities that introduced a semi-public bus operating system carry out performance evaluations (e.g. via customer satisfaction surveys) and reward the best-ranking companies according to the scores. While the share of revenues earmarked for this reward mechanism ranges from 10% to 24% in the five metropolitan cities, in Seoul it increased gradually up to half today. Seoul also encouraged private operators to cut unnecessary expenses by calculating its subsidies based on an upward-levelled standard unit cost (average of the top 50% cost-efficient companies). This may help the city government promote healthy competition among the 65 bus companies currently operating in Seoul. To complement the incentives targeting bus companies, Seoul also monitors the behaviour of individual drivers by making the most of the digital tachographs installed on each bus, which reports the driver's behaviour directly to the Transport Operation and Information (TOPIS) data centre (see discussion below). Drivers with poor driving habits are screened out and are given one-on-one training on good driving conduct.
- **The bus reform was combined with a wider range of urban renewal policies.** The goal was not only to make public transport sustainable in the long term but also to overhaul the city's overall development strategy. Seoul has sought to reduce the transport system's reliance on heavy public subsidies and encourage consumer demand for public transport through a series of actions, such as the TOPIS information system, the construction of median-bus lanes, the introduction of transfer discounts and multi-modal transfer centres. This was done in the broader framework of redesigning Seoul – one of the hallmark initiatives was to tear down a six-metre-long elevated highway that used to cross the city and restore the historic stream of Cheonggyecheon underneath into a modern, recreational and environmentally friendly public space.

Sources: Authors' own elaborations drawing on Lee, C.G., Y.S. Kim and D.H. Lee (2015), "Research on efficient introduction of quasi-public bus operating system in Gyeonggi-do" (in Korean), https://www.ggc.go.kr/get/bbs/30/83/38/1; Mo, C.H., J.Y. Park and D.J. Kim (2007), "Assessment and improvement strategy for bus quasi-public operating system".

It should be noted that Seoul's semi-public bus operational model is not necessarily replicable everywhere. While the reform in Seoul had undeniable positive outcomes, these also came with a cost. According to an analysis carried out by KOTI, public expenses related to the bus system were multiplied by two to five in Seoul, Daejeon and Daegu between the year before the reform and the first year after the reform. In particular, the city of Seoul had to spend KRW 2.3 trillion in bus subsidies during the first decade following the reform and the amount is increasing each year. However, it is difficult to distinguish to what extent such positive or negative outcomes are attributable to the bus system reform itself. Exogenous shocks (notably rises in oil prices) and policy instruments other than the governance reform itself might have simultaneously affected the outcomes. For example, all six cities introduced or expanded transfer discounts on public transport fees along with the reform (see details in the following subsection). Around 50% of the increase of public expenses is actually estimated to result from such transfer discounts. In the case of Seoul, the city government launched a series of concerted actions starting in 2004, the same year as the reform, aiming to induce a modal switch from private to public transport modes. There is therefore a possibility that both losses and gains from the reform have been overestimated. In any case, cities that are financially worse off than Seoul or struggle with financial uncertainty may be advised to explore alternative models, such as introducing a tendering scheme for new and discarded routes, with the possibility to expand public ownership in the future. At the moment, in an attempt to further support the reforms carried out by city governments, the Korean government is initiating efforts to improve the transparency of bus operating systems. For example, it is looking into establishing a database of private operators, including data on their licenses, the subsidies that they receive and the number of traffic accidents that they have been involved in, starting from 2017.

Figure 1.20. **Number of bus users and bus accidents in Korea**



Notes: * Dashed lines represent figures before the adoption of the semi-public system.

Sources: Authors' own elaborations drawing on several datasets from Lee, C.G., Y.S. Kim and D.H. Lee (2015), "Research on efficient introduction of quasi-public bus operating system in Gyeonggi-do", www.ggc.go.kr/get/bbs/30/83/38/1; and Kostat (2016c), "Regional population size and density, 1970-2015" (in Korean), www.index.go.kr/potal/main/EachDtlPageDetail.do?idx_cd=1007.

A nation-wide unified fare-collection system

A second example of an efficient governance reform in Korea's urban public transport sector is the integration of the fare-collection system at a quasi-national scale. This was made possible through the introduction of a single mobility and smart payment card throughout the country, called the T-Money card, joined shortly by other types of cards (Box 1.6 and Figure 1.21). Originally launched by the city of Seoul together with the Korea Smart Card Corporation (KSCC) and later expanded to cover many local governments in Korea, this system allows users to ride most public transport systems in the country with a single pass and benefit from discounts when they transfer from one mode to another, thereby encouraging public transport use and multi-modality. Many credit cards also provide the same service. MOLIT is now working on developing a nationally integrated system to analyse the big data that can be collected from fare payment devices and use it to improve the effectiveness of transport planning. This integrated approach stands in stark contrast with the fragmentation of urban transport systems that characterises many OECD metropolitan areas. For example, in Chicago, the division of the public transport system into an urban part (Chicago Transit Authority, CTA) and a suburban part (Pace and Metra) meant that CTA bus services typically ended abruptly at the city limits where Pace services begin, and none of Metra's downtown commuter rail connected directly to the CTA rail network (Merk, 2014). Each service board also had its own fare structure, and the Ventra card system, implemented by CTA and Pace, was not compatible with Metra, which had its own fare card, until a single fare card, named Ventra, was finally introduced in July 2014.

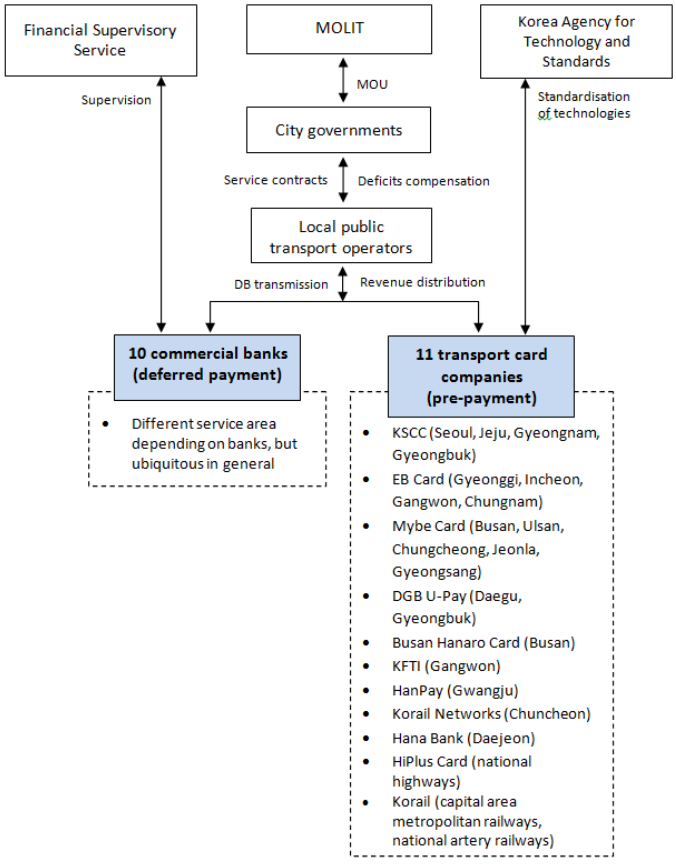
Box 1.6. **A single mobility pass in Korea**

In 2004, the city of Seoul launched a revolutionary fare payment method by contracting the Korea Smart Card Corporation (KSCC) (34.4% owned by the city of Seoul, 31.85% by LG CNS and 15.73% by Credit Card Union) to develop and operate a smart payment card called the T-Money card. "T" stands for travel, touch, traffic and technology. T-Money can be used on buses and/or subways in different metropolitan cities and locations across Korea, including Seoul, Gyeonggi, Incheon, Sejong, Daejeon, Daegu, Gwangju, Busan and other provinces. There are now 11 transport card companies (including KSCC), operating in different cities and provinces through direct service contracts with subnational authorities. Beyond these conventional pre-paid services, ten commercial banks nationwide also topped their own credit or debit cards with a public transport card function, with deferred payment.

Using this pass (either a card, phone or T-Money enabled device), travellers can save themselves from the hassle of purchasing single-journey tickets for every ride and enjoy discounts on rides with transfers from one bus to another, one subway line to another, or from bus to subway or vice versa. Transfer discounts are applicable for up to 4 times a day, within a transfer time limit of 30 minutes (up to 1 hour from 9 pm to 7 am the next day). The user simply needs to tap his device on the sensors as he/she gets off the bus or exits the subway. Many taxis also accept payment via T-Money.

Following the Ministry of Land, Infrastructure and Transport's (MOLIT) "One Card, One Pass" initiative, in 2014, the service was expanded to integrate the public transport fare-collection system throughout most of Korea. MOLIT concentrated efforts in testing relevant technologies, building nationally standardised infrastructures, as well as building consensus among subnational governments and private card companies. Finally, a series of Memoranda of Understanding were signed with all the 17 TL3-level subnational governments and public transport operators in 2013. The new pass is accepted in all buses, subways, taxis, trains, inter-city buses, express buses, toll gates and even major retailers. The pass costs about KRW 3 500 (about USD 3) and can be purchased and recharged at subway stations, bank ATMs, convenience stores and kiosks located adjacent to bus stops. This enables seamless journeys both in terms of inter-modal and inter-regional transport, allowing for new levels of user convenience that are rarely achieved in other countries.

Figure 1.21. **How does the unified fare-collection system work in Korea?**



Notes: MOLIT: Ministry of Land, Infrastructure and Transport; MOU: Memorandum of Understanding.

Sources: Authors' own elaborations based on Korea Transportation Card Industry Association (2016), "Industry status introduction" (in Korean), www.kotcia.or.kr/02_intro/intro02.htm; Kim, Y.D. (2013), "MOLIT to open the era of smart transport card compatible nationally" (in Korean), www.pmnews.co.kr/sub_read.html?uid=8847.

Use of big data in urban transport management

Korea's strong level of IT uptake has translated itself into advanced use of big data for managing urban transport systems. A shining example of smart urban public transport can be found in Seoul, where the city government introduced an extremely sophisticated Transport Operation and Information Service (TOPIS) in 2004 to monitor traffic flows and public transport use (Box 1.7). Other cities are also running or building similar information systems, most notably Suwon's Urban Safety Integrated Center, which provides multi-sectoral monitoring on traffic, crime and natural disasters (see Chapter 3). While such initiatives have considerably improved user convenience, they operate along strictly administrative boundaries (e.g. Seoul and Incheon, albeit neighbouring cities, each have their own system), under the rationale that they are entirely funded by local tax revenues.

MOLIT plans on further expanding the use of intelligent transport technologies, particularly in buses and taxis because these sectors have a high modal share and play a key role in road safety in Korea. By 2021, a Bus Information System (BIS) will be

introduced in 80 subnational jurisdictions that currently do not have any passenger information system in place. The data collected through these subnational centres will be linked to the national system on mass transport information, TAGO (Transport Advice on GOing anywhere), to promote smart mobility at the national level. The centres will be grouped together and jointly operated by subnational entities to reduce costs. The first joint BIS centre is scheduled to be launched in 2017 through a partnership of 15 jurisdictions in Gangwon-do. Apart from the conventional function of collecting real-time data on bus operation, the new system will also allow for close monitoring of bus drivers' behaviour, which is an internationally pioneering example. Likewise, a Taxi Information Management System (TIMS) will be set up in 157 subnational jurisdictions by 2018. This will help taxi operators provide customised, demand-responsive transit (DRT) services (KOTSA, 2015).

Box 1.7. **Big data at the service of public transport efficiency and urban planning: The Transport Operation and Information Service in Seoul**

The city of Seoul set up an integrated Transport Operation and Information Service (TOPIS) in 2004. The service was last upgraded into TOPIS 3.0 in 2013. TOPIS processes a massive flow of data coming from cameras (at least one camera every 250 metres in the city, including 360-degree rotating ones), sensors, GPS systems and fee-collecting devices. It also collects information from the Korea Meteorological Administration, the Seoul Metropolitan Police Agency and citizens' tip offs to prevent natural disasters, react quickly to accidents, reorient traffic in case of street protests, etc. All vehicles circulating in the city are tracked in real time (location and speed). The public can access the collected information via smart phone apps, the TOPIS website and digital information boards in stations. TOPIS shows the city road network in three colours according to the speed of vehicles in real time, to help citizens select the fastest route to their destination. The system is based on highly interoperable software and runs with minimum workforce.

This comprehensive information system serves safety monitoring purposes as well. For example, the system tracks not only the current location of a bus, but also the driver's behaviour, by monitoring whether the bus stops, accelerates or opens its doors erratically. Smart phones and apps provide a "safe getting home service", which informs parents when their child has reached his/her bus/metro stop and arrived at his/her intended destination. The city penalises traffic law offences through cameras installed in areas with frequent parking violations and cameras mounted on buses monitor parked cars. If a car remains in a "no parking" zone for longer than five minutes, a parking ticket is automatically issued and sent to the car's owner (about 3 million tickets are issued every year). Front-facing cameras on buses ensure that private cars that use the dedicated "median" bus lanes are also fined. The revenue from parking tickets is then reinvested in improvements of public parking facilities.

Seoul has exported TOPIS to other countries, primarily in a knowledge-sharing approach. The city government does not make any direct economic profit out of the export, since private companies are in charge of developing the hardware and software required for implementing TOPIS elsewhere.

Source: Authors' own elaborations drawing on site visit to TOPIS in July 2016.

Financial and institutional constraints against efficiency and sustainability goals

While urban public transport services in Korea are generally fast and efficient, they also tend to run large chronic deficits. This is the case in many OECD countries, and this

fiscal gap is projected to last over time, as the global budget earmarked for infrastructure investments covers only 40% (USD 24 trillion) of the cumulative needs over 2010-30 (USD 60 trillion) (World Economic Forum, 2013). The financial burden is particularly salient in Korea where local governments have a relatively low fiscal autonomy to start with. Although the 1988 Local Finance Act was amended several times (in 2005, 2009 and 2011) to enhance fiscal decentralisation, subnational governments in Korea still depend heavily on central government transfers. In 2013, the share of central government in total subnational government revenue in Korea remained well above the OECD average (61.6% vs. 37.3%) (Figure 1.22 and Box 1.8). According to the Act on the Management of Grants, the national government provides grants to cover part or all of the costs of traffic-related investments in cities and provinces. In general, such grants are earmarked (used only for a specific purpose), discretionary (subject to the judgment of the national government in selecting recipients) and matching (requires a mutual contribution of national and subnational governments). Costs are shared in accordance with predetermined ratios or lump sums, applied identically across all local jurisdictions (Table 1.4).

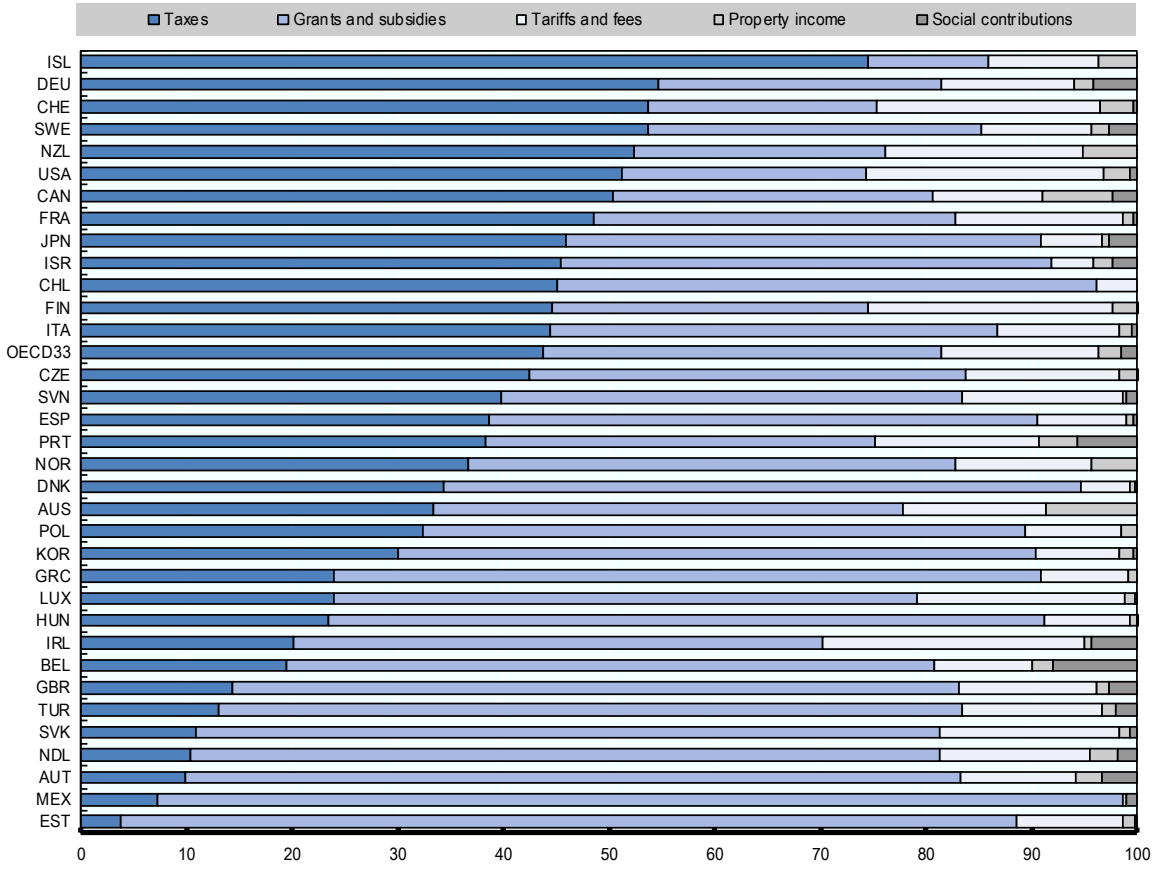
Box 1.8. **Subnational government financing in Korea**

- **Tax revenue.** The tax system for Korean subnational governments was reformed in 2011 in order to simplify the tax mix. The number of taxes allocated to local authorities declined from 16 to 11, 9 of which are ordinary taxes and 2 of which are earmarked (a regional resource and facilities tax and a local education tax). Most rates are determined by the central government. The highest taxes are the acquisition tax levied on persons acquiring real estate, motor vehicles, heavy equipment, boats, etc. either through purchase or inheritance (it benefits only the upper level and represent 26% of all subnational government tax revenue), the local income tax (both levels, 19%), the property tax (mainly for the lower level, 15%), the automobile tax (both levels, 12%) and a local consumption tax. Metropolitan cities can levy both provincial and municipal own taxes. Taxes on properties represent a total of 30% of subnational government tax and 1.2% of gross domestic product.
- **Grants and subsidies.** Transfers from the central government to local authorities mostly include transfers from revenue sharing between levels of government and categorical grants. Revenue sharing is divided into regular revenue sharing (RRS) and revenue sharing for decentralisation (RSD). The RRS consists of 18.3% of national tax revenue. Of the receipts allocated to subnational governments according to an equalising formula based on an assessment of standard fiscal needs and revenues, 96% are non-earmarked. The remaining 4% is earmarked (natural disaster recovery, construction of public facilities, national project, etc.). The RSD system, financed through a decentralisation tax, was introduced in 2006 in order to finance the decentralisation of administrative functions. Categorical grants are very diverse and are aimed at helping local governments to provide services that are otherwise too costly, finance delegated tasks and policy projects, provide financial assistance and compensation, etc.
- **Other revenues.** Other revenues include user charges and fees (8% of revenue) and revenue from property (sales of assets, leasing, dividends, etc.).

Source: Adapted from OECD/UCLG (2016), *Subnational Governments Around the World: Structure and Finance*, www.oecd.org/regional/regional-policy/sngs-around-the-world.htm.

Figure 1.22. **Structure of subnational government finance in OECD countries, 2014**

In %



Source: OECD (2016i), "Subnational government structure and finance", *OECD Regional Statistics* (database), http://dx.doi.org/10.1787/05fb4b56-en.

A long-standing criticism about the current grant system points out the lack of fiscal continuity and predictability. The Act on the Management of Grants states the matching ratios only for 114 projects, compared with a total of 881 projects that were subsidised in 2014. Close to 90% of the subsidised projects are being administered at the discretion of the Minister of Strategy and Finance, some being set up while others are scrapped every year in a reportedly arbitrary manner. This could hinder the capacity of subnational governments to plan long-term investments with stability (Kim et al., 2014).

Unclear legal provisions on selection criteria also unnecessarily increase administrative costs. Imperfect information may lead to game plays across levels of government to shift financing responsibility to each other. For example, in the province of Gyeonggi (adjacent to Seoul), three subway projects that were not essentially different from each other received a different share of central government subsidy because they were classified in different categories. The Jinjeop line was categorised as a metropolitan railway (entitled to a central government aid equivalent to 75% of the total costs) whereas the Byeolnae and Hanam lines were classified as urban railways (eligible only for a 60% grant). Legal ambiguity may provide incentives for stakeholders to prolong negotiations and engage in rent-seeking behaviour, which may jeopardise the transparency and coherence of the system (Cho and Park, 2013).

Table 1.4. **Cost-sharing ratios for transport projects between levels of government**

	Type	National government	Subnational government	Public corporation	Note
Road	National expressway	Compensation 100%, Planning 40%, Construction 40%	-	Planning 60%, Construction 60%	Planning costs fully subsidised until 2015
	National highway	100% of overall costs	-	-	
	National bypass	Planning 100%, Construction 100%	Compensation 100%	-	If the compensation costs exceed 30% of the overall costs, the exceeding amount can be partially subsidised
	Government-funded provincial road	Planning 100%, Construction 70%	Compensation 100%, Construction 30%	-	Construction costs fully subsidised until 2014
	Special/ metropolitan city road	50% of overall costs	50% of overall costs	-	
	Congested road in metropolitan city	Planning 100% Construction 50%	Compensation 100%, Construction 50%	-	
	Local road (*Si/Gun/Gu* road)	-	100%	-	
	Safety enhancement work	50%	50%		
Railroad	Express railroad	40~60%	-	50~60%	Ratio determined by Railroad Industry Committee
	Single-track railroad	100%	-	-	
	Metropolitan railroad	70%	30%	-	Used to be 75:25 until March 2014
	Urban railroad	60%	40%		Seoul (40:60)
	Private railroad	Different ratios are applied for each project, e.g. Incheon International Airport Railroad (24.3:75.7)			
Airport	Airport	Aid or loans are available and different ratios are applied for each project, e.g. Incheon Airport (0:100), Ulleung Airport (77:23), Heuksan Airport (75:25)			
Harbour	Harbour	100%	-	-	
	Connecting road and railway	Lump sum			
Logistics facilities	Entry lanes to distribution complex	90%			
	Small/medium-sized logistics facilities	60%	40%		
	Metropolitan parking lot	50%	50%		
	Metropolitan public garage	70~90%	30~10%		

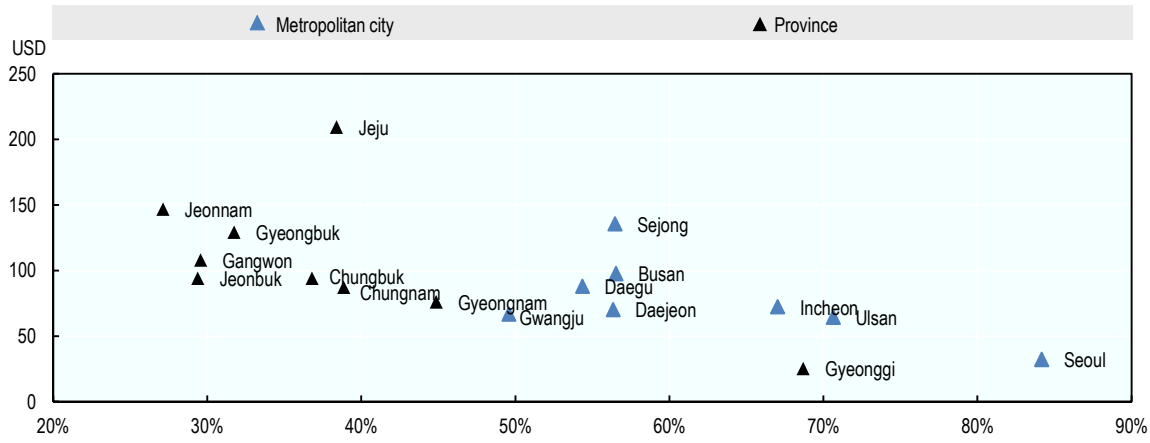
Notes: Planning costs include expenses spent for feasibility studies and engineering design; construction costs here refer to direct costs of construction, including materials, equipment and labour during the pure construction; compensation costs comprise costs for land acquisition, compensation for properties and transplantation of residents.

Source: Authors' own elaborations based on information provided by MOLIT in response to an OECD questionnaire.

Finally, another concern that has been voiced by some observers is that the matching ratio in transport grants is applied in a uniform way to all local governments throughout Korea, with no built-in equalisation function. An ideal equalisation formula should consider both fiscal capacity and expenditure needs, which are two different sources of fiscal disparities and vary depending on economic bases, demographic profiles, geographical conditions and urban structures (Martinez-Vasquez and Boex, 2001). While Korea's general equalisation system (Local Shared Tax) takes into account more than

50 socio-economic indicators (OECD, 2013), the transport subsidy system does not include such indicators. This may end up marginalising subnational entities in greater financial distress, as they cannot afford to pay the remaining share of the matching funds (Kim et al., 2015). Standardised, earmarked and conditional grants in Korea often end up restricting the flexibility of local authorities, thus reducing their ability to meet local demands and risking sub-optimal spending (Jones and Yokoyama, 2005). Interestingly, this concern seems to fade when comparing the per-capita amount of subsidies from MOLIT and the financial independency rate of local governments, which shows a strong negative correlation: the higher the financial independency rate of the metropolitan city or the province, the less subsidies the latter received from MOLIT (Figure 1.23). However, this may be also at least partially due to lower population density in lagging regions, rather than reflecting solid evidence of an equalisation function in transport grants.

Figure 1.23. **Central government transfers and financial independency rate in Korean metropolitan cities and provinces, 2014**



Notes: Financial independence rate = {[(local tax revenues+local non-tax revenues)*100]/total general budget}. Around 47.5% of total the Ministry of Land, Infrastructure and Transport subsidies is estimated to serve traffic-related purposes.

Source: Authors' own elaborations based on Ministry of Strategy and Finance (2016), "Open fiscal data" (in Korean), www.openfiscaldata.go.kr/portal/foss/sheetGovStatsPage.do?tab=one.

Key options for strengthening urban transport governance in Korea

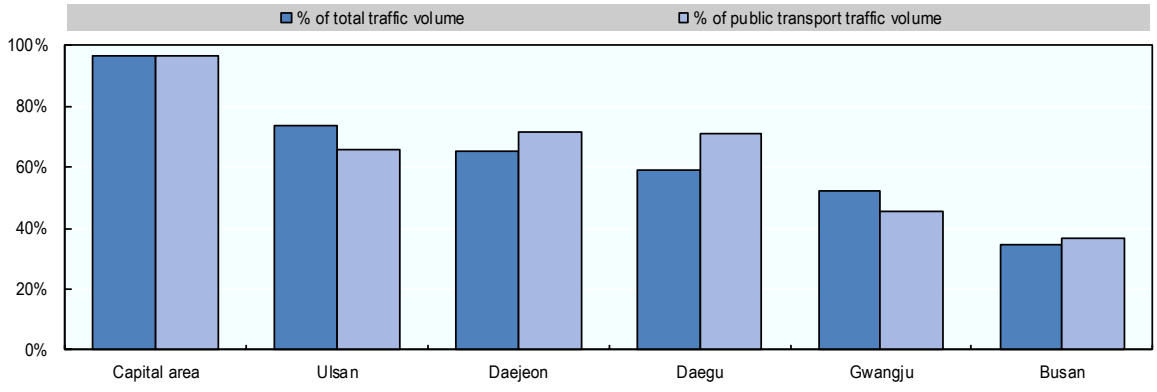
This section offers insights on four main options for improving the effectiveness of urban transport governance in Korea: establishing effective incentives to promote integrated transport networks at the metropolitan scale; supporting economically, socially and environmentally driven urban transport; rethinking urban transport financing; and enhancing monitoring and evaluation of urban transport performances.

Establish effective incentives to promote integrated transport networks at the metropolitan scale

Implementing practical tools for reinforcing collaboration on a joint transport strategy within metropolitan areas could help achieve the goals set out in the various national, metropolitan and local transport plans. Evidence shows that a sizeable share of urban traffic crosses administrative boundaries out of the urban core and flows into the rest of the metropolitan area – this share is particularly high in the capital area (Figure 1.24).

Despite this evident expansion of traffic flows, collaboration among individual local governments is only budding and could be enhanced. For example, a Capital Area Traffic Center was founded in 2005 with the objective to facilitate consultations on metropolitan transport matters between Seoul, Incheon and Gyeonggi. The centre is composed of 48 members (19 representatives from Seoul, 18 from Gyeonggi and 11 from Incheon) and operates with a common budget based on contributions from the three local governments. One of the most representative projects is the metropolitan artery express bus rapid transit (BRT) links. The construction of the Seoul-Hanam BRT line was completed in 2011 and three more routes are under study or planning (Gyeonggi-do Provincial Government, 2015). However, the role of the centre is limited to BRT construction/operation and conducting National Household Travel Surveys. Due to conflicting interests, no permanent management functions have been transferred from the jurisdictions to the organisation. Today, more than 3 000 bus routes and dozens of subway lines are running across the 3 jurisdictions without a systematic mechanism that allows for integrated management and planning.

Figure 1.24. **Share of traffic volume that crosses administrative boundaries**



Notes: Traffic volume coming out of the urban core towards the rest of the functional urban area (FUA, as defined in the OECD classification), as a share of the total traffic volume flowing from the urban core towards the province where each FUA belongs to. "Capital area" encompasses Seoul, Incheon and Gyeonggi.

Source: Authors' own elaborations based on KOTI (2016b), "O/D data 2015", *Korea Transport Database*, www.ktdb.go.kr/www/selectBbsNttView.do?key=45&bbsNo=2&nttNo=2970.

Further upscaling of management authority to a joint "control tower" could help address more effectively the complex interactions in the public transport network of the metropolitan area (Shin, 2005). For example, Seoul has recently announced that it plans to ban all diesel-fuelled buses coming in from Incheon and Gyeonggi. The decision was made in order to put a break on the rising levels of particulate matter pollution within the city. While Seoul completed a 100% conversion to compressed natural gas (CNG) buses in 2014, around 1 700 buses out of 2 200 coming in from Incheon and Gyeonggi are still diesel-fuelled. For Incheon and Gyeonggi, this unilateral decision from Seoul raises a major financial issue. One unit of CNG bus is estimated to cost around USD 102 000, and building CNG stations will obviously entail additional costs. The lack of consultation among the three jurisdictions might result in extreme inconvenience for the millions of commuters (Kim, 2016).

Other metropolitan areas in Korea could also benefit from stronger inter-municipal collaboration on urban transport decisions. For example, Daejeon took the lead in setting

up a metropolitan consultative group called the G9, launched through an MOU in 2007 among Daejeon and eight neighbouring jurisdictions (Gongju-si, Nonsan-si, Gyeryong-si, Boeun-gun, Okcheon-gun, Youngdong-gun, Geumsan-gun, Yeongi-gun [currently Sejong]). The group aimed to discuss joint policy challenges and solutions to improve the quality of life of all citizens and has implemented around 20 joint projects related to transport, agriculture and tourism (Ahn, 2013). Another metropolitan transport planning structure was established in the south-east of Korea, integrating Busan, Ulsan and Gyeongnam-do, but it was abolished within a year due to the lack of political will. Recently in 2016, a BRT planning workforce was launched as a consortium among Daejeon, Sejong, Chungnam-do, Chungbuk-do, Cheongju-si and Gongju-si. It is expected that the participation of Sejong in the workforce might help bring greater management competencies and budget power to the joint body, given its unique status as a Special Administrative City.[8]

A possible source of inspiration for Korea could be the creation of metropolitan transport authorities – or multi-purpose metropolitan governance bodies that include transport in their portfolio – which is increasingly common in OECD countries. Such authorities are responsible for multiple jurisdictions that share an economic territory beyond simply administrative boundaries. Transport is the second most important field of work for metropolitan governance bodies in the OECD (see Annex 1.A3). International experience suggests that there is not a single model, but rather a variety of organisational models that reflect specific local characteristics (Table 1.5). Some of the most successful examples of transport authorities include the Île-de-France Transport Authority (Syndicat des transports d'Île-de-France, STIF) in Paris, Transport for London (TfL) and the Regional Consortium of Transport (Consorcio Regional de Transportes, CRTM) in Madrid. The World Bank identifies three conditions as essential for ensuring the sustainability and effectiveness of urban transport institutions: ability to deliver public value; legal authority and political support; and strong internal capacity (Kumar and Agarwal, 2013). Metropolitan transport authorities need to identify specific ways in which they can deliver mobility improvements that are significant, effective and visible to the population.

Co-ordination across levels of government on urban transport planning and investment is also particularly important to align objectives and funding. In this regard, one of the most sophisticated examples of intergovernmental co-ordination for urban transport can be found in Germany and may yield useful insights for Korea. All large metropolitan areas in Germany have set up a metropolitan transport authority called *Verkehrsverbund*. Such transport authorities usually bring together all local governments located in the metropolitan area as well as the corresponding *Land* (or *Länder* if there are several of them, as in the case of Hamburg). The creation of such metropolitan transport authorities has facilitated the expansion of the public transport supply, as illustrated in the example of Frankfurt (Box 1.9). A few authorities also enjoy competencies in terms of public parking and sometimes urban spatial planning.

Table 1.5. **Comparative overview of selected transport authorities in OECD metropolitan areas**

	Paris	London	Madrid	Vancouver	Amsterdam	Seoul
Transport authority	Syndicat des transports d'Île-de-France (STIF)	Transport for London (TfL)	Regional Consortium of Transport (Consorcio Regional de Transportes, CRTM)	TransLink	Transport Authority Amsterdam	Seoul Metropolitan Government
Metropolitan governance authority	Métropole du Grand Paris (7 million people across the city of Paris and 130 other municipalities)	Greater London Authority (GLA) (8.2 million people across the city of London and 32 boroughs)	Autonomous Community of Madrid (6.5 million people)	Metro Vancouver (2.5 million people across 23 local authorities)	Metropoolregio Amsterdam (MRA) (36 municipalities and 2 provinces)	Seoul Metropolitan Government (1 special city divided into 25 districts)
Relationship between the two authorities	The STIF goes beyond the realm of Métropole du Grand Paris and includes the entire Île-de-France region	The TfL is an executive agency within the GLA	The CRTM is a public limited company belonging to the autonomous community of Madrid	TransLink is a statutory authority created by the government of British Columbia to cover the territory of Metro Vancouver	Transport Authority Amsterdam serves a much smaller territory within the MRA (16 municipalities)	Same entity. Deals with a variety of operators (Seoul Metro, Seoul Metro Rapid Transit, Korail, Seoul Metro Line 9 Corporation)
Funding	About one-third of regional operation expenditures for the STIF comes from the *versement transport*. This is a dedicated tax levied on employers and based on payroll mass that the STIF (and other transport authorities) are entitled to collect.	According to the 2016-17 funding plans, around 40% of the budget is covered by fares, while the rest raised from grants (23%), local bonds (20%), fare revenues from congestion charges and road fees (9%), and savings from Crossrail, one of the TfL's subsidiaries (8%).	According to the 2016 budget proposal, about 55% of the CRTM's budget is jointly funded by community, the central government and the city government, while the remaining 45% comes from fee collection.	Fuel taxes and property taxes are earmarked for TransLink and together make up 40% of TransLink's budget. Translink has been able to enlarge its funding base by gaining political support from the municipalities.	Around 44% of the budget comes from passenger revenues. The Ministry of Transport compensates the deficits, while the participating municipalities contribute a small portion.	There are three special accounts (urban railway, general traffic, metropolitan traffic), each made up of different revenue sources, such as national grants, operation profit and revenues from traffic fines.

Source: Authors' own elaborations drawing on OECD (2015c), *Governing the City*, http://dx.doi.org/10.1787/9789264226500-en.

Support economically, socially and environmentally driven urban transport

An important aspect of rethinking the effectiveness of urban transport systems in Korea is to help them better serve economic, social and environmental objectives. In particular, both central and local governments are focusing on reducing reliance on cars, sometimes adopting a "road diet" approach, and promoting public transport and soft mobility. For example, the approach of reducing road lanes and parking space is applied drastically in Sejong, Korea's most recently created city (see detailed profile in Chapter 3). Implementing such a vision requires a holistic approach to the metropolitan area's development. For example, Transport for London (TfL) has been highly successful in generating economically driven transport policies, which are well-aligned with demographic and employment dynamics and effectively promote public and non-motorised transport

modes. Well-integrated transport, spatial and economic policies have contributed to making it possible for 90% of morning journeys to be by public transport or non-motorised modes (TfL, 2015). TfL's performance highlights the importance of developing a transport strategy within a broader long-term economic planning framework. The TfL is responsible for developing the Mayor's Transport Strategy, which is the long-term transport plan for Greater London, in accordance with the economic, spatial and environmental objectives set out in the Economic Development Strategy and the London Plan (the spatial development strategy), both developed by the Greater London Authority (Box 1.10). Likewise, in Seoul and other major cities in Korea, there have been attempts to promote inter-sectoral co-ordination. For example, traffic-related big data is being exploited to inform land-planning decisions, although there is no systematic mechanism for this purpose.

Box 1.9. **An intergovernmental transport authority for the metropolitan area: The example of Frankfurt**

The Rhein-Main Transport Association (Rhein-Main Verkehrsverbund, RMV) is the single authority over public transport in the metropolitan area of Frankfurt. The RMV brings together 3 levels of government: 15 counties, 11 cities and the state of Hesse. It is led by a board where all member governments are represented. Its geographic coverage includes about two-thirds of the state of Hesse and the city of Mainz (outside of Hesse).

The creation of the RMV was facilitated by a former Association of Municipalities, called Umlandverband Frankfurt (UVF), which was created by the state of Hesse in 1975 as a vehicle for inter-municipal policy co-ordination in the region. The UVF had wide-reaching competencies in policy planning and implementation for many specific-purpose functions at the local level. Membership of the 43 municipalities with about 1.6 million inhabitants was compulsory by law. The assembly (Verbandskammer) of the UVF consisted of non-elected delegates from member governments. In 1990, the UVF proposed a new expanded transport association that incorporated several smaller transport associations and municipalities that did not belong to any transport associations. Thus, it paved the way for the creation of the RMV in 1995, also supported by federal transfers.

The RMV defines metropolitan transport policy and is in charge of planning, investment decisions, price setting and co-ordinating 153 public and private operators (subway, bus, suburban railway, trains). It integrates regional and local transport under uniform and needs-based rules for the entire metropolitan area: one timetable, one price and one ticket. This includes important tasks such as tariff design, scheduling, allocation of transport services to carriers, the development of the network, the tendering of transport services, the assurance of quality and security standards, innovation (e-ticket, mobile ticket, touch&travel, R&D) as well as communication, information and marketing. It ties individual traffic, car-sharing services and the bicycle in its mobility concept, and partners with shipping lines and taxi companies. Similar associations exist in nine other German regions. In terms of number of trips, the RMV holds the fourth position (after Berlin-Brandenburg, Rhine-Ruhr and Hamburg) in Germany. It comprises 42 railway connections with 390 stations and 943 bus routes with 11 900 stops. On average, it handles some 2.5 million passengers per workday, with an average length of travel of 10 kilometres.

Since its inception, the RMV has seen the number of passengers increase by about 25%, from 520 million in 1995 to 708 million in 2013. In terms of revenue per trip, it achieves a top value in Germany, covering its costs at 57%, with the remainder coming from federal regionalisation funds passed through the state budget, and from municipalities via state financial equalisation.

Source: OECD (2015c), *Governing the City*, http://dx.doi.org/10.1787/9789264226500-en.

Box 1.10. **Integrated planning in London**

London's integrated planning framework is based on three key documents: the London Plan, the Economic Development Strategy and the Mayor's Transport Strategy. The planning framework is complemented with other strategies (e.g. the Mayor's Climate Change Mitigation and Energy Strategy, the Air Quality Strategy). The strategies outlined in the three main planning documents are closely related.

The London Plan: Long-term spatial development strategy

The London Plan sets out the long-term spatial development strategy (currently to 2036). It identifies the main objectives for London: a city that meets the challenges of economic and population growth; an internationally competitive and successful city; a city of diverse, strong, secure and accessible neighbourhoods; a city that delights the senses; a city that becomes a world leader in improving the environment; a city where it is easy, safe and convenient for everyone to access jobs, opportunities and facilities.

The London Plan addresses specific planning policies that can, on the one hand, help Transport for London (TfL) cope with the impacts of demographic growth and, on the other hand, foster urban development conditions that are favourable to more sustainable mobility. Examples of these policies are: housing densities, which are linked directly to public transport accessibility levels; maximum car parking limits that are also linked to public transport accessibility; minimum cycle parking standards for all different types of land use; requirements for electric charging provision in new developments; construction and servicing management plans.

The Economic Development Strategy

The Economic Development Strategy (EDS) outlines the long-term economic vision and goals for London. Long-term projections of continuing growth in London's economy and population (various scenarios are examined in the London Plan) are an essential input to the EDS. All proposals in the EDS must be consistent with the spatial strategy set out in the London Plan. The EDS in force (developed in 2010) sets out the following objectives: promote London as the world capital of business, the world's top international visitor destination, and the world's leading international centre of learning and creativity; ensure that London has the most competitive business environment in the world; make London one of the world's leading low-carbon capitals by 2025 and a global leader in carbon finance; give all Londoners the opportunity to take part in London's economic success, access sustainable employment and progress in their careers; attract the investment in infrastructure and regeneration which London needs to maximise the benefits from this investment, and in particular from the opportunity created by the 2012 Olympic and Paralympic Games and their legacy.

The Mayor's Transport Strategy

The Mayor's Transport Strategy (MTS) lays out the strategic direction for the TfL to 2031. The TfL is the statutory authority responsible for ensuring the delivery of the MTS. The MTS takes into account the emerging policies in the London Plan and the EDS and is supported by a detailed evidence base, including the "Travel in London" report, strategic transport models and recommendations from the Outer London Commission. The MTS currently in force identifies six major objectives: support economic development and population growth; enhance the quality of life for all Londoners; improve the safety and security of all Londoners; improve transport opportunities for all Londoners; reduce transport's contribution to climate change and improve its resilience; support delivery of the London 2012 Olympic and Paralympic Games and its legacy.

Another governance mechanism to promote coherent policies for the overall development of the metropolitan area is to monitor transport and housing costs together in Korean cities. In this respect, international experience suggests that a key priority is to set up a measurement tool. For example, in the United States, a federal government initiative called the US Partnership for Sustainable Communities aims to develop more sustainable communities by integrating transport, housing and energy policies. Recognising that housing and transport costs account for almost half the average household's budget, the initiative has developed the Location Affordability Index (LAI), which provides estimates of the percentage of a family's income dedicated to the combined cost of housing and transport in a given location. The LAI builds on and expands the H+T Index, which was initially developed by the Center for Neighborhood Technology (CNT) (Box 1.11). Because what is "affordable" is different for everyone, users can choose among eight different family profiles, defined by household income, size and number of commuters, and see the affordability landscape for each in a neighbourhood, city or region. The Korean government has also started to move in this direction. For example, the "Happy Housing" programme aims to provide affordable housing to target groups (such as newly married couples, students and new workers during their first year of employment) in areas that are close to public transport. The introduction of an index similar to the LAI could help select such sites and assess them effectively.

Box 1.11. **A measurement tool to promote more coherent urban planning: The H+T Index in the United States**

The relationship between transport and housing costs is well known and central to theories and models of urban form, suburbanisation and housing markets (Alonso, 1960, 1964; Muth, 1969; Mills, 1972; Brueckner, 1987). This well-established relationship has led researchers, advocates and policy makers to argue that measures of neighborhood affordability ought to incorporate the costs of transport as well as the costs of housing (Bogdon and Can, 1997; Belsky et al., 2005; Jewkes and Delgadillo, 2010).

The Center for Neighborhood Technology's (CNT) H+T Index has played a prominent role in documenting the relationship between housing and transport and in influencing local and national housing policies. The H+T Index incorporates transport costs into measures of neighbourhood affordability and maps these relationships across US metropolitan areas. It provides an estimate of the typical cost of housing and transport in different neighbourhoods and compares this estimate to a household or typical household's income. The CNT deems a neighbourhood affordable if a given household would spend 45% or less of its income on housing and transport costs. This number accounts for the 30% housing affordability rule of thumb and adds another 15% for transportation costs. According to the national consumer expenditure survey, American households spend an average of 18% of their income on transport.

$$H + T\ Index = \frac{Housing\ costs + Transport\ costs}{Income}$$

The central motivation for this work is to encourage more centralised housing development and discourage urban sprawl. According to the index's supporters, the failure to account for the higher transport costs in remote neighbourhoods has led to policies, plans and regulations that exacerbate sprawl and locate households far from civic, social, and economic amenities and opportunities. It also may harm families.

Source: Adapted from Guerra, E. and M. Kirschen (2016), "Housing plus transportation affordability indices: uses, opportunities, and challenges", www.itf-oecd.org/sites/default/files/docs/housing-transport-affordability.pdf.

Rethink urban transport financing for more sustainable and inclusive cities

Cities in Korea, as in other OECD countries, are grappling with growing demand for transport investment and limited public resources in a context where urban transport is required to be not only economically efficient, but also environmentally sustainable and socially inclusive. This new combination of objectives has complex implications on the financial model that could help Korean cities cope with such evolving demand. Particularly critical financial challenges in urban transport in Korea include the following:

- One of the most pressing issues is how to finance the costs related with the deterioration of transport infrastructures. Although only 6.8% of the overall transport infrastructure in Korea is more than 30 years old (as of 2014),[9] this share will rise to 30% by 2030 and the corresponding maintenance costs are expected to increase by 6.1% per annum by 2030 (Kim, 2016). Given that 51.9% of road repair and maintenance costs are currently borne by the national government, 45.6% by the subnational governments and 2.5% by the private sector (MOLIT, 2015), this will inevitably strain the public budget, national and subnational governments alike. By 2030, the Korea Highway Corporation, a government agency in charge of maintaining motorways, will have to set aside a quarter of its total revenues exclusively for repairing and maintaining existing infrastructures; metropolitan city governments will have to freeze up to 58% of the revenues from subway fares to repair their urban rail networks; and local governments will be spending around one-fifth of their overall transport budget for the same purpose (Kim, 2016). It is likely that actual costs will easily surpass the official estimates, as only national or regional links are subject to data collection, according to the Special Act on Facility Management. It is imperative to respond to the maintenance needs well before the life cycle of the infrastructure terminates, because repair costs increase steeply once deterioration takes place. By contrast, early actions can help extend the life cycle of such infrastructure.[10]
- A relatively more recent issue in Korean cities is how to make transport services more affordable for vulnerable users, following the current government's focus on social welfare. Some examples of initiatives include subsidies to compensate for the deficit of private bus operators in exchange for keeping the fares low, transfer discounts and a free pass for the elderly (particularly important in light of the rapid ageing of the Korean society) and the disabled. Many city governments have also started to provide on-demand public transport services in unprofitable areas or during low-traffic hours, such as Seoul's Owl Bus system and Changwon's Hope Taxi, a demand-responsive transit (DRT) service for remote areas (see Chapter 3).

While many cities in OECD (and non-OECD) countries are confronted with similar challenges, no single financial model has emerged from the great diversity of national and local institutional arrangements. Recent OECD research, however, points to a number of key principles for enhancing the efficiency, sustainability and inclusiveness of urban transport financing in general, which could perhaps help inform the current policy reflection in Korea (Table 1.6). Experience in OECD countries suggests that strengthening economic appraisal procedures and eligibility criteria for subsidies could improve the cost-efficiency of transport projects. Financial mechanisms to improve environmental sustainability in urban transport are largely based on the well-known avoid-shift-improve approach (Box 1.12), and include a range of initiatives such as effective road pricing, greater access to carbon finance[11] and capacity building for well-designed public-private

partnerships. Social inclusion can also be reinforced through land-value capture mechanisms, targeted subsidies for the neediest users and reasonable fare levels. Many of such overall orientations for strengthening urban transport financing are already at least partially in place in Korea and could be further put in action, with a particular focus on enhancing collaboration across local governments and across levels of government. Although the legal basis for intergovernmental agreements is already established in Article 20 of the Special Act on Balanced National Development, it has never been put into practice, due to the lack of political and administrative culture in this field, as well as a lack of specific, practical provisions (Cho and Park, 2013). Reinforcing a culture of partnership across levels of government on mutually agreed objectives, shared commitment (including on financial terms) and an evaluation method in terms of urban transport performances could therefore help improve the stability and quality of investments.

Table 1.6. **What does OECD research find in terms of financing efficient, sustainable and inclusive urban transport?**

Economic efficiency	Environmental sustainability	Social inclusion
– Strengthen economic appraisal procedures and eligibility criteria for subsidies – Adopt a "benefiter pays" approach (e.g. levying a public transport tax on employers on the basis of payroll mass, using business and office real estate taxes to cover the capital costs of expanding the public transport system) – Support innovation in internalising externalities and real consumer willingness to pay into general tariffs and fares, in order to ensure the fiscal sustainability of the system	– Use road pricing (e.g. congestion charging) to reduce traffic and pollution, and link it with vehicle types to encourage shift to greener transport – Ensure that congestion charging comes with alternative mobility solutions and consider earmarking these revenues to improve public transport – Make carbon finance accessible to cities – Build financial, technical and legal capacity in cities and enhance collaboration across levels of government to tap public-private partnerships effectively	– Mobilise land-value capture mechanisms – Implement targeted subsidies (as opposed to generalised support) to strike a balance between financial sustainability and affordability of services – Set tariffs at adequate levels through solid methodologies to assess both demand and costs of operations (e.g. open competitive tendering)

Sources: Authors' own elaborations drawing on OECD/ITF (2013), "Funding urban public transport: Case study compendium", www.itf-oecd.org/sites/default/files/docs/13compendium.pdf; Merk, O. et al. (2012), "Financing green urban infrastructure", http://dx.doi.org/10.1787/5k92p0c6j6r0-en; Ang, G. and V. Marchal (2013), "Mobilising private investment in sustainable transport: The case of land-based passenger transport infrastructure", http://dx.doi.org/10.1787/5k46hjm8jpmv-en; OECD/ITF (forthcoming), *Income Inequality, Social Inclusion and Mobility*.

Enhance monitoring and evaluation of urban transport performances

Measuring and communicating successful performances in urban transport policies on a regular basis can help increase trust in the capacity of central and local authorities to deliver concrete improvements in people's daily life and build public support for necessary reforms. An international example of a tracking document that is also useful for communication purposes is the TfL's annual publication, "Travel in London", which reports progress on a wide set of indicators outlined in the Mayor's Transport Strategy (Box 1.13). In this respect, the Korean government is conducting transport appraisals on a regular basis and opens the data to the public. For example, it has carried out a Public Transport Policy Evaluation every two years since 2007. The evaluation tracks the performance of 161 subnational jurisdictions on a wide range of quantitative and qualitative indicators related to public transport services in order to reward the best-performing local governments with financial benefits (additional shared tax) and encourage knowledge-sharing across jurisdictions. Another example is the Sustainable

Urban Transport Evaluation, which was established in 2014 after a four-year pilot study carried out by KOTI. The evaluation covers 74 cities with a population of more than 100 000 and incorporates environmental, social and economic indicators (National Archives, 2016).

Box 1.12. **Adapting the Avoid-Shift-Improve approach to different contexts of urban transport planning**

The strategy for sustainable transport is often described in the literature as the Avoid-Shift-Improve (A-S-I) approach. Sustainable transport policies can be grouped into three types of policies:

1. "Avoid" or "reduce" the need to travel and the trip length, by improving the efficiency of the overall transport system through integrated land-use planning and transport demand management, e.g. through compact, mixed-use development planning, traffic restrictions, mobility management and marketing, and national subsidies for low-carbon transport metropolitan design and planning.
2. "Shift" or "maintain" tools, to improve trip efficiency by encouraging modal shift to low-carbon transport modes such as public transport, e.g. through parking restrictions, road space allocation, public awareness campaigns on alternatives to private vehicles; procurement of public transport.
3. "Improve" fuel and vehicle efficiency and technologies, e.g. through vehicle standards, speed limits, labelling of vehicles' environmental performance and fiscal incentives for electric or hybrid vehicles.

Experiences to date show that A-S-I strategies need to be tailored to the specific local context, depending on infrastructure needs, income levels, transport trends, energy mix and urban development patterns. While in developed countries "Improve" strategies can help promote electric vehicles and rail electrifications, developing countries often make better use of encouraging small, efficient cars and innovations for traditional non-motorised transport modes such as cycle rickshaws. Effective sustainable transport strategies often require enhancing synergies between "Avoid", "Shift" and "Improve" policies. For example, when investing in a bus rapid transit (BRT) corridor ("Shift"), urban policy makers can alter land-use regulations to promote densification around the corridor ("Avoid"), and use clean-fuel buses ("Improve"). A-S-I strategies require infrastructure investments, such as: BRT corridors ("Shift"); rail infrastructure for metros and high speed rail ("Shift"); parking ("Avoid"); and electric vehicle charging stations ("Improve").The model is most applicable to the urban context and to long-distance or international freight transport, where multiple transport modes and options are likely to be available. In rural areas, where options are often limited, "shifting" is less relevant, at least in the short term. Other imperatives, including the speed demanded by consumers, may also mean that some freight or shipping operators, for instance, focus more on the "improve" approach, though there are instances where freight may be shifted from road to rail or waterways or from conventional delivery trucks to electric vehicles. Ultimately, however, the world as a whole can work toward "shifting" to a reality where efficient and effective intermodality is achieved and all modes contribute to a better system.

The concept of enabling is a critical addition to the 'Avoid-Shift-Improve' framework. Essentially, as a prerequisite to effectively employ 'Avoid-Shift-Improve,' sound policy and governance structures and basic technical and financial capacities at all levels must be in place. While most developed countries tend to have such structures and capabilities at least in some form, many countries, especially in the developing world, need capacity building to create or enhance them.

Sources: Authors' own elaborations drawing on Ang, G. and V. Marchal (2013), "Mobilising private investment in sustainable transport: The case of land-based passenger transport infrastructure", http://doi.org/10.1787/5k46hjm8jpmv-en; UN (2016), *Mobilizing Sustainable Transport for Development*, https://sustainabledevelopment.un.org/content/documents/2375Mobilizing%20Sustainable%20Transport.pdf.

Box 1.13. **Monitoring and communicating urban transport performance in London**

"Travel in London" is the annual report issued by Transport for London (TfL). It provides key statistics and communicates the progress of TfL and its partners toward delivering quality transport in London. The document is divided into two main parts: 1) travel demand and the performance of transport networks; 2) monitoring and assessing progress with the implementation of the Mayor's Transport Strategy. As part of the second section, TfL reports on the evolution of a wide range of indicators that measure its progress in delivering the objectives set by the Mayor's Transport Strategy. The following indicators are used by TfL:

- Total number of trips.
- Total number of journey stages.
- Modal shares.
- People's access to jobs: number of jobs available to people within a 45-minute travel time by public transport.
- Journey time reliability indicator: percentage of vehicle journeys completed within five minutes of a typical average journey time.
- Average traffic speed.
- Public transport reliability: extra time that people have to wait over and above that if the service was running exactly to schedule (for buses and the underground); percentage achievement of operational or reliability targets (other rail modes).
- Public transport capacity: place-kilometres offered by the principal public transport modes.
- Operating costs per passenger kilometre (both gross and net expenditure per passenger kilometre).
- Asset condition: asset deemed, according to benchmarks previously set by TfL, to be in "good" condition.
- Emissions from particulate matter (PM_{10}) from ground-based transport (as a total over the calendar year).
- Emissions of nitrogen oxides (NO_x) from ground-based transport.
- Perception of customer satisfaction with aspects of the transport environment that contribute to quality of life: six indicators are used to measure this. They are all scaled from 0 to 100 and scores are derived from annual surveys conducted among Londoners or users of particular parts of the transport system (as appropriate). The six indicators are: 1) public transport customer satisfaction; 2) public transport crowding (satisfaction indicator); 3) road user customer satisfaction; 4) perception of journey experience; 5) perception of noise; 6) perception of the urban realm.
- Number of road traffic casualties (killed or seriously injured).
- Crime rates on public transport.
- Perception of crime/safety while travelling: percentage of people that feel safe when travelling on public transport.
- Access to jobs and services: local area score of average journey time by public transport, walking and cycling to jobs and local services.
- Physical accessibility to the transport system: level of step-free access across the TfL public transport and streets networks, expressed as a weighted average according to the relative use made of each mode. It is expressed as a percentage score.
- Real fares levels: average actual fare paid in London per kilometre travelled. It is a composite measure, covering bus and underground only.
- Emissions of CO_2 from ground-based transport in London.

Conclusion

Planning urban transport as part of a broader, integrated urban development strategy is essential if Korean cities are to meet efficiency, sustainability and inclusiveness goals. Korea has already demonstrated its capacity to implement ambitious governance reforms to improve urban transport service delivery, as illustrated by the introduction of the semi-public bus operating system in several cities and the harmonisation of fares throughout the country. Strengthening partnerships among local governments and across different levels of government on mutually agreed objectives and a fair distribution of costs could help address chronic financial constraints in Korean urban transport systems. A shared, forward-looking vision of urban transport as an enabler of economic, environmental and social opportunities will play a key role in upgrading growth and quality of life in Korean cities.

Notes

1. This figure only includes population living in predominantly urban regions (as defined in the OECD territorial classification). The sum of the share of population living in predominantly urban regions and that living in intermediate regions is 82.7%, compared with an OECD average of 73.7%.
2. See OECD (2016a).
3. For a further discussion of the comparative costs of roads and railways, see KOTI (2008).
4. The respective ratios of investments in roads and railways have been gradually levelling out. As of 2015, roads and railways accounted for around 45% and 33% of total traffic-related public investment, respectively (Kim, 2015).
5. According to recent OECD research, regions with 10% more developed land per capita have on average a car ownership rate that is 0.75 cars per 100 inhabitants higher. This observed positive relationship between the area of developed land per capita and car ownership continues to hold even when controlling for GDP per capita levels and country-specific effects (OECD, forthcoming). The research covered 382 TL3 regions in Europe; Korea was, however, not included due to the lack of availability of comparable data.
6. According to the OECD's own calculations based on the 2010 Population Census data from the National Statistics Office, the average commuting time in urban areas (*dong*) was 35.14 minutes, compared with 22.99 minutes in non-urban areas (*eup/myeon*). This is not exactly the same figure that is used in international comparisons with other OECD countries. The reason for this is that national statistics on average commuting time are not collected systematically based on the distinction between urban and non-urban areas. However, the National Statics Office has had past practices of classifying *dong* as urban and *eup/myeon* as non-urban when providing national data to international organisations.
7. For example, see detailed discussion in Lee (2013).

8. Following several unsuccessful attempts to curb overconcentration in Seoul and delocalise the administrative capital, Sejong was planned and created by the central government as a Special Autonomous City, about 120 kilometres south of Seoul. It opened in 2012 and more than 30 central government administrations (including 9 ministries) moved there. See Chapter 3 for a more detailed profile of Sejong.

9. The standard life cycle of infrastructures differs across countries. For example, it is 35 years in the Netherlands, 60-70 years in Germany and 60 years in France (Kim et al., 2015). This is because use frequency, climate and other traffic environments vary across countries. In Korea, infrastructures over 30 years old are considered old and are subject to a thorough safety evaluation.

10. According to the typical pavement condition index curve, delayed rehabilitation, when the road has undergone more than a 40% drop in quality, will cost 6-10 times more than preservation works (US Department of Transportation, 2016). This suggests that the present savings from deferred maintenance will be cancelled out by a surge of costs in the long term. Maintenance needs that remain unmet eventually pose greater budget risks for the government as well as extensive social costs. The damage might appear as a major catastrophe at an unexpected moment, but also slip into household bills inconspicuously; in the United States, for example, an average family is found to spend over USD 300 per year on auto repair costs caused by driving on bad roads (Utah Foundation, 2014).

11. Article 28 of the Basic Act on Supporting Low-Carbon Green Growth in Korea, enacted in 2009, stipulates that the Korean government shall create financial instruments to support low-carbon green growth. Accordingly, state-run financial institutions, such as the Korea Finance Corporation and Korea Eximbank, have established support measures for green industries, including expanded credit guarantees and exemption in guarantee fees (Noh, 2010). In 2005, carbon emission trading was introduced, yielding transactions of KRW 22 billion (Lee, 2015).

References

Ahn, G.W. (2016), “Changes in fiscal structures following Changwon’s administrative elevation: Impacts on the vertical tax revenue distribution”, 2016 Spring Conference of the Korean Association for Local Government Studies.

Ahn, S.J. (2013), “Research on cooperation measures among Gyeongbuk eastern coast five jurisdictions”, Daegu Gyeongbuk Development Institute, Daegu Metropolitan City, Korea.

Alonso, W. (1964), *Location and land use. Toward a general theory of land rent*. Cambridge, MA, Harvard University Press.

Alonso, W. (1960), "A theory of the urban land market", *Papers in Regional Science*, 6 (1), 149–157.

Ang, G. and V. Marchal (2013), "Private investment in sustainable transport: The case of land-based passenger transport infrastructure", *OECD Environment Working Papers*, No. 56, OECD Publishing, Paris, http://dx.doi.org/10.1787/5k46hjm8jpmv-en.

Belsky, E., et al. (2005*), Measuring the Nation's Rental Housing Affordability Problems*, Harvard University Press.

Bogdon, A. and Can, A. (1997), Indicators of Local Housing Affordability: Comparative and Spatial Approaches. Real Estate Economics, 25 (1), 43–80.

Brueckner, J.K. (1987), "The structure of urban equilibria: A unified treatment of the Muth-Mills model", in E.S. Mills, ed. *Handbook of Regional and Urban Economics*. New York: Elsevier, 821–845.

Cho, N.G. and J.I. Park (2013), "Improvement measures on investment costs sharing between the central and local governments for infra-construction", KRIHS Policy Brief, No. 424.

Guerra, E. and M. Kirschen (2016), "Housing plus transportation affordability indices: Uses, opportunities, and challenges", Discussion Paper No. 2016-14, OECD Publishing, Paris, www.itf-oecd.org/sites/default/files/docs/housing-transport-affordability.pdf.

Gyeonggi-do (2015), "Research on effective measures to introduce the quasi-public bus operating system in Gyeonggi-do", report commissioned by Gyeonggi-do Assembly, www.ggc.go.kr/get/bbs/30/83/38/1.

Gyeonggi-do Provincial Government (2016), "General facts about Capital Area Traffic Centre" (in Korean), www.gg.go.kr/archives/1489473 (accessed 24 November 2016).

ITF (2016), "Shared mobility: Innovation for liveable cities", *International Transport Forum Policy Papers*, No. 21, OECD Publishing, Paris, http://dx.doi.org/10.1787/5jlwvz8bd4mx-en.

Jewkes, M. and Delgadillo, L. (2010), "Weaknesses of Housing Affordability Indices Used by Practitioners", *Journal of Financial Counseling and Planning*, 21 (1).

Jones, R. and T. Yokoyama (2005), "Getting the most out of public sector decentralisation in Korea", *OECD Economics Department Working Papers*, No. 468, OECD Publishing, Paris, http://dx.doi.org/10.1787/570027228062.

Kim, G.S. et al. (2015), "Report on the SOC (traffic) sector, 2015-19 National Fiscal Management Plan" (in Korean), SOC Research Unit for the National Fiscal Management Plan, www.kdi.re.kr/research/subjects_view.jsp?pub_no=14627.

Kim, J.A. (2016), "Seoul to ban diesel buses from Gyeonggi and Incheon" (in Korean), Newsis Media, www.newsis.com/ar_detail/view.html?ar_id=NISX20160526_0014109517&cID=10801&pID=10800.

Kim, J.Y. (2016), "Conflicts regarding aging traffic infrastructures and countermeasures" (in Korean), KOTI-Brief <3>, Gyotong N, www.gyotongn.com/news/articleView.html?idxno=16632.

Kim, T.I., J.H. Kim and G.B. Kim (2014), "Analysis on the relationship between subnational granted projects and grant ratios" (in Korean), report commissioned by National Assembly Budget Office, www.nabo.go.kr.

Kim, Y.D. (2013), "MOLIT launches a nationally compatible smart transport card" (in Korean), www.pmnews.co.kr/sub_read.html?uid=8847, KuktoMaeil (accessed 25 November 2016).

Kim, Y.H. (2016), "Analysis of Changwon's intra-city bus system: (3) Seoul's semi-public model, Gyeongnam News, www.knnews.co.kr/news/articleView.php?idxno=1188923 (accessed 25 November 2016).

Korea Transportation Card Industry Association (2016), "Industry status introduction" (in Korean), www.kotcia.or.kr/02_intro/intro02.htm (accessed 25 November 2016).

Korean Public Service and Transport Workers' Union (2015), "Policy discussion for the introduction of a pure public bus operation system", background document for the public discussion at Seoul City Council, 15 April 2015, www.kptu.net.

Kostat (2016a), *Consumer Price Inflation Database*, National Statistics Office, http://kosis.kr (accessed 22 November 2016).

Kostat (2016b), *2010 Population Census Database*, National Statistics Office, http://kosis.kr (accessed 22 November 2016).

Kostat (2016c), "Regional population size and density, 1970-2015" (in Korean), National Statistics Office, www.index.go.kr/potal/main/EachDtlPageDetail.do?idx_cd=1007 (accessed 28 November 2016).

KOTI (2016a), "Trends of traffic congestion costs", *National Index System*, www.index.go.kr/potal/main/EachDtlPageDetail.do?idx_cd=1248 (accessed 29 November 2016).

KOTI (2016b), "O/D data 2015", *Korea Transport Database*, Korea Transport Institute, www.ktdb.go.kr/www/selectBbsNttView.do?key=45&bbsNo=2&nttNo=2970 (accessed 29 November 2016).

KOTI (2008), "Estimation of social costs of railways and analysis on demands" (in Korean), report commissioned by Ministry of Land, Infrastructure and Transport, January, Korea Transport Institute, www.dbpia.co.kr/SKnowledge/ArticleDetail/NODE03695341 (accessed 28 November 2016).

KOTSA (2015), "Research for establishment of operation and management systems of demand-responsive transit (DRT)" (in Korean), Korea Transportation Safety Authority, www.prism.go.kr.

Kumar, A. and O.P. Agarwal (2013), "Institutional labyrinth: Designing a way out for improving urban transport services – Lessons from current practice", World Bank Group, Washington, DC, http://documents.worldbank.org/curated/en/903181468346145008/Institutional-labyrinth-designing-a-way-out-for-improving-urban-transport-services-lessons-from-current-practice.

Lee, C.G. (2015), "Kangwon-do's political strategies in new climate order following the Paris COP 21", Green Issue 2015-32, Climate Change Research Institute of Korea.

Lee, C.G., Y.S. Kim and D.H. Lee (2015), "Research on efficient introduction of quasi-public bus operating system in Gyeonggi-do" (in Korean), https://www.ggc.go.kr/get/bbs/30/83/38/1.

Lee, S. (2014), "Valuing convenience in public transport in the Korean context", in *Valuing Convenience in Public Transport*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789282107683-5-en.

Martinez-Vasquez, J. and J. Boex (2001), "The design of equalization grants: Theory and applications", World Bank Institute and Georgia State University.

Merk, O. (2014), "Metropolitan governance of transport and land use in Chicago", *OECD Regional Development Working Papers*, No. 2014/08, OECD Publishing, Paris, http://dx.doi.org/10.1787/5jxzjs6lp65k-en.

Merk, O. et al. (2012), "Financing green urban infrastructure", *OECD Regional Development Working Papers*, No. 2012/10, OECD Publishing, Paris, http://dx.doi.org/10.1787/5k92p0c6j6r0-en.

Mills, E.S. (1972), *Studies in the Structure of the Urban Economy*, Baltimore: The Johns Hopkins Press.

Ministry of Strategy and Finance (2016), "Open fiscal data" (in Korean), www.openfiscaldata.go.kr/portal/foss/sheetGovStatsPage.do?tab=one (accessed 24 November 2016).

Mo, C.H., J.Y. Park and D.J. Kim (2007), "Assessment and improvement strategy for bus quasi-public operating system", Korea Transport Institute, Research Series 2007-04.

MOI (2016), "Transportation", *National Archives*, Ministry of the Interior, www.archives.go.kr/next/search/listSubjectDescription.do?id=009252 (accessed 28 November 2016).

MOLIT (2016a), "Current state of the Traffic/Energy/Environment Tax" (in Korean), Ministry of Land, Infrastructure and Transport, www.molit.go.kr/USR/policyData/m_34681/dtl.jsp?id=331 (accessed 28 November 2016).

MOLIT (2016b), "Trends of car registration" (in Korean), *Regional Database*, Ministry of Land, Infrastructure and Transport, www.index.go.kr/potal/main/EachDtlPageDetail.do?idx_cd=1257 (accessed 27 November 2016).

MOLIT (2015), "Yearbook of national land and traffic (2015)" (in Korean), Ministry of Land, Infrastructure and Transport, http://stat.molit.go.kr/portal/stat/yearReport.do.

MOLIT (2011), "2nd Public Transport Master Plan" (in Korean), Ministry of Land, Infrastructure and Transport, www.molit.go.kr/USR/I0204/m_45/dtl.jsp?idx=8118.

Muth, R.F. (1969), *Cities and Housing; The Spatial Pattern of Urban Residential Land Use,* Chicago, University of Chicago Press.

National Archives (2016), "Urban traffic policy" (in Korean), Transportation, National Archive, www.archives.go.kr/next/search/listSubjectDescription.do?id=006463&pageFlag= (accessed 6 December 2016).

Noh, H.J. (2010), "New growth engine that protects environment", *Monthly Hana Finance*, Hana Institute of Finance, www.koreafocus.or.kr/design2/layout/content_print.asp?group_id=103391.

OECD (forthcoming), *The Governance of Land Use in OECD Countries: Policy Analysis and Recommendations*, OECD Publishing, Paris, forthcoming.

OECD (2016a), "Real GDP forecast" (indicator), http://dx.doi.org/10.1787/1f84150b-en (accessed 30 November 2016).

OECD (2016b), *OECD Regions at a Glance 2016*, OECD Publishing, Paris, http://dx.doi.org/10.1787/reg_glance-2016-en.

OECD (2016c), "Infrastructure investment" (indicator), http://dx.doi.org/10.1787/b06ce3ad-en (accessed 29 November 2016).

OECD (2016d), "Better Life Index 2015", *OECD Social and Welfare Statistics* (database), http://dx.doi.org/10.1787/data-00823-en (accessed 28 November 2016).

OECD (2016e), "Metropolitan areas", *OECD Regional Statistics* (database), http://dx.doi.org/10.1787/data-00531-en (accessed 29 November 2016).

OECD (2016f), "Family indicators", *OECD Social and Welfare Statistics* (database), http://dx.doi.org/10.1787/efd30a09-en (accessed 29 November 2016).

OECD (2016g), *OECD Regional Outlook 2016: Productive Regions for Inclusive Societies*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264260245-en.

OECD (2016h), *Road Infrastructure, Inclusive Development and Traffic Safety in Korea*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264255517-en.

OECD (2016i), "Subnational government structure and finance", *OECD Regional Statistics* (database), http://dx.doi.org/10.1787/05fb4b56-en (accessed 29 November 2016).

OECD (2015a), *The Metropolitan Century: Understanding Urbanisation and Its Consequences*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264228733-en.

OECD (2015b), "Road traffic, vehicles and networks", in *Environment at a Glance 2015: OECD Indicators*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264235199-17-en.

OECD (2015c), *Governing the City*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264226500-en.

OECD (2014a), *Effective Public Investment Across Levels of Government: Principles for Action*, brochure, OECD, Paris, www.oecd.org/effective-public-investment-toolkit/Effective-Public-Investment-Brochure.pdf.

OECD (2014b), OECD (2014), "Compact city policy in Korea", in *Compact City Policies: Korea: Towards Sustainable and Inclusive Growth*, OECD Publishing, Paris. DOI: http://dx.doi.org/10.1787/9789264225503-7-en.

OECD (2013), "Fiscal equalisation: A key to decentralised public finances", in *Fiscal Federalism 2014: Making Decentralisation Work*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264204577-7-en.

OECD (2012), *Redefining "Urban": A New Way to Measure Metropolitan Areas*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264174108-en.

OECD/ITF (forthcoming), *Income Inequality, Social Inclusion and Mobility*, OECD Publishing, Paris.

OECD/ITF (2015), *ITF Transport Outlook 2015*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789282107782-en.

OECD/ITF (2013), "Funding urban public transport: Case study compendium", OECD, Paris, www.itf-oecd.org/sites/default/files/docs/13compendium.pdf.

OECD/UCLG (2016), *Subnational Governments Around the World: Structure and Finance*, www.oecd.org/regional/regional-policy/sngs-around-the-world.htm.

Park, J.H. (2012), *A Case Study on the Legal Framework and Financing of Transport Infrastructure*, Ministry of Strategy and Finance, Seoul, http://archives.kdischool.ac.kr/bitstream/11125/4217/1/36%20English_A%20Case%20Study%20on%20the%20Legal%20Framework%20and%20Financing%20of%20Transport%20Infrastructure.pdf.

Shin, S.I. (2005), "Analysis and improvement measures on the Capital Area integrated public transport system", Working Paper 2015-OR-13, Seoul Institute, www.si.re.kr/sites/default/files/2015-OR-13.pdf.

TfL (2015), "Future low carbon cities", presentation provided to the OECD delegation, Transport for London.

UN (2016), *Mobilizing Sustainable Transport for Development*, Global Sustainable Transport Outlook Report, High-level Advisory Group on Sustainable Transport, https://sustainabledevelopment.un.org/content/documents/2375Mobilizing%20Sustainable%20Transport.pdf.

US Department of Transportation (2016), "Asset Sustainability Index: A proposed measure for long-term performance", *Planning Processes*, US Department of Transportation, www.fhwa.dot.gov/planning/processes/statewide/practices/asset_sustainability_index/page01.cfm (accessed 28 November 2016).

Utah Foundation (2014), "Roadmap to 2050: Planning for Utah's future infrastructure needs", Research Report No. 721, www.utahfoundation.org/uploads/rr721.pdf.

Veneri, P. (2015), "Urban spatial structure in OECD cities: Is urban population decentralising or clustering?", *OECD Regional Development Working Papers*, No. 2015/01, OECD Publishing, Paris, http://dx.doi.org/10.1787/5js3d834r3q7-en.

World Economic Forum (2013), *The Green Investment Report: The Ways and Means to Unlock Private Finance for Green Growth*, World Economic Forum, Geneva, www3.weforum.org/docs/WEF_GreenInvestment_Report_2013.pdf.

Yun, S.H. (2016), "Changwon's elevation to a metropolitan city, will it pass the National Assembly?" (in Korean), Ohmynews, www.ohmynews.com/NWS_Web/View/at_pg.aspx?CNTN_CD=A0002261775 (accessed 17 November 2016).

Annex 1.A1.
Authorities in charge by mode of transport in Korea

Roads

	Primary authority	Secondary authority		Total (km)	Opened road (km)	Paved road (km)	Road pavement rate (%)	Unpaved road (km)	Unopened road (km)
		Construction	Maintenance						
Total				105 673	97 919	89 701	91.6	8 218	7 754
National expressways	Minister of Land, Infrastructure and Transport	Minister of Land, Infrastructure and Transport	Minister of Land, Infrastructure and Transport	4 139	4 139	4 139	100.0		
				(3 670)	(3 670)	(3 670)			
		(deputy agency: chief of Korea Highway Corporation) (private sector)	(deputy agency: chief of Korea Highway Corporation) (private sector)	(469)	(469)	(469)			
National highways	Minister of Land, Infrastructure and Transport	Minister of Land, Infrastructure and Transport	Minister of Land, Infrastructure and Transport	13 950	13 708	13 651	99.6	57	242
	(mayor, if inside a city)	(mayor, if inside a city)	(mayor, if inside a city)	(2 168)	(2 142)	(2 142)	(98.8)		26
Special city/ metropolitan city roads	Mayor of special/ metropolitan city	Mayor of special/ metropolitan city	Mayor of special/ metropolitan city	4 758	4 758	4 758	100.0		
Local roads (supported by national government)	Governor at TL3	Governor at TL3	Governor at TL3	18 058	16 755	15 251	91.0	1 504	1 303
	(mayor, if inside a city)	(or Minister of Land, Infrastructure and Transport, if necessary) mayor (if inside a city)	(mayor, if inside a city)	(3 848)	(3 480)	(3 275)	(94.1)	(205)	(368)
City (*Si*) roads	*Si* mayor	*Si* mayor (or governor at TL3, if necessary)	*Si* mayor	27 170	22 716	21 650	95.3	1 066	4 454
County (*Gun*) roads	*Gun* governor	*Gun* governor (or governor at TL3, if necessary)	*Gun* governor	22 202	20 447	14 921	73.0	5 526	1 755
District (*Gu*) roads	Head of *gun*	Head of *gun* (or mayor of special/ metropolitan city, if necessary)	Head of *gun*	15 396	15 396	15 331	99.6	65	

Railways

	Primary authority	Secondary authority		Total (km)
		Construction	Maintenance	
High-speed railroad	Minister of Land, Infrastructure and Transport	Minister of Land, Infrastructure and Transport, municipalities, Korea Rail Network Authority or private enterprises	Korean Railway Corporation	596.3
Conventional railroad	Minister of Land, Infrastructure and Transport	Minister of Land, Infrastructure and Transport, municipalities, Korea Rail Network Authority or private enterprises	Korean Railway Corporation	3 335.2
Inter-city railroad	Minister of Land, Infrastructure and Transport	Minister of Land, Infrastructure and Transport, municipalities or joint public-private corporations		156.8
Urban railroad	Minister of Land, Infrastructure and Transport, governor at TL3 (special city, metropolitan city, province)	Minister of Land, Infrastructure and Transport, municipalities which have obtained the approval for the construction project, Urban Railway Corporation or private enterprises entrusted with the construction		643.5
Total				4 633.1

Airports

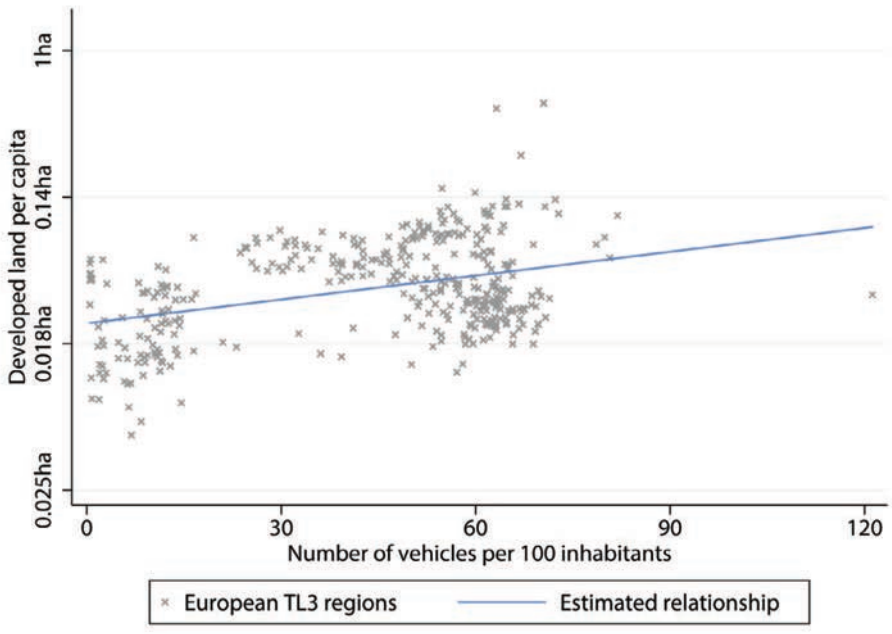
Type	Primary authority	Secondary authority		Total
		Construction	Maintenance	
Civilian airport	Minister of Land, Infrastructure and Transport	Minister of Land, Infrastructure and Transport, Korea Airports Corporation, Incheon International Airport Corporation	Korea Airports Corporation, Incheon International Airport Corporation	7 (5 international)
Civil military dual use airport				8 (3 international)
Total				15

Ports

Type	Primary authority	Secondary authority		Total
		Construction	Maintenance	
Trade ports	Minister of Finance	Minister of Finance, port authorities		14
	Governor at TL3 level or *Si* mayor	Governor at TL3 level or *Si* mayor		17
Coastal ports	Minister of Finance	Minister of Finance, port authorities		11
	Governor at TL3 level or *Si* mayor	Governor at TL3 level or *Si* mayor		18
Total				60

Annex 1.A2.

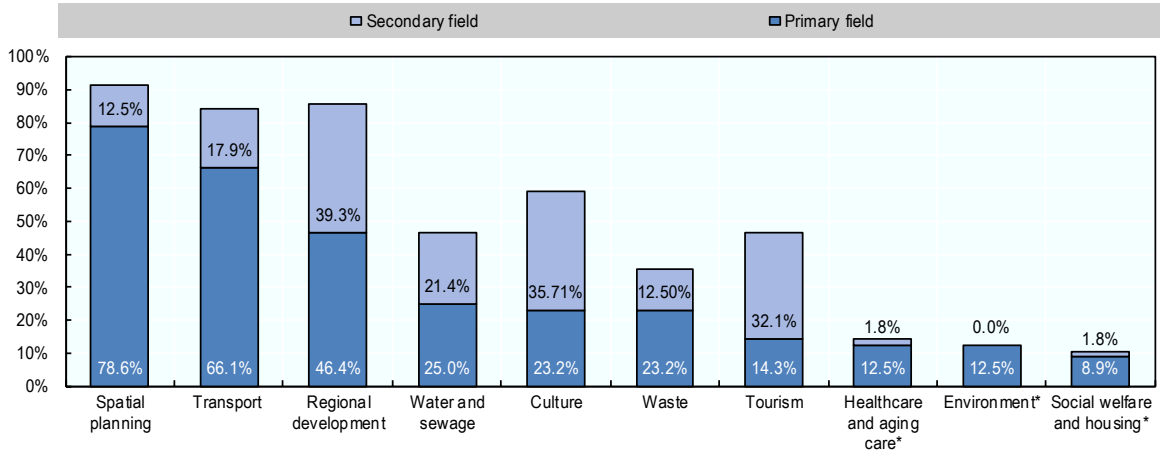
Developed land per capita and car ownership



Source: OECD calculations based on *OECD Regional Database* and Corine Land Cover data, as quoted in OECD (forthcoming), *The Governance of Land Use in OECD Countries: Policy Analysis and Recommendations*, OECD Publishing, Paris, forthcoming.

Annex 1.A3.

Main fields of work of metropolitan governance bodies in the OECD area



Source: OECD Metropolitan Governance Survey 2016 update.

Chapter 2.

Urban public transport accessibility and inclusive growth in Korea

This chapter examines the level of accessibility to public transport in Korean metropolitan areas and how inclusive it is. First, it introduces the research methodology. Second, it discusses the results of data analysis for all Territorial Level 3 (TL3) regions in Korea. Finally, it presents the results of a further analysis, called space syntax, which overlays street networks with public transport networks.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

Introduction

While Korea has enjoyed a remarkable expansion over the past decades, its future success is facing potential obstacles due to a slowdown in economic and demographic growth, an ageing population, some environmental side effects of growth, and a rise in inequalities across the country. In this respect, good access to public transport, independent of a person's wealth or status, is essential for promoting both inclusive and sustainable growth in Korea. Inadequate public transport, with long waits and multiple transfers, pushes those with sufficient means into their cars and results in a radical reduction of mobility for the less fortunate (OECD, 2015a). In particular, large cities in Korea, as in other countries, may contain areas within them that are ill-served by public transport, leading to a vicious circle of low property prices, concentrated poverty, poor facilities and dim prospects for upward mobility. Accessibility to public transport can have particularly strong effects on low-income residents, whose earnings typically do not allow them to live close to the areas that offer the most jobs. Their "effective" labour market – the area accessible to them for daily work – therefore highly depends on the city's spatial pattern and transport networks, and might in reality cover only part of the city (OECD, 2015b). Easy access to public transport also plays a key role in reducing emissions of air pollutants and in helping cities address climate change. Encouraging a shift away from private cars can be supported by dissuading car use (e.g. via congestion charges and parking fees) or by facilitating alternative mobility solutions such as public transport and inducing concrete behavioural responses (e.g. Park, 2014 for Korea). Cities are best equipped to successfully implement such modal shift policies, both on the demand side (due to the magnitude of urban residents' mobility needs) and on the supply side (as cities have a higher financial capacity to implement an adequate public transport system).

This chapter examines the level of accessibility to public transport in Korean cities and how inclusive it is. The chapter is divided into three parts. The first part presents the rationale and the methodology for assessing urban transport accessibility and inclusiveness in Korean cities. The second part discusses the results obtained for each Territorial Level 3 (TL3) region (metropolitan city or province) in Korea. The third part presents the results of a further analysis, called space syntax, which overlays public transport access with urban street networks to detect how inclusive public transport is.

Measuring urban public transport accessibility and inclusiveness in Korea

Calculating accessibility to urban public transport

The present report focuses on the two modes of transport that prevail by far in Korean cities, i.e. buses and trains (including the subway).[1] Measuring accessibility to buses and trains is a complex task, not the least because accessibility can take different forms – physical, economic, institutional or social, for example. This chapter measures physical accessibility and it does so through the angle of "walkability". For this purpose, it is presumed that all roads in Korea have sidewalks – a reasonable hypothesis, considering that even expressways provide sidewalks as long as they run through cities (as is often the case in Korea). The speed of walking is assumed to be fixed to 3 km/hr. Due to the lack of data, the analysis did not incorporate any variables concerning the frequency of public transport (i.e. how many buses or trains run in a given period of time) or the different routes (i.e. orientation and destination). However, this is not a significant omission given the relatively wide coverage of public transport in Korea (with more than 100 000 bus stops and 1 000 train/metro stations across the country as of 2010).

Box 2.1. **What is accessibility to public transport?**

Recent OECD research defined accessibility to public transport as the percentage of population living within a public transport service area in the metropolitan area (Matsumoto, 2013).

Litman (2016) defines accessibility more broadly as "the ease of reaching goods, services, activities, and destinations, which are called together opportunities" and indicates that accessibility depends on numerous factors – including mobility (defined as "physical movement" measured by trips, distances and speed) and modes of transport.

Through their literature review, Bok and Kwon (2016) find that the measurements of accessibility to public transport vary according to the researchers' perspectives and objectives. While Bok and Kwon (2016) used the same definition of accessibility to public transport as the OECD, they used the frequency of the transport mode to establish the different levels of service. By contrast, this report does not include the frequency for data availability reasons.

The concept of accessibility to public transport is similar to the concept of public transport coverage, which measures the number of residents in a city who live within a walking distance (defined as within 12-15 minutes) from public transport stops (ITF, 2017).

However, accessibility **to** public transport is different from accessibility **by** public transport. The latter concept describes the area that can be reached with public transport from a certain point (i.e. the city centre) within a given amount of time (see, for example, ITF [2017]).

Sources: Matsumoto, T. (2013), "Accessibility to public transport: The OECD approach", www.oecd.org/gov/regional-policy/PPT-Transport.pdf; Litman, T. (2016), "Accessibility for transportation planning: Measuring people's ability to reach desired goods and activities", www.vtpi.org/access.pdf; Bok, J.J. and Y.S. Kwon (2016), "Comparable measures of accessibility to public transport using the general transit feed specification", http://dx.doi.org/10.3390/su8030224; ITF (2017), *ITF Transport Outlook 2017*, http://dx.doi.org/10.1787/9789282108000-en.

The next step of the methodology consisted of calculating how easy or difficult it is for urban residents to walk to a bus stop or a train/metro station. The analysis therefore exploits the GIS maps of all roads, bus stops and train/metro stations in Korea, which the Korea Transport Institute (KOTI) makes available on its website. Those maps were loaded into the ARCGIS programme (version 10.1) to generate the areas that can be reached on foot from each bus stop or train/metro station within 10, 20 and 30 minutes. These service areas were then summed up to the smallest administrative unit in Korea (i.e. *eup*/*myeon*/*dong*), which corresponds to the Territorial Level 5 (TL5) in the OECD territorial classification.

However, just looking at the areas themselves does not fully capture the essence of accessibility. In particular, two areas of the same size but with a different population density cannot be considered to be equally important when measuring accessibility to public transport. Therefore, the analysis also included data on population grids (100 meters by 100 meters)^2 and calculated the number of people who fall into each service area, which was then summed up to the scale of TL5. The result is the number of people per TL5 who live within a 10-, 20- and 30-minute walking distance from a bus stop or a train/metro station. To measure the relative magnitude of this variable, this number was divided by the total population of each corresponding TL5. We refer to the share of people who live within a ten-minute walking distance from bus stops or train/metro stations in total TL5 population as the degree of "accessibility", the ratio of people who live farther than a 30-minute walking distance as the degree of "inaccessibility", or the degree of disconnection from bus or train/metro access.

Measuring inclusiveness

While myriad indicators could help measure the complex concept of inclusiveness, constraints in terms of data availability in Korea have led to the choice of income as a dominant variable. Income levels can give an indication of what range of goods and services residents can afford, and the ensuing quality of life. Income data were downloaded from the same source that was used to obtain population grid data. More precisely, the income level data are provided on a scale of 1 (lowest income) to 10 (highest income), being the result of a simulation based on real data on house prices, monthly rents and deposits. The income level of an area was then calculated as the average of the income of people who live in a grid (100 metres by 100 metres).

Other socio-economic variables, extracted from housing census data, include population (per age groups, per gender, per sector of employment and per educational attainment) as well as the number of firms (in different sectors, including industry) and the number of schools.

Once these indicators of urban transport accessibility and inclusiveness were calculated at the TL5 level,[3] the aim was to assess how the two are related to each other. This was done by ordinary least square (OLS) regressions. Controlled correlations were measured between accessibility and other socio-economic variables or among socio-economic variables. Some summary statistics are presented in Table 2.1. These partial correlations were calculated for each TL3 region, and then compared across all TL3 regions in Korea. The following section discusses the results of this exercise.

Table 2.1.**Selected socio-economic features of each TL3 region in Korea**

Descending order in average income levels

TL3 region	Total population (million)	Population density (1 000 inhabitants per km²)	Regional GRDP per capita (USD)
Seoul	10.31	15.31	27 597.09
Gyeonggi	11.79	1.18	22 215.76
Daejeon	1.50	2.88	18 051.52
Incheon	2.76	2.11	21 620.08
Ulsan	1.13	1.06	54 817.35
Daegu	2.51	2.81	15 088.67
Busan	3.57	4.67	17 548.09
Gwangju	1.45	3.13	17 828.64
Gyeongnam	3.29	0.31	26 097.05
Jeju	0.57	0.30	18 741.69
Chungbuk	1.55	0.21	25 021.88
Chungnam	2.08	0.26	39 362.04
Gangwon	1.53	0.09	19 666.68
Gyeongbuk	2.69	0.14	29 521.19
Jeonbuk	1.87	0.23	19 253.61
Jeonnam	1.92	0.15	30 671.00

Note: GRDP: gross regional domestic product.

Source: Authors' own elaborations based on KOTI (2016), "Data request", https://www.ktdb.go.kr/www/contents.do?key=202; Biz-GIS Corp. (2016), "Big data in humanities and social science", www.biz-gis.com/XsDB; Kostat (2016), "Date utilization", http://mdis.kostat.go.kr.

How inclusive is urban transport accessibility in Korea?

Results show that – as would be expected – the areas that offer better economic and educational opportunities also enjoy greater accessibility to buses and trains. Accessibility to bus and train/metro stops in Korean cities also showed a significant positive correlation with population density.[4]

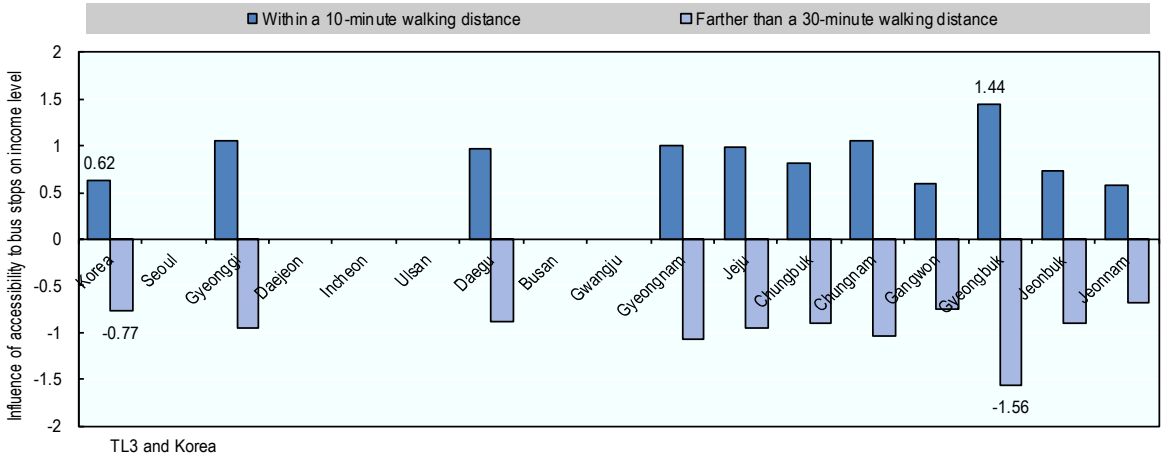
Richer people live closer to bus stops

The nearer people live to bus stops, the more likely they are to have a higher level of income. When jointly looking at all TL3 regions of Korea where data were available, there is a strong positive correlation between bus accessibility and the average income at TL5 level (Figure 2.1).[5] The analysis is based on the two indicators presented earlier: the ratio of people who live within a 10-minute walking distance from a bus stop (hereinafter, "bus accessibility") in total TL5 population, and the ratio of people who live farther than a 30-minute walking distance from a bus stop (hereinafter, "bus inaccessibility") in total TL5 population. The results show that, overall, a 10 percentage points higher level of bus accessibility is associated with a 0.06 higher level of the indicator for income overall in Korean regions. However, there are strong differences across Korean cities. Whereas the transport system shows a high degree of inclusiveness in certain cities, including Seoul, Incheon, Daejeon, Ulsan and Busan where no correlation between income levels and public transport accessibility has been found (both for access to bus and train/metro stops), a fairly strong positive correlation for bus connectivity is found for Daegu, as well as for provinces with comparatively low population density such as Gyeongnam, Jeju, Chungbuk, Chungnam, Gangwon, Gyeongbuk, Jeonbuk or Jeonnam. For the latter, this may in part reflect the difficulty of providing public transport in areas with lower population density. For example, in the province of Gyeongbuk, a 10 percentage points higher level of bus accessibility is associated with a 0.14 higher level of the indicator for income. Correspondingly, if bus inaccessibility is higher by 10 percentage points, the income level indicator is lower by 0.08 overall in Korean regions, and by 0.16 in the province of Gyeongbuk.

School-age children live close to bus stops

Evidence suggests that in Korea families with school-age children tend to locate in areas that are well-connected to public transport. The ratio of high school students in a TL5 area is positively correlated with bus accessibility and negatively correlated with bus inaccessibility in Korea as a whole and in most of its TL3 regions (Gwangju, Gyeonggi, Gangwon, Chungbuk, Chungnam, Jeonbuk, Jeonnam, Gyeongbuk, Gyeongnam, and Jeju) (Figure 2.2). Similar results are obtained for school children of other ages. When bus accessibility of a TL5 area was higher by 10 percentage points in Korea, the ratio of high school students in the TL5 was 1.3 percentage points higher. Similarly, when bus inaccessibility of a TL5 was 10 percentage points higher, the ratio of high school students was on average 2.0 percentage points lower. This pattern was the most exacerbated in Gyeongbuk, where increased bus accessibility was linked with a ratio of high school students that was 2.8 percentage points higher, and its decrease with 3.0 percentage points lower. Surprisingly, Seoul showed the opposite pattern (i.e. high school students having a tendency to live in areas that were less well-connected to public buses).

Figure 2.1. **The higher the income level, the better accessibility to bus**



Notes: The values on the y axis represent regression coefficients between bus accessibility/inaccessibility and the average income at TL5 level within each of the TL3 regions in Korea, controlling other variables. On the x axis, TL3 regions are arranged in descending order of average income level.

Accessibility and inaccessibility range from 0 to 1. The average income level ranges from 1 to 10.

"Within a 10-minute walking distance" and "farther than a 30-minute walking distance" represent the ratio of the population in total TL5 population who live within 10 minutes or farther than 30 minutes on foot from bus stops, respectively.

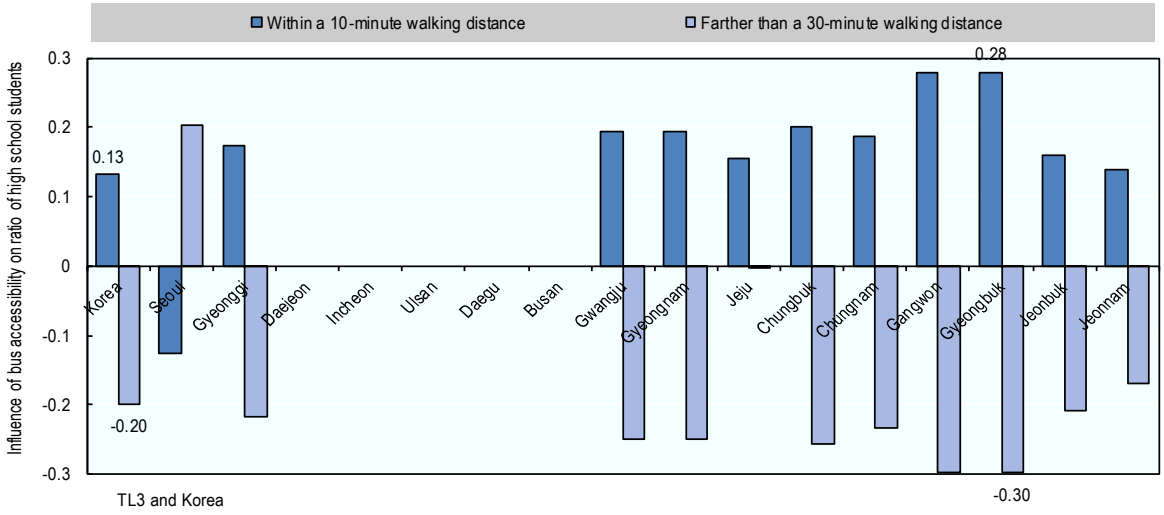
A value of 0 means that there was no statistically significant indicator in the corresponding TL3 region. "Statistically significant" means that the p-value of the coefficient is less than 0.05.

Source: Authors' own elaborations based on KOTI (2016), "Data request", https://www.ktdb.go.kr/www/contents.do?key=202; Biz-GIS Corp. (2016), "Big data in humanities and social science", www.biz-gis.com/XsDB; Kostat (2016), "Date utilization", http://mdis.kostat.go.kr.

A gender gap in bus accessibility

Surprisingly, there is a strong tendency for women to live in areas that have lower accessibility to bus stops. In Korea overall, when the ratio of people who live farther than a 30-minute walking distance from bus stops in a TL5 was 10 percentage points higher, the share of women living there was 2.2% higher. Likewise, when the share of people living within a 10-minute walking distance from bus stops in a TL5 was 10 percentage points higher, the share of women in the TL5 population was 1.8% lower (Figure 2.3). The highest correlations were observed in the province of Gyeongbuk (4.2% and 3.8%, respectively). Similarly, women tend to live in areas that are less densely populated and have fewer firms.[6] In contrast, men are more likely to live closer to bus stops. The ratio of men in TL5 population is strongly positively correlated with bus accessibility and negatively correlated with bus inaccessibility (Figure 2.4).

Figure 2.2. **High school students tend to live close to bus stops**



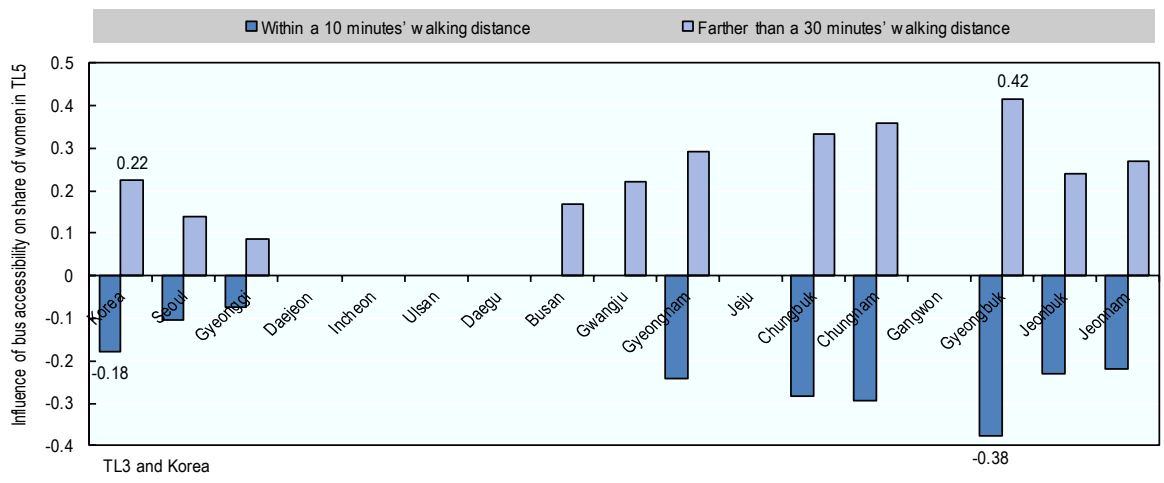
Notes: The values on the y axis represent the regression coefficients between bus accessibility/inaccessibility and the ratio of high school students in TL5 population in each of the TL3 regions in Korea, controlling other variables. On the x axis, TL3 regions are arranged in descending order of average income level.

Accessibility and inaccessibility range from 0 to 1. "Within a 10-minute walking distance" and "farther than a 30-minute walking distance" represent the ratio of the population in total TL5 population who live within 10 minutes or farther than 30 minutes on foot from bus stops, respectively.

A value of 0 means that there was no statistically significant indicator in the corresponding TL3 region. "Statistically significant" means that the p-value of the coefficient is less than 0.05.

Sources: Authors' own elaborations based on KOTI (2016), "Data request", https://www.ktdb.go.kr/www/contents.do?key=202; Biz-GIS Corp. (2016), "Big data in humanities and social science", www.biz-gis.com/XsDB; Kostat (2016), "Date utilization", http://mdis.kostat.go.kr.

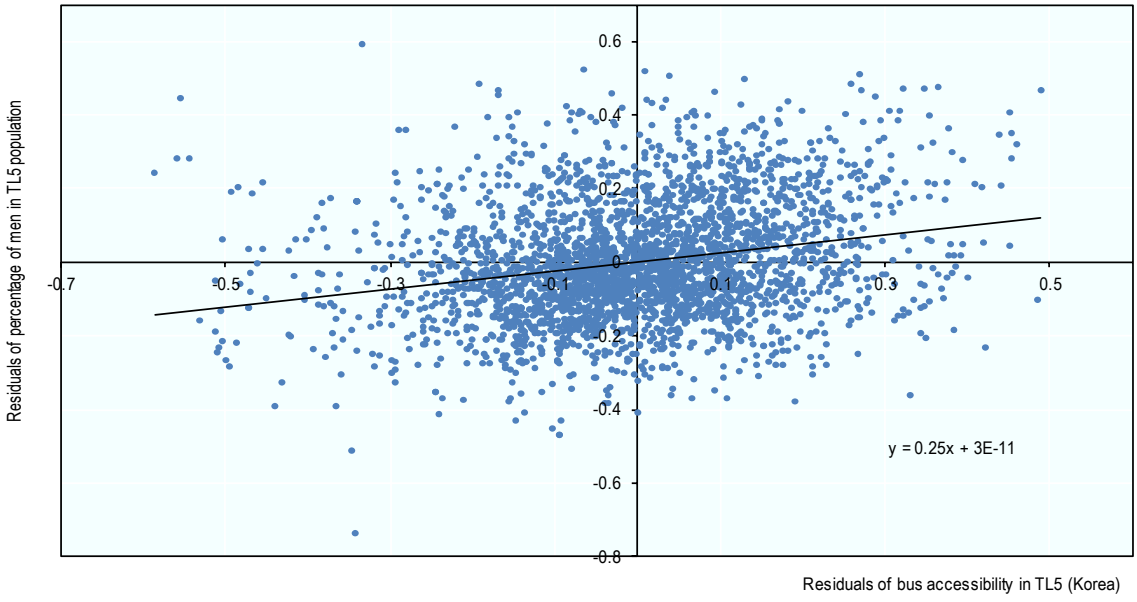
Figure 2.3. **Korean women live farther than men from bus stops**



Sources: Authors' own elaborations based on KOTI (2016), "Data request", https://www.ktdb.go.kr/www/contents.do?key=202; Biz-GIS Corp. (2016), "Big data in humanities and social science", www.biz-gis.com/XsDB; Kostat (2016), "Date utilization", http://mdis.kostat.go.kr.

Figure 2.4. **Men have better accessibility to buses in Korea**

Share of men vs. bus accessibility



Notes: This graph plots the residuals obtained by regressing both the share of men in an area and the accessibility to bus stops on fixed effects for TL4 regions, as well as some other control variables (number of education establishments, manufacturing firms and retail/wholesale shops in the TL5 area).

Sources: Authors' own elaborations based on KOTI (2016), "Data request", https://www.ktdb.go.kr/www/contents.do?key=202; Biz-GIS Corp. (2016), "Big data in humanities and social science", www.biz-gis.com/XsDB; Kostat (2016), "Date utilization", http://mdis.kostat.go.kr.

Women's lower accessibility to buses may reflect a deeper, underlying aspect of the Korean society – the relative lack of economic opportunities for women compared to men. As described earlier, accessibility to urban public transport is strongly positively correlated with average income. High accessibility areas are likely to offer more expensive housing than elsewhere, which only higher income people can afford. Income is directly linked with the status of employment. The employment rate of women in Korea was 49.9% whereas the one for men was 71.1% in 2015. This gap has barely changed in ten years, since the employment rate in 2005 was 48.4% for women and 71.6% for men. Likewise, the wage gap between men and women in Korea is 36.6%, the widest gap among OECD countries, more than twice the OECD average gap of 15.46% in 2013.[7] In light of this combination of factors, it is plausible that fewer women live in areas that are well-connected to the bus network because they neither need to (as they are less employed, thus less need to go to work) nor can afford to (as they have a lower income) compared to men. This explanation also applies to the earlier finding that women live in areas that have fewer firms; women who don't have jobs are less likely to need to live close to jobs.

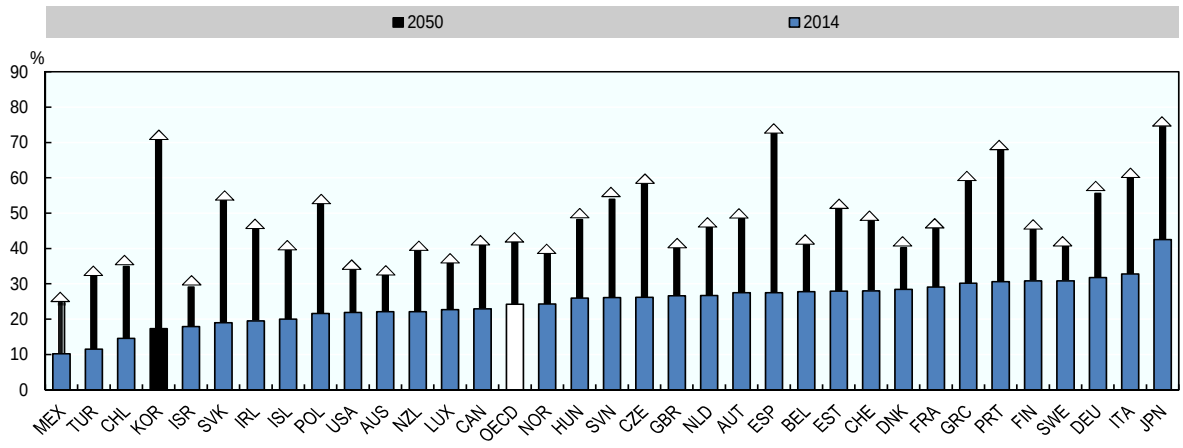
On the upside, some recent trends seem to indicate more encouraging signs towards greater gender balance in the labour market, at least in the public sector. For example, more than 40% of new middle grade civil servants joining the Korean public administration annually have been women since 2012, and this share rose to 48.2% in 2015.[8] The share of women among newly appointed national judges also jumped, from 64% to 87.5% between 2007 and 2013.[9]

The elderly live close to bus stops… and possibly, close to their grandchildren

Korea's population ageing is projected to be the fastest in the OECD (Figure 2.5). While Korea currently has one of the youngest populations among OECD countries, by 2050 it will have one of the oldest, only behind Japan and Spain. In this context, the present analysis finds that the elderly (defined here as those over 65) tend to live close to bus stops, in high-income areas. In Korea as a whole, and in a number of TL3 regions (especially Gangwon, but also Gyeonggi, Gwangju, Gyeongnam, Jeju and Chungbuk), there was a significantly positive correlation between the ratio of the elderly in TL5 population and bus accessibility (Figure 2.6). A possible explanation is that many elderly are unable to drive or to walk, thus tend to locate closer to bus stops. The share of the elderly in TL5 population was also positively correlated with the average income at TL5 level.

Figure 2.5. **Population ageing in Korea is projected to be the fastest in the OECD**

Population aged 65 and over as a percentage of the population aged 15-64

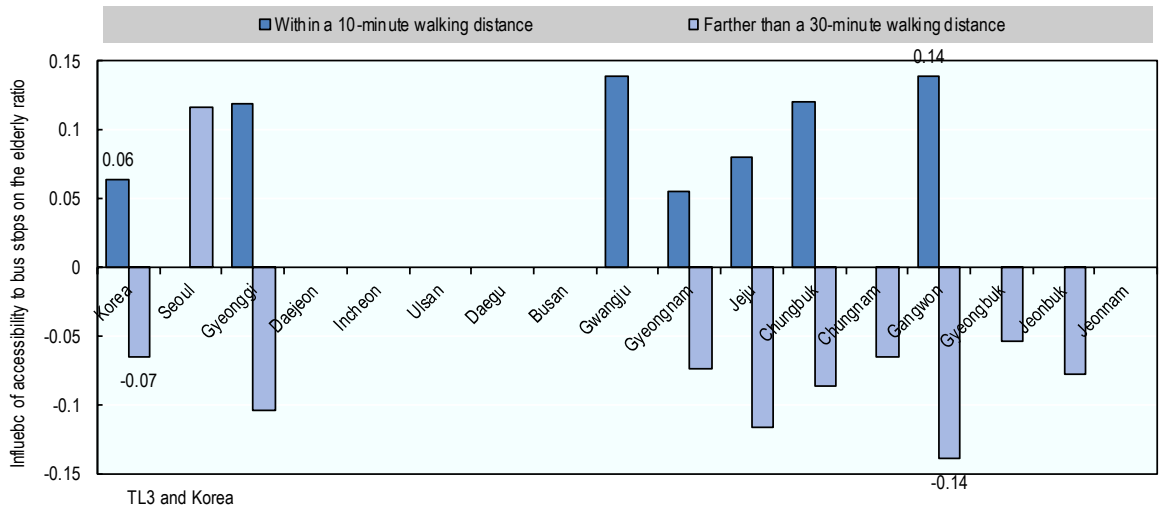


Source: OECD (2016), *Economic Surveys: Korea*, http://dx.doi.org/10.1787/888933355971.

Interestingly, the elderly also tend to live in areas that have many school-age children (Figure 2.7). This pattern was consistent from elementary school students to middle and high school students. For example, if the ratio of middle school students in TL5 population increases by 1 percentage point, the ratio of the elderly in total population increases by 1.12 percentage points. This might be because these two groups have common mobility needs. For example, both groups are unlikely to own a car or to be able to drive one. The elderly might find it easier to take the bus rather than the subway due to their physical limits, and students might need to live close to bus stops in order to commute easily to education facilities. The elderly might also choose to live near their children to maintain close family relationships. Another explanation may be that some elderly have little financial choice but to live with their children and grandchildren. Although the employment rate for the 50-64 year old age group in 2014 was the eighth highest in the OECD at 70%, their poverty rate was the second highest in the OECD at 15.5%, nearly 1.5 times the OECD average (OECD, 2016). Poverty then skyrockets in the next age group and Korea has the highest rate of elderly poverty by far among OECD countries (49.6% of Koreans aged 65 or more lived below the poverty line as of 2012, a staggering almost four times the OECD average of 12.6%) (Figure 2.8).[10] According to a MOLIT survey of Korean housing welfare, 13.2% of households included both elderly and grandchildren members

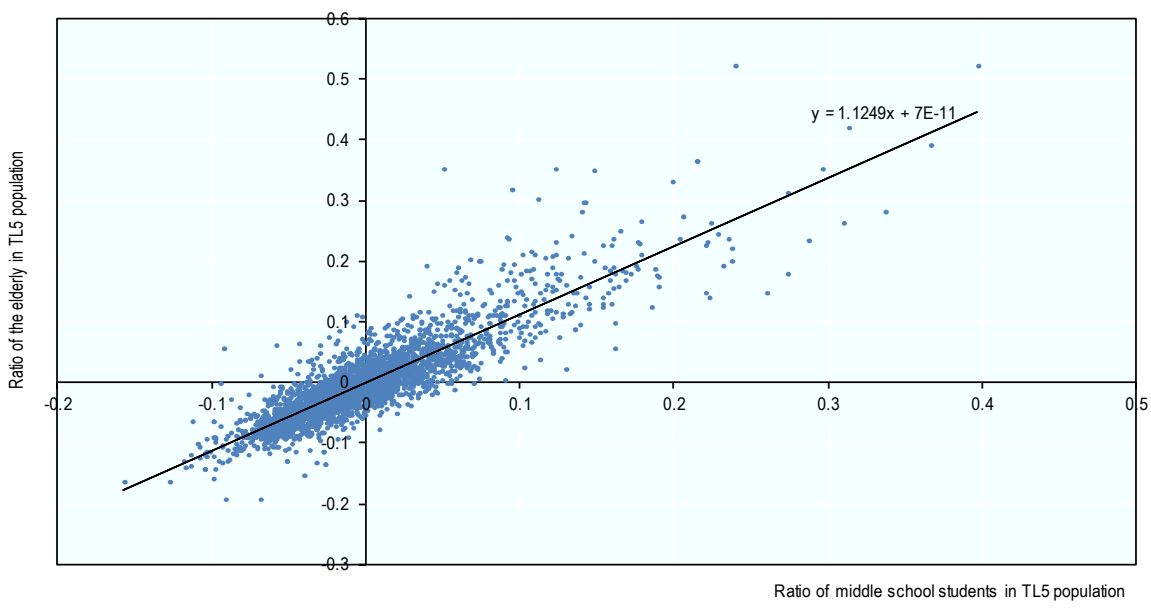
in 2010, up from 12.7% in 2007. In European Union (EU) countries, the share was 6.6% on average in 2008 (Iacovou and Skew, 2011).

Figure 2.6. **The elderly live close to bus stops**



Sources: Authors' own elaborations based on KOTI (2016), "Data request", https://www.ktdb.go.kr/www/contents.do?key=202; Biz-GIS Corp. (2016), "Big data in humanities and social science", www.biz-gis.com/XsDB; Kostat (2016), "Date utilization", http://mdis.kostat.go.kr.

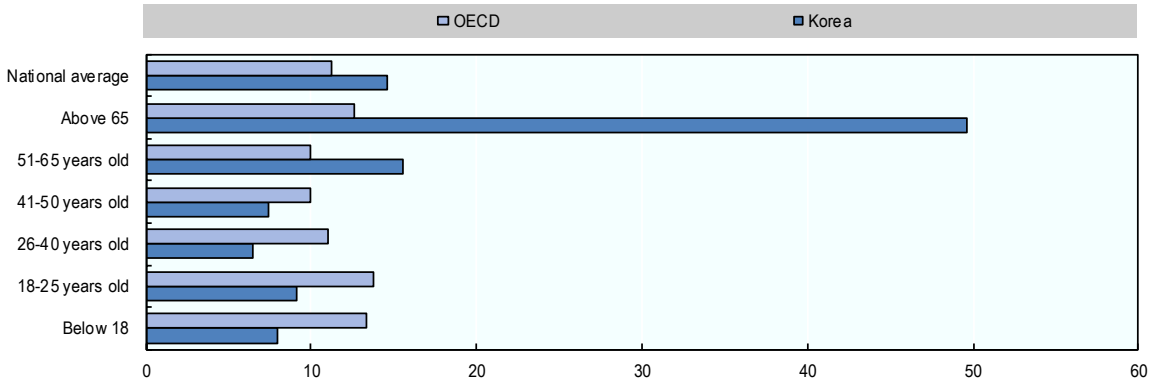
Figure 2.7. **Do the elderly live with their grandchildren in Korea?**



Sources: Authors' own elaborations based on KOTI (2016), "Data request", https://www.ktdb.go.kr/www/contents.do?key=202; Biz-GIS Corp. (2016), "Big data in humanities and social science", www.biz-gis.com/XsDB; Kostat (2016), "Date utilization", http://mdis.kostat.go.kr.

Figure 2.8. **Relative poverty rates for people aged over 65 are astoundingly high in Korea**

Percentage in 2013



Note: Relative poverty is measured by reference to median income, not taking into account household assets and liabilities.

Source: OECD (2016), *Economic Surveys: Korea*, http://dx.doi.org/10.1787/888933356197.

A special tool for analysing accessibility: Space syntax and its application in Korean cities

How do urban street networks and public transport accessibility relate?

To complement the analysis carried out in the previous sections of this chapter, an additional tool was used to assess the inclusiveness of the urban transport system in Korea. "Space syntax" aims to represent and analyse how urban street networks may shape each user's "possibilities and restrictions" (Holanda, 2010). By assessing how a particular street is integrated with the others and how likely people are to choose it, space syntax helps identify those parts of cities that may be less accessible than others in the broader urban grid and hence to the social and economic opportunities provided by a city (Box 2.2). Space syntax uses the term "integration" to describe the relative "depth" or accessibility of a particular street to all others (in other forms of network analysis, this would be called "closeness"). Space syntax also looks at how likely a street will be used for "through-movement" as people go from one street to the next, for which it uses the term "choice" (also known in other forms of network analysis as "betweenness"). The key arteries within a city which support the most movement are known as a "foreground network" – this network is revealed when the streets that are in the top 10% of both integration and choice values are highlighted. It is important to keep each of these concepts in mind as they have been used in the analysis of Korean cities that will be presented in this section.

The relationship between accessibility of urban streets and different socio-economic variables can be described as follows:

- Space syntax results have demonstrated that streets and segments of streets that host more pedestrian and vehicular movement are more likely to host economic activity. Conversely, less accessible areas may suffer from a lack of "natural surveillance" (people observing the activities of other people), which can lead to problems of crime and anti-social behaviour (Hillier, 1999). Further, certain groups (such as youth gangs) can monopolise the use of such unsurveilled space, making it unattractive (and threatening) for other groups of people, particularly the elderly.

Box 2.2. **An overview of space syntax**

Space syntax is a set of techniques for representing and analysing urban street networks, and identifying how these might influence human activities, most notably pedestrian and vehicular movement. Since its development in the late 1970s at University College London, a significant amount of evidence has been gathered of correlations between space syntax predictions and actual vehicular and pedestrian movement patterns in cities (Lerman et al., 2014). The aim of using space syntax is not to identify some kind of "architectural determinism" or to suggest that we are governed by our built environment – rather architecture is seen to create "a field of possibilities and restrictions" (Holanda, 2010), which may or may not impact on each person navigating the urban system.

There have been a number of previous studies using space syntax to analyse Korean cities, particularly Seoul (Park, 2015; Kim et al., 2011; Min et al., 2007; Choi et al., 2006; Jun et al., 2005; Kim and Sohn, 2002).

Theoretical background. Space syntax is based on two fundamental propositions: space is not a background to human activity, but intrinsic to it; and space is first and foremost configurational (i.e. what happens in individual spaces – rooms, corridors, streets and public spaces – is fundamentally influenced by the relations between that space and the network of other spaces into which it connects). A key theory developed by space syntax is that of "pervasive centrality". Most cities that have developed "organically" over long periods of time have both a central core and then multiple more local centres across the urban fabric. These local centres can be identified within the street configuration as both local deformations in the grid and areas of grid intensification – and they show up within the space syntax analysis as having high integration and choice values at different scales. Such local centres often host local economic development, shops and services. With its theory of "pervasive centrality", space syntax adds depth to the idea of "polycentricity", to show that different parts of cities have different functions (and different kinds of "centrality") at different scales.

Techniques. The space syntax analysis is based on road-centre line data. Space syntax uses a form of graph analysis, incorporated in software called Depthmap, to better understand the accessibility of a given space to all other spaces in a given system. When analysing cities, these spaces equate to streets, or often segments of streets. The design of Depthmap reflects the understanding that pedestrians may not only consider metric distance when choosing paths from one place to the next. Accessibility is also analysed on the basis of topology (the number of turns that need to be taken from one destination to another) and least angle choice (the paths requiring the least angular change from one destination to another). Space syntax has traditionally focused on the latter two forms of analysis because it is understood that people are more likely to choose routes that are more direct (i.e. that require fewer turns, and that require turns of a less acute angle). Depthmap also allows movement to be analysed at a number of different scales or radii, from small journeys at 100 or 200 metres up to much larger journeys that would cover the whole system (defined here as radius $R=\infty$).

Source: Adapted from Froy, F. and H.T. Park (2016), "Space syntax analysis of four Korean cities", unpublished.

- However, the relationship between poverty and social segregation is not straightforward. Vaughan points out that often people naturally "sort" into more accessible and less accessible parts of cities according to their income, but that this often occurs at the very local level, with rich and poor people living on relatively adjacent streets (Vaughan, 2005; Vaughan and Geddes, 2009). While richer people often live on (or close to) streets that are accessible on the city-wide scale, poorer people tend to live further away in more isolated back street

networks. Such fine differentiation is not always visible in statistical analysis, which tends to group streets into broader "statistical areas". In addition, there is a problem of causality to address – do people who are less well-off sort into less accessible spaces, or do the less accessible spaces actually reduce their economic prosperity? This is likely to be a mutually reinforcing process (Froy and Park, 2016).

- Accessible, "walkable" cities are increasingly highlighted as a policy tool for promoting health, and reducing cognitive decline and dementia amongst older people (Watts et al., 2015). The city of Moscow, for example, declared at the 2016 International Transport Forum Summit that pedestrians and cyclists were becoming the key strategic focus of transport master planning, while this is also a priority for the city of Leipzig (Green et al., 2016). In this regard, walkability is likely to be of particular relevance to Korea due to its ageing population. All three Korean metropolitan cities examined in the section below (Seoul, Busan and Incheon), showed a relatively low share of pedestrian movement (less than 23%) in comparison with other cities in the world, particularly those in Europe. For example, in Seoul approximately 13.0% travel by foot (Seoul, 2016), compared with 38% in Barcelona, 39% in New York and 30% in London (Singapore Land Transport Authority, 2011). The local integration of the grid system, and the degree to which people can access local amenities – particularly the elderly and those with limited transport, is important in encouraging walkability. The city of Portland in the United States, for example, has been trying to increase the number of "complete neighbourhoods", where people have access to basic shops and services within a local radius (Green et al., 2016). However, in many planned mono-use developments, such centres fail to develop, meaning that people are cut off from basic services and more reliant on cars or public transport.

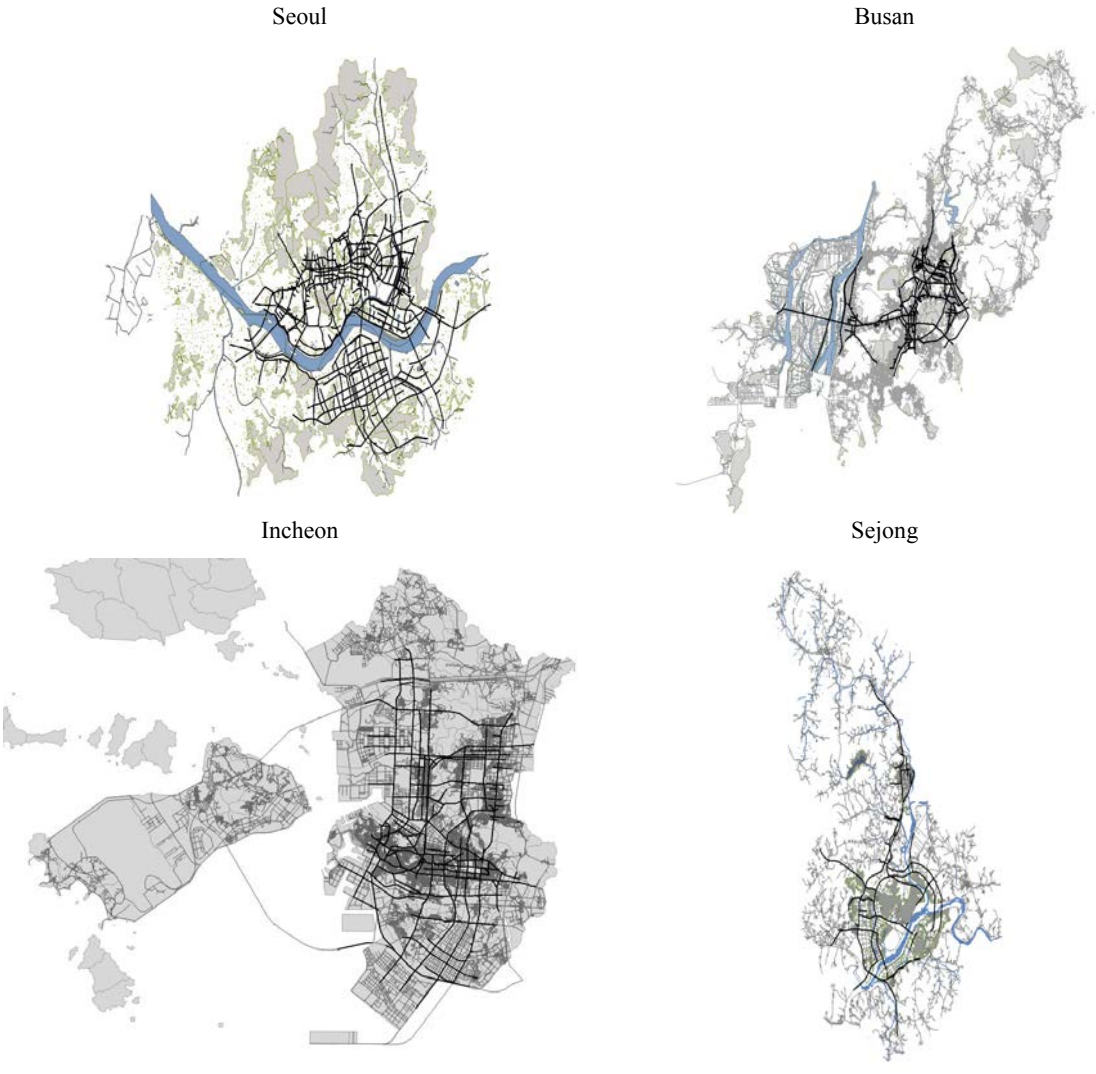
An assessment of the underlying accessibility patterns associated with urban street networks can therefore inform a number of urban policies including public transport, but also economic development, health and crime management (Froy and Park, 2016). For sure, changes to the underlying street structure of cities remain relatively rare, as city development incorporates a strong degree of path dependency and infrastructure changes are expensive (Bertaud, 2002). However, in some cases, other policy interventions – such as increasing public transport coverage – can compensate for the relative segregation of particular parts of the street network or poor connections between different parts of the city.

An important caveat to keep in mind is that public transport networks do not always play the positive role that might be expected in mitigating the urban segregation observed through space syntax analysis. In fact, public transport networks often tend to follow already accessible routes within the network (Scheurer and Curtis, 2008; Vieira and Medeiros, 2012). This may be because public transport networks are dependent on a certain degree of usage to be cost-efficient. For example, it can be difficult to obtain adequate coverage of public transport in less dense areas of the city as there will not be enough passengers to make this cost-efficient (Bertaud, 2004). Transport policies can also exacerbate problems of segregation in cities when new transport routes can act as barriers, cutting through neighbourhoods and destroying local vitality when they are not well-connected locally into their surrounding urban fabric. In order to fully understand how these different systems work together, space syntax analysis should be incorporated into broader models that also feature public transport networks (Gil and Read, 2013). Although this has not been possible here, the space syntax maps have been overlaid with public transport maps in GIS to assist in the analysis.

An illustration in four selected cities in Korea

Given that Korea is one of the most urbanised and densely populated countries in the OECD, its largest cities offer a naturally interesting terrain for applying space syntax. The capital, Seoul, has the highest density in Korea, while Busan and Incheon are the second and third largest cities, respectively. Sejong was also selected because it provides a unique case of a new city that was entirely planned and created by the central government in an attempt to alleviate overconcentration in the capital area. While the results of the space syntax analysis carried out on each city are presented in more detail in Chapter 3, this section offers a summary of the main findings and discusses their link with urban transport accessibility.

Figure 2.9. **The top 10% integration and choice core in Seoul, Busan, Incheon and Sejong**



Source: Froy, F. and H.T. Park (2016), "Space syntax analysis of four Korean cities", unpublished.

First, urban street networks in Seoul, Busan, Incheon and Sejong display varying patterns of "integration and choice cores" (Figure 2.9). Overall, Seoul, Busan and Incheon have developed multiple city centres, which are more or less weakly connected together. In each case, the historic city centres still seem to be acting as strong "integration and

choice cores", and would therefore be expected to host a high degree of movement. Where new centres have been recently developed as part of urban planning initiatives (e.g. through the development of the "new international city" of Songdo and the establishment of a new administrative centre in Sejong), they are not yet functioning so effectively as integration and choice cores – meaning that they are likely to be less navigable and less accessible. More specifically in each city:

- Seoul has developed a rather fragmented and polycentric overall spatial configuration, with an old centre in the north (incorporating Jong-ro) and more recently developed centres in the south-west and south (Gangnam). While Gangnam is relatively well-connected to the old historic centre, the south-west is more poorly integrated at the city scale, although it has high population density. Areas of the north also appear to be more poorly integrated. The preponderance of "super blocks" in the urban grid (blocks that are much larger than traditional blocks and are typically bounded by wide arteries rather than small streets) may increase people's walking time to public transport connections.
- Busan has developed multiple small centres that seem to function as "high accessibility points". The fragmented nature of the city reflects its geographical topography, with mountains coming right into the city's heart, and hence relatively narrow development corridors. The four subway lines and one light train line connect residential areas to the fragmented centres. Bus services are provided more evenly than in other cities (i.e. not just on the roads with high choice values), in order to cover the hilly residential areas.
- Incheon still has a well-integrated historic centre (near the old port), where the street grid is the most intensive, and this connects fairly well into a newer centre to the east which hosts key public and cultural amenities. Both the newer centre to the east and the new "international city" of Songdo to the south show low local integration scores. The island of Youngjong-do is relatively well-connected in terms of through-movement routes, but it is not connected into the city's integration and choice core.
- Sejong has a divided structure, with the relatively well-integrated city centre (connected to Seoul through a rail link) being rather disconnected from the new administrative centre to its south. The new administrative centre is also weakly integrated locally, meaning that moving around this centre may be challenging – not helped by the relatively poor access to bus stops in this area.

Second, while this can only be speculative, tentative implications of these findings in terms of social inclusion in each city include:

- Large groups of residents in Seoul are weakly connected to the "foreground accessibility network" of the city. In the south-west of the city, such people may be working within the broader Seoul-Incheon conurbation, meaning that this disconnect is less important. However, in the north-east of the city, lower accessibility coincides with pockets of low-income residents, who may be restricted in accessing the economic and social opportunities that Seoul has to offer. In such areas, enhancing public transport connections into the city centres will be particularly important. It is a positive sign, for example, that several light train lines are planned and currently under construction in the north-eastern part of Seoul, to connect it more directly to the city centre.

- In Busan, the fragmented nature of the city may hinder lower income people from accessing opportunities, including jobs, and may increase transport and commute times.
- In Incheon, the fact that the new city of Songdo seems to be slightly disconnected from the rest of the city may support a growing disconnect between the old industrial centre and newer high-skill, high-income developments in the "urban fringe" (Ducruet et al., 2013). This will make the connections into these areas through the city's rail and bus network particularly important.
- In Sejong, the disconnection of the newer administrative centre from the rest may principally affect the people who work in this part of the city, who are likely to be the higher income workers that have arrived from the Seoul metropolitan area. The implications for lower income local workers, and thus for social inclusion, are less clear.

Conclusion

Evidence presented in this chapter has shown that urban transport accessibility (particularly bus accessibility) in Korea is highest in areas that are densely populated and offer more economic opportunities. Accessibility is particularly high for the richest and for men. At the same time, it is also high for specific age groups, such as school-age children and the elderly. When public transport networks were overlaid with urban street networks in a selection of Korean cities, the analysis highlighted an effective coverage of mobility needs, but also a number of areas within these cities where lower income residents were likely to be disconnected from economic and social opportunities. Expanding the analysis of urban inclusiveness, notably in terms of the affordability and quality of housing markets, could strengthen the evidence base for designing more effective urban policies.

Notes

1. While other modes, such as cycling and walking, also offer relevant alternatives to individual cars, they have not been considered in the analysis. The reason is that they are typically most suitable for short-distance trips and currently account for a relatively low modal share in Korean cities (although they may gain ground in the future).
2. Population grid data was downloaded from www.biz-gis.com.
3. All the micro data were gathered in 2010, whereas public transport data are from 2012-13.
4. The OLS regression is based on data for 2010 from KOTI, Biz-GIS and Ministry of Security and Public Administration micro databases, and includes fixed effects for TL4 regions. The OLS equation for access to buses is (share of people who live within a ten-minute walking distance from bus stops) = (0.00000618)***×

(population density) + (0.000958)***×(number of educational institutions) + (0.0000637)*** ×(number of retail or wholesale stores) with an R^2 of 0.64, and for 3 416 observations. The OLS equation for access to trains is (share of people who live within a ten-minute walking distance from train/metro stations) = (0.00000128)***× (population density) + (0.0000484)×(number of educational institutions) + (0.0000278)* ×(number of retail or wholesale stores) with an R^2 of 0.45, and for 3 416 cases.

5. A similar analysis carried out for the accessibility and inaccessibility to train/metro stations did not show any significant correlation patterns between the latter and the income level. This might be due to the lower number of train/metro stations compared to the number of bus stops and to the fact that buses and trains do not have the same functionality. In any case, this is coherent with a high degree of inclusiveness for bus transport in most larger and more densely populated cities, and with train/metro playing a lower role in public transport compared to buses in less densely populated provinces.

6. The OLS analysis is based on data for 2010 from KOTI, Biz-GIS and Ministry of Security and Public Administration. It includes fixed effects for TL4 regions. The OLS equation is (share of women living outside of a 30-minute walking distance from bus stops) = -0.177***×(bus accessibility)+ (-0.0000216)**×(# of manufacturing firms) + (-0.000556)***×(# of education firms) + (-6.57e-06)×(# of retail/wholesale shops).

7. For further details on the gender wage gap, see: https://www.oecd.org/gender/data/genderwagegap.htm.

8. See www.gosibox.pe.kr/413 for further information.

9. For further information, see: www.hani.co.kr/arti/society/society_general/617262.html (Kim, W.C., 2013) and www.hani.co.kr/arti/society/women/184594.html (Yeon Hap News, 2007) (accessed 7 December 2016).

10. The poverty rate refers to the share of total population that makes less than 50% of the median income. See further details at: https://data.oecd.org/inequality/poverty-rate.htm.

References

Bertaud, A. (2002), "Note on transportation and urban spatial structure", ABCDE conference, Washington.

Bertaud, A. (2004), "The spatial organisation of cities: Deliberate outcome or unforeseen consequence?", http://alain-bertaud.com/images/AB_The_spatial_organization_of_cities_Version_3.pdf (accessed 7 December 2016).

Biz-GIS Corp. (2016), "Big data in humanities and social science" (in Korean), www.biz-gis.com/XsDB (accessed 7 December 2016).

Bok, J.J. and Y.S. Kwon (2016), "Comparable measures of accessibility to public transport using the general transit feed specification", *Sustainability*, Vol. 8/3, pp. 224, http://dx.doi.org/10.3390/su8030224.

Choi, A.S. et al. (2006), "Application of the space syntax theory to quantitative street lighting design", *Building and Environment*, Vol. 41/3, pp. 355-366, http://dx.doi.org/10.1016/j.buildenv.2005.01.026.

Ducruet, C. et al. (2013), "The flight of Icarus? Incheon's transformation from port gateway to global city", in Hall, P.V. and M. Hesse (eds.), *Cities, Regions and Flows*, Abingdon, Routledge, Oxon, https://halshs.archives-ouvertes.fr/halshs-00717425 (accessed 7 December 2016).

Froy, F. and H.T. Park (2016), "Space syntax analysis of four Korean cities", a report prepared for the OECD, unpublished.

Gil, J. and S. Read (2013), "Patterns of sustainable mobility and the structure of mobility in the Randstad city-region", in: Kim, Y.O., H.T. Park and K.W. Seo (eds.), 9th International Space Syntax Symposium, Seoul.

Green, A. et al. (2016), "How do cities lead an inclusive growth agenda: International experiences", Joseph Rowntree Foundation, York, https://www.jrf.org.uk/report/how-do-cities-lead-inclusive-growth-agenda.

Hillier, B. (1999), *Space is the Machine: A Configurational Theory of Architecture*, Space Syntax, London, www.ninsight.at/ak_stdb/SpaceIsTheMachine.pdf (accessed 7 December 2016).

Holanda, F. (2010), "Sociological architecture: A particular way of looking at places", *The Journal of Space Syntax*, Vol. 1/2, pp. 337-355.

Iacovou, M. and A. Skew (2011), "More than 10% of households in Romania, Latvia, and Bulgaria were three-generation in 2008", webpage, http://ec.europa.eu/eurostat/documents/3433488/5579620/KS-SF-11-052-EN.PDF/9a190f6f-8949-4d3d-99ad-989479c6b23b (accessed 16 February 2017).

ITF (2017), *ITF Transport Outlook 2017*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789282108000-en.

Jun, C. et al. (2005), "Assessing public transportation accessibility based on topological structure", *CUPUM 2005 Proceedings*, pp. 329-338.

Kim, H.K. and D.W. Sohn (2002), "An analysis of the relationship between land use density of office buildings and urban street configuration", *Cities*, Vol. 19/6, pp. 409-418, http://dx.doi.org/10.1016/S0264-2751(02)00071-9.

Kim, H.K. et al. (2011), "A study on the transformation of urban layout patterns through analysis of spatial relationships with urban street configurations", *International Journal of Urban Sciences*, Vol. 15, pp. 25-34, http://dx.doi.org/10.1080/12265934.2011.580140.

Kim, W. C. (2013), "87.5% share of women among newly appointed judges in 2013: The highest record so far", *Hankyoreh* newspaper's webpage, http://www.hani.co.kr/arti/society/society_general/617262.html (accessed 19 February 2017).

Kostat (2016), "Date utilization", Micro data Integrated Service, National Statistics Office, http://mdis.kostat.go.kr (accessed 7 December 2016).

KOTI (2016), "Data request", Korean Government 3.0 open data, Korea Transport Data Base, https://www.ktdb.go.kr/www/contents.do?key=202 (accessed 7 December 2016).

Lerman et al. (2014), "Using Space Syntax to model pedestrian movement in urban transport planning", *Geographical Analysis*, Vol. 46, p.p. 392-410.

Litman, T. (2016), "Accessibility for transportation planning: Measuring people's ability to reach desired goods and activities", Victoria Transport Policy Institute, www.vtpi.org/access.pdf (accessed 13 December 2016).

Matsumoto, T. (2013), "Accessibility to public transport: The OECD approach", presentation in the workshop on "Accessibility to Quality Services in Regions and Cities: Measures and Policies", 18 June 2013, Paris, www.oecd.org/gov/regional-policy/PPT-Transport.pdf (accessed 13 December 2016).

Min, K. M. et al. (2007), "The effect of spatial configuration on land use and land value in Seoul", 6th International Space Syntax Symposium, Istanbul.

OECD (2016), *OECD Economic Surveys: Korea 2016*, OECD Publishing, Paris, http://dx.doi.org/10.1787/eco_surveys-kor-2016-en.

OECD (2015a), *The Metropolitan Century: Understanding Urbanisation and Its Consequences*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264228733-en.

OECD (2015b), "Road traffic, vehicles and networks", in *Environment at a Glance 2015: OECD Indicators*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264235199-17-en.

Park, D.S. (2016), "A comparative assessment of modal shift policies (MSPs) in the passenger sector in Korea", University of Southampton, mimeo. http://eprints.soton.ac.uk/388075/1.hasCoversheetVersion/PARK_FINALTHESIS.pdf (accessed 3 December 2016).

Park, H.T. (2015), "The spatio-temporal routine of pedestrian movements in large cities: The case of Seoul", in: Karimi, K. et al. (eds.), *10th International Space Syntax Symposium*, London.

Scheurer, J. and C. Curtis (2008), "Spatial network analysis of multimodal transport systems: Developing a strategic planning tool to assess the congruence of movement and urban structure", Curtin University of Technology, www.curtin.edu.au/research/cusp/local/docs/perth-snamuts-report.pdf (accessed 7 December 2016).

Seoul (2016), "Commuting transport modes of the year 2015" (in Korean), Seoul Statistics, Seoul Metropolitan City website, http://stat.seoul.go.kr/octagonweb/jsp/WWS7/WWSDS7100.jsp.

Singapore Land Transport Authority (2011), "Passenger transport mode shares in world cities", *Journeys,* November, www.lta.gov.sg/ltaacademy/doc/J11Nov-p60PassengerTransportModeShares.pdf (accesssed 7 December 2016).

Vaughan, L. (2005), "The relationship between physical segregation and social marginalisation in the urban environment", *World Architecture*, Vol. 185, pp. 88-96, http://discovery.ucl.ac.uk/884/1/Vaughan_2005.pdf.

Vaughan, L. and I. Geddes (2009), "Urban form and deprivation: A contemporary proxy for Charles Booth's analysis of poverty", *Radical Statistics*, pp. 46-73, http://discovery.ucl.ac.uk/16440/1/16440.pdf.

Vieira, P.D.A. and V.A.S.D. Medeiros (2012), "Urban morphology and public transportation system: The segregation process in Goiana, Brazil", in Greene, M., J. Reyes and A. Castro (eds.), *Proceedings: Eighth International Space Syntax Symposium*, PUC, Santiago de Chile.

Watts, A. et al. (2015), "Neighbourhood integration and connectivity predict cognitive performance and decline", *Gerontology and Geriatric Medicine*, Vol. 1, http://dx.doi.org/10.1177/2333721415599141.

Chapter 3.

Spotlight on four Korean cities

This chapter provides an in-depth analysis of public transport in four Korean cities: Seoul, Suwon, Changwon and Sejong. It explores each city's strengths and challenges in terms of public transport policy, with an analysis of accessibility and inclusiveness when available.

Introduction

This chapter provides an in-depth analysis of four Korean cities: Seoul, Suwon, Changwon and Sejong. The first three cities were selected as case studies because they received several awards from the Korean Ministry of Land, Infrastructure and Transport (MOLIT) in "sustainable transport" and "public transport policy evaluation" (Box 3.1). The fourth city, Sejong, offers a unique case of a city entirely planned and created by the central government as a new administrative hub of Korea, which is strongly committed to transit-oriented development (TOD). The chapter will explore each city's strengths and challenges in terms of public transport, with an analysis of accessibility and inclusiveness whenever possible (see detailed methodology in Chapter 2, particularly about "space syntax" techniques). A detailed profile of each metropolitan city or province in Korea in terms of public transport accessibility is also available in the annex of this chapter.

Box 3.1. **Ministry of Land, Infrastructure and Transport evaluation of local public transport**

The Korean Ministry of Land, Infrastructure and Transport (MOLIT) conducts several evaluations of local public transport, where top-performing cities receive financial rewards. Two examples of such evaluations include:

- Sustainable urban transport. Cities are evaluated according to the following criteria: greenhouse gas emissions, transport safety, accessibility to and share of public transport, share of green transport, traffic congestion cost, average commuting time, share of environmentally friendly vehicles, policy effort to reduce the use of private cars, degree of transport customisation for pedestrians or bike users, and facilities for seamless transport (e.g. through transfer centres). Cities compete in four categories: metropolitan cities (Territorial Level 3, TL3); cities that have 300 000 or more inhabitants, but are not "urban-rural complex cities" as defined by the Local Autonomy Act;[1] urban-rural complex cities that have 300 000 inhabitants or more; and cities that have between 100 000 and 300 000 inhabitants.
- Public transport policy evaluation. Cities are evaluated according to the following four criteria: public transport infrastructure and transfer system; public transport service, convenience for customers and employee training; policy excellence and administrative support for the policies; and customer satisfaction and usage rate. Cities compete in five categories: metropolitan cities (TL3); cities that operate a city railway (subway, tram and light rail); cities that do not operate a city railway but have 300 000 inhabitants or more; cities that have fewer than 300 000 inhabitants; and TL4 regions (named "*gun*").

Seoul, Suwon and Changwon have ranked first in both categories several times (i.e. Seoul was the best in "sustainable urban transport" among metropolitan cities and the best in "public transport policy evaluation" among metropolitan cities five consecutive times since 2007; Suwon was the best in "sustainable transport" in 2015 and the best in 2011 and 2015 in "public transport policy evaluation" among the cities that have 300 000 inhabitants or more; Changwon was the best in "sustainable transport" among the cities that have 300 000 inhabitants or more in 2014, and the best in "public transport policy evaluation" among the cities that do not operate a city railway but have 300 000 inhabitants or more since 2013).

Note: 1. The Local Autonomy Act defines "urban-rural complex cities" as: 1) a combination of a city and a *gun* (TL4); 2) a *gun* that has a city-type area with a population of more than 50 000; 3) a *gun* that has more than two city-type areas with a population of more than 20 000, where the sum of the population is more than 50 000 and the total population of the *gun* is more than 150 000; and 4) a region that includes a nationally built city, a branch office from the province (TL3), a population of more than 30 000, and which is a part of another urban-rural complex city with a population of more than 150 000.

Source: Authors' own elaborations drawing on information from MOLIT.

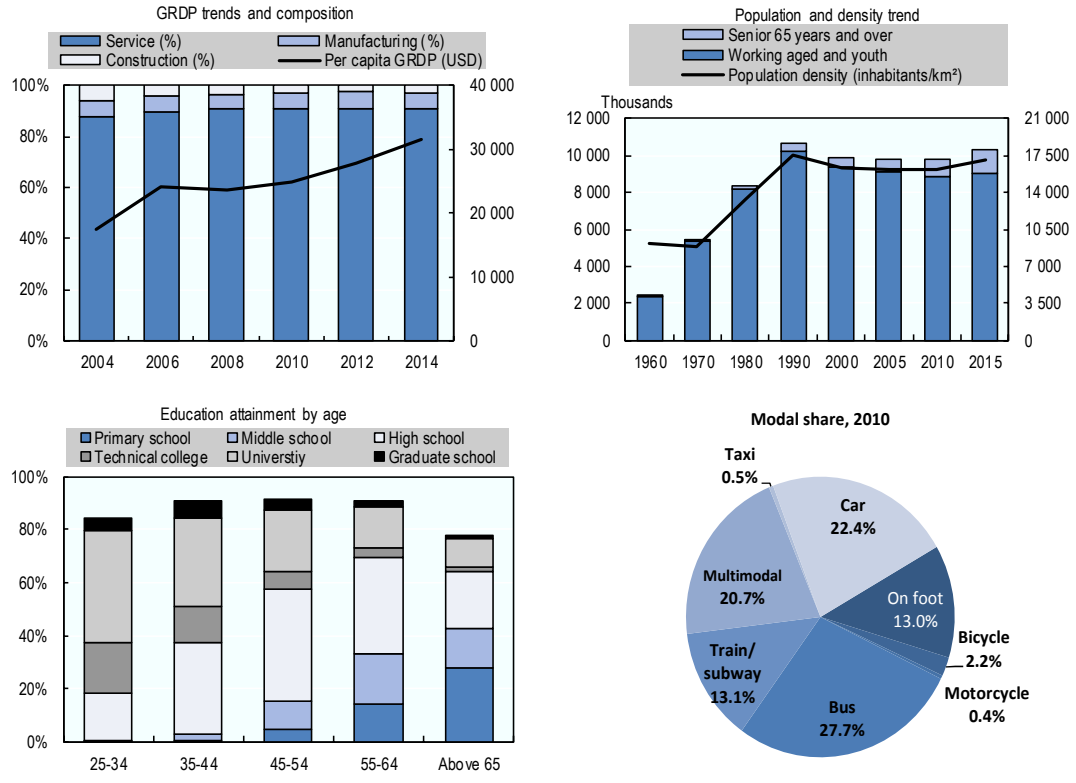
Case study of Seoul

Seoul pioneers and operates a distinctive model of a semi-public bus operation system, an integrated single transport pass and a traffic-related big data system that can inform the policy-making process.

City profile

Seoul is the capital of Korea. Although the city accounts for only 0.6% of the national territory (605.2 km²), it is home to one-fifth of the national population (10 million) and almost half if considered together with neighbouring Incheon and Gyeonggi (the capital region). The population density is high in Seoul (17 013/km²), and considerably above the level in most other large OECD cities, including Greater London (5 389), Berlin (3 855) or Tokyo (6 992) in 2014 (OECD, 2016) (Figure 3.1). The gross regional domestic product (GRDP) per capita averages USD 31 955,[1] with around 90% of it being produced in the service sector. Seoul is indisputably the most affluent and the most autonomous subnational government in Korea, with a financial independence rate (calculated as the percentage of local own resources over total budget) of 75%, which is by far the highest rate among subnational governments in Korea.

Figure 3.1. **Seoul's key socio-economic indicators**



Notes: The data on educational attainment are based on the 2010 Population and Housing Census. The bars do not equal 100% due to a number of possible reasons: when there was no response; when the government voluntarily eliminated some responses to protect individuals' privacy; and when the Census automatically eliminates records if the number of responses collected in the investigation area is less than five (to eliminate outliers).

Source: Authors' own elaborations based on KOSIS and Seoul Statistics (2016), "Transport modal choice for commuting", http://stat.seoul.go.kr/ (accessed 20 December 2016).

Seoul has an outstanding transport infrastructure. It ranks first among Korean TL3 regions in terms of road length (5 022 m/km^2 compared with a national average of 0.28 m/km^2), the number of train stations (320, including 257 subway stations), railway length (701 m/km^2) and subway line length (532.7 m/km^2, far above second-ranked Busan with 122.9 m/km^2 and third-ranked Daegu with 57.5 m/km^2) in 2010 (KOTI, 2016; Kostat, 2016a). The combined modal share of public transport and non-motorised modes is almost 77% (see Figure 3.1).

Seoul offers the highest level of accessibility to public transport among Korean TL3 regions (Figure 3.2). Its total population (based on TL5 data) that lives within a ten-minute walking distance from a bus stop is 81% (compared to 75% in Daejeon, second-ranked) and 19.8% within a ten-minute walking distance from a train station on average (compared with 12.2% in Busan, second-ranked). Most areas in Seoul have a balanced level of accessibility to bus stops and train stations, which is quite unique compared with other TL3 regions in Korea. A comprehensive public transport network, composed of 9 subway lines, 355 intra-city bus routes and 238 village bus routes, serves Seoul's 25 autonomous districts (*gu*) (Seoul, 2016a). Buses are the most widespread mode of public transport in the city, while the subway primarily serves demand in areas of high traffic flows. Buses service a much wider area than the subway, interconnecting all districts (apart from the northern and southern mountainous areas). The walking distance to the nearest bus stop is usually much shorter than that to the nearest train/subway station. Considering that accessibility is a key determinant of user convenience and citizens' choice of transport mode, this may explain the fact that buses account for a higher share of total trips than the subway (27.7% versus 13.1%) (Seoul Statistics, 2016).

Overview of public transport policy

Seoul's pioneering initiatives for public transport stem from a deep recognition of the problems generated by car- and road-centred planning. For example, excessive use of private vehicles has brought about environmental degradation and health concerns. For many years already, Seoul's citizens have been enduring a level of particulate matter concentration that is twice the acceptable threshold suggested by the World Health Organization (Choi, 2016). Automobiles are the main culprit of greenhouse gases in Seoul, as they generate 7 times more CO_2 than buses and 15 times more than the subway (Seoul, 2013). Another significant negative consequence has been road congestion. Generally speaking, cars consume 20 times more road space and 8.5 times more parking space than buses. Congestion costs in Seoul are estimated to amount to KRW 7.5 trillion (USD 6.4 billion) per year and are expected to triple, up to KRW 22 trillion (USD 18.9 billion) by 2030 (Seoul, 2013).

Faced with such challenges, Seoul has established a variety of innovative traffic-related initiatives since the mid-2000s, with the main goal to shift gradually towards a people-friendly and low-carbon traffic environment. The 2004 bus reform marked the starting point of a series of political efforts (see more detailed discussion in Chapter 1). All these policy measures are part of a broader transport integration to deliver seamless services. Preston (2012) defines nine types of integration that need to be pursued to ensure the sustainability of the transport sector. Seoul has achieved successful outcomes in several types of integration, particularly regarding information, mass transport pricing and services, and public-private operations:

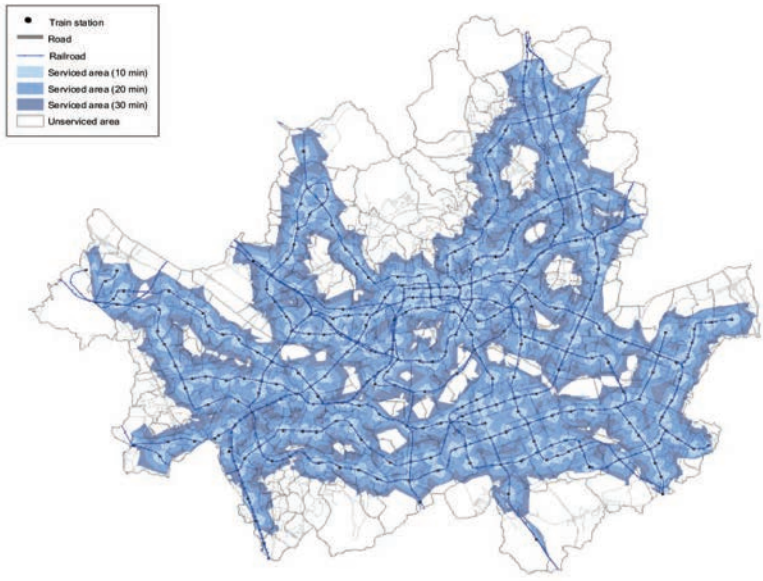
- Integration of information: Seoul has implemented a world-class traffic information system. The city's Bus Information System (BIS) has greatly enhanced user convenience by providing real-time information (updated every ten seconds) about

the buses' current location, arrival times, service intervals and recommendations for best routes and transfers. The real-time data are collected through 811 units of fixed cameras installed every 250 metres along the roads, as well as moving GPS devices mounted on buses. All the devices measure traffic volume and speed and detect illegal parking. The entire operation is supervised by the Seoul Transport Operation and Information Service (TOPIS).

Figure 3.2. **Public transport accessibility in Seoul in 2010**

10-, 20- and 30-minute walking distances to bus stops

10-, 20- and 30-minute walking distance to train stations



Note: These maps were produced by ArcGIS 10.1 with a network analysis tool using the service area of points of interest.

Sources: Authors' own elaborations based on KOTI (2016), "Data request", https://www.ktdb.go.kr/www/contents.do?key=202; Biz-GIS Corp. (2016), "Big data in humanities and social science", www.biz-gis.com/XsDB; Kostat (2016a), "Date utilization", http://mdis.kostat.go.kr.

- Integration of pricing: Seoul was the first city to create an electronic payment system that allowed users to ride buses and subways within the capital area (Seoul, Incheon, Gyeonggi) with a single transport card and benefit from transfer discounts. Such a seamless fare structure in Seoul laid the foundation for the "One Card, All Pass" system later introduced by MOLIT in 2014, which made it possible to travel with one single card in almost all regions of Korea on a wide range of transport modes, including inter- and intra-city buses, city buses, subways, regional trains, taxis, Nanum car (Seoul's public car system), and even to pay toll-gate fees. The transport card can also be substituted with an ordinary bank card or a smart phone. This high-tech pricing system not only eliminates the user's discomfort of having to queue to recharge the conventional pre-paid transport card, it also facilitates the collection of traffic big data. Considering that 99% of users in Seoul travel with a transport card (Seoul Solution, 2016), the data directly reflect consumer needs and indirectly signal consumer satisfaction. This opens up new opportunities for making transport and land-use decisions more responsive to community needs.

- Integration of transport services: Seoul Station is one of the most crowded transport hubs of the city. Previously, bus stops and subway exits were scattered around the station without proper direction boards, which made transfers inconvenient and time-consuming. Therefore, the city government built a multi-modal transit centre, which brings together 89 bus routes on one spot within a close walking distance to subway lines 1 and 4, as well as KTX express railway (Seoul, 2016b). Another successful initiative is the creation of inter-city transfer centres. They are situated on the major access points to the capital with a total parking capacity of 1 689 vehicles, offering on-site access to subways and buses, as well as bike racks. The service runs day and night throughout the year, with a relatively affordable monthly membership (around USD 60) (Seoul, 2016a). Seoul has completed the construction of five inter-city transfer centres, and is planning on building four more centres in the near future (Seoul, 2016c).

- Integration of public-private operations: The introduction of a semi-public bus operation system was part of the 2004 reform package. Previously, bus routes were treated like the private property of bus operators, so that the city government could not intervene in designing the bus network in a way that maximises social benefits. The new system aims to ensure both public ownership and assisted private operation. The city government compensates the operation deficits of private operators in exchange for the right to modify, create or eliminate bus routes. With the reform, the bus network has been fully reorganised into a trunk-feeder system, and buses are now classified into five types, which are serial-numbered and colour-coded to make it easier for users to recognise them. Traffic accidents have been halved during the last decade and citizens' satisfaction has improved by 32% since the city government introduced an evaluation and incentive scheme (Seoul, 2016d).

According to the city government, its recent transport policy is based on four pillars.[2] First, the city seeks to improve citizens' accessibility to public transport. The Seoul Urban Railway Comprehensive Enhancement Strategy proposes to build two additional subway lines to connect the districts that are currently outside the catchment area. The project will extend the current 327.1-kilometre-long urban railway network to 441 kilometres, with the ambitious aim to make the subway reachable within a 10-minute walking distance

from anywhere within the city. The second pillar is to give priority to pedestrian safety. At present, there is no speed limit regulation specific to residential roads of less than 13-metre-wide, although 53% of traffic fatalities in Seoul occur on these roads (Lee, 2016). The city government is currently identifying the 43 most precarious roads, which will be subject to targeted treatment, including stamped pavement, crash barriers and parking control plans. The third pillar of the strategy concerns disincentives against car use. A comprehensive "road diet" approach will be put in place to redistribute road space in favour of pedestrian streets and bus-only lanes. Finally, the fourth pillar is about enhancing social cohesion. While transport used to be regarded as a simple construction work, the social impact of traffic infrastructure and services is now assessed right from the initial stage of the policy-making process. Customised services for vulnerable users are also being developed. By 2017, low-floor buses will be expanded from 30.3% today to 55% of the city's bus fleet and on-demand taxi services for disabled users will be improved, so that the majority of these users can be serviced within 30 minutes of their request.[3]

Opportunities and challenges

Seoul has put forward a forward-looking, comprehensive strategy to shape its urban transport landscape over the coming decades in its Seoul Traffic Vision 2030 (Box 3.2). The Vision proposes 11 actions, all geared towards achieving the "Triple 30" by the year 2030, i.e. a 30% reduction of car traffic volume; a 30% reduction of commuting time by public transport; and a 30% increase in the use of green transport (walking, cycling and public transport). A well-balanced combination of push (disincentives for using private vehicles) and pull (rewards for choosing public and soft transport modes) instruments could help Seoul achieve such goals. Seoul's modal shift strategy has so far relied more on pull instruments to improve the quality of public transport. For example, the congestion charging scheme, which has been applied to two tunnels of the Nam Mountain in the city since 1996, levies a relatively low fee (around USD 2 per vehicle) and on a very restricted area. This allows citizens to bypass the scheme through alternative routes nearby without changing their modal behaviour. Raising the level of the congestion charge and expanding the area of application is a politically difficult task, which is likely to trigger public opposition. Winning public support requires raising stronger awareness on the benefits that would come from less traffic and reduced air pollution. In the case of Stockholm, a temporary seven-month trial was initially conducted, after which the support rate among citizens jumped from 36% to 74% (European Conference on Mobility Management, 2015). On the other hand, alternatives to congestion pricing might also be considered in Seoul, including limited traffic zones (which only allow pedestrians, bikes and buses, as is done in part of Seoul and has been experimented with in Suwon's Eco-Mobility Village), higher parking fees and car-pooling mechanisms.

Green transport is also a major field of action for Seoul. Following the Korean national policy to tighten the average emission standard of automobiles from 140 g/km in 2015 to 97 g/km in 2020, Seoul is planning on installing a fuel-reduction system on around 4 000 compressed natural gas (CNG) buses over the next five years to improve fuel efficiency by 15%. The fuel-reduction system is based on indicators to signal the optimal time for gear shift based on real operation data about speed, passengers, road structure and the cooling system for vehicle heat. Seoul's target renewable energy share is 18% in 2016 and 21% in 2017 (Seoul, 2016e).

Road maintenance and customised buses are also essential for customer satisfaction. For example, the city's Roadside Stop Improvement Plan proposes to repair and ensure the maintenance and renovation of 5 712 old bus stops which pose a threat to the safety of

bus passengers and pedestrians (Seoul, 2016f). A night bus network, called "Owl Bus", has operated at night since 2014 and is currently running eight lines, with an adjustment of routes based on big data.

Box 3.2. **Seoul Traffic Vision 2030**

The Seoul Traffic Vision 2030 frames the way forward for the city's urban transport for the upcoming decades. The vision is the highest level transport plan at the local level and revolves around three main axes: people, sharing and the environment. Under these 3 axes, the vision puts forward 11 goals together with specific implementation goals. The expected outcomes approaching the target year 2030 include: an increase in the modal share of green modes (e.g. walking, cycling, public transport) from 70% today to 80%; and a decrease in greenhouse gas emissions from 1.2 tonnes/year today to 0.8 tonnes/year.

People	1. Consideration for pedestrian convenience 2. Bicycles as a daily means of transportation 3. Reduction of road accident fatalities 4. Obstacle-free traffic environments for vulnerable users	– Doubling the surface area of pedestrian ways – Expanding pedestrian-only and public transport-only zones – Expanding the public bike network with close integration with the public transport networks – Reducing road fatalities by introducing a 30 km/h speed limit on all residential streets by 2030 – Converting all buses to low-floor buses – Increasing the number of on-demand taxis for disabled users
Sharing	5. Focused investments on railways 6. A mass transit system with enhanced convenience and speed 7. Promotion of a sharing culture in the transport sector	– Constructing an artery express subway line connecting the three urban cores of Seoul – Restructuring the bus service as a secondary complement to the subway system through coinciding bus schedules to train arrivals – Providing public transport services without time breaks by expanding night buses (Owl Bus) and on-demand taxis – Applying the notion of "Complete Street" by incorporating the space for walking, cycling, driving and riding public transport in parallel on the road – Improving the accessibility to car-sharing stations within a five-minute walking distance across the city
Environment	8. Efficient mobility society by reducing unnecessary travel 9. Environmentally friendly transport 10. Seamless road environments 11. Transport policies rooted in citizen engagement	– Introducing a distance-based congestion charging scheme – Transforming roads as a clean energy generator by implanting solar panels and self-regenerating pavement – Establishing a new urban transport governance model, based on close-knit engagement of citizens, in particular vulnerable users, in policy planning

Source: Seoul (2013), "Seoul City Traffic Vision 2030", http://traffic.seoul.go.kr/files/2013/05/519d7de064e380.20006840.pdf.

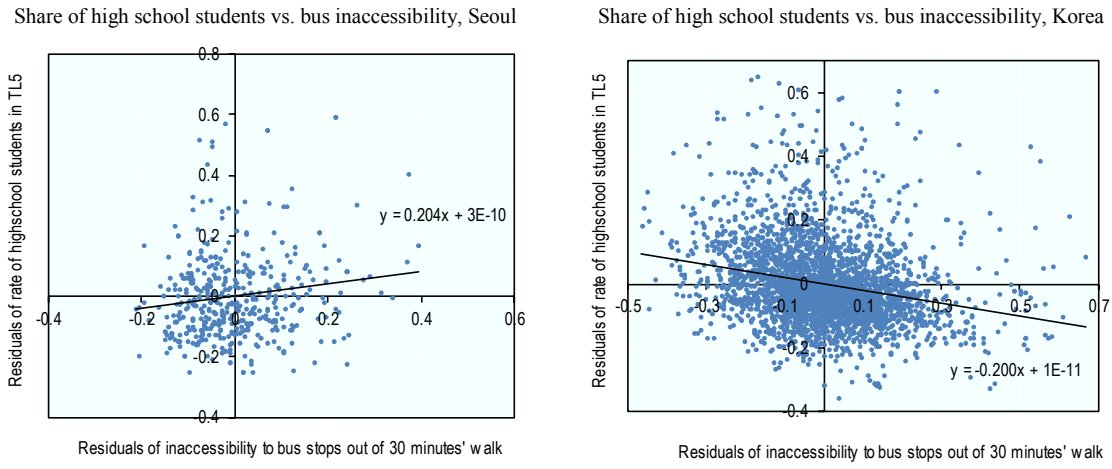
Public transit accessibility for selected groups

While the public transport network in Seoul is among the best developed in the OECD, there remain differences in access across certain groups. For example, the distribution of students according to the level of accessibility in Seoul was quite different from that of all other Korean regions. In Korea, high school and middle school students tend to live closer to bus stops, whereas in Seoul they tend to live further away from bus stops (Figure 3.3).[4] This may in part be explained by the higher population density in Seoul, which goes hand in hand with a much higher density of schools and other

education institutions. As a result, the average distance of students to a school in Seoul is much shorter than in the other Korean cities, implying that a much larger number of students actually do not need to take a bus but simply can walk to school.

Figure 3.3. **Unlike in the rest of Korea, Seoul's high school students do not live closer to bus stops**

Contrast between Seoul and Korea



Notes: These graphs plot the residuals obtained by regressing both the share of high school students in an area and the inaccessibility to bus stops on fixed effects for TL4 regions, as well as some other control variables (number of education institutions and retail/wholesale shops in the TL5 area). Residuals, by construction, are normally distributed around zero.

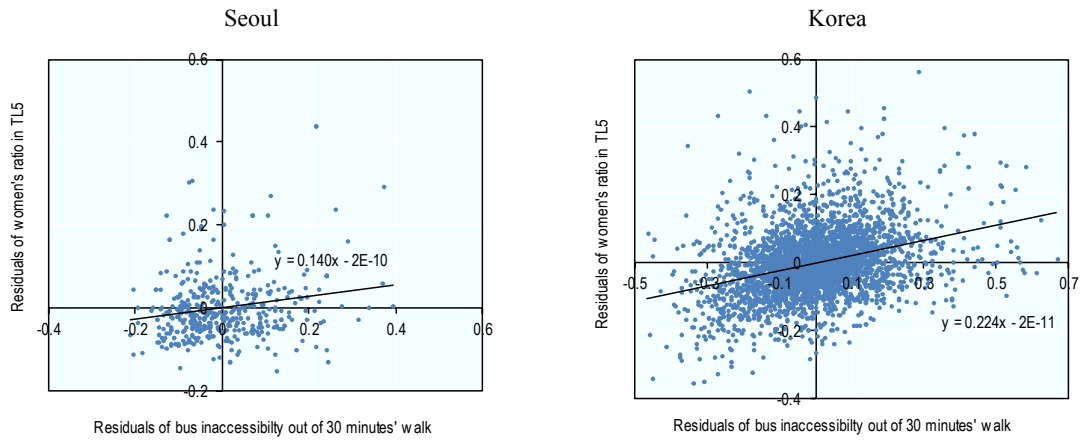
Sources: Authors' own elaborations based on KOTI (2016), "Data request", https://www.ktdb.go.kr/www/contents.do?key=202; Biz-GIS Corp. (2016), "Big data in humanities and social science", www.biz-gis.com/XsDB; Kostat (2016a), "Date utilization", http://mdis.kostat.go.kr.

The distribution of women in Seoul acording to bus accessibility seems to follow the overall pattern of Korea – i.e. women having a tendency to live in areas where accesibility to public transport is lower – but this effect seems to be weaker in Seoul than in Korea (Figure 3.4).[5] The lower impact observed in Seoul might be connected with a lower employment/income gap for women in Seoul than in other parts of the country; as indicated in Chapter 2, accessibility to bus stops tends to be higher in areas with higher average incomes and higher job density.

In Seoul, the distribution of the elderly with respect to bus accessibility appears to be reversed. While, on average, in Korea the share of the elderly in TL5 population tends to be lower in areas further away from bus stops, in Seoul the elderly seem to have a tendency to live in areas further away from bus stops (Figure 3.5).[6] A possible explanation could be that the settlement pattern of the elderly in Seoul in part reflects that of school-age children, as many elderly live with their families to help with their grandchildren's upbringing. This hypothesis is also confirmed by the strong correlation that exists between the distribution of the elderly and that of school-age children in Seoul (as in Korean regions overall).[7]

Figure 3.4. **Women live further away from bus stops in Seoul**

Comparison of Seoul with the Korean average Korea



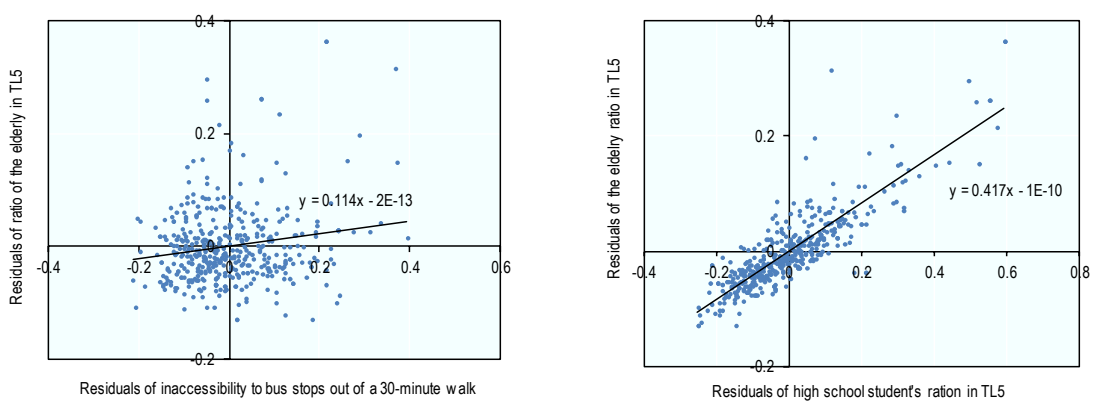
Notes: These figures plot the residuals obtained by regressing both the share of women in an area and the inaccessibility to bus stops on fixed effects for TL4 regions, as well as some other control variables (number of education institutions and retail/wholesale shops in the TL5 area). Residuals, by construction, are normally distributed around zero.

Sources: Authors' own elaborations based on KOTI (2016), "Data request", https://www.ktdb.go.kr/www/contents.do?key=202; Biz-GIS Corp. (2016), "Big data in humanities and social science", www.biz-gis.com/XsDB; Kostat (2016a), "Date utilization", http://mdis.kostat.go.kr.

Figure 3.5. **The elderly in Seoul live further away from bus stops**

The share of elderly is higher in areas where bus access is less developed

The share of elderly is positively correlated with the share of school-age children in Seoul



Notes: The left graph plots the residuals obtained by regressing both the share of elderly in an area and the inaccessibility to bus stops on fixed effects for TL4 regions, as well as some other control variables (number of education institutions and retail/wholesale shops in the TL5 area). The right graph plots the residuals obtained by regressing both the share of elderly and school-age children in an area on fixed effects for TL4 regions, as well as some other control variables (number of education institutions and retail/wholesale shops in the TL5 area). Residuals, by construction, are normally distributed around zero.

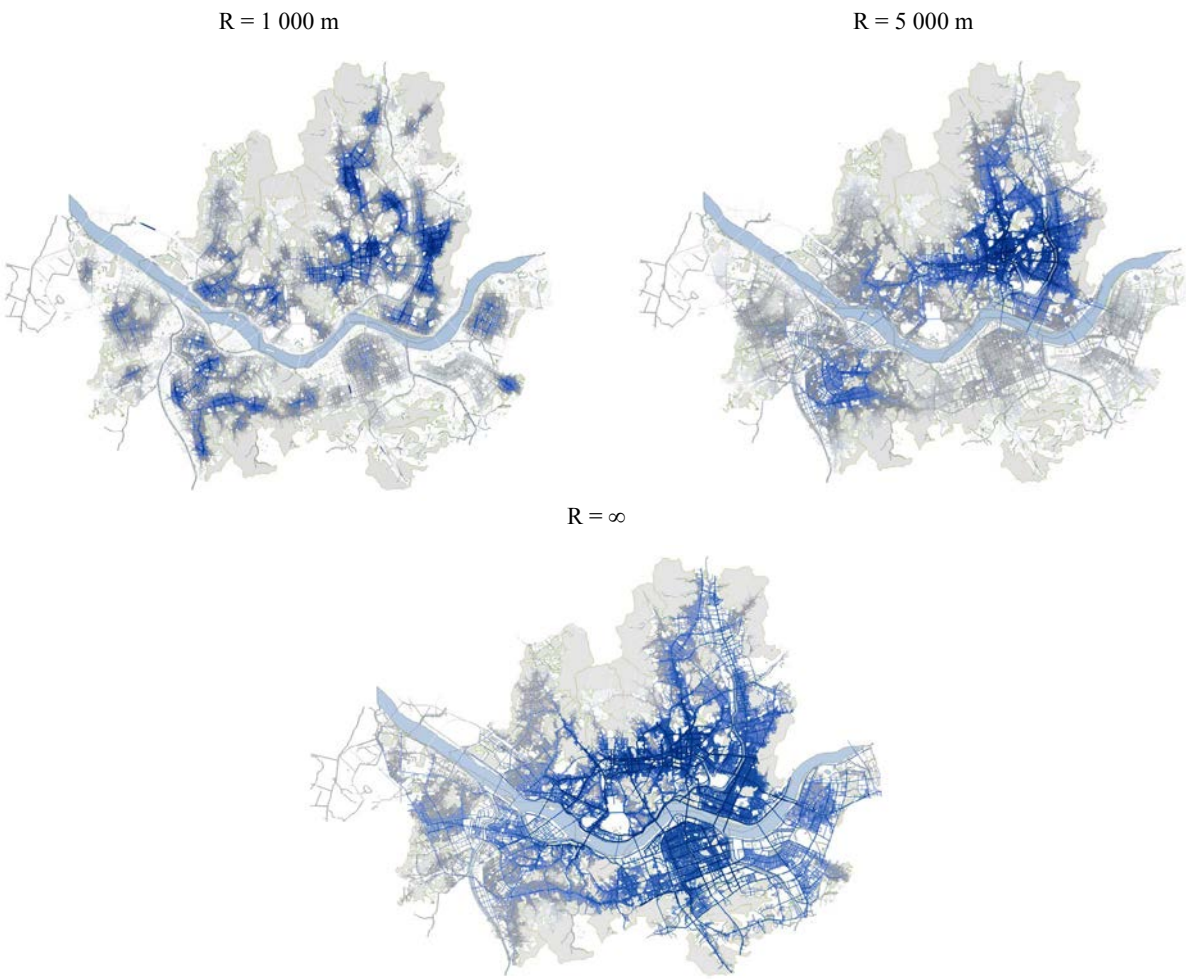
Sources: Authors' own elaborations based on KOTI (2016), "Data request", https://www.ktdb.go.kr/www/contents.do?key=202; Biz-GIS Corp. (2016), "Big data in humanities and social science", www.biz-gis.com/XsDB; Kostat (2016a), "Date utilization", http://mdis.kostat.go.kr.

Space syntax analysis of Seoul

Space syntax is a set of techniques for representing and analysing urban street networks, and identifying how these might influence human activities, most notably pedestrian and vehicular movement. An introduction to its basic concepts is provided in Box 2.2. in Chapter 2 of this report. A first space syntax analysis was carried out on Seoul's level of "integration", i.e. the accessibility of each street segment of the city to all other parts of the city (Figure 3.6). This was done at a number of different scales, including local (R1000), medium (R5000) and global scales (R=∞). When analysing local integration, a number of locally accessible centres were highlighted in the north-eastern part of the city. These areas are also perceived by residents as being rather segregated "urban villages" (such as Cheongnyangni, Mia and Myeonmok). At the medium scale, a joined-up integrated zone connected to the old city centre is highlighted, which functions as an urban core. At the global scale, the newer Gangnam area to the south appears to connect back into the northern urban core through a series of bridges across the Han River.

Figure 3.6. **Seoul's integration (accessibility) space syntax map**

Influence range in radius = 1 000 m, 5 000 m, and ∞ m



Source: Froy, F. and H.T. Park (2016), "Space syntax analysis of four Korean cities", unpublished.

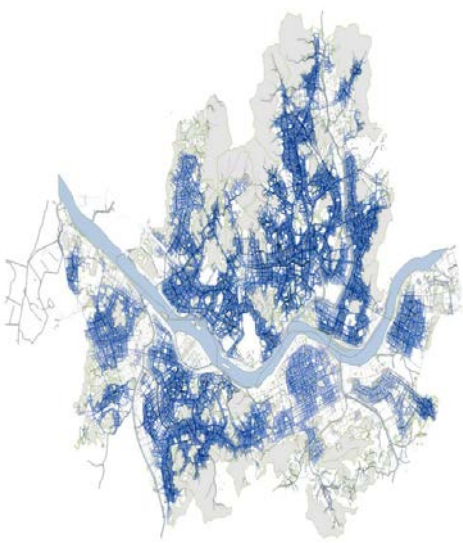
The strong level of global accessibility experienced in Gangnam may be advantageous to the high concentration of businesses that are located there, in addition to the relatively high proportion of high-income residents who live in the area. However, as mentioned earlier, there is a preponderance of "super blocks" – a block where the distances between the arteries adjacent to the group are longer than 1 kilometre – created by its grid formation. This may have an impact on local integration and pedestrian movement, while meaning that on average people have to walk further to reach local public transport stops.

Seoul's north and south-west arteries comprise the most through-movement areas while Gangnam showed contradictory patterns as the range of analyses were changed. Analysis was also carried out about the potential for through-movement or "choice" at a number of different scales (Figure 3.7). The key local arteries most likely to be singled out for through-movement are located in the north and south west of Seoul. There, a connecting structure inherent within the south west of the city is more visible. It is notable that the Gangnam area shows relatively low values for through-movement, with its grid structure "spreading movement" so that people do not necessarily pass through one particular street segment as opposed to another. Gangnam regains its role as a centre of through-movement only at the global city-wide level. At this global scale, all the main artery streets in Seoul are clearly picked up by high choice values – this includes Jongro, Sejongro and Dongdaemun (the latter famous for its market). These streets are also well-served by public transport.

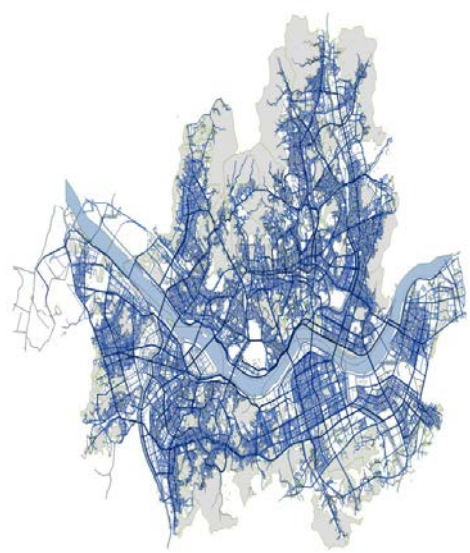
Figure 3.7. **Seoul's choice (betweenness) space syntax map**

Influence range of radius = 1 000 m and R = ∞

R = 1 000 m



R = ∞



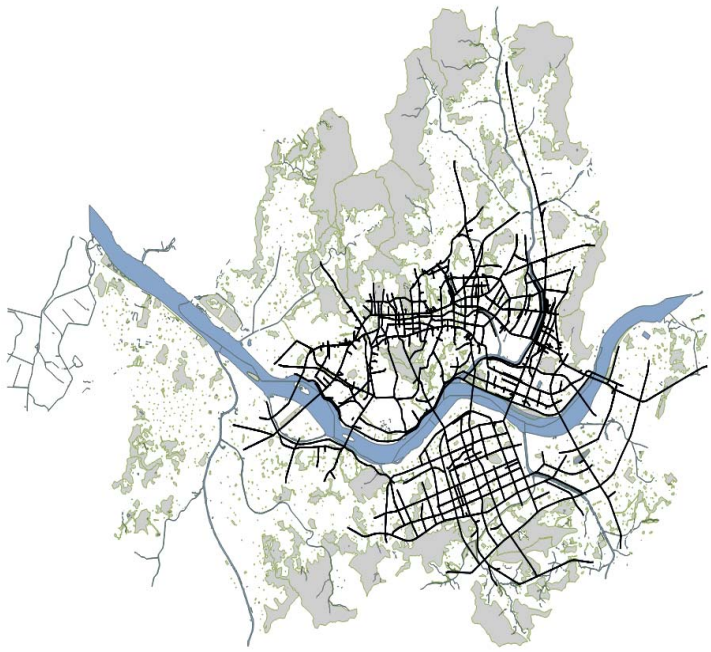
Source: Froy, F. and H.T. Park (2016), "Space syntax analysis of four Korean cities", unpublished.

As identified above, it is useful to identify the top 10% of streets that are both highly integrated and more likely to be singled out for through-movement at the city-wide scale – the "integration and/or choice" core (Figure 3.8). An analysis of the integration and choice core in Seoul shows that an area comprising the old centre (Jongro area) and the Gangnam area connects together over the Han River to form the most prominent "foreground network" of the city. Other areas in the north-western and south-western

parts are relatively isolated from this network, despite the high densities of people living in the south west. Perhaps not coincidentally, the areas to the north-east of the city, which are only connected into the foreground network through a few roads, are the areas in which house and rental prices are the lowest in Seoul.

Figure 3.8. **Seoul's top 10% of integration or choice core streets**

Overlaid



Source: Froy, F. and H.T. Park (2016), "Space syntax analysis of four Korean cities", unpublished.

Seoul's public transport network is far-reaching and has become known for its extensive coverage of both rail and bus routes following a series of recent reforms. For this research, the location of bus stops was overlaid with a global through-movement or choice map (R=∞) for a number of different parts of the city (Figure 3.9). While in many cases, bus stops were found on the higher choice streets, they do penetrate into the background network of residential streets (for example, in the south west). High-choice segments with no bus stops were mainly roads for the exclusive use of motor vehicles. As previously mentioned, the size of the "super blocks" in the Gangnam grid system may mean that people have to walk further to reach their local bus stops.

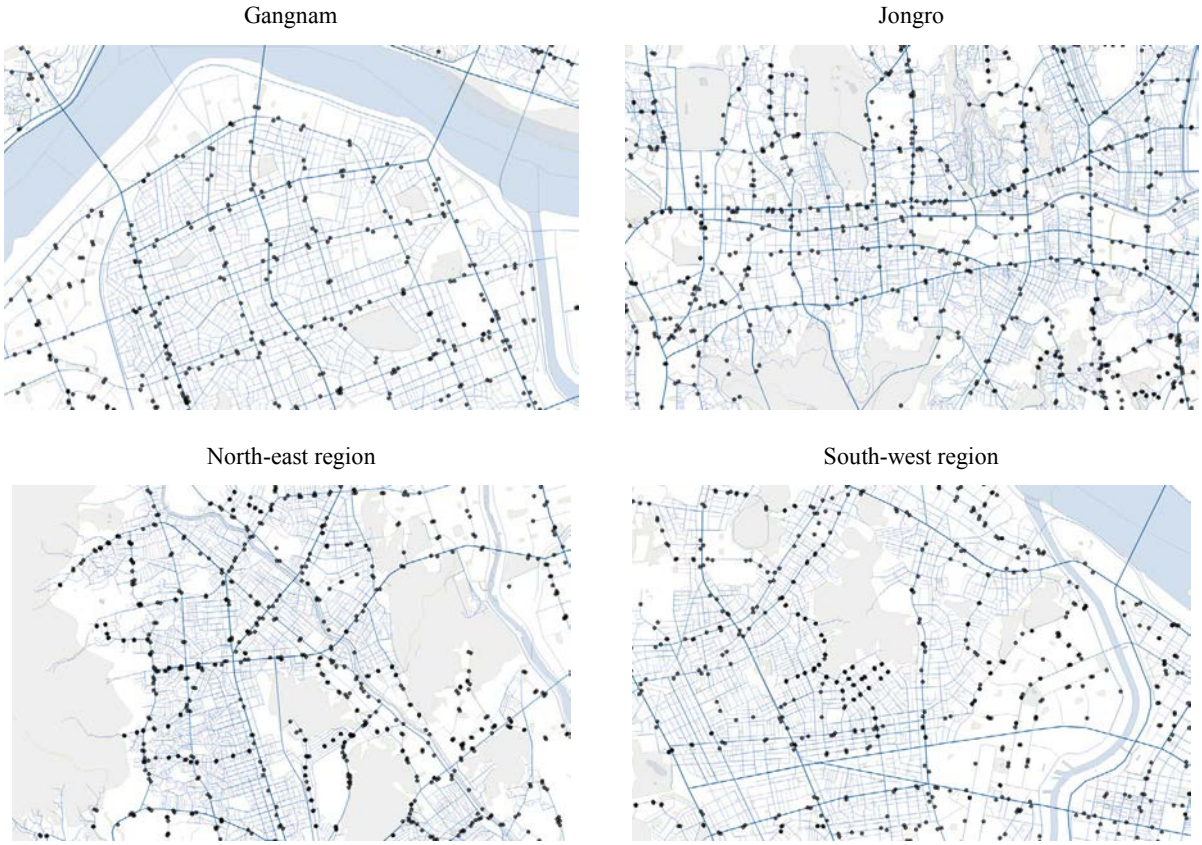
In conclusion, Seoul has developed a rather fragmented and polycentric overall spatial configuration with an old centre in the north (incorporating Jongro) and more recently developed centres in the south west and south (Gangnam). While Gangnam is relatively well connected to the old historic centre, the south west is more poorly integrated at the global scale, despite hosting high densities of people. Areas of the north also appear to be more poorly integrated. The high global accessibility of the Gangnam area may be exploited by both the high number of businesses located in this area and the high concentration of high-income people who reside there. However, the preponderance of "super blocks" may have an impact on local pedestrian movement, while increasing walking time to public transport connections.

There are clearly high densities of people living in areas of Seoul that are weakly connected to the "foreground accessibility network" of the city. In the south west of the city,

such people may be working within the broader Seoul-Incheon conurbation, meaning that this disconnect is less important. However, in the north east of the city, lower accessibility coincides with pockets of low-income residents, who may be restricted in accessing the economic and social opportunities that Seoul has to offer. In such areas, public transport connections into the city centres will be particularly important, and residents are likely to disproportionally benefit from Seoul's extensive rail and bus service network. It is a positive sign, for example, that several light train lines are planned and currently under construction in the north-eastern part of Seoul, to connect it more directly to the city centre.

Figure 3.9. **Seoul bus stops overlaid with space syntax's high choices**

Gangnam, Jongro, north-east region and south-west region



Source: Froy, F. and H.T. Park (2016), "Space syntax analysis of four Korean cities", unpublished.

Case study of Suwon

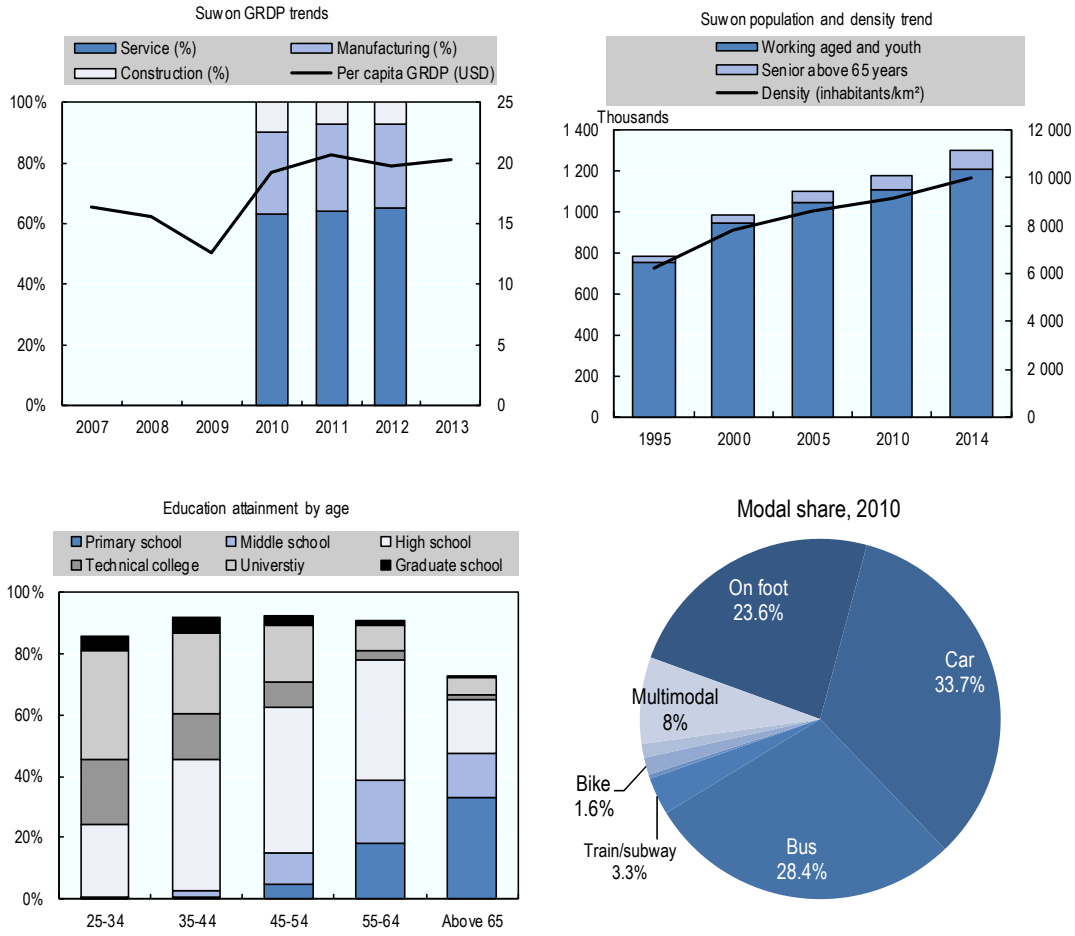
Suwon's Good Governance Committee and Civil Transport Evaluation Committee have helped focus the city's transport policy on greener, more people-centred and more cost-effective solutions.

City profile

Suwon is the most densely populated city in the province of Gyeonggi, which surrounds Seoul. The city hosts around 1.2 million people (2.4% of the national population) on a land area of 121 km². Almost 70% of the population is of working age. The GRDP per capita is USD 20 200, with most of the production taking place in services (65% of GRDP) in 2012. The financial independence rate (calculated as the percentage of local own

resources over total budget) is fairly stable at 57.7% in 2012, well above the national average (52.0%), due to the city's strong industrial tax base. Car dominance is higher than in Seoul (Figure 3.10). Currently, the bus accounts for around 30% of total commutes, compared with only 3% for the subway. However, as the Suwon city government forecasts, continued investments in railways (mainly the metropolitan subway in the capital area) will contribute to reshaping the traffic landscape of the city, giving a strong impulse to the city's modal shift towards public transport (Suwon, 2016).

Figure 3.10. **Suwon's key socio-economic indicators**



Notes: The data on educational attainment are based on the 2010 Population and Housing Census. The bars do not equal 100% due to a number of possible reasons: when there was no response; when the government voluntarily eliminated some responses to protect individuals' privacy; and when the Census automatically eliminates records if the number of responses collected in the investigation area is less than five (to eliminate outliers).

Source: Authors' own elaborations based on KOSIS.

Overview of public transport policy

While buses are the most frequently used mode of transport, the city government is increasingly investing in the subway, which is likely to change citizens' travel patterns. Suwon is known nationwide as one of the best performing cities in terms of public transport policies (Box 3.3), as illustrated by its nomination as one of the top five cities among 161 subnational jurisdictions in the evaluation of public transport policy that MOLIT conducts every two years.

Box 3.3. **Suwon's public transport plan**

The 2nd Public Transportation Master Plan (2012-16) put forward by the Korean government aims to increase the national average modal share of public transport from 40.9% in 2008 to 47% in 2016 and 52% by 2030. The objectives are established distinctively across six different city categories. Suwon belongs to A Group (composed of 14 "principal economic cities", see Chapter 1, and in particular Table 1.1), which is required to meet more ambitious goals, i.e. 54.2%, 60% and 73% along the same target years. Suwon's current public modal share stood at 32.1% as of 2010, but the railway constructions currently underway are expected to accelerate the speed of the modal shift. The city government has proposed diverse strategies to promote public transportation, which can be summarised as follows:

- Integration of public transport and maximisation of inter-complementarity: Efforts focus on facilitating commutes with zero to one single transfer. The city government is looking for ways of optimising the mix of bus and subway routes, positioning multi-modal transit centres on the major traffic junctions, and densifying the urban railway network. Considering the city's high population density and lack of space, the city government considers the subway as the best suitable mode of mass transit.

- Embracing eco-mobility at the heart of transport policy: The city has proclaimed the objective to reduce CO_2 emissions by 40% by 2030. As part of its efforts to achieve this goal, the city is building 280 public bike stations, which are expected to be inaugurated in 2018. The stations will be located across the city in consideration of transfer connectivity to public transport as well as fluctuations in population patterns. The bike lane network currently comprises three artery lanes (68.6 kilometres) and three branch lanes (43.7 kilometres), which will be expanded in accordance with the mapping of public bike stations (Suwon Research Institute, 2015). Public transport-oriented mobility education for children and youth will be introduced into the school curriculum. The general purpose is to raise children's awareness on the history of how automobiles have become a dominant mode of urban transport, its negative impact, as well as general road safety instructions. Suwon is also developing a set of eco-mobility evaluation indicators in reference to the national and international examples such as KOTI's Green Growth Evaluation Indicator and the OECD Green Growth Indicators. The city aims to establish a customised set of measurable variables. According to the final draft of the city's research on developing eco-mobility indicators, 22 indicators have been shortlisted, including political willingness, budget availability to implement eco-mobility initiatives, land areas reserved for green areas (car-free zones, bike lanes, public transport infrastructures or pedestrian streets), modal shares, traffic accident casualty, and CO_2 emissions (SRI, 2015). To promote electric vehicles, the city government offers a subsidy of KRW 2 100 million (USD 1.8 million) for the purchase of one of the seven electric vehicles approved by the Ministry of Environment. So far, 13 796 compact cars, 3 568 hybrid cars and 24 electric cars have been registered in Suwon, and the city aims to increase the number of electric cars to 1 000 units by 2018, while replacing 50% of its official-purpose vehicles with electric cars.

- Mobility for all: To make transport convenient and safe for users of all ages, genders, and economic and health situations, Suwon pursues a barrier-free urban traffic environment. The fundamental philosophy of the city government is that ensuring the right to mobility for vulnerable users is a prerequisite to ensuring the full realisation of the universal right, because all citizens are bound to fall into a vulnerable state as a child or an elderly. In this respect, policy makers are trying to find the right balance between profitability and social equity. Consideration for vulnerable users is evident in various initiatives, such as the creation of 144 protected zones for the elderly and children with unmanned camera surveillance, expansion of low-floor buses, on-demand taxi services for wheelchair users and obstacle-free pedestrian environments (braille blocks, elimination of bollards and raised spots). A specific initiative for women is the "Road Manager" programme. The service runs from 10 pm to 1 am to accompany women residing in obscure and deserted areas from the bus stop to the front door. This initiative is operated in co-operation with the local university students specialising in bodyguarding and safety.

Source: Authors' own elaborations drawing on site visit to Suwon City Hall in July 2016.

One of the distinctive features in Suwon's transport governance is the strong presence of civil society participation mechanisms. For example, the Good Governance Committee, which was established in 2011, brings together elected politicians, experts and citizens. The committee is organised in five working groups, specialised in employment, safety and urban development, environment and transport, education, and welfare and women, respectively. Another example is the Suwon Civil Transport Evaluation Committee. The committee is composed of 150 members (representatives of non-governmental organisations, traffic experts, citizens and youth) and contributes to the formulation of the city's urban transport vision for 2030. In addition, citizens are invited to engage in budget planning and make suggestions on matters directly related to their well-being. The city government organises workshops and training sessions in each district to empower civil society engagement in public administration. Every year, the city government publishes the list of projects that have been designed based on the recommendations of the citizen budget committee. In the budget year 2016, 809 projects were conceived with the ideas of the committee. Although consensus-building through public discussions may often be time-consuming, the city government is strongly committed to the idea that participatory governance unlocks opportunities for open discussions on potentially conflicting ideas and can help improve service delivery, social equity and mutual trust in society (SRI, 2016).

Another interesting initiative carried out by Suwon is the creation of the Eco-Mobility Village. During one month in 2013, a neighbourhood in the old city centre, called the Hanggung-dong area, went completely car-free (Box 3.4). The city government adopted various measures to minimise the inconvenience caused to the residents (e.g. by providing parking space and running free shuttle buses). It also proactively fostered citizen participation. While the car-free experiment ended after the planned month, it contributed to promoting a modal shift from cars to public transport and it was estimated to have a long-lasting impact on residents' modal behaviour. For example, residents have voluntarily been enforcing a car-free day per month on a few selected streets in the neighbourhood.

Opportunities and challenges

Although Suwon is connected to Seoul by a 30-minute subway ride, about 17% of Suwon's residents (202 000 people) commute to Seoul by car on a daily basis. This raises a number of issues, such as congestion, the risk of road accidents, a lack of parking space and potential loss in quality of life due to congestion. Suwon is gradually expanding its subway network to provide its citizens with alternative modes of transport. However, there are concerns that people who have long been accustomed to driving might stick to their old habits. In particular, pull factors alone are often not enough because the door-to-door convenience that only private vehicles can offer may be too attractive unless the disadvantages of driving are felt more acutely. Another factor of complexity stems from the fact that Suwon is part of the functional urban area of Seoul (according to the OECD methodology), which requires collaboration across administrative boundaries.

Box 3.4. **Suwon's Eco-Mobility Village**

"Eco-mobility" largely means travelling with non-motorised transport means, such as walking, cycling, public transport or car-sharing. While the term is mostly interchangeable with "green transport" or "sustainable transport", the former tends to draw more attention to types of transport modes, and the latter to the comprehensive impact of transport across environment, economy and society. An additional message that "eco-mobility" conveys is the cultural aspect of transport. It interprets roads not as an exclusive property of cars, but as a recreational space. It also advocates for changes in lifestyle and alternative ways of urban development.

During the entire month of September 2013, the Hanggung-dong area in the old city centre of Suwon was converted into a village without cars. All 4 300 residents of the neighbourhood made their daily commuting, shopping and leisure trips by foot or non-motorised modes. The city government believed that the project would not be successful without full citizen support and participation. Therefore, it conducted one-on-one visits to all the households in the area to overcome any reluctance. The city government also adopted various measures to minimise the inconvenience caused to the residents, for example by providing 1 620 parking spots on the boundaries of the village and running free shuttle buses. This also required cross-sectoral collaboration across 34 departments of the city hall, which worked together on 59 joint projects, including the presentation of 35 types of eco-transport modes, pedestrian area maintenance, the creation of urban community parks and urban farms, urban eco-mobility camps for youth, public contests on eco-mobility policy ideas and cultivation of eco-village curators, among others.

The car-free festival came to an end after the planned month, but it had long-lasting implications in the city. The Eco-Mobility Village initiative in Suwon allowed for the following major changes:

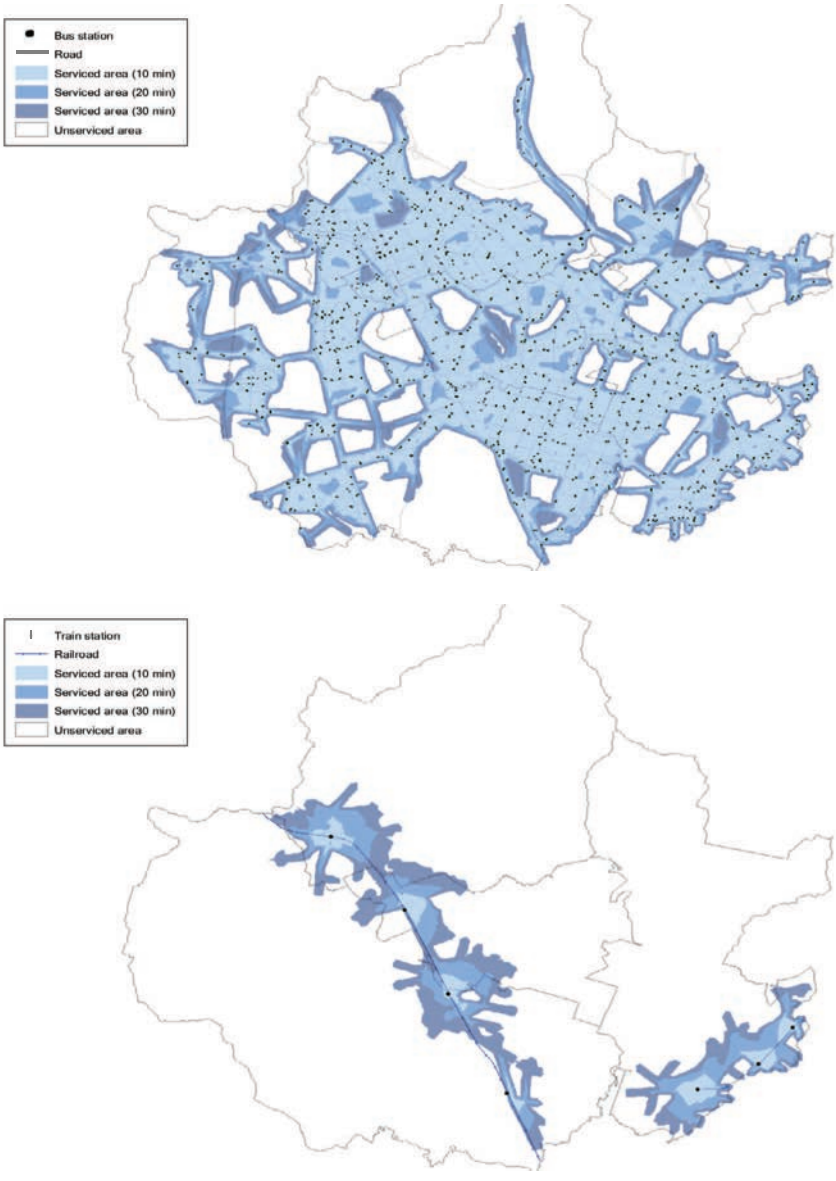
- A step closer to a green transport city: The city government hosted a public roundtable after the month-long eco-mobility experiment in order to collectively decide on the future of the village. The citizens had an opportunity to learn that it is possible to live without cars and to experience first-hand the benefits of improved quality of life. Around 300 people reached an agreement to permanently preserve the Haenggung-dong area as the Eco-Mobility Village. The experience is considered to have improved citizen's acceptance of the city's overall sustainable transport policies. The modal share of private cars in the neighbourhood decreased from 82.3% before the festival to 78.8% after, while the share of public transport rose from 6.6% to 8.8%.

- An alternative urban regeneration model: The Hanggung-dong area hosts a UNESCO World Heritage site called the Hwaseong Fortress. Prior to the Eco-Village experiment, the area was left underdeveloped compared to newer parts of the city. The car-free project gave the neighbourhood a powerful momentum for urban regeneration, building on the forward-looking visions of green transport and participatory civil governance. The village is now experiencing a constant influx of new population, in particular young artists and tourists.

- Roads for the community: Residents developed new imaginative ideas for public space and a strong social structure, which will benefit their community long after the festival has ended. The restoration of a long-lost sense of community and changes in residents' mindset are additional long-term benefits for the community. Today, the residents of the village voluntarily run a car-free day on four streets every last Saturday of the month, and use the space for diverse community activities.

Sources: ICLEI (2013) "Eco-mobility World Festival 2013 report presents legacy of car-free neighbourhood", http://suwon.ecomobilityfestival.org/news/latest%20news/news%20details/?tx_ttnews%5Btt_news%5D=163&cHash=38b110b629bddf1219875eed8af8b5b1; SRI (2015), Development and Application of Evaluation Indicators for EcoMobility Transportation System in Suwon.

Figure 3.11. **Service areas of bus stops and train stations in Suwon**



Note: These maps were produced by ArcGIS 10.1 with a network analysis tool using the service area of points of interest.

Sources: Authors' own elaborations based on KOTI (2016), "Data request", https://www.ktdb.go.kr/www/contents.do?key=202; Biz-GIS Corp. (2016), "Big data in humanities and social science", www.biz-gis.com/XsDB; Kostat (2016a), "Date utilization", http://mdis.kostat.go.kr.

Analysis on Suwon's accessibility shows similar patterns to Seoul, in the sense that the bus network is more extensive than the train network (Figure 3.11). Looking at the first map depicting the bus service areas at a 10-/20-/30-minute walking distance, several holes can be spotted in the polygon, as well as several missing links around the edge of the city. The vacuum in the north-east district can be explained by the presence of the vast Gwanggyo Mountain and a handful of reservoirs, while the one in the western part corresponds to the land spared for agricultural research of national institutes. The large

chunk of land in the south is occupied by the air force base (Suwon, 2014). Suwon's bus system is considered to be very advanced at the national level, and the map shows that almost the entire service area is accessible within 10 minutes of walking. As to the railway network, the principal artery of the city (Gyeongbu line) forms a north-south line and serves the capital area subway line 1, as well as long-distance trains. Another line (Bundang line) connects Suwon with neighbouring cities. Its partial horizontal axis will be completed following the inauguration of Suin line in 2017. In addition, three metropolitan railways and an urban tramway are currently going through a feasibility test or are under construction.

Case study of Changwon

Although Changwon has met new challenges after merging with its two neighbouring cities, the city has initiated a pioneering public bike service called "Nubiza" and was rewarded several times by the Korean government as a top-performing city in public transport policy and in sustainable transport.

City profile

The Unified Changwon City (hereinafter Changwon) is the result of a merger of three cities, i.e. Changwon, Masan and Jinhae in the province of Gyeongnam in the south of Korea. The previous city of Changwon grew rapidly around a national industrial complex, which was initiated in 1974 to foster the development of heavy chemical industries. Currently, the industrial complex hosts 2 575 companies, 113 704 employees and generates a production of up to USD 3.75 billion (Changwon, 2016a). The former city of Jinhae is an important port, and the former city of Masan (besides having its own port) hosts a free trade zone (initially created as a free export zone in 1970 before turning into a free trade zone in 2010). The three cities merged in 2010, strongly encouraged by various financial incentives offered by the national government. The new agglomeration is now home to a population of 1.07 million on a territory of 747.67 km² in 2015. While the per capita GRDP of Changwon was on the decline before the merger, it picked up afterwards (Figure 3.12). The industrial composition of the GRDP also evolved: the share of the service sector increased (43%), although the manufacturing sector remains the biggest contributor (52%).

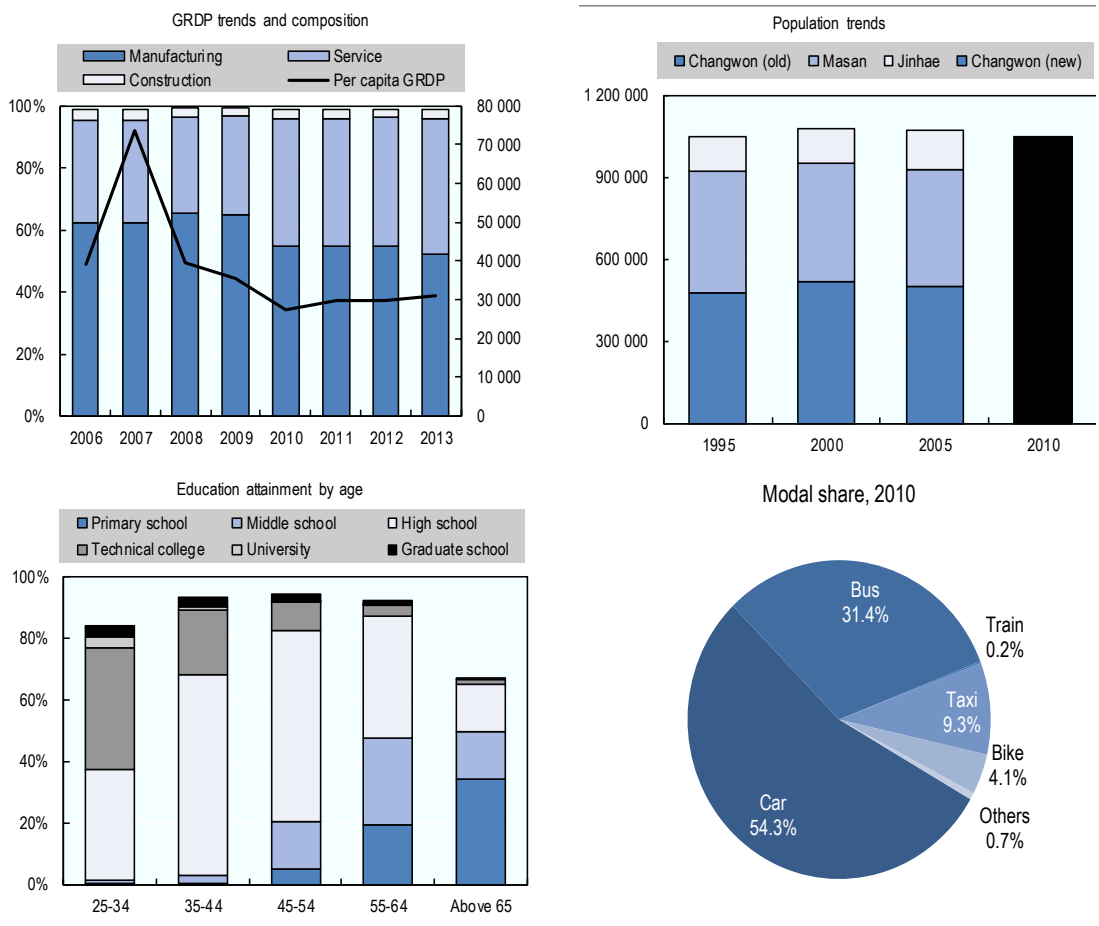
Changwon is highly automobile-dependent, with cars accounting for more than half of total commutes. Passenger cars represent about 84% of all vehicles in the city (Lee, 2013). The ratio of vehicles to population stands high in Changwon at 1:2.6 and the supply rate of parking space is only 66.6% (Lee, 2013). This has domino effects in terms of illegal parking and road safety risks. The bus is the only public transport available for commuting in the city and accounts for a little less than one third of internal trips. Train stations in the city include Korea eXpress Train (KTX) stations and other railway stations (Figure 3.13).

Overview of public transport policy

Changwon has been nominated as one of the five best cities in MOLIT's public transport policy evaluation for five consecutive years. In particular, the city has focused its efforts on promoting green mobility policies, under the slogan "Environmental Capital, Changwon". It has also enhanced user convenience and implemented creative measures to link public transport with cultural activities. However, the city is struggling to

harmonise urban patterns and traffic environments across the three previously distinct cities.

Figure 3.12. **Changwon's socio-economic indicators**



Notes: The data on educational attainment are based on the 2010 Population and Housing Census. The bars do not equal 100% due to a number of possible reasons: when there was no response; when the government voluntarily eliminated some responses to protect individuals' privacy; and when the Census automatically eliminates records if the number of responses collected in the investigation area is less than five (to eliminate outliers).

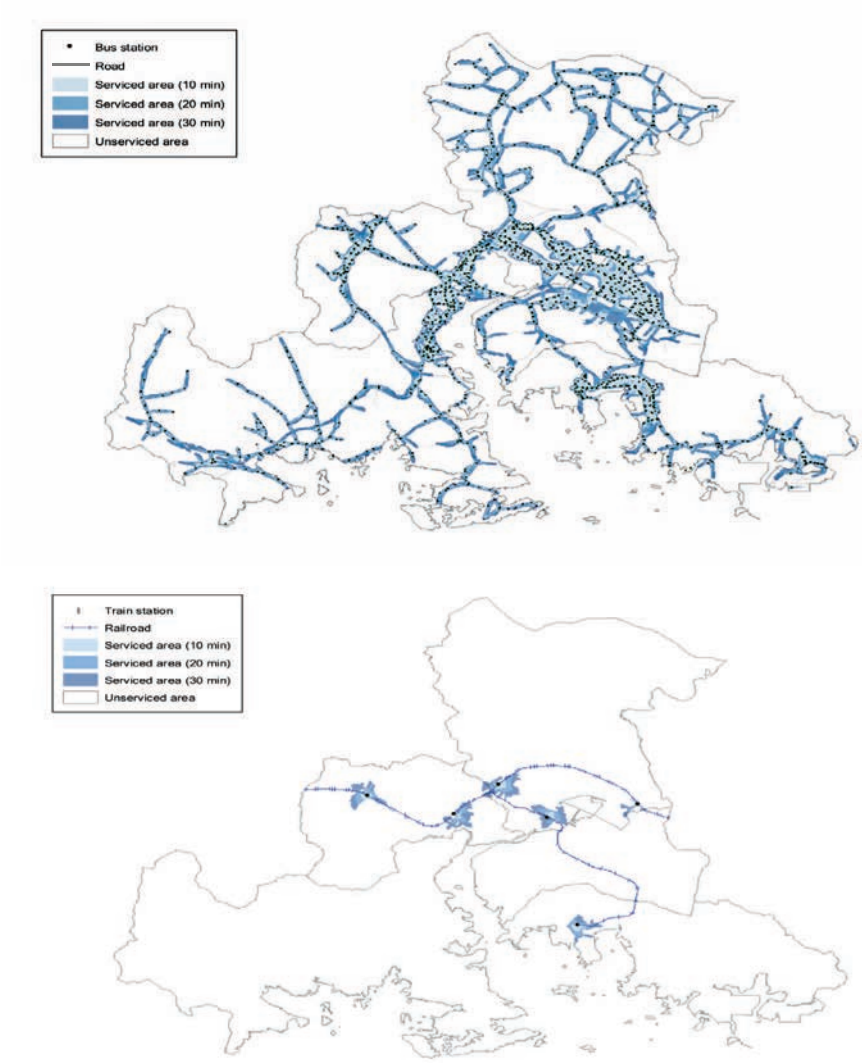
Source: Authors' own elaborations based on KOSIS.

According to the Changwon Urban Transport Master Plan 2030, the city's population is expected to increase from 1.08 million today to 1.5 million by 2030; the number of cars will continue to rise by 2.7% per year; the annual increase of traffic volume will average 1.9% during the decade 2010-20, while decelerating to 1.4% during the following decade. Under this scenario, Changwon has set rather moderate goals of reducing the modal share of cars from 54.3% to 52.4%, while increasing the share of public transport from 31.6% to 33.9% by 2030. In order to achieve these goals, the city government has proposed the following four strategies and policy indicators (Table 3.1):

1. Strengthening inter-district connectivity: Changwon's urban transport policy aims to reinforce inter-district linkages and facilitate traffic flows while establishing a

shared sense of identity as one city. Currently, there are only a few connections between the three urban cores of the unified city, traffic is saturated on these roads and the presence of mountains between those cities makes it difficult to extend road networks. The previous cities of Changwon and Jinhae are connected through a tunnel (Anmin tunnel), which is notorious for traffic congestion and poor safety conditions, and a curvy hill road (Anmin Gogae). The consolidated city of Changwon started building a second Anmin tunnel at the end of 2016. The previous cities of Changwon and Masan are connected through a congested general road and a bridge (Machang bridge, built in 2008). This bridge reduced the travel time from 35 minutes to just 7 minutes between the two cities. The construction of the bridge was privately financed (Hwang, 2016).

Figure 3.13. **Public transport accessibility in Changwon**



Notes: ARCGIS 10.1 was used to generate the service areas that can be reached within a 10-, 20- and 30-minute walk from bus stops in the upper map. ARCGIS 10.1 was used to generate service areas that can be reached within a 10-, 20- and 30-minute walk from train stations in the lower map.

Sources: Authors' own elaborations based on KOTI (2016), "Data request", https://www.ktdb.go.kr/www/contents.do?key=202; Biz-GIS Corp. (2016), "Big data in humanities and social science", www.biz-gis.com/XsDB; Kostat (2016a), "Date utilization", http://mdis.kostat.go.kr.

2. Transit-oriented development: The Plan 2030 proposes a package of measures, including networking of railways (trunk line) and buses (feeder line). The city government negotiated with national and regional authorities to obtain intergovernmental grants for the construction of two subway lines, but its request was turned down due to low economic feasibility. Alternatively, Changwon is studying the viability of a tramway, although this raises similar financial concerns.
3. Promotion of non-motorised transport: Changwon adopted the first public bike system in Korea in 2008, after the mayor declared the city an "environmental capital" in 2006. As part of this system called "Nubija", the city government built 603 kilometres of bike lanes over 209 routes by reducing the initial road width. Around 10% of the city's population has a Nubija membership and 25 000 bicycles are rented on a daily basis. The combined benefits of the system, including non-monetary gains from congestion relief and improved environment and health, have been estimated to reach USD 3.2 million (KRW 3 700 million) per year. However, the actual modal share of bicycles (only 2%) still remains quite disappointing relative to the scale of investments made. A major challenge is again the financial constraint. It takes roughly USD 40.2 million (KRW 47 billion) per year to maintain the Nubija system, whereas profits are only USD 13.7 million (KRW 16 billion). While the introduction of the bike-sharing system is laudable, Changwon will need to improve the value for money of the system going forward. The city government is also shifting its efforts from increasing the quantity of biking infrastructure towards improving user safety and convenience. The bike-sharing system has since been introduced in other cities in Korea.

Table 3.1. **Policy indicators for Changwon Urban Transport Master Plan 2030**

Goals to achieve until 2020 or 2030

Strategies	Indicators		Base year (2010)	Mid-term target year (2020)	Long-term target year (2030)
Strengthening inter-district connectivity	Volume/capacity (per day)	National roads	0.56	0.53	0.5
		Local roads	0.69	0.6	0.5
	Average speed on trunk lines (km/h)		25.8	28	30
	Road extension (km)		2 151	2 424	2 517
	Truck load rate (%)		64.2	67	70
Transit-oriented development	Modal share of trains (%)		0.2	5.3	5.9
	Modal share of public transport (%)		31.6	34	33.9
	Number of transit centres		2	5	7
	Number of daily bus terminal users		20 777	24 450	28 048
Promotion of non-motorised transport	Modal share of automobiles (%)		54.3	52.5	52.4
	Modal share of bicycles (%)		4.1	15	15
	Number of public bike stations		230	270	270
	Pedestrian service quality		A	A	A
	Number of low-floor buses		162	250	314
	Road fatality rate (%)		2.22	1.75	1.5
Application of technologies in traffic management	Average traffic signal waiting time (seconds per vehicle)		79.1	70	65
	Supply rate of parking space (%)		66.6	80	90
	Number of traffic experts in the city hall		2	10	10

Source: Changwon (2016b), "Changwon Urban Transport Master Plan", www.changwon.go.kr.

4. Reform of the traffic management system: Given the expected continuous increase in the number of vehicle users, Changwon's strategy consists of improving road capacity through the modernisation of the traffic management system rather than simply increasing the road stock. The policy package includes the rationalisation of traffic signals, investments in intelligent transport systems (ITS) and big data platforms, as well as training programmes for fostering traffic specialists within the local administration.

The expansion of electric vehicles (EV) is part of the green transport policies pursued in Changwon. It aims to curb emissions from passenger cars and reduce car maintenance costs. Changwon is expanding EV battery recharging service for the employees of companies registered in areas of Changwon where such recharging infrastructures are in place (Park, 2015). In 2016, Changwon was nominated "EV pioneering city" by the Ministry of Environment (Lee, 2016).

Opportunities and challenges

One of the main contributors to road congestion in Changwon is single drivers (one person per vehicle). According to the 2016 KOTI *O/D database*, the number of occupants per vehicle averaged 1.26 in internal traffic and 1.38 in inter-regional traffic in Changwon, which is among the lowest at the national level. An important share of such single drivers is employees of Changwon's industrial complex, who work shifts and do not have access to public transport at night. Targeted policy instruments are required to close such gaps in service delivery, such as a customised night shuttle service or incentive schemes to promote a car-sharing culture in partnership with firms.

Low population density in Changwon's mountainous land with three dispersed urban cores poses an important challenge to efficient delivery of public transport services, especially when buses are the only public transport available to cover this vast area.[8] As a result of the 2010 merger, intra-city bus routes had to be extended, resulting in prolonged waiting time for passengers, reduced revenue for bus companies and mounting subsidy needs for the city government. It is therefore necessary to restructure bus routes, increase the number of buses and ultimately build a rapid transit system (e.g. subway, to connect the dispersed three urban cores with high passenger capacity and an exclusive right-of-way) as an alternative to buses.

The greatest difficulty in implementing any of these tasks is the lack of financial capacity. To be able to modify bus routes, the city government would need to de-privatise the system, but this has proved to be costly even for metropolitan cities (Lee, 2011). Introducing an urban railway or a tramway would also exceed the city's financial capacity.

Changwon has recently put in a request to the central government to be upgraded to a metropolitan city. In case of an upgrade, the city budget would increase due to the transfer of some taxes that are currently levied by the province of Gyeongnam (e.g. acquisition tax, leisure tax, registration/licence tax, local consumption tax and local education tax, which amount to about USD 105 million in total) (Ahn, 2016).

Overall, challenges in the design and governance of urban public transport in Changwon reflect the overarching limits of an administrative merger that was primarily driven by the central government (as opposed to one that was grounded in consultations with the three cities and their residents). Although the initial offer from the central government for the merger in 2009 sparked a popular request for submitting the question to a local referendum, the latter was never organised and the merger went through. The

lack of an extensive, consensus-building dialogue across levels of government, across the three cities, and between the government and local residents has generated tensions on several decisions that shape the new city's urban environment, including the demand for transport (e.g. where to locate the new city government building and the large baseball stadium) (Choi, 2014).

Case study of Sejong

A new administrative city with ambitious public transport-oriented city plans, Sejong struggles to put in place innovative solutions in terms of bus rapid transit (BRT), cycling and a public bus operation system to meet citizens' transport demand.

City profile

Sejong Special Autonomous City (hereinafter "Sejong") was founded in July 2012 as Korea's *de facto* new multifunctional administrative city. The main purpose of creating the city was to achieve a more balanced national development by delocalising administrative functions out of Seoul.[9] As of 2014, 36 national governmental agencies, including 9 ministries, had been relocated from Seoul to Sejong. The city is located in the middle of Korea, reachable from Seoul within an hour by express train. It resulted from the merger of Yeongi-gun and several townships of Gongju-si and Cheongwon-gun, mainly on what used to be agricultural land. Today, 74.7% of the city's land surface remains fields and farmlands, and over half will be reserved as parks and green space, according to the Sejong Urban Master Plan 2030. The Master Plan 2030 further illustrates the city's vision as a multifunctional city, composed of six functional areas (specialising in national administration, technology, education, leisure, eco-industry and residential development, respectively).

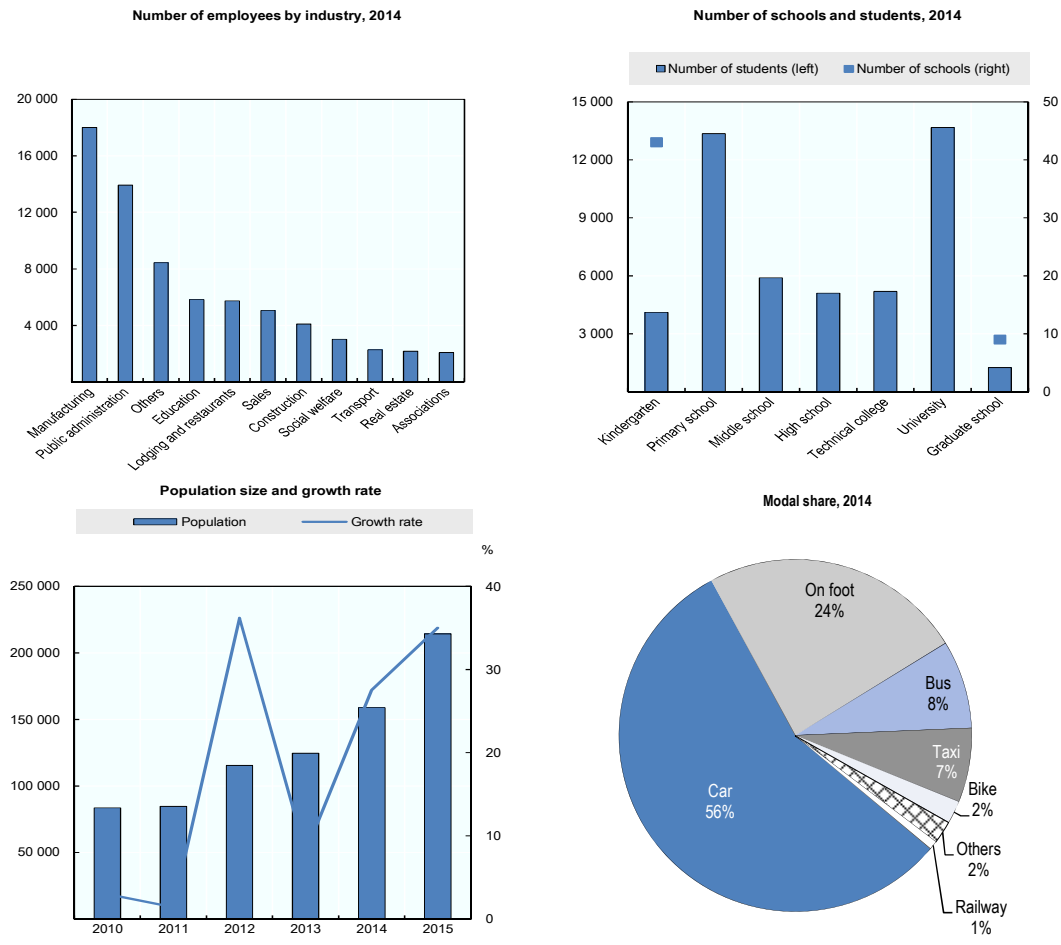
Sejong displays the typical pattern of a new city in terms of population growth and composition. Population density is considerably lower than the national average (324 inhabitants/km² vs. 505/km²) (Kostat, 2016b). However, population growth since the creation of the city in 2012 has oscillated between 8% and 36.2%, which is naturally way above the national average (0.36%). Around one-third of the new immigrants come from the adjacent metropolitan city Daejeon. Incomers from the capital area and the neighbouring Chuncheong province represent around 20% each. Sejong has a younger population than the rest of the country, with an average age of 36.7 compared with a national average of 40.9 (MOI, 2016a). The population is mostly composed of youth (25%) and working-age population (64%) (MOI, 2016b). The fertility rate is also higher than the national average (1.48 vs. 1.25) (MOI, 2016a; Sim, 2015). The Sejong Urban Master Plan 2030 aims to stabilise population density to 300 people/km² as the population size is expected to plateau at 500 000 inhabitants upon the "completion" of the city by 2030. Public administration accounts for the second largest provider of jobs in Sejong after manufacturing (Figure 3.14).

Overview of public transport policy

Sejong has a strong commitment to transit-oriented development (TOD). Under the ambitious long-term goal to increase the share of public transport to 40% and the share of soft modes to 30% by 2030, all of Sejong's 21 community units in the newly constructed area[10] will be accessible by public transport. The city has also used various push factors in its urban design. For example, the main avenue (Hannuri Avenue) provides four driving lanes – which is low by Korean standards – while the remaining two lanes are exclusively

reserved for BRT. This reflects the city government's strong political will to discourage the use of private cars (Lee, 2016). The city also has a dense network of bike lanes: 1.25 km per km of road, compared to 0.1 in Seoul and 0.62 in Copenhagen (Choi, 2016). Likewise, only 0.4% of the city's land serves as parking space and some buildings are built without a parking lot. While this strategy might fit a more "mature" city with a larger population, it might not be economically viable in a four-year old city with a population of only 220 000 (2% of Seoul's population), which might not have the capacity to provide public transport with a satisfactory level of frequency and connectivity.

Figure 3.14. **Sejong's key socio-economic indicators**



Notes: The data on educational attainment are based on the 2010 Population and Housing Census. The bars do not equal 100% due to a number of possible reasons: when there was no response; when the government voluntarily eliminated some responses to protect individuals' privacy; and when the Census automatically eliminates records if the number of responses collected in the investigation area is less than five (to eliminate outliers).

Source: Authors' own elaborations based on Sejong Statistics Yearbook 2015, www.sejong.go.kr and KOSIS.

In this context, the city government is currently focusing on increasing the supply of public transport. The number of buses grew fourfold between 2012 and 2016 (from 30 to 126) (Choi, 2012; Kim, 2016). Service intervals are shortened during peak hours. Bus routes have also been modified to minimise the number of transfers for daily commuters. In the long run, the city government aims to expand the number of bus routes from 72 today to 218 by 2030, and the BRT network from 27 buses to 120. Sejong is also looking

to build a 99-seat bi-modal tram as an express mass transit server, which will take a circular route connecting the 6 functional areas of the city (Jin, 2016). Additionally, discussions are underway about extending Daejeon's subway lines to Sejong, but this remains a rather remote possibility due to low economic feasibility.

Efforts to detect user needs and enhance service quality have also been initiated. According to a recent consumer survey carried out by the city government, citizens are largely unsatisfied with the city's bus services, and the level of disappointment seems to be greater among those coming from Seoul or Daejeon, who have experienced a large drop in service quality. Together with the survey results and traffic data collected through the electronic payment system, the city government is building a set of indicators that will be used to evaluate and monitor the progress of policy initiatives.

Sejong's first public bus corporation is scheduled to be launched in January 2017. This major project aims to reflect the social consensus that monopolistic private bus operation is a major cause of chronic debts and poor service quality, as confirmed through KOTI's opinion poll targeting residents in 13 districts in Sejong (out of the 14 districts). Before Sejong was created, the bus service in the area used to be supplied by a single private operator, and the sudden enlargement of the service area in 2012 aggravated its deficit substantially. As of 2015, the revenue-cost ratio in Sejong was only 56%, which is significantly lower than in other major cities, such as Seoul (82%), Cheongju (79%) and Daejeon (77%). Accordingly, the public subsidy burden has increased. The city government has run three public bus lines as a pilot test prior to the establishment of the public corporation. Following the reform, the public corporation will be responsible for the bus and BRT services in the city's newly built area, whereas the role of the private operator will be restricted to the more rural areas (called *eup* and *myeon*).

On-demand taxi services were first introduced in 2015 to supply public transport to residents in the far-off *eup* and *myeon* districts in a more cost-effective way. The taxi runs on a regular schedule like the bus, but operates at lower costs, even with a small number of passengers. It offers an effective tool to service the areas that are difficult to access by traditional buses (either because the demand is lower or because the road is narrower). The city government is currently considering the possibility to expand the service, based on the results of feasibility tests and demand surveys (Roh, 2016).

Finally, experimental policies to improve transport convenience or the environment are underway, as in other cities. An evaluation of intra-city bus services will be conducted through citizen surveys to assess diverse aspects of the city's public transport, including cleanness, the driver's attitude and convenience. The city is also planning on designing bus routes and corresponding policies based on customer surveys, which is quite innovative. Regarding green transport, one electric bus that is rechargeable without a plug-in was developed by the Korea Advanced Institute of Science and Technology (KAIST) and is currently in operation in Sejong. The practicality of the bus is still low for the moment, as full recharging takes one hour but only lasts 40-60 kilometres maximum. Recharging also requires a non-contact recharging facility to be installed at the station (such a recharging system is running in other Korean cities such as Jeju, Suwon and Pohang). The introduction of compressed natural gas buses is another example of low-pollution transport policy in Sejong. The central government provided a subsidy to Sejong to help the city adopt CNG buses.

Opportunities and challenges

The new city is forming a principal service area in the southern part of the city, but the connectivity to the rest of the city, especially the remote *eup* and *myeon* areas, seems limited. (Figure 3.15). Sejong's bus network includes 72 routes, served by 130 buses, among which 24 are BRT types. The bus routes are established along the roads constructed in between mountains. In terms of railways, the Gyeongbu line runs from north to south, and the Gyeongbu Express Railway through the city's north-east shoulder. These regional railways stop at the Osong station, from which BRT services connect to the city centre as well as to the Sejong Governmental Complex. The Chungbuk line is a feeder line branching from the Gyeongbu line, connecting Sejong with neighbouring cities Daegu, Youngju, Daejeon and Jechon.

There might be a certain level of contradiction between Sejong's general vision of urban planning and its will to pursue transit-oriented development. The city's urban planning vision consists in creating a city without a city centre, so that every part of the city can be developed with equity. It is planned to place six clusters (functional centres) in the outer circle of the city, each one with its independent functions, while the city centre remains green space (Kim, 2015). However, a scattered city, which is not in line with the principles of mixed land use or compact development, can raise the costs of public transport (OECD, 2012). In Sejong, the vicious circle of inefficient public transport is already taking place. High costs lead to a decrease in bus frequency and service quality, which in turn diminishes the ridership, which further deteriorates the cost-benefit ratio. To break this cycle, subsidies will inevitably need to rise until the passengers react to the improvement and eventually switch to buses. A virtuous circle, where high demand induces an increase in supply, could be more easily triggered in Sejong than in other cities due to the strong presence of disincentive factors against car use in the city's urban design.

Space syntax analysis of Sejong

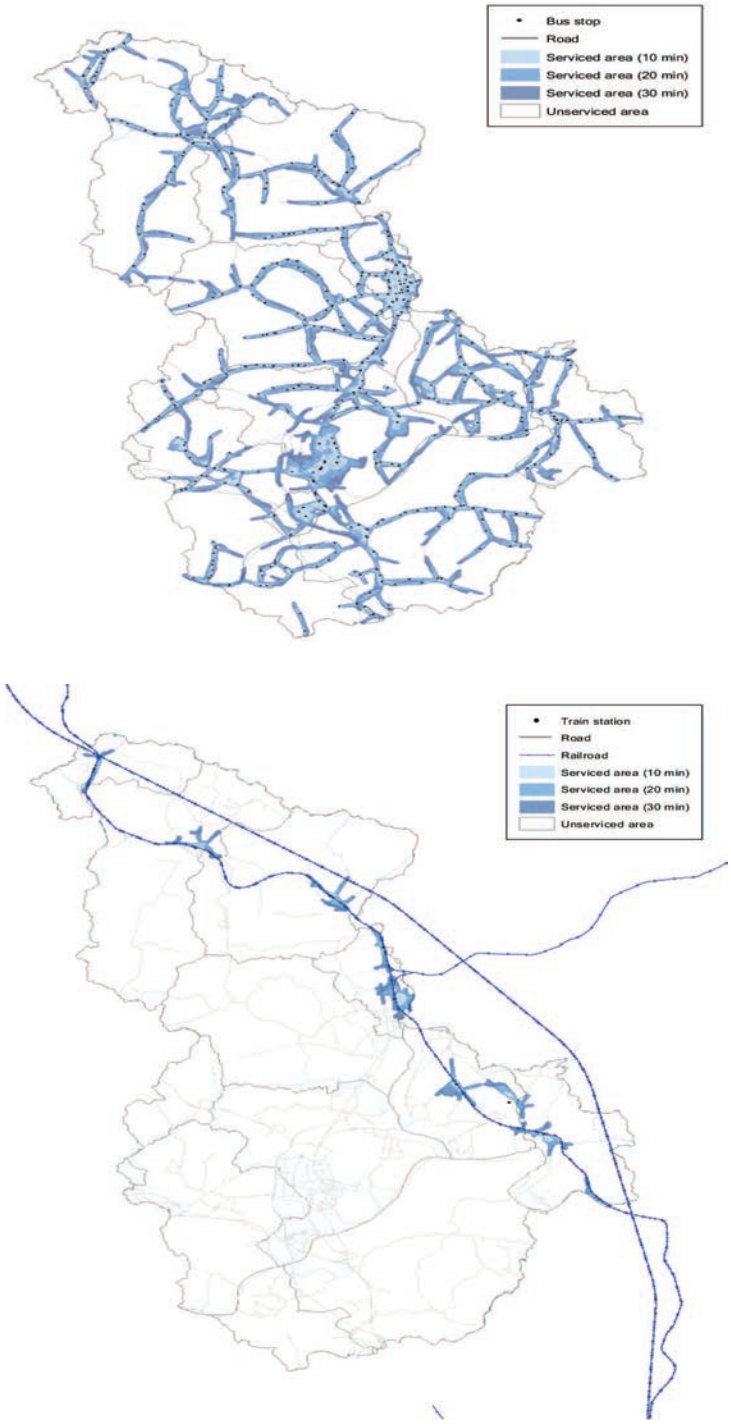
This section provides the results from a "space syntax" analysis of Sejong (see detailed methodology and key concepts in Chapter 2) (Figure 3.16). Sejong is mainly comprised of two parts: Jochiwon (the old town in the north) and the special administrative city (the new city in the south). It is unusual that land uses are arranged around a green space, creating a form of "hollow centre" at its heart. Apart from Jochiwon and the administrative city, Sejong remains predominantly rural. At the local scale, Jochiwon is the only marked part of the city which shows high local integration in the space syntax analysis – in part because the old town has an intense grid structure. It is only at the global level that the administrative city regains its position as a centre. The new administrative centre is itself poorly integrated at the local scale, with a "loose" organisation of the grid (as with Gangnam in Seoul, the city has been developed based on the super-block neighbourhood concept).

These findings are echoed when looking at through-movement or choice: at the local scale – areas around Korail stations, including Jochiwon, have high choice values. The main artery road in the north-south direction (a #1 national road) and the circular roads in the administrative city are picked out at the global level (Figure 3.17).

The 10% integration and choice core map does, however, connect the new administrative centre to the foreground network of a city as a whole (Figure 3.18).

Figure 3.15. **Public transport accessibility in Sejong**

10-, 20- and 30-minute walking distances from bus stops or train stations



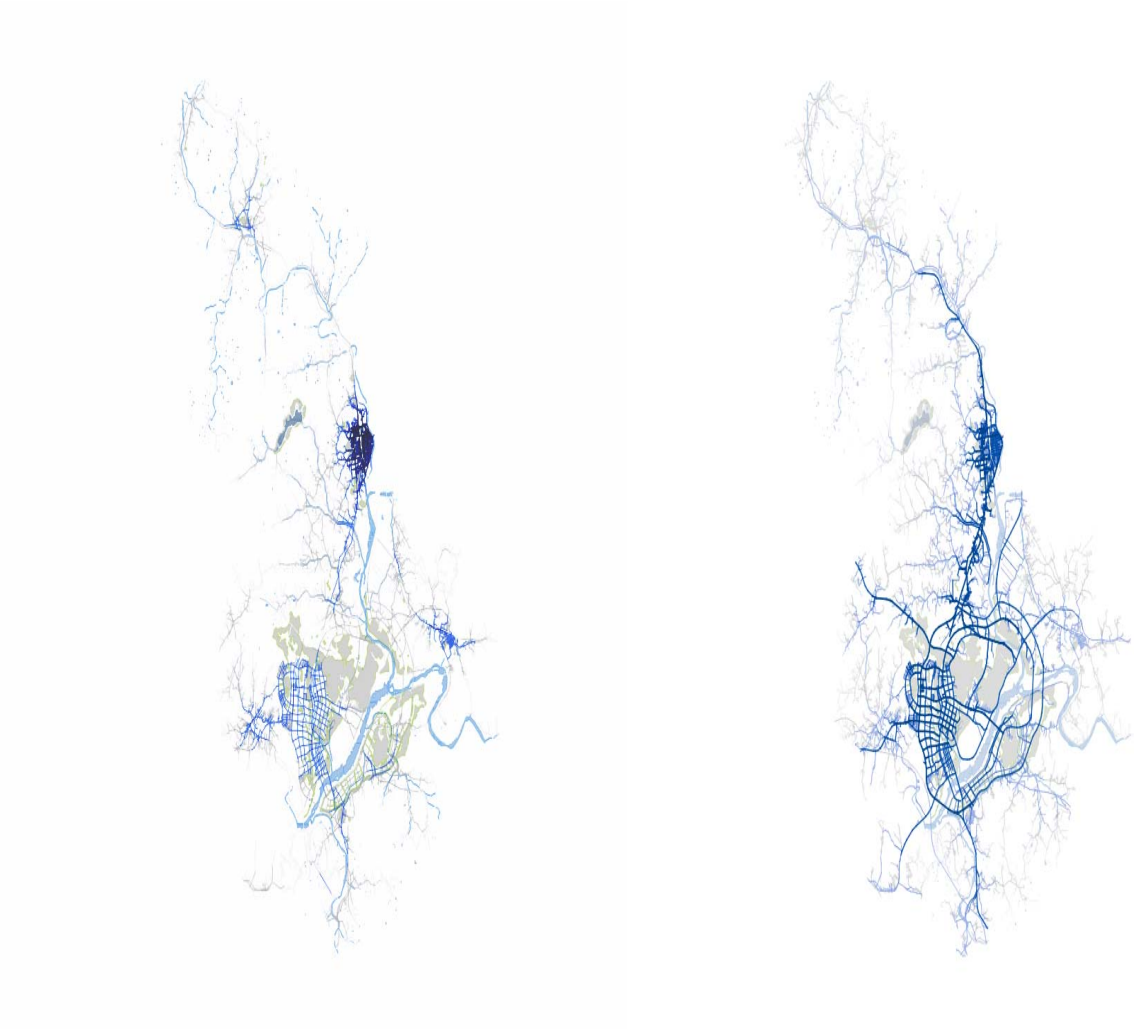
Notes: ARCGIS 10.1 was used to generate the service areas that can be reached by a 10-, 20- and 30-minute walk from bus stops in the upper map. ARCGIS 10.1 was used to generate the service areas that can be reached by a 10- 20- and 30-minute walk from train stations in the lower map.

Sources: Authors' own elaborations based on KOTI (2016), "Data request", https://www.ktdb.go.kr/www/contents.do?key=202; Biz-GIS Corp. (2016), "Big data in humanities and social science", www.biz-gis.com/XsDB; Kostat (2016a), "Date utilization", http://mdis.kostat.go.kr.

Figure 3.16. **Sejong's space syntax map of integration (accessibility)**

Contrast between influence radius of 2 km and global range

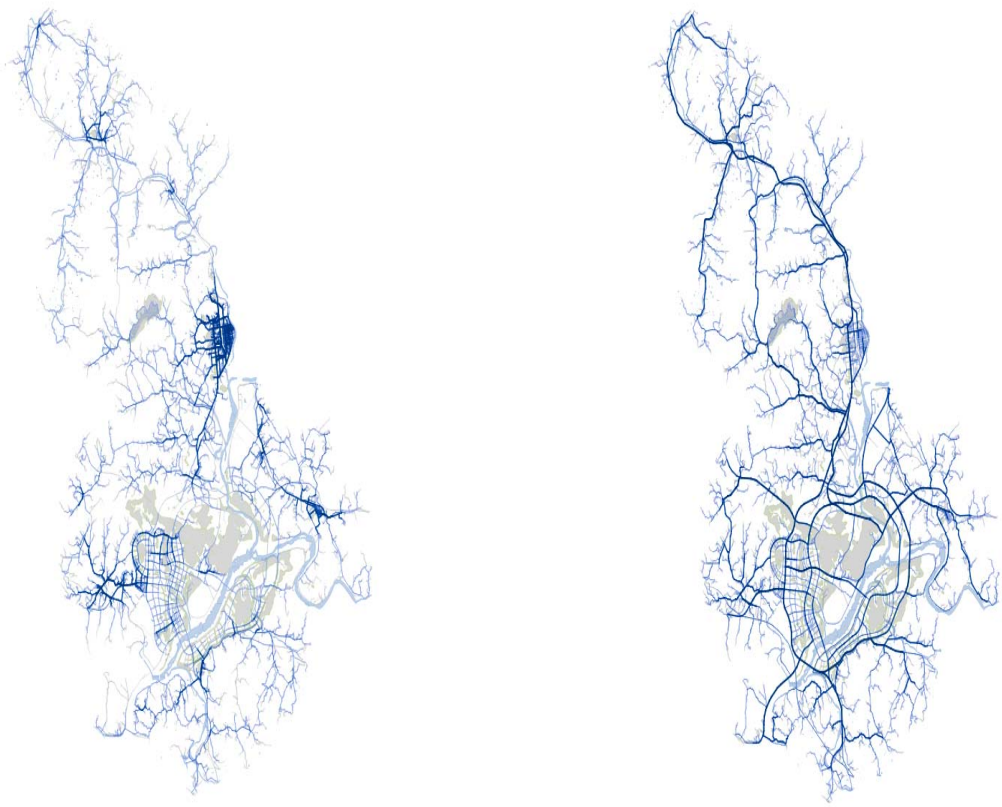
R = 2 000 m R = ∞



Source: Froy, F. and H.T. Park (2016), "Space syntax analysis of four Korean cities", unpublished.

Figure 3.17. **Sejong's space syntax map of choice (betweenness)**

Contrast between influence radius of 2 km and global range



Source: Froy, F. and H.T. Park (2016), "Space syntax analysis of four Korean cities", unpublished.

Figure 3.19 shows the location of bus stops in Sejong overlaid with a global through-movement or choice map. The new administrative city is particularly poorly serviced by public transport – this may be problematic given the weak local integration already present in the area.

The expanding city of Sejong has a divided structure, with the relatively well-integrated old city centre (connected to Seoul through a rail link) being rather disconnected from the

new administrative centre to its south. The new administrative centre is also weakly integrated locally, meaning that moving around this centre may be challenging – a situation that is not helped by the relatively poor access to bus stops in this area. The disconnection of the newer administrative centre from the rest may principally have an impact on the people who work in this part of the city, who are likely to be the higher income workers that have arrived from the Seoul metropolitan area. The implications for lower income local workers, and thus for social inclusion, are less clear.

Figure 3.18. **The top 10% core roads in Sejong**

Selected based on integrations or choices

Source: Froy, F. and H.T. Park (2016), "Space syntax analysis of four Korean cities", unpublished.

Figure 3.19. **Bus stops overlaid with highly integrated or chosen locations**

Jochiwon and new administrative centre

Jochiwon – north-eastern part of Sejong

New administrative centre

Source: Froy, F. and H.T. Park (2016), "Space syntax analysis of four Korean cities", unpublished.

Notes

1. The exchange rate was 1 USD for 1 018 KRW in June 2014.
2. This is based on the discussions with the representatives of Seoul Metropolitan Government during the OECD study mission in Seoul on 18 July 2016.
3. Please see the 2nd Seoul Traffic Vulnerable Convenience Improvement Plan (2012-17) for further details about the policies targeting vulnerable users.
4. For Korean TL3 regions, when the share of people living more than a 30-minute walk from bus stops was 1 percentage point higher, the share of high school students in TL5 population was 0.20 percentage points lower; it was, however, 0.20 percentage points higher in Seoul. As for middle school students, the decrease in Korea was 0.042 whereas the increase in Seoul was 0.082.
5. When the share of people who live further away than a 30-minute walking distance to bus stops was 1 percentage point higher, the share of women in TL5 area population

was higher by 0.14 percentage points in Seoul and by 0.22 percentage points in Korea on average.

6. When the share of people living further than a 30-minute walking distance from bus stops increased by 1 percentage point, the ratio of the elderly increased by 0.11 percentage points in Seoul whereas it decreased by -0.06 percentage points in Korea on average.

7. When the share of high school students in TL5 population is 1 percentage point higher, the ratio of the elderly is 0.42 percentage points higher in Seoul. For middle school students, this impact was 1.16.

8. Changwon's land surface is larger than that of Seoul and its two satellite cities combined (Uijeongbu and Pankyo), whereas its population size is only one-tenth of theirs.

9. According to the law, the construction of Sejong city aims to solve the side effects caused by the overconcentration and overcrowding in the capital area and to contribute to a more balanced regional development in Korea to reinforce national competitiveness.

10. Sejong is divided into 14 districts at TL5 level. Five of the 14 districts are located in the newly constructed area of Sejong, while the remaining units are in rural areas. Within this new urban core of 5 districts, 21 community units will be constructed.

References

Ahn, G.W. (2016), "Changes in fiscal structures following Changwon's administrative elevation: Impacts on the vertical tax revenue distribution", 2016 Spring Conference of the Korean Association for Local Government Studies, Seoul, 15 April.

Biz-GIS Corp. (2016), "Big data in humanities and social science",

www.biz-gis.com/XsDB (accessed 14 November 2016).

Changwon (2016a), "Changwon's national industrial complex" (in Korean), Changwon's website supporting corporations, http://economy.changwon.go.kr/jsp/sub06/06_07.jsp (accessed 14 November 2016).

Changwon (2016b), "Changwon Urban Transport Master Plan", www.changwon.go.kr (accessed 14 November 2016).

Choi, H.W. (2016), "Urban transport policies of the Happiness City", Multifunctional Administrative City Construction Agency, presentation at the Indaba on Traffic Safety in the Happiness City, Sejong, 16 November 2016.

Choi, J.G. (2012), "Makeover of Sejong's public transportation system" (in Korean), Good morning Chungcheong,

www.goodmorningcc.com/news/articleView.html?idxno=2944 (accessed 14 November 2016).

Choi, S.J. (2016), "Korea's notorious fine dust a burning issues", *Korea Times*, published online 8 June, www.koreatimes.co.kr/www/news/nation/2016/06/116_206558.html (accessed 30 November 2016).

Choi, S.W. (2014), "The future of Masan-Changwon-Jinhae, faced with dis-unification" (in Korean), Huffington Post, www.huffingtonpost.kr/2014/10/26/story_n_6048652.html (accessed 14 November 2016).

European Platform on Mobility Management (2015), "Congestion charging", www.epomm.eu/newsletter/v2/content/2015/0415/doc/eupdate_en.pdf (accessed 14 November 2016).

Froy, F. and H.T. Park (2016), "Space syntax analysis of four Korean cities", unpublished.

Hwang, B.K. (2016), "Masan-Changwon Bridge swallowing KRW 100 billion despite increasing traffic flows" (in Korean), Yonhap News,

www.yonhapnews.co.kr/bulletin/2016/09/30/0200000000AKR20160930093100052.HTML (accessed 14 November 2016).

ICLEI (2013) "Eco-mobility World Festival 2013 report presents legacy of car-free neighbourhood", http://suwon.ecomobilityfestival.org/news/latest-news/news-details/?tx_ttnews%5Btt_news%5D=163&cHash=38b110b629bddf1219875eed8af8b5b1.

Jin, H.J. (2016), "Public enterprise will undertake Sejong city's BRT, launch of the city transport corporation" (in Korean), Construction and real estate section, News1, published online 14 February, http://news1.kr/articles/?2569633 (accessed 1 December 2016).

Kim, C.S. et al. (2015), "National transport statistics, version for domestic", Korea Transport Database, Public Registration Number: 11-1613000-000816-10, MOLIT, Sejong City, Korea.

Kim, H.S. (2016), "Sejong's bus in great loss" (in Korean), T-broad Channel, http://ch4.tbroad.com/content/view?parent_no=24&content_no=66&p_no=392 (accessed 14 November 2016).

Kim, K.W. (2015), "Makeover of Sejong during the last three years, but four things missing" (in Korean), The Hankyoreh, www.hani.co.kr/arti/economy/economy_general/723657.html (accessed 24 January 2017).

KOSIS (2016), Regional statistics, Korean Statistical Information Service, http://kosis.kr/statisticsList/statisticsList_02List.jsp?vwcd=MT_ATITLE01&parmTabId=M_02_01_01 (accessed 14 November 2016).

Kostat (2016a), "Date utilization" (in Korean), Micro data Integrated Service, Korea National Statistical Office, http://mdis.kostat.go.kr (accessed 29 November 2016).

Kostat (2016b), "Regional population and population density" (in Korean), Korea National Statistics Office, www.index.go.kr/potal/main/EachDtlPageDetail.do?idx_cd=1007 (accessed 14 November 2016).

KOTI (2016), "Data request", Korean Government 3.0 open data, Korea Transport Database, Korea Transport Institute, www.ktdb.go.kr/www/contents.do?key=202 (accessed 29 November 2016).

KOTI (2014), 2014 National Transport Statistics in Korea (in Korean), Korea Transport Institute, www.ktdb.go.kr/www/selectPblcteWebView.do?key=39&pblcteNo=67 (accessed 14 November 2016).

Lee, H.T. (2016), "Why is it necessary to drive a BMW in Sejong?" (in Korean), DT News, www.dtnews24.com/news/article.html?no=388652 (accessed 14 November 2016).

Lee, J.H. (2016), "Changwon's plan to supply 100 units of electronic vehicles" (in Korean), Yonghap Newsshing, www.yonhapnews.co.kr/bulletin/2016/02/03/0200000000AKR20160203194200052.HTML (accessed 14 November 2016).

Lee, J.H. (2013), "JinHae baseball stadium, accessibility is the problem: The evaluation of Changwon road maintenance master plan said…" (in Korean), Culture section, News
Tomato, published online on 22 October, www.newstomato.com/ReadNews.aspx?no=410529 (accessed 1 December 2016).

Lee, J.Y. (2016), "Seoul starts limiting the speed in backside road to 30 km/h" (in Korean), Herald Economy, published online on 3 March, http://news.heraldcorp.com/view.php?ud=20160303000170 (accessed 1 December 2016).

Lee, S.H. (2011), "Abolition of the semi-public bus operation system and introduction of route allocation system in Masan" (in Korean), Gyeongnam CBS, www.nocutnews.co.kr/news/789291 (accessed 14 November 2016).

Ministry of Land, Transport and Maritime Affairs (2011), "2nd Traffic Convenience Improvement Plan for Vulnerable Users, 2012-2016", http://www.molit.go.kr/.

MOI (2016a), "Registered population and households" (in Korean), http://rcps.egov.go.kr:8081/jsp/stat/ppl_stat_jf.jsp (accessed 14 November 2016).

MOI (2016b), "Regional population by age" (in Korean), http://rcps.egov.go.kr:8081/ageStat.do?command=month (accessed 14 November 2016).

OECD (2016), "Regional demography (Edition 2016)", *OECD Regional Statistics* (database), http://dx.doi.org/10.1787/50dcefee-en (accessed 9 December 2016).

OECD (2012), *Compact City Policies: A Comparative Assessment*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264167865-en.

Park, O.J. (2015), "Changwon's plan to expand the provision of electronic vehicles to its citizens" (in Korean), Newsis Press, www.newsis.com/ar_detail/view.html?ar_id=NISX20150714_0013792007&cID=10812&pID=10800 (accessed 14 November 2016).

Preston, J. (2012), "Integration for seamless transport", *International Transport Forum Discussion Papers*, No. 2012/01, OECD Publishing, Paris, http://dx.doi.org/10.1787/5k8zvv8lmswl-en.

Roh, W.S. (2016), "Sejong plans to expand the village taxi service" (in Korean), Newsis Press, www.newsis.com/ar_detail/view.html?ar_id=NISX20160301_0013928865&cID=10818&pID=10800 (accessed 14 November 2016).

Seoul (2016a), "Seoul in-city bus system and how to use it", Transport, Seoul Metropolitan City website, http://traffic.seoul.go.kr/archives/1706 (accessed 1 December 2016).

Seoul (2016b), "Improvements of bus transit centre of the Seoul Station", http://traffic.seoul.go.kr/archives/28616 (accessed 14 November 2016).

Seoul (2016c), "Construction plans on regional transit centres", http://traffic.seoul.go.kr/archives/14699 (accessed 14 November 2016).

Seoul (2016d), "Seoul median bus lanes report three times higher fatality rate than regular roads", http://english.seoul.go.kr/policy-information/traffic/public-transport/1-bus-operation-system (accessed 14 November 2016).

Seoul (2016e), "Environmental-friendly and economic driving of Seoul buses", http://traffic.seoul.go.kr/archives/15191 (accessed 14 November 2016).

Seoul (2016f), "Improvement of road-side bus stops", http://traffic.seoul.go.kr/archives/1645 (accessed 14 November 2016).

Seoul (2013), "Seoul's Traffic Vision 2030 (a draft for Seoul's Traffic Management Master Plan)", Urban Transport Unit, http://traffic.seoul.go.kr/files/2013/05/519d7de064e380.20006840.pdf.

Seoul Solution (2016), "Establishment of a traffic card system", *Seoul's Principal Policies*, https://seoulsolution.kr/ko/content/%EA%B5%90%ED%86%B5%EC%B9%B4%EB%93%9C%EC%8B%9C%EC%8A%A4%ED%85%9C-%EA%B5%AC%EC%B6%95 (accessed 9 December 2016).

Seoul Statistics (2016), "Transport modal choice for commuting", http://stat.seoul.go.kr/octagonweb/jsp/WWS7/WWSDS7100.jsp (accessed 20 December 2016).

Sim, Y.G. (2015), "Korea's birth rate in 2015, ranked 220th world-wide; how can we save the country?" (in Korean), SBS News,

http://news.sbs.co.kr/news/endPage.do?news_id=N1003204546 (accessed 14 November 2016).

SRI (2016), SRI website, www.suwon.re.kr (accessed 1 December 2016).

SRI (2015), Development and Application of Evaluation Indicators for EcoMobility Transportation System in Suwon.

Suwon (2016), "Railway network" (in Korean), www.suwon.go.kr.dj3.ncsfda.org/sw-www/deptHome/dep_traffic/traffic01/traffic01_03.jsp (accessed 14 November 2016).

Suwon (2014), "How will the western part of Suwon, the golden land, be developed?" (in Korean), News, Suwon city's public relation homepage,

www.urisuwon.co.kr/news_view.jsp?ncd=993 (accessed 1 December 2016).

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