# Summary

## 11.1 Summary

The internal structure of cities has been analysed by urban planners, geographers and sociologists for a long time. Economists only recently became interested in what forces shape the urban spatial structure. In this thesis we analyse three, arguably the most important, economic forces that may have an impact on the structure of contemporary cities. We have investigated the impact of agglomeration economies, amenities and accessibility. *Agglomeration economies* arise between firms due to labour market pooling, input and output sharing and knowledge spillovers (Marshall, 1890). Firms therefore cluster in central business districts and subcentres and are willing to pay higher rents and wages in these locations. Contemporary cities are also shaped by *amenities*, as cities generate a critical mass for the provision of many consumer amenities like cinemas, theatres, cafés, restaurants and a plethora of other consumer goods. Also historic amenities are typically found in many centres of European cities. Households may prefer to locate in dense areas because of an abundant supply of these amenities. The reason that the economy does not only consists of extremely dense cities is the presence of dispersion forces. Households often are not willing to pay high house prices for a small apartment in the inner city but move to suburbs and take a longer commute for granted. This likely explains why many large cities experience severe traffic congestion. Improving *accessibility* is therefore an important issue on the agenda of local policy makers. Many policies have been proposed to reduce congestion, for example by investing in public transport and aiming at mixed land use near railway stations.

Each chapter in this thesis analyses at least one of these three economic forces that shape the urban spatial structure of Dutch cities. The Netherlands is dominated by the polycentric city region of the Randstad, which is comparable in size, density, sector structure, and many other important location factors to other mega-city regions in Europe, like Frankfurt, Lombardy and Catalunia (Thissen et al., 2012). Each of the chapters focuses on one city (Rotterdam) in the Randstad (Chapters 6, 7, 9), several cities or areas within the Randstad (Chapters 2, 4, 5) or whole of the Netherlands (Chapters 3, 8, 10). We employ a hedonic price approach (in all but one chapter). Hedonic methods are useful to investigate to what extent firms and consumers appreciate public goods, such as agglomeration economies and amenities. By using state-of-the-art semiparametric estimation techniques, we allow for heterogeneous profitability and preferences of respectively firms and households. Identification of the effects of interest is obtained by including a plethora of control variables, by adding location fixed effects and by using instruments. The first part of this dissertation then focuses on the location choices of firms, whereas the second part of this thesis analyses the locational preferences of households.

In Chapter 2 we pay attention to agglomeration economies. It is shown that doubling of agglomeration leads to an increase in commercial rents of about 3.5 percent. In this chapter, we are particularly interested in the heterogeneity in the profitability of agglomeration across firms. It appears that especially retailers and local governments prefer to locate in the dense parts of cities.

Several identification issues that plague estimates of agglomeration economies are discussed in Chapter 3. Using spatial fixed effects and instruments we are able to consistently estimate the impact of agglomeration economies on the commercial rents. The effect is found to be higher than in the previous

chapter: doubling of agglomeration leads to an increase in rents of about 10 percent. This difference is likely because Chapter 2 includes municipality fixed effects, so agglomeration economies are assumed to be bounded by municipal boundaries. This assumption appears not to be fully correct, because we show in Chapter 3 that the spatial extent of agglomeration economies is about 15 kilometres. It is also shown that agglomeration economies are mainly important in the office market and within-sector agglomeration economies do not capitalise in commercial rents.

Chapter 4 analyses high rents in extremely tall buildings. We hypothesise that high rents in tall buildings are caused by the possibilities to interact with other workers in the building (within-building agglomeration economies) and a landmark effect that is only relevant for the tallest buildings. Conditional on location attributes, we find that buildings that are 10 meters taller are about 4.2 percent more expensive, so within-building agglomeration economies seem to be very important. We also show that the landmark effect is economically significant: it is about 2.8-5.5 percent of the rent for a building that is 5 times the average height (about 140 meters in the Netherlands).

We analyse the tendency of knowledge intensive business services and multinational enterprise to co-agglomerate within cities in Chapter 5. For example, many headquarters of multinational corporations as well as lawyers, accountants and consultants are located in and near the Amsterdam South-axis. We show that business services tend to co-agglomerate with multinational enterprises in the northern part of the Randstad. In addition, we present empirical evidence that the presence of multinationals enhances the births of new business services firms because of agglomeration economies.

The second part of this dissertation analyses location choices of households. Chapter 6 uses house prices to proxy land prices in the city of Rotterdam. We then test the implications of the theory by Lucas and Rossi-Hansberg (2002), who developed a model where the urban spatial structure is determined by the external benefits of agglomeration and the commuting costs for workers. We show that in mixed urban areas, agglomeration is an important determinant of the rent, while in predominantly residential areas accessibility significantly impacts rents. This is in line with the theory of Lucas and Rossi-Hansberg (2002).

Chapter 7 analyses mixed land use in a more sophisticated way. For each property in Rotterdam, we calculate the number of employees in different sectors around each property, as well as a diversity index. We show that households are willing to pay about 2.5 percent more for a house in a mixed neighbourhood compared to a house in a monofunctional neighbourhood. Again, we analyse heterogeneity and it appears that especially apartment occupiers tend to prefer mixed neighbourhoods, likely because they are willing to pay more for urban amenities.

In Chapter 8 we focus on historic amenities and how these amenities cause sorting of households within cities. Using a semiparametric regression-discontinuity approach we show that there is a price difference at the conservation boundary of about 3 percent, which we interpret as the willingness to pay for external historic amenities. Listed buildings are about 6 percent more expensive, which we interpret as the willingness to pay for internal historic amenities. Moreover, it is shown that rich households sort themselves in conservation areas and in listed buildings, because they have a higher willingness to pay for historic amenities. The results contribute to an explanation for the substantial spatial income differences within cities.

We analyse policies to protect historic amenities in Chapter 9. It is argued that these policies may have adverse side-effects as they limit the possibilities of house owners to change their houses. We show that regulatory costs may be as large as 10 percent of the house price. So, house owners' benefits due to protection should be substantial to compensate for the regulatory costs.

In Chapter 10 we analyse the effects of improved access to public transport on house prices. We do not find a house price increase due to station openings. We also show that in other chapters public transport accessibility seems of limited importance in the location choices of firms and households.

To summarise, agglomeration, amenities and accessibility are all found to be relevant economic forces that shape the urban spatial structure. It is also shown that agglomeration and the presence of amenities seem to be more important than accessibility. Despite the vast decrease in transportation costs of goods in the last century and the dramatic reduction in communication costs, agglomeration economies still seem to be a main driver of firms' location choices. This is likely caused by the need for costly face-to-face contacts that are needed in deal-making, relationship adjustments and exchanging ideas. Consumer amenities are likely to become an even more important driver of the urban economy: as households tend to become increasingly rich, it may be expected that the quality of life becomes the backbone of location choices of households within cities. Likely because of the (relatively) superb accessibility of many Dutch cities by car and public transport, we find limited effects of increased public transport accessibility.

## 11.2 Policy implications

Our results also have several implications for space-based policies. We start with the evidence on agglomeration economies. A vast number of subsidies is given to attract firms to certain regions (Greenstone et al., 2012). An example is the policy to attract and maintain headquarters of multinational enterprises in the Netherlands. These policies are justified if there are substantial agglomeration externalities, so that the money invested to attract one firm will have substantial wider economic benefits. Our results in Chapters 2, 3, 4 and 5 show that agglomeration economies are important. This may suggest that policies that aim to attract firms improve welfare because of agglomeration economies, but this conclusion is difficult to verify: general equilibrium effects are extremely hard to measure, i.e. if a certain municipality attracts a certain firm, another municipality will lose that firm and the related benefits. Nevertheless, we can learn something from the evidence on agglomeration economies. First, in Chapter 3 we showed that agglomeration economies seem to be much more pronounced in urban areas. This suggests that subsidies aiming at attracting firms to deprived rural density may be inefficient because positive agglomeration externalities are absent in these places. Second, Chapter 4 shows that within-building agglomeration economies are likely important. This suggests that if municipalities should stimulate construction, they should encourage the construction of relatively tall buildings. Municipalities should also reconsider and relax limitations on building heights. Third, in Chapter 5 we highlight that policies that aim at attracting multinational enterprises may yield external benefits through the births of knowledge intensive business services, although the effect is relatively small. Fourth, we show in Chapters 2 and 7 that household density is generally valued negatively, likely because of negative crowding effects (e.g. less access to open space). This is bad news

for planning policies, such as Transit Oriented Development and Smart Growth, which aim at increasing (household) densities near nodes of public transports.

Our evidence on the importance of amenities also leads to policy recommendations. First, from Chapter 8 it may be concluded that the physical side of cities, and therefore history, leads to sorting of households over space. Policy makers should be aware of the fact that long-term national policies that stimulate preservation of historical buildings in specific cities may have large spatial effects and may cause problems related to social segregation, as high income households are attracted disproportionally by historic amenities. Chapter 9 also highlights that the house owners' costs of regulatory restrictions may be large. Policies aiming at protecting historic amenities should be aware of this and should only protect cultural heritage that yields sufficient benefits for house owners. Third, we showed that the urban fabric is valued by house owners: planning policies that stimulate mixed land use may increase house prices, given that land uses are compatible.

This dissertation also analyse the impact of accessibility, in particular access by public transport. Many planning policies aim to fight traffic congestion and reduce automobile dependency by investing in public transport. For example, Transit Oriented Development aims at a development of a high-quality public transport system together with development of mixed use neighbourhoods around stations. We find little evidence for positive accessibility benefits of new stations, which makes it harder to justify huge investments in the opening of new stations. The evidence also questions the strong focus of planning concepts like Transit Oriented Development on new development around public transport nodes.

## 11.3 Directions for further research

There are numerous possibilities for further research on the internal structure of cities. First, we deliberately choose to ignore crowding effects. Many large metropolitan areas are however plagued by air pollution and high crime rates, among other things (Glaeser, 2012). Future research may analyse how these negative crowding effects influence location patterns of firms and households within cities. It would be particularly interesting to analyse sorting of households and firms due to the presence of these negative externalities.

Second, our data do not enable us to distinguish between different sources of agglomeration economies, such as labour market pooling, input and output sharing, and knowledge spillovers. Detailed data on labour markets and workers, client relations and interactions will be useful to determine the importance of the three Marshallian sources of agglomeration economies.

Third, with respect to research on mixed land use, we encountered a number of endogeneity issues because location choices of firms and households are interdependent, and so are the rents and prices (see Chapter 3 for a stylised example). Future research should search for credible identification strategies to identify the impacts of mixed land use on house prices and commercial property values.

Fourth, in general, hedonic house price studies suffer from omitted variables, as the economist is unlikely to observe all building and location attributes. In this dissertation we try to control for unobserved attributes by including fixed effects and using instrumental variables. Nevertheless, unobserved housing attributes may still bias our results. Hedonic studies may be improved by relying

on quasi-natural experiments or by using a rational expectations approach, as recently proposed by respectively Gibbons and Overman (2012) and Bajari et al. (2012).

Finally, apart from Chapter 2, we did not aim to identify the structural willingness to pay for building and location attributes in hedonic price models (as in Ekeland et al., 2004; Bajari and Kahn, 2005; Heckman et al., 2010). The implication is that we only can analyse marginal changes in variables of interest, rather than evaluating non-marginal changes. Using repeated-sales data and by making some assumptions on the profit or utility function we may identify structural parameters, which enables us to evaluate non-marginal changes in variables of interest.