The Corridor Chronicles

Integrated perspectives on European transport corridor development

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Integrated perspectives on European transport corridor development

De Corridor Kronieken
Geïntegreerde perspectieven op de ontwikkeling van Europese transport corridors
(met een samenvatting in het Nederlands)

Proefschrift

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door

Patrick Albert Witte

geboren op 4 oktober 1988
te Den Helder

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Preface

I used to have a part-time job in a stationery shop. One day I met an anonymous researcher, who was attracted by a world map in the display window. We had a talk about my Master's programme in Urban and Regional Planning, and I mentioned that I was happy to have almost finished university. He raised an eyebrow and told me: *"Without finishing a PhD study, you cannot say that you have finished university"*. But I am not much of a scientist. Nor was it ever my childhood dream to become one. This dissertation has been the outcome of a combination of some talent and the willingness to do what I do best. That is, apparently, being a scientist.

My grandfather, in contrast, was a road worker. For over forty years he paved the very streets that I am now considering to be part of the transport network that I study. He worked until his body gave out, and took care of my ill grandmother after his early retirement. She died only a couple of years later, leaving a hole full of grief. Her passing away happened to be at a time when I was facing a crossroads. Will I finish my Master's programme, become a teacher and return to the island of Texel to teach geography in college? Or will I strive for excellence, seize the day, and become Texel's *'Good Will Hunting'*? *"Don't be afraid to stand out,"* my colleague and friend Marca Wolfensberger told me. I chose the latter road.

Along this road I have been supported by some people to whom I owe my gratitude. To begin: my former supervisor at the PBL Netherlands Environmental Assessment Agency, Edwin Buitelaar. I am glad that the empirical work which we have done during my internship at the PBL in the end resulted in a thorough academic paper. In December 2010, I changed from the PBL to Utrecht University and started working on the CODE24 project and this dissertation. At first, though, it took me some time to find my way with my office roommates from China, Jianxi Feng and Xu Huang. We began exploring each other's culture by occasionally having *'Room 4.09 discussion sessions'* and became good friends along the way.

I have felt fortunate to be working in an inspiring atmosphere among colleagues. It is beyond count how many cups of coffee I have consumed at the secretaries' office, or how many kilometres we have walked outside during lunchtimes; if it were not for the friendship of Tibisay Christian and Annemarie Savidis, my working days would have been much less fun. I would like to thank Wouter Jacobs for introducing me to the SmartPort initiative, where I met Bart Kuipers and earned an award for the best PhD poster on seaport research. Thomas Hartmann helped me checking my manuscript and introduced me to language editor Wendy Toole. They have been of great help to me. Gert Jan Dral pulled me out of my 'ivory tower' and introduced me to the world of teaching and entertaining students, which is great.

This piece of work would not have been possible without my team of (co-)promoters. Bart Wiegmans: although the travelling time from Utrecht to Delft was not always very practical (so much for corridors...), we made it work, and I am very thankful for his critical input and his personal touch at our meetings. Frank van Oort: we always

had fun at work, and his lessons on how to use SpaceStat have proven invaluable to me. A special line of thanks is dedicated to Tejo Spit. He has connected the dots ever since my Master's thesis, all the way down to this dissertation, and beyond. He values work ethic, and through his enthusiasm I have learned to really take pleasure in the work I do. From the start I have considered him my tutor in Urban and Regional Planning and I will continue to do so.

The CODE24 project has provided me with great opportunities to visit a multitude of Europe's largest urban regions along Corridor 24. Although aligning the diverging interests of five different countries in the meetings was at times a challenge, I really appreciated the *couleur locale* of all colleagues during the dinners and social events which we have had. From these foreign meetings, it is only a small step to my often-abroad fellow PhD friends Alissa Zuijdgeest and Richard Bakker, who made me feel welcome whenever I visited Zürich. Of course, I could mention other friends to thank, but let it suffice to say that their help in my *not* having to talk about my dissertation all the time is greatly appreciated. Besides, mentioning everybody would not do justice to my three dearest of friends.

Joram, thank you for never stopping believing in me. Whatever I do, be it a PhD study, a running race, a marriage, you have always backed me up – and oftentimes unasked – with advice, questions, a listening ear and your unconditional friendship. Marco, you bring out the best in me. Whenever we come across some absurd idea, we somehow always get it done. I know our friendship has had its ups and downs, but I hope that our *'Band of Brothers'* will flourish like it did in the old days. Jeroen, we happened to accidentally meet at a running race, and since then our friendship has grown so much faster than my progress in running did. Thank you for keeping me 'on track' with your enthusiasm and your competitiveness.

It goes without saying that the preface of a dissertation is not complete without some words dedicated to family. Mum and Dad, you sometimes joke about how I must have been swapped with another baby in the hospital, for my ability to study has proved to exceed yours by far (no offence). But I must say that all the honour is yours; you have been a great example to me and I could not have wished for a better one. You have done a wonderful job in raising me, Bonita and Joery: *'The Scientist, the Artist and the Policeman'*. Bonita, thank you for the wonderful cover design! Joery… joe! I also would like to extend my gratitude to my parents-in-law, Jos and Elly, for welcoming me into their family with so much warmth and personal interest. I really feel at home whenever we are visiting you.

Excuse me for saving the best until the last. My dear Lisan, you make my clock tick. The joy in life we are experiencing together is the foremost reason that I have committed myself to this dissertation in the first place. It has been a difficult road combining a full-time PhD study with all our personal plans: a beautiful wedding, a lovely honeymoon, a cosy apartment of our own and raising our puppy Lewis. But it has been worth it, and despite having a busy schedule of your own, you have never failed to support me and to take care of me to the best of your capabilities. Soon we

will finish another *'Dream of a Lifetime'*: obtaining a PhD degree – another green sticker on our poster. I hope many more green stickers will follow.

I like the idea that everything happens for a reason. At first, John Locke from the unprecedented TV-series *LOST* taught me that. Back then, I was still a Jack Shephard: ready to fix everything with the pure logic and reason of science. But Lisan helped me in finding a new Source of wisdom. I was changing as Jack was: *'Man of Science, Man of Faith'*. And so we come back to this anonymous researcher in the stationery shop telling me that finishing a PhD study is *"what I am supposed to do"*, as Jack would often say. Whenever I encountered hard times in writing up this dissertation, I reminded myself of this mysterious researcher, recalled Proverbs 16's *"Commit to the Lord whatever you do, and He will establish your plans"*, put my head down, and worked. The result of which is this.

Utrecht, February 28, 2014

Patrick Albert Witte

"There but for the grace of God, go I"

Proverbial saying – John Bradford (1510-1555)

Prologue

Once upon a time, a local entrepreneur decided to start a farm in a desert, far away from everyday civilisation, on a plot of land that no one else was willing to buy. He was soon baptised as the town's fool. However, his location decision proved not to be at all random, for his land happened to be intersected by a yet-to-be-built long-distance railway track. Moreover, his plot of land contained the only access to a water source to be found in the wide surroundings: a superb location factor. The fool became a genius; the farm became a railway station, and the land in the desert flourished from activity.

One may recognise this story as the setting of Sergio Leone's classic 1968 spaghetti western movie, *Once Upon a Time in the West*. Yet from the movie a bigger picture emerges: what happens when towns are built around railroads? In other words, what happens when land use and transport interact and integrate? This is a subtle and simple but at the same time crystal-clear example of one of the most important academic debates in modern land use and transportation studies. The idea of land use transport integration covered by this example is one of the concepts which will be discussed in this dissertation.

Taking the argument of land use transport integration one step further, the example might also include a consideration of the causality question between land use and transportation. What causes the land in the desert to flourish? The farm would still be a farm if it were not be intersected by the railway. But the railway would simply move on without interruption if it were not for the availability of water at that exact location. Both sides are therefore related in multiple, complex ways. Untangling the causality is difficult, if not impossible: an important premise to keep in mind throughout this dissertation.

Still, there are more metaphors to be found in this American Wild West story that might help in introducing some academic debates which fit within the scope of this dissertation. The opening scene of the movie is infamous: three rough cowboys in dusters are waiting for a train to arrive at a railway station. Minutes of silence and anticipation go by before the train stops at the platform and a man with a harmonica disembarks. Before long, gunfire starts and the stranger concludes that the men in dusters brought two horses too many.

The point being made is this: the action can only take place at access points, in this case the railway station. The cowboys wait where the train will stop, not three miles up ahead. In this way, the story also sheds some light on the basic principle of corridor development. A corridor, in this case a railroad, is a narrow bundle of infrastructure crossing through the landscape, only interrupted by an occasional railway station (i.e. node). These access points to the corridor are the only places where synergies can be achieved; the only places where the action happens. Corridor development is thus another important topic in this dissertation.

A final example derived from *Once Upon a Time in the West* again concerns the building of the town around the railroad. The original landowner, McBain, has passed away, leaving Cheyenne and Harmonica, the main characters of the movie, behind at the farm. In the next days, huge piles of building materials are delivered at the farm:

Harmonica: *It's a station. And all around it a town. McBain's town. […] He knew someday or another that railroad through Flagstone would continue on west. So he looked over all this county here. Until he found this hunk of desert. Nobody wanted it! But he bought it. Then he tightened his belt, and for years he waited for the railroad to reach this point.*

Cheyenne: *Ah, but how did he know the railroad would pass through his property?*

Harmonica: *Them steam engines can't roll without water. And the only water within fifty miles west of Flagstone is right here. Under this land!*

Cheyenne: *Ah ha, he was no fool, our dead friend, ah? He was going to sell this piece of desert for his weight in gold, wasn't he?*

Harmonica: *You don't sell the Dream of a Lifetime! McBain wanted his station: he got the rights to build it. It was all in order, seals, signatures, everything! One thing though, in very small print, there is a short clause. Which says that McBain or his heirs lose all rights, if by the time the railroad reaches this point… the station isn't built yet.*

Two additional topics come to the fore here. First, McBain's decision to order such large piles of building materials hints that he had high expectations for the contribution of infrastructure investments (i.e. the railroad construction) to economic growth (i.e. his railway station and town). Again, a causality problem can be introduced: is it really the arrival of the railroad that will trigger the development of that plot of land? Are there other factors at stake as well? Does economic growth follow infrastructure investments? Or, alternatively, once economic growth is already happening due to those other factors, do infrastructure investments follow anyhow?

Second, the economic growth potential is both enabled and restricted by some potential bottlenecks. On the one hand, the necessity of water for steam engines to roll is a technical bottleneck limiting the reliability and speed of the corridor, but at the same time enabling economic opportunities at McBain's site. On the other hand, the formal arrangements in place (i.e. the building rights containing a short clause) function as an institutional bottleneck to restrict this economic potential: if the station has not been built before the arrival of the track itself, the building right will be withdrawn, and hence the station and town will not be constructed.

To summarise, some recurring themes of this dissertation can be identified by metaphorically revisiting *Once Upon a Time in the West*. These themes include:

1. corridor development;
2. infrastructure investments and regional economic growth;
3. the influence of bottlenecks on transportation networks;
4. the pivoting role of nodes in transportation networks;
5. land use transport integration.

These topics will be at the heart of this dissertation. When the context is then shifted from the fictional town of *Sweetwater* in the American Old West to the present-day situation in Europe, what remains is more or less the scope and nature of this dissertation. The concepts mentioned before are still in place but can no longer be viewed in isolation from one another. Present-day transport corridor development in Europe is of a complex, integrated nature, cutting across borders at different spatial scales, operating in a setting of forces such as globalisation, telecommunication and sustainability, and combining the diverging worlds of transportation, spatial planning and economic geography in one coherent framework.

The first step of this dissertation is therefore to create order in this up to now fragmented and under-researched part of academia dealing with European transport corridor development. Since this dissertation is titled *The Corridor Chronicles*, it goes without saying that it should start at the beginning. The aim of the first chapter is to do exactly that.

Concerning Corridors

1. Corridor development in Europe

The Book of Stories concerning corridors has recently added a new chapter to its already considerable chronicle. The inception of the *Connecting Europe Facility* by the European Commission (2011) has triggered the evolution of yet another definition of corridor routes and programmes. This time, nine transnational corridors have been defined, which are together called Europe's *Core Network Corridors* (European Commission, 2013). As will be shown in this chapter, such corridor programmes have for years been driven to a large extent by ambitions regarding the integration of different scales and dimensions involved in corridor development. The topic of interest in this dissertation therefore is the question of to what extent an integrated perspective on corridor development can be proven to be of added value for European policy makers in their current and future governance strategies regarding European corridor development.

This chapter is organised as follows. First of all, the call for corridors is brought to the fore (Section 1.1.1) and it will explain what are the characteristics of the corridor concept (Section 1.1.2) and the issues in corridor development (Section 1.1.3). Next, attention will turn to the topic of integrated corridor development (Section 1.2), explaining the research goal, relevance, conceptual framework and research questions of the dissertation. Section 1.3 will discuss the research design and the thematic interests of Chapters 2 to 6, including an introduction to the theories and methods used in those chapters. Finally, this will be followed by an introduction to Corridor 24: Rotterdam–Genoa – the corridor of main interest in this dissertation (Section 1.4).

1.1 Corridors and corridor development

1.1.1 Calling for corridors

European corridors are receiving ongoing attention from policy-makers and academics alike. First, this can be observed from the considerable number of European policy programmes with regard to corridor routes, programmes and definitions. Examples of corridor programmes involving different corridors across Europe are the ERTMS corridors, ERIM corridors, TEN-T Priority Axes, RNE corridors, CER corridors, NEW OPERA corridors, EUFRANET corridors and TREND corridors (European Commission, 2008).[1] As was mentioned above, in the recent Connecting Europe Facility of the European Commission, nine different Core Network Corridors have been identified (European Commission, 2011; 2013). Examples of individual corridor studies include CODE24,[2] Corridesign, CREAM and Danube Corridor.

Second, the attention to European corridors can be observed from the academic literature. The attempts at introducing corridor development into the academic debate as a promising spatial concept to integrate different kinds of objectives resulting from different sectors and scales of policy-making is of relevance in this respect. This is reflected in the work of Priemus and Zonneveld (2003), Albrechts and Coppens

(2003), Chapman *et al.* (2003), Romein *et al.* (2003) and De Vries and Priemus (2003) on the governance of corridors. Corridors and corridor development thus can be regarded as potentially important concepts for spatial policy-making on different levels of scale, able to deal with the challenging and complex spatial reality presented to Europe's urban regions nowadays.

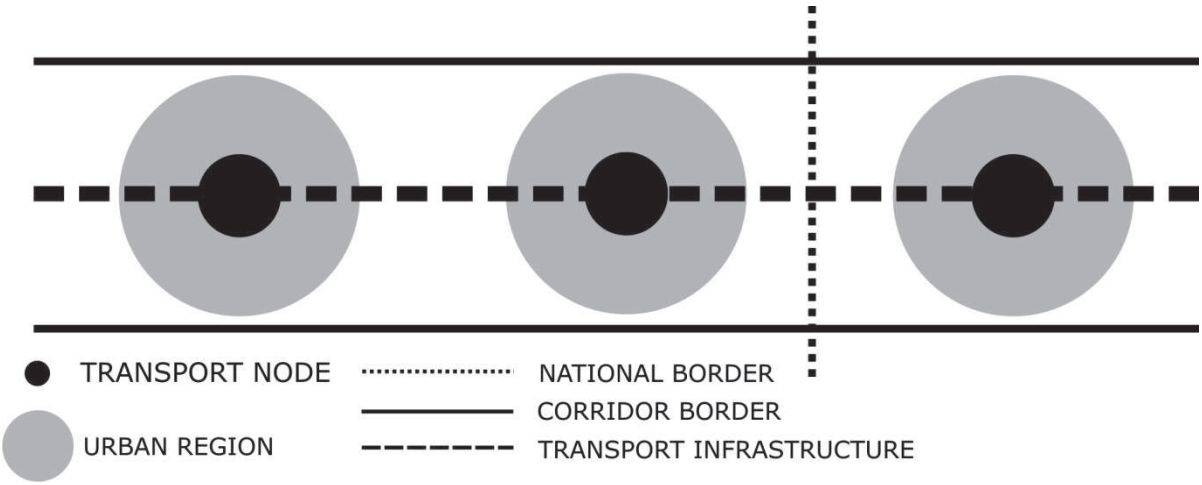
However, despite this abundant attention, the corridor concept thus far seems not to have been sufficiently or rightly addressed in policy, practice and academia. First, many policy programmes still have a limited scope in the sense that they merely take into account one-dimensional, transport-oriented issues related to logistics and transport operations (Section 1.4). Second, many of the issues in the practice of corridor development have not been solved yet and remain relevant (especially the persistence of bottlenecks along corridors), regardless of the fact that most of these issues and bottlenecks have already been known for over a decade since their initial introduction.[3] Finally, a fragmentation in the academic debate is observed regarding the availability of knowledge, institutions and governance structures fit to efficiently address present-day issues in European corridors (Section 1.1.3).

As a result, knowledge on corridors has been developed in a sectoral manner for many years, despite a growing call for an integrated analysis of corridor issues. In other words, a discrepancy is observed between the call in policy-making as well as in the academic debate for an integrated approach towards the development of European transport corridors, and the often isolated, local and sectoral-based practices of corridor development. This disparity raises the question of to what extent striving for an integrated approach to corridor development is the right way forward, both in policy and in the academic debate on European transport corridors. A first step towards answering this question is to define the concepts of corridors and corridor development (Section 1.1.2).

1.1.2 Defining corridors

Essentially, corridors can be viewed as narrow bundles of infrastructure which are connecting two or more urban regions dispersed over a certain physical space (Figure 1.1). These bundles usually exist in three modes: motorways, railway links and inland navigation or short sea connections. One can also include ICT infrastructure such as power lines, cables and oil pipes to arrive at a broader definition of a corridor. In general, however, corridors concern connections that use one or more of the three previously mentioned modes (road, rail and inland waterway) and include both passenger and freight transport (Priemus & Zonneveld, 2003).[4] For years, however, the corridor concept[5] has been considered from a broader point of view, which is exemplified by greater attention to the various scales at which corridors operate, and the various (sectoral) dimensions which seem to be integrated in corridor development (Chapman *et al.*, 2003; Priemus & Zonneveld, 2003; Romein *et al.*, 2003; De Vries & Priemus, 2003).

Figure 1.1: Transport corridor conceptualisation



It is thus stressed that corridors occur at many spatial scales, ranging from tramway corridors in urban regions to high-speed intercity rail corridors and freight corridors at the global level (Pain, 2011). Other examples of corridors are 'necklace-of-pearl' corridors for channelling smart growth at the local to regional level or corridors from production areas to port areas. Moreover, corridors are perceived as a structuring concept for infrastructure development (Bruinsma & Rietveld, 1995; Bruinsma *et al.*, 1997) and urban development plans (Banister *et al.*, 1995), as a network structure in freight and passenger transportation (Hesse & Rodrigue, 2004; Notteboom & Rodrigue, 2005; Woxenius, 2007), as a policy concept in the European cohesion discourse (Peters, 2003; Dühr *et al.*, 2007) or as a vehicle to trigger economic development (European Commission, 1999; 2011). According to Rodrigue (2004), corridors can be viewed as the place where transport, economic and demographic processes are linearly articulated. In summary, the corridor concept (also known as 'megacorridors') strives to integrate policies on infrastructure, urbanisation and economic development (Priemus & Zonneveld, 2003). The crucial factor is the multi-dimensional and multi-scalar nature of present-day corridors. In this sense, the concept refers to corridors not only as infrastructure axes, but also as economic development and urbanisation axes (Priemus, 2001; Pain, 2011).

On basis of the foregoing, it can be stated that a definition of corridors should not only be concerned with the different scopes (freight and passenger) and modes (road, rail and inland waterway) involved in corridor development, and that the different scales (local, regional and [trans-]national)[6] and dimensions (transport, spatial, institutional and economic) are also of relevance (Table 1.1). This understanding is largely in line with the corridor conceptualisation by Chapman *et al.* (2003). Corridors thus are perceived to incorporate multi-modal infrastructure connections that serve both freight and passenger transportation, operate on multiple scales and impact multiple dimensions. In other words, present-day corridor development is concerned with a complex interrelatedness between transport capacity, economic benefits and spatial structures. This dissertation is especially interested in the variety of scales and dimensions involved in corridor development, because knowledge is lacking on many of these scales and dimensions. Moreover, these are the

levels to which many of the present-day issues in corridor development can be related (Section 1.1.3).

Table 1.1: Characteristics of the corridor concept

Level	*Aspects*
Scope	- Freight - Passenger
Mode	- Road - Rail - Inland waterways
Scale	- Local - Regional - National - Transnational
Dimension	- Transport - Spatial - Institutional - Economic

1.1.3 Issues in corridor development

Numerous issues can be found in literature and practice regarding corridor development in Europe, mostly related to difficulties in achieving the wished-for successful transnational spatial governance in European corridors. For example, a common remark is on the lack of institutional involvement in the management of corridors. Although there is no great support among stakeholders for a governmental authority for complete corridors, the need to coordinate central government policies with local land use and transport policy at the corridor level is felt (Chapman *et al.*, 2003). Chapman *et al.* (2003) also point to a strategic conceptual choice to be made between developing corridors in general, and developing at dense, nodal points. In addition, the key issues for corridors are poor transnational connectivity; conflicts between long-distance and short-distance traffic; the inability to manage infrastructure congestion; competitive pressures and inequalities between regions; environmental impacts of increasing demands for transport and development; development patterns increasing the need to travel; and institutional discontinuities and a lack of coordination in decision-making.

As can be observed, the majority of issues in corridor development are related to either the multi-scalar or the multi-dimensional nature of corridors. Zooming in on the multi-scalar, multi-dimensional nature of corridors, Albrechts and Coppens (2003) argue that corridors have become trapped between the global and the local scale. In this way, European policy for efficient transportation and communication systems intertwines with local policy aimed at quality of life and the environment. This is related to the argument presented by Bertolini and Spit (1998) on node development and Scholl (2012) on corridor development: while the direct costs of node development are likely to remain at the lowest spatial level, its benefits tend to spread over a wider area. Therefore, the aims of economic development and transport

improvement on an interregional level must be accompanied by the aims of environmental protection and social integration on a local to regional scale. To this end, advance is favoured in governance structures able to support the integration of different kinds of objectives resulting from different sectors and scales of policy-making (Priemus & Zonneveld, 2004).

What is becoming evident from this brief overview of the corridor concept and its major issues is that a call for a more holistic approach to corridor development is desired to adequately address the variety of issues. It should be noted, however, that the call for integration is not at all new and stems from the traditional debate in spatial planning on the self-evident efficiency of sector-based planning versus the sector-transcendent benefits of integrated planning (Spit, 1998; Janssen-Jansen, 2004; Van Ark, 2005; Waterhout, 2007; Vigar, 2009). When this debate is related to European corridor development, the spatial impacts of transport infrastructure and the positioning of corridors within these spatial and transport dimensions are of interest. In other words, the spatial dimensions of the growing transport sector and the implications of corridor development for European policy strategies are of relevance. As seen from this perspective, it is remarkable to note that either way planning has failed to produce a systematic approach to deal with corridor issues, because many of the corridor issues that are now mentioned have already been known for over a decade. That the issues that are mentioned in this section can still be seen as highly relevant for present-day corridor development will be highlighted by a discussion of the research goal, relevance, conceptual framework and research questions of this dissertation (Section 1.2).

1.2 Integrated corridor development in Europe

1.2.1 Research goal and relevance

On basis of the characteristics mentioned before corridors can be seen as integrating both multiple dimensions (i.e. transport, spatial, institutional and economic) and multiple spatial scales (i.e. local, regional and [trans-]national). As many of the present-day issues in corridor development can be related to this multi-scalar, multi-dimensional nature of corridors, it has been put forward that a more holistic approach to corridor development is desired to adequately address the variety of issues. However, given the sectoral-based practices and the fragmented nature of the available knowledge, it can be argued that there is up to now little research available that in a satisfactory way has evaluated the added value of an integrated perspective on corridor development to solve the remaining corridor issues. As the empirical support for corridors and integration is limited (e.g. Banister & Berechman, 2001; Bertolini & Dijst, 2003), analyses of the potentials of and challenges for corridor development at different scales and across different dimensions is desired.

This dissertation therefore aims to clarify the added value of an integrated perspective on corridor development in Europe. The question is put forward as to whether corridors can have a problem-solving capacity that transgresses local and sectoral levels (e.g. the value of a transnational corridor authority versus sticking to local and sectoral-based planning and decision-making – see for instance Chapman *et*

al., 2003; De Vries & Priemus, 2003). In other words, whether an integrated conceptualisation of corridor development has added value for European policy makers in their current and future governance practices regarding corridors and corridor development in Europe is explored. Whether the added value of the integration argument is provable and whether this leads to a restating of the importance of corridors for present-day European policy objectives is also examined. This has resulted in the following main research question:

"To what extent can integrated corridor development be of added value for European policy makers in their governance practices regarding European corridors?"

The societal relevance of this dissertation will largely be reflected in the contribution of the theoretical and empirical work to the CODE24 project (Appendix 1), the umbrella under which this dissertation can be placed. This project is concerned with the transnational transport corridor – Corridor 24 – ranging from Rotterdam (Netherlands) to Genoa (Italy). Some major bottlenecks on different parts of this corridor still persist, notably technical and managerial problems in freight transportation, which limit the performance of the freight transport nodes and possibly indirectly hamper the development of the entire corridor. This gives rise to fundamental questions regarding the future economic, spatial, environmental and transport development of the corridor.

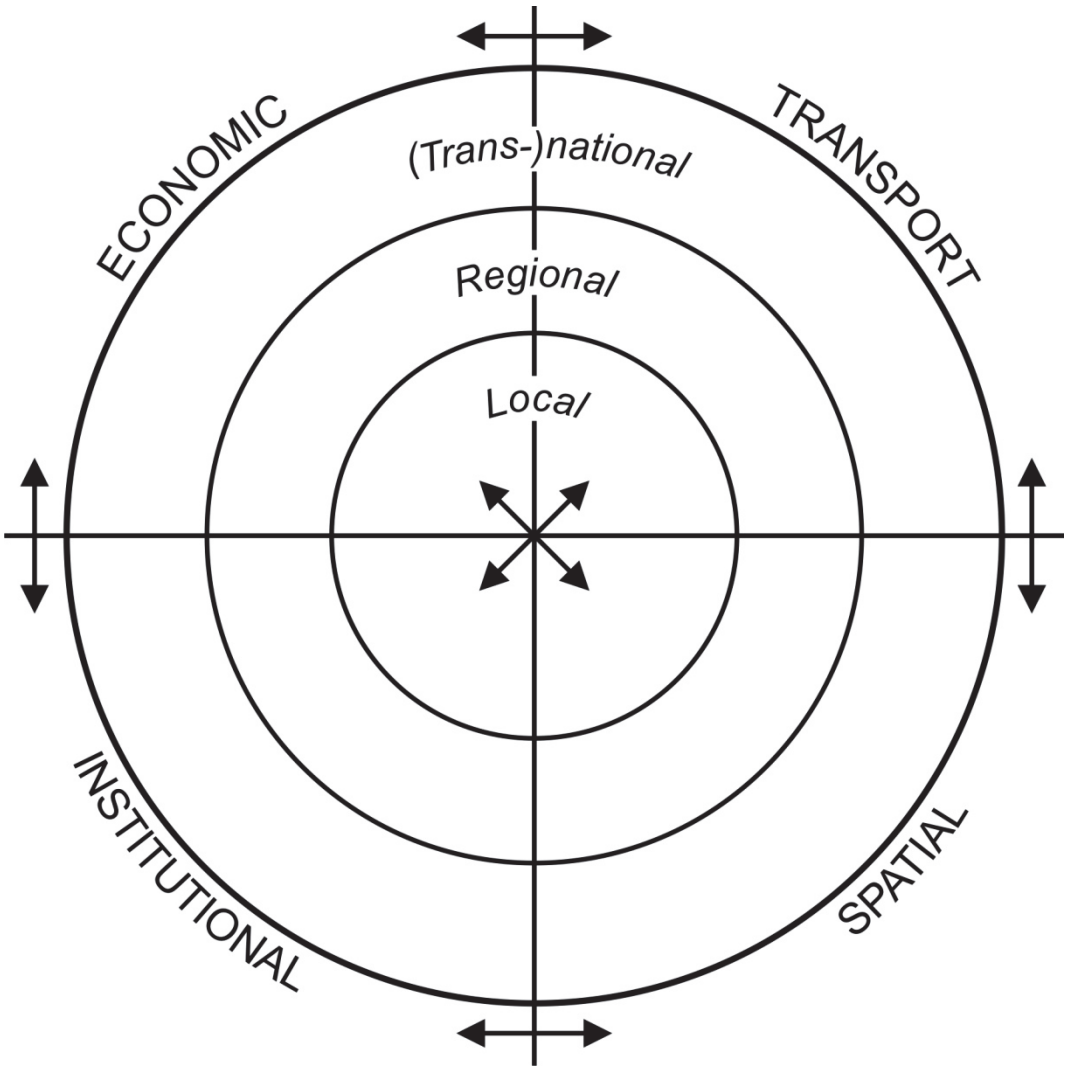
From a scientific perspective, the integration of these fundamental questions is of relevance in relation to the question of to what extent different spatial concepts capture the complexity of the present-day spatial reality. In particular, forces such as globalisation, telecommunication and sustainability continue to shape the spatial reality of many urban regions in Europe (Hall *et al.*, 2006). It is suggested that such societal developments pose challenges to spatial planners that are not adequately addressed by existing spatial categories such as 'regions' or 'networks' (De Vries & Priemus, 2003). Following the main research question, integrated perspectives on corridor development *might* thus help to better assess and contextualise these societal challenges, and be more sensitive to the scales and dimensions at which integration does or does not matter for efficient corridor development in Europe. To what extent integration proves to be a useful corridor governance strategy and to what extent integrated corridor development offers opportunities to interacting land use and transport strategies in future European policy on corridors will be assessed in this dissertation.

1.2.2 Conceptual framework and research questions

The previous paragraphs have illustrated that the supposed added value of integrated corridor development is at the centre of attention in this dissertation. However, for the added value of an integrated approach towards corridor development to be a plausible hypothesis, the integration argument is lacking specific knowledge on different problem areas (i.e. transport, spatial, institutional and economic). The question thus remains of to what extent an integrated analysis would be beneficial to resolve persistent corridor issues such as the existence of bottlenecks. This dissertation is

sensitive to the multi-dimensional nature of corridors and explores the extent to which the various problem areas of corridors contribute to an integrated analysis of corridor issues at different spatial scales (i.e. local, regional and [trans-]national). This research approach can be translated in a conceptual framework (Figure 1.2). The framework visualises the integration between the different spatial scales and the multiple dimensions of corridor development. In this way, it becomes possible to shift between different scales and dimensions (in accordance with e.g. Chapman *et al.*, 2003; De Vries & Priemus, 2003) and to pinpoint different problem areas where knowledge is lacking regarding the integration argument in corridor development.

Figure 1.2: Conceptual framework for integrated corridor development



This dissertation adds to the existing body of knowledge a number of theoretical and empirical insights on European corridor development. First of all, this is pursued by reflecting on the various conceptualisations of corridors. This can be placed in the institutional dimension, at the transnational level. Second, the economic importance of corridors is put to the test, because this has not been adequately founded on empirical evidence thus far. This is part of the economic dimension, at the regional level. Third, the cumulative and culminative nature of bottlenecks will be analysed. Although this is

rooted in the transport dimension at the local and transnational levels, linkages and spill-overs to all dimensions and scales are expected with regard to the scope of bottlenecks. Fourth, to gain a more sophisticated insight into the nature of bottlenecks, attention turns to the ways in which corridor issues are crystallised in transport nodes. This can be placed at the regional level of the transport dimension. Finally, the financial feasibility of land development projects is explored to analyse the possible contribution of the land development process to efficient corridor development. This is especially reflected at the local level of the spatial dimension.

In the end (Chapter 7), the sum total of these contributions to the problem areas of European corridors is used to assess the provability of the added value of integrated corridor development. The contributions enable a reflection on questions such as: Does the empirical evidence support the integration argument? Is the added value of the integration argument provable? Does this lead to a restating of the importance of corridors in European policy? Are corridors stimulating or hampering European policy objectives regarding territorial cohesion and decreasing regional disparities?

The five topics that have been covered in this way can be summarised in the following research questions. Each research question will be covered by one of the subsequent chapters of this dissertation (Chapters 2–6). In the research design (Section 1.3), the research questions will be explained in greater detail.

1. Conceptualising Corridors (Chapter 2)

"To what extent can capitalising on the spatial structure of corridors contribute to governance strategies for addressing present-day issues in European corridors?"

2. Coping with Corridors (Chapter 3)

"In what ways do agglomeration economies influence regional economic growth and to what extent does this differ over various types of European corridors?"

3. Chokepoints in Corridors (Chapter 4)

"What are the most important dimensions of bottlenecks in transportation and to what extent can these bottlenecks be identified in European corridors?"

4. Challenges in Corridors (Chapter 5)

"What inland port-city challenges can be identified and in what ways are these challenges shaping inland ports' governance strategies in European corridors?"

5. Capturing value in Corridors (Chapter 6)

"How do location factors influence the costs and benefits of land development and what does this imply for perspectives of value-capturing in European corridors?"

1.3 Research design

This section will outline the research design, including the themes, theories and methods used in each of the upcoming chapters (Chapters 2–6).

1.3.1 Conceptualising Corridors (Chapter 2)

The focus of Chapter 2 will be on the concept of corridor development in general and on the complex relation between corridors and spatial structure in particular. Although corridors are a common feature in transportation studies and European policy, the spatial structure of corridors (i.e. the 'spatiality' of corridors) is hardly considered in these documents. The role of corridors in spatial planning also seems to be limited. Despite the recognition of corridors and corridor development as a valid, empirically observable phenomenon (Priemus, 2001), accurate spatial policy is oftentimes lacking. At the same time, governments face increasingly complex tasks, providing the spatial reality of today's urban regions with sound policy on transport development (Barca *et al.*, 2012). This is especially true in a European context where, since the opening up of the European Union in the 1990s and the institutionalisation of a borderless Europe, there is a growing call for transnational spatial governance (Priemus & Zonneveld, 2003; De Vries & Priemus, 2003).

There seems to be a mismatch between corridors and spatial structure that has not been adequately addressed by spatial planners and European policy-makers. The goal of this chapter therefore is to set the agenda regarding the opportunities and challenges for the governance of transnational corridors in the light of the recent attention to place-based development strategies (Barca *et al.*, 2012). In line with initiatives such as ESPON (Dühr *et al.*, 2007), the starting point of this chapter is the suggestion that integrating spatial structure with corridors provides interesting common ground for future research and practice. A literature review and an explorative empirical analysis of quantitative evidence regarding the possibilities of integrating spatial structure with corridors provides an overview of the potential of and challenges for integrated corridor development. This can be used to shape the future research agenda for the planning of European corridors. In this way, the contribution of the chapter can be seen as an extension to the work of Priemus and Zonneveld (2003), Albrechts and Coppens (2003), Chapman *et al.* (2003), Romein *et al.* (2003) and De Vries and Priemus (2003) on the governance of corridors.

1.3.2 Coping with Corridors (Chapter 3)

The occurrence of agglomeration effects in corridors will be the main topic of interest in Chapter 3. The starting point of this chapter is the often-heard assumption in policy documents that corridor development contributes positively to regional economic growth (e.g. European Commission, 1999; 2011; World Bank, 2006). In particular, corridors are being viewed as a promising way forward in European transport planning. It is assumed that a well-functioning corridor will contribute positively to regional economic development, especially in the vicinity of the main transport nodes along the corridor's network (Schönharting *et al.*, 2003; McCann & Shefer, 2004).

However, this assumption is largely unfounded and empirical evidence that supports the argument is largely absent. Although the economic potential of corridors is increasingly recognised by European policy-makers – given the attention to corridors in policy documentation such as the European Spatial Development Perspective (ESDP) – the empirical validity of this potential is much less evident.

The corridor focus of many European transportation policies, backed up by agglomeration arguments (in corridor-related projects such as CODE24, Corridesign, CREAM, Danube Corridor) as well as corridor-related studies and initiatives (e.g. TEN-T, ERIM, CER), suggests that corridors may operate as an independent economic cluster (Bathelt, 2005), while other research also states that corridors may not be more than co-located agglomeration advantages of large urban regions (Louter, 1999). This chapter contributes to the discussion by means of an empirical analysis of the economic potential of corridors, and the added value of the corridor concept for explanations of regional economic growth in terms of positive externalities and spill-overs. This will be backed up by means of spatial econometric estimations and analyses of differentiating spatial regimes. The analyses build on accepted theoretical insights and methodologies derived from New Economic Geography (NEG) theorising (Van Oort, 2004; Frenken *et al.*, 2007; Capello *et al.*, 2008; Beaudry & Schiffauerova, 2009; Dogaru *et al.*, 2011; Bosma & Van Oort, 2012; Marrocu *et al.*, 2012).

1.3.3 Chokepoints in Corridors (Chapter 4)

Bottlenecks are the most prominent feature of Chapter 4. For corridor linkages in Europe are often compromised by barriers or bottlenecks (Chapman *et al.*, 2003). In order to contribute to the future development of corridors and to support the sustainable development of urban regions, these barriers or bottlenecks in transport nodes have to be resolved. The existence of bottlenecks in the European transport network is a persistent issue in European spatial policy (European Commission, 1999; 2011). The problem is that current policy is not sufficiently informed of and sensitive towards the full scale and scope of the existing bottlenecks. This chapter will highlight the problematic nature of the one-dimensional understanding of the scope, scale, complexity and cumulative effects of bottlenecks in the European transport network and adds to the literature a new integrative framework to deal with bottlenecks.

Theoretically, the contribution of this chapter can be seen as an extension to the bottlenecks perspective provided by Rothengatter (1996) and as a complementary perspective to the work of Hesse and Rodrigue (2004) on friction effects. On basis of a substantive literature review, an integrated analytical framework to analyse and evaluate the complexity of bottlenecks is developed. This chapter relies on mixed-scanning methodology, to test in a preliminary way the validity of the analytical framework. Case study areas on Corridor 24 are explored using Etzioni's mixed-scanning methodology, thus taking into account the macro-level, while also zooming in to the micro-level when necessary. The main inputs to this analysis are provided for by the results of expert interviewing with stakeholders along Corridor 24. The results can be used as a first step to the empirical work in Chapter 5.

1.3.4 Challenges in Corridors (Chapter 5)

Chapter 5 can be viewed as a continuation of the work in Chapter 4, which is applied to the concrete case of inland port development. As most of the dynamics of corridor development are crystallised in transport nodes, and when considering the 'weakest link' principle of nodes in networks, the functioning of inland ports can be considered to be of importance for the overall efficiency of corridors. For years, however, the port system development literature has shown a strong focus on the maritime context within a network-based perspective (Outside–In), in which inland ports play second fiddle (Notteboom, 1997; Van Klink & Van den Berg, 1998; Hesse & Rodrigue, 2004; Rodrigue, 2004; Notteboom & Rodrigue, 2005; Wiegmans *et al.*, 2009). In contrast, as inland ports are growing in complexity and importance, it can be argued that port system development literature should also be sensitive to the independent role and structure of inland ports in transportation networks and corridors (Inside–Out).

The classical theoretical transportation models of Taaffe *et al.* (1963) and Bird (1971), and extensions to these models (Hayuth, 1981; Barke, 1986) are used as a starting point for discussing port system development concepts. In recent years, these models have been elaborated upon by, among others, Notteboom and Rodrigue (2005), Wilmsmeier *et al.* (2011) and Monios and Wilmsmeier (2012). This chapter puts forward a next step in port system development, that is, the emergence of inland port-city challenges. On the basis of an empirical analysis of inland ports' development strategies, using an institutional methodological approach which is in accordance with the recent 'institutionalist turn' observable in port literature (e.g. Jacobs & Hall, 2007; Daamen & Vries, 2013), the extent to which challenges between inland ports and cities can be identified, and if and how these challenges take physical shape in governance strategies of inland ports, will be assessed.

1.3.5 Capturing value in Corridors (Chapter 6)

Chapter 6 draws attention to the financial feasibility of land development projects, in order to analyse the possible contributions of the land development process to efficient corridor development. The chapter aims at an empirical validation of a number of theoretical insights derived from, among others, Ricardian land rent theory and Alonso's bid rent curve. To this end, multivariate regression analyses are carried out on large-scale, quantitative data-material. The results pay particular attention to the policy shift from greenfield to brownfield development (Adams & Watkins, 2002) that occurred in many countries and to the effects of the residual valuation method as a plan-making tool.

In particular, the possible implications for integrating land use and transport in land development projects where a node-place synergy can be achieved are of interest (Bertolini & Spit, 1998; Bertolini & Dijst, 2003; Peek *et al.*, 2006). It is argued that land use transport integration could for a long time be seen as a useful strategy to create added value and to achieve synergies in, for example, railway station redevelopment projects (Kooijman & Wigmans, 2003; Majoor, 2006; Haywood & Hebbert, 2008; Peek & Louw, 2008; Reusser *et al.*, 2008). However, as Bertolini and Spit (1998) stress, specific opportunities and problems at railway stations tend to be

overlooked, because of inadequate understanding of the ambivalent nature of both land use and transport issues at railway station areas. This might also impact the possibilities for value capturing (Debrezion *et al.*, 2007; Enoch *et al.*, 2005; Van der Krabben *et al.*, 2008).

The previous sections have illustrated the diverse nature of European corridors, by showcasing the multiple spatial scales and dimensions that are at stake in present-day corridor development. To facilitate the future development of corridors, thus aiming at increasing the economic potential of corridors without compromising on environmental and spatial quality, an integrated perspective on European corridor development is more frequently called for. However, the added value of integrated corridor development seems to be questionable, because of an incomplete and limited understanding of present-day corridor issues. This dissertation therefore contributes to the knowledge base regarding corridors and corridor development by adding new theoretical and empirical insights on a number of problem areas of present-day European corridors. An assessment of the sum total of these contributions can shed more light on the extent to which the integration argument in corridor development can be seen as a relevant approach to address the present-day corridor issues. However, before moving on to these contributions, the corridor of main interest in this dissertation – Corridor 24 – will be introduced (Section 1.4).

1.4 Corridor 24: Rotterdam-Genoa

Corridor 24, or the Rotterdam–Genoa corridor, is well known in European policy and practice (infamous nicknames including 'Blue Banana'[7] and 'European backbone'). This corridor connects the most intensive value-creating spaces in Europe, and follows the historical routes of Europe's initial development (Scholl & Günther, 2012; Schönharting *et al.*, 2003). The corridor is an important axis in terms of both passenger and freight transportation (serving a population of 75 million inhabitants and operating 700 million tons of goods per year); the corridor serves all modes, influences people and businesses ranging from the local to the global scale and, from a geographical point of view, the corridor has a range of approximately 1.200 kilometres and hosts the most densely populated urban regions in Europe (Figure 1.3). Because of these characteristics, Corridor 24 can be seen as a prime example of a present-day European corridor, in which the diverging interests of transport, economic and spatial development are present at different spatial scales (Figure 1.4).

Figure 1.3: Corridor 24 and its environment

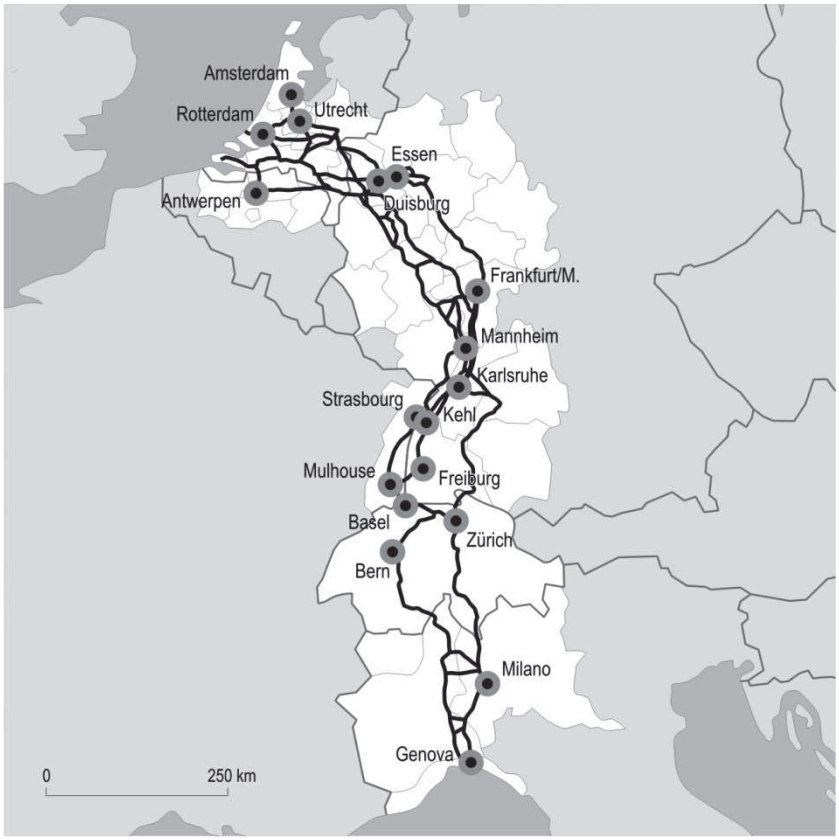
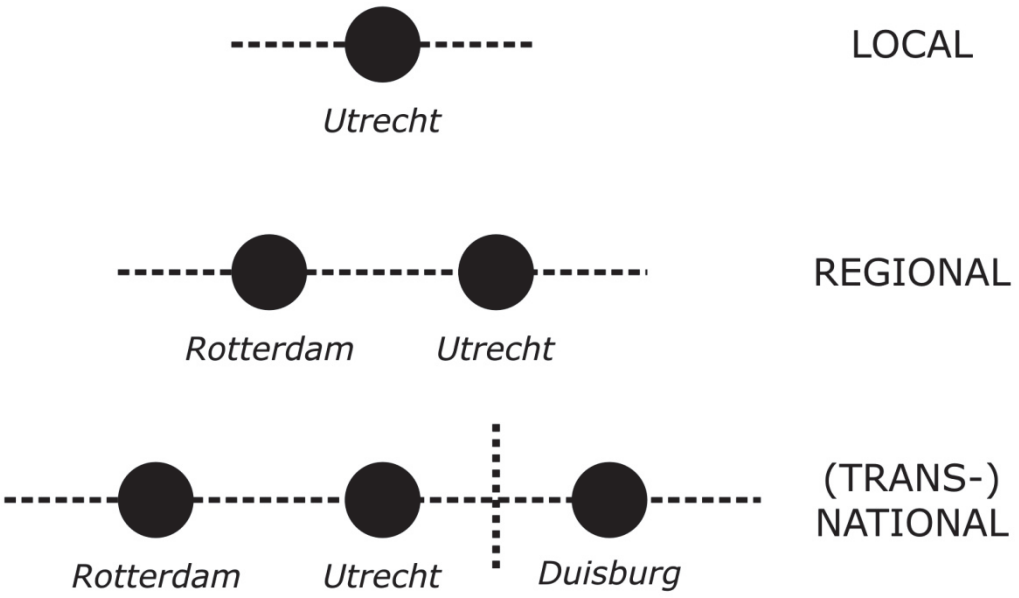


Figure 1.4: Corridor 24 at different spatial scales



The corridor's space includes the following urban regions:

- the Randstad region in the Netherlands, including Amsterdam, Rotterdam, the Hague and Utrecht;
- the Ruhr region in Germany, including Essen, Düsseldorf, Oberhausen and Duisburg;
- the German urban regions of Frankfurt, Mannheim and Karlsruhe;
- the north-west region in Switzerland, including Basel and Zürich;
- the macro-region of the Swiss Alps and north-west Italy, including Ticino, Wallis, Lombardia, Piemonte and Liguria.

In the NUTS3 regions belonging to the corridor's space live about 75 million inhabitants. This implies that Corridor 24 is one of the most densely populated areas in Europe, with an average of 700 inhabitants per square kilometre (the European average is 70 inhabitants per square kilometre). To the corridor's space belong the metropolitan regions and all transport infrastructures connecting them. The geographical borders of the corridor have been defined by selecting the most important railway lines directly connecting these metropolitan areas. Furthermore, all NUTS2 areas served by this core network have been added to the map.

To illustrate the complexity of present-day corridor policies and programmes on Corridor 24, and to align the various definitions, a chronological overview of these programmes will be presented.

ERTMS: Corridor A (2003)

In 2003 the Ministries of Transport from the Netherlands, Germany, Switzerland and Italy agreed upon a Memorandum of Understanding to enhance the quantity and quality of the Rotterdam–Genoa corridor on the basis of a comprehensive plan of action. In 2005, the infrastructure operators involved committed themselves to a European programme for rail corridors, by doing so becoming known as 'Corridor A'. The goal of Corridor A is to implement the European Rail Traffic Management System (ERTMS) for conventional and high-speed rail transport in a trans-European railway network. In 2006 this was formalised in a Letter of Intent, which ensures implementation of ERMTS in two stages before 2015.

RNE: Corridor 2 (2004)

Rail Net Europe (RNE) is an association of twenty-two European railway infrastructure managers, aiming to improve international railway traffic on eleven corridors. The Rotterdam-Genoa corridor is in this case called 'RNE Corridor 2'. The aim of RNE is to support railway undertakings in their international activities, including freight as well as passenger activities. Besides, the aim is to enlarge the efficiency of infrastructure managers. In practice this means optimisation of time schedules, marketing and cooperation between infrastructure managers. RNE Corridor 2 cooperates closely with the ERTMS initiative 'Corridor A'.

TEN-T Priority Axis: Project 24 (2005)

The Trans-European Transport Network (TEN-T) refers to a European infrastructure policy programme that was initiated in 1993, followed in 1996 by the publishing of the first guidelines and fourteen so-called Priority Projects. In 2004, new guidelines were published as a response to the enlargement of the European Union. A new project portfolio, containing thirty Priority Projects, was created in 2005. These projects are aimed at improving the so-called Priority Axes – the most important (freight) transport axes in Europe. Each Priority Project contains different concrete projects. In the present situation of Project 24, the Rotterdam–Genoa corridor, there are twelve projects running (with starting dates ranging from 2005 to 2009). The Core Network Corridors (see below) can be viewed as a continuation of this programme.

European regulation 913: Corridor 1 (2010)

The European regulation 913/2010 is titled 'European Rail Network for Competitive Freight'. Whereas the previous initiatives are mainly focused at supporting the 'physical' infrastructure of freight corridors, this regulation is aimed at improving the operational dimension of the freight corridors. The new regulation aims to provide directions to the selection, organisation and management of possible investments in freight corridors. The appointed corridors of this regulation are consistent with the TEN-T corridors. In this case, the Rotterdam–Genoa corridor is called 'Corridor 1'.

INTERREG IVB: CODE24 (2010)

The INTERREG IVB project 'CODE24' (Appendix 1) is focused at the coordination of a transnational strategy to improve Corridor 24: *"It intends the interconnection of economic development, spatial, transport and ecological planning along the Trans-European Transport Network (TEN-T 24) from Rotterdam to Genoa."* CODE24 is mainly concerned with the mobilisation of actors and stakeholders on the regional and local level, to highlight the importance of this corridor and to strive for spatial integration at the regional level. New methods are implemented, to remove the remaining bottlenecks along the corridor and to improve the corridor's area and surroundings.

Core Network Corridors: Rhine–Alpine Corridor (2011–2013)

The Core Network Corridors have resulted from a revision of the TEN-T guidelines. Under the umbrella of the overarching Connecting Europe Facility, in which corridor platforms are advocated as a means to counter transnational institutional fragmentation, the European Commission proposed a TEN-T Core Network which consists of nine Core Network Corridors. An attempt has been made to align the different definitions of corridors in Europe as coherently as possible. The Rotterdam–Genoa corridor in this case is called the 'Rhine-Alpine Corridor'. At the time of writing this dissertation there is a call for tender for future studies on the core network corridors.

What has become clear from this overview of corridor programmes on Corridor 24 is that in most cases the scope of these initiatives is rather limited to a one-dimensional, transport-oriented approach towards corridor development. Exceptions to this rule are

the integrated nature of the CODE24 initiative (see for example the case study in Appendix 1) and the yet unknown status of the future corridor studies on the Core Network Corridors. To go into detail on the remaining initiatives, first, some initiatives aim to resolve the technical problems on the corridor. These include the improvement of the 'physical' infrastructure of the corridor (TEN-T) and the improvement of the ERMTS security system along the corridor (Corridor A). Second, some initiatives aim to resolve the managerial problems along the corridor. These include the improvement of the efficiency of infrastructure managers (RNE corridor 2) and the improvement of the operational dimension of the corridor (European regulation 913/2010).

In other words, the corridor programmes to a large degree take Corridor 24 into account merely as a bundle of transport infrastructure and limit their focus to issues regarding logistics and transport operations. However, when this is seen in the light of the multi-scalar, multi-dimensional nature of corridors as was observed in the literature (Section 1.1 to 1.3), a discrepancy between the call for an integrated approach to corridor development and the isolated, sectoral-based practices comes to the fore. This disparity will be an important and recurring theme in this dissertation, as will already be shown in the next chapter.

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Notes

[1] ERTMS: European Rail Traffic Management System; ERIM: European Rail Infrastructure Masterplan; TEN-T: Trans-European Transport Network; RNE: Rail Net Europe; CER: CER Business Cases for a Primary European Rail Freight Network; NEW OPERA: NEW OPERA Operating Project for a European Rail Freight Network; EUFRANET: European Freight Railway Network; TREND: Towards new Rail freight quality and concepts in the European Network in respect to market Demand.

[2] In this dissertation, the analysis is to a large degree limited to the specific context of Corridor 24, and the CODE24 initiative (Appendix 1).

[3] In 2013, it was ten years since the *Journal of Transport Geography* published a Special Issue on the governance of corridors (which was edited by Priemus & Zonneveld, 2003).

[4] It is worth mentioning that this definition is only one of the many definitions possible. For example, Chapman *et al.* (2003) conducted a specific research on stakeholders' perceptions of the megacorridor concept and found that there is no one single or shared definition. Another example is provided by Rodrigue's (2004) contribution on different paradigms in representing corridors. These paradigms are mainly focused at freight distribution and the rise of intermodal transportation, in contrast to the stronger focus on passenger transport, urbanisation and economic development which is prevalent in the definition of Priemus & Zonneveld (2003).

[5] This should be understood as a set of (mental) representations which stakeholders have regarding the scope and nature of corridors and corridor development. As Chapman *et al.* (2003) argue: any coherence between stakeholders in such representations is largely absent.

[6] In this dissertation, the national and transnational level are often taken together to indicate the relatedness between the two levels (following for instance Chapman *et al.*, 2003; Rodrigue, 2004). For example, when regarding bottlenecks, certain institutional practices stemming from the national level (which in themselves are not problematic) can turn into a bottleneck when the transnational context is considered, because now the differences between the institutional structures of different countries come to the fore. A practical example concerns the differences between railway security systems of different nations or problems with electromagnetic compatibility of railway tracks at the transnational corridor level.

[7] The concept of 'The Blue Banana' was developed in 1989 by RECLUS, a group of French geographers. Consequently, the press at that time termed the corridor 'Blue Banana', referring to the shape of the corridor and the colouring of the French mapmakers.

2. Capitalising on spatiality in European transport corridors

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Abstract

After half a century of corridor development in Europe, the corridor concept is well-established in the academic discourse on transportation. Transport corridors have also been common practice in European transport policy since the creation of a borderless Europe in the 1990s. What is largely lacking in present-day research on European transport corridors is a consideration of a sector-transcendent and comprehensive spatial approach. We argue that adopting such an approach is beneficial to a valued analysis of European transport corridors, especially in the light of EU cohesion policy, agglomeration effects and place-based development. Also, negative external effects of persisting bottlenecks on welfare and quality of life in transport corridors should be better assessed and contextualised. This chapter therefore suggests that policy can and should capitalise more on spatiality in corridors.

Keywords

Eurocorridor, megacorridor, spatiality, agglomeration effects, place-based development

2.1 Introduction

Almost a decade ago, the governance of corridors was introduced as an important issue for European spatial and urban planning (Priemus & Zonneveld, 2003, p. 169). Institutional fragmentation was mentioned as a key problem, implying a need for planned corridor development. Nowadays, the urgency to plan for corridors remains largely unaltered. The European Commission has recently reaffirmed the importance of transport corridors for the future development of the European transport networks (European Commission 2011, p. 2). It is still stated that 'corridor platforms' can function as a governance structure to help implement cross-border corridor development plans.

This apparent lack of result or progress might imply a mismatch between corridors and spatiality that has not been adequately addressed by spatial planners and EU policy-makers alike. We however argue that adopting a spatial perspective might be beneficial to capturing agglomeration effects occurring in corridors and combating negative external effects of corridors (e.g. bottlenecks) on welfare and quality of life. This mainly theoretical chapter therefore aims to advocate capitalising on spatiality in European transport corridors. This results in recommendations for a place-based research agenda.

2.2 Origins of the corridor concept

When discussing corridors, one encounters a plethora of definitions (e.g. eurocorridor, megacorridor, TEN-T corridor) and meanings (e.g. infrastructure axis, urbanisation axis, economic development axis) of the concept. Moreover, corridor development occurs at many spatial scales, ranging from local tramway corridors in urban regions to high-speed intercity rail corridors and freight corridors at the global level. To understand the multi-faceted nature of the present-day understanding of corridors, we start off with exploring the – largely aspatial – origins, development and implementation of the concept.

The historical antecedents of the corridor concept – corridors as linear extensions of infrastructure – already had a clear spatial structure (Priemus & Zonneveld 2003, p. 168). This localised concept of transport corridors attracted much attention, and many regional plans have contained elements of linear extensions of infrastructure. Examples are the Finger Plan of Copenhagen or the Ciudad Lineal district in Madrid. The historical link of corridors with transport and land use was however devalued by the rise of global transport networks and the network economy as leading concepts, driven by the constant exchange of goods in human economic activity (Hesse & Rodrigue 2004, pp. 173-175). Still, global transportation networks in the end do not mitigate the role of local corridors and agglomeration advantages, but rather values these forms of planned local organisation alongside 'global pipelines' (Bathelt *et al.* 2004).

Influenced by processes of globalisation, (containerised) freight transport rapidly increased from 1956 onwards, with the introduction of the standardised (TEU) freight container (Hesse & Rodrigue 2004, p. 172; Notteboom 1997, p. 99). This led to a concentration of container usage and congestion in traditional port areas (Notteboom 1997, pp. 100, 110-111). The development of infrastructure corridors proved to be the way out, relieving the crowded port areas and transferring freight along these major corridors to the inland terminals in the hinterland (Notteboom & Rodrigue 2005, pp. 299-306). The concept of infrastructure corridors was thus quickly perceived as a useful network structure in freight transportation (Hesse & Rodrigue 2004, p. 179).

In the early 1990s, a broader understanding of the corridor concept was also successfully introduced in EU policy. The assumption was that enhancing the level of connectivity would stimulate the economic performance of lagging regions. This was translated into transport concepts stimulating the development of transnational infrastructure linkages (Priemus & Zonneveld 2003, p. 169). The political agenda was that this would make economic integration of the EU physically possible. This was

formalised in the adoption of the Trans-European Networks (TEN-T) and the introduction of 'eurocorridors' as a comprehensive planning concept. In this way, the concept was explicitly linked to the EU cohesion discourse. The eurocorridor became a comprehensive planning concept and conceptual tool for integrating different sectoral policies, giving corridors a renewed meaning.

This new understanding of the corridor concept is referred to as 'megacorridors' (Priemus & Zonneveld 2003; Chapman *et al.* 2003). The crucial difference from the historical antecedents of the corridor concept is the multi-faceted and transnational, cross-border character of transport corridors. In this sense, the concept refers to corridors not only as infrastructure axes, but also as economic development and urbanisation axes (Priemus 2001, p. 102). In the remainder of this chapter, we refer to this understanding of the concept, whenever we speak of 'corridors' or 'corridor development'.

2.3 Capitalising on spatiality in corridors

One would expect that the concept of megacorridors would have paved the way for a comprehensive spatial approach which integrates the complex interactions existing between transport corridors, regional economic development and territorial cohesion. Surprisingly, we find that only little attention is paid to corridors in European planning and economic agglomeration literature. Notwithstanding exceptions such as the ESPON initiative (Dühr *et al.* 2007, p. 293) or Peters' (2003) account of corridors as EU policy 'storyline', transport corridors not appear to have received wide-spread 'mainstream' attention in literature. In other words, it seems that either the corridor concept has not (yet) acquired an important position in spatial planning on different scales or, alternatively, that transport corridors are not considered a very useful tool in spatial planning. Apparently, there is a mismatch between corridors and spatiality, which is not adequately addressed.

Partly, this mismatch can be explained by the critical reception of the corridor concept by national governments. It was assumed that corridor development would lead to unplanned extensions of urban regions, also known as 'ribbon development' (Priemus & Zonneveld 2003, p. 170; Priemus 2001, p. 105) and gradually the concept of linearity in regional plans lost popularity and was not widely implemented (Chapman *et al.* 2003, pp. 180-181). Another explanation may be that valuation techniques on agglomeration effects (corridors may hypothetically improve productivity, employment or welfare in the connected urban regions under certain conditions) fail consistent estimation on its magnitude and direction (Rosenthal & Strange 2004; Beaudry & Schiffauerova 2009).

Spatial planners nevertheless have attempted to connect corridors and spatiality. Priemus and Zonneveld (2003, p. 173) started off with the assumption that infrastructure (e.g. corridors) not only is a derived demand from social and economic processes, as is often suggested in literature, but to some extent determines these as well. In other words, the structuring role of infrastructure (see, amongst others: Bruinsma & Rietveld, 1995) should not be underestimated; corridors might have a notable impact on spatial development patterns. De Vries and Priemus (2003, pp. 225-226) point out that important challenges for transnational governance will be

overlooked if corridors are not taken seriously. For example, a growing differentiation in the spatial scope of social relationships and practices is an important challenge which is not adequately addressed by existing spatial categories such as 'regions' or 'networks'. However, since corridors as an empirical phenomenon are too complex (i.e. involvement of multiple actors, multi-level problems, negative external effects, etc.), it has been argued that concepts suitable for the planning of corridors should be developed. A spatial perspective should be advocated (De Vries & Priemus 2003, pp. 226-231).

Romein *et al.* (2003, p. 211) agree that transnational corridors seem promising as a spatial concept, but warn that in practice the intertwining of corridors with urbanisation, economic development and quality of life tends to be neglected. Corridors should be considered a multi-dimensional affair, taking advantage of opportunities to connect diverse sectoral policies (e.g. transport, housing, economic or environmental policies). One of the problematic aspects of corridor development is institutional fragmentation due to planning power on the local level. Related to this is the lack of a corridor-institution to coordinate national governments' issues with local land use and transportation (Chapman *et al.* 2003, pp. 182-183). Yet, it is questionable whether such an institution is desired by practitioners; 'Whatever is happening, is evolving despite planning' (Chapman *et al.* 2003, p. 185).

It seems that the potential of integrated corridor development has not been utilised to its fullest extent, partly hindered by institutional fragmentation and the absence of a clear framework for transnational governance. Still, there is some promising common ground for corridors and spatiality in connecting multi-dimensional issues such as urbanisation, economic development and quality of life. We therefore argue that capitalising on spatiality should be the way forward for EU policy-makers.

However, it appears that explicitly linking corridors to spatiality is experienced as complex and time-consuming by spatial planners, because of difficulties involved in coordinating numerous sectors, scales, perspectives and stakeholders (Priemus & Zonneveld 2004, p. 294), and because it is hard to measure the effects of corridors on economic development opportunities and agglomeration effects. Moreover, owing to the absence of a clear framework, the application of policies such as the European Spatial Development Perspective (ESDP) relies on the perceived needs or benefits of the actors involved on the national to local levels (Dühr *et al.* 2007, p. 295).

The resulting lack of attention paid to the integration of corridors with spatiality could be explained by the efficiency of decision-making processes on the sectoral level. In other words, sticking to a sectoral approach might be more efficient (e.g. in terms of lower costs for coordination) than trying to integrate infrastructure, urbanisation and economic development in a sophisticated, space-sensitive way. For example, the corridor concept has been (re)introduced effectively in the Netherlands in a number of White Papers by the Ministry of Economic Affairs, after being largely abandoned by the Ministry of Spatial Planning (Priemus & Zonneveld 2003, pp. 170-172).

Still, taking a sectoral approach towards corridors has serious drawbacks. First, when developing and maintaining transport infrastructure, negative external effects on the local level (e.g. noise nuisance, air pollution, and congestion) are often disregarded

in a sectoral perspective. These bottlenecks hinder the most efficient use of the existing infrastructure (Witte *et al.*, 2012, p. 64). Second, sectoral fragmentation and local embeddedness of decision-making often result in limited capacity for integrative problem-solving on the corridor level (e.g. Notteboom 1997, p. 114). In our view an integrated approach, focused on the wider economic and cohesive implications (Priemus & Zonneveld 2004, pp. 288-290), should be able to deal with these drawbacks and better capture the complex interactions in corridors and the balance of advantages and disadvantages of corridors in terms of valued externalities and spill-overs.

2.4 Agglomeration effects in corridors: an empirical example

As an example, we present some indicative findings of an ongoing research project. The hypotheses underlying this analysis stem from the debate on the ambiguous causality between infrastructure investments and regional economic growth.[1] One can argue that the reduction of (direct) transport costs, caused by infrastructure investments such as corridor development, ultimately influences modal choice and routing and, hence, expansion of economic activities in certain areas (Bruinsma *et al.* 1997, pp. 392-393). Of course, other factors such as technology, demography, economy and governance influence the spatial pattern of economic activities too.

An alternative explanation is that indirect effects of transport infrastructure on regional economic development occur to a great extent because of agglomeration effects (Thissen *et al.* 2011, pp. 549-556). In this explanation, infrastructure investment trickles down to affect interregional trade and labour markets. What effect (if any) will prevail in which region depends on the relative dependence of a region on trade and the size of the regional market. This has important implications for the welfare gains of regions. Thus, agglomeration effects will ultimately influence spatial economic developments such as location decisions of firms (De Bok & Van Oort 2011).

The foregoing implies that one should pay close attention to the effects of agglomeration economies on corridor regions. Not taking into account the spatiality of corridors limits the explanatory power for network patterns, regional competitiveness, territorial cohesion, welfare gains and quality of life in corridors. What is however missing is a consistent estimation of the magnitude of these agglomeration effects. We have therefore analysed an aggregated sample of 235 European NUTS2 regions[2] including six different European transport corridors (Figure 2.1).[3] Data is tested for the conditions which influence the occurrence of agglomeration economies within corridor regions, compared to regions outside corridors. Table 2.1 presents the descriptive statistics and outcomes of the independent t-test.

Figure 2.1: NUTS2 regions of ERTMS corridors in Europe, based on the ERIM network

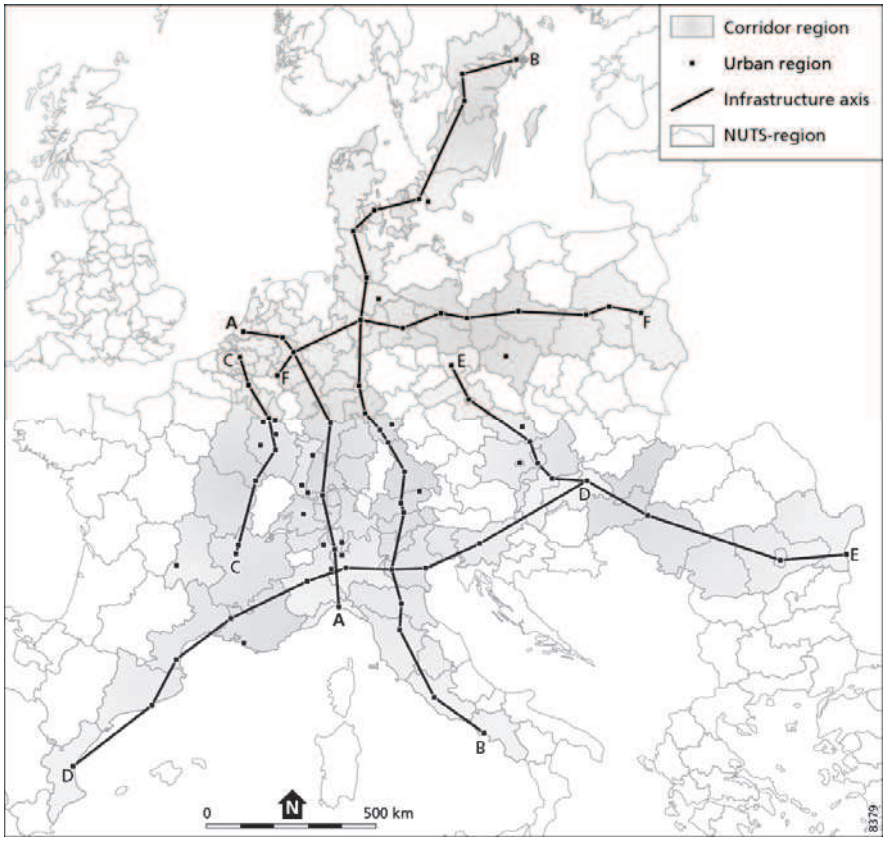

Table 2.1: Descriptive statistics and outcomes independent t-test

	Corridor regions (n=95)	*Non-corridor regions (n=140)*	*Total NUTS2 (n=235)*	*t (* p<0,05)*
Employment growth	0,062	0,079	0,072	-1,745
Productivity growth	0,172	0,180	0,177	-0,454
Employment level 2000	1.040.998	724.097	852.206	3,962*
Productivity level 2000	39,146	36,547	37,598	0,163
Specialisation-diversity	0,070	0,081	0,077	-1,376
Private R&D (%GDP)	0,992	0,743	0,844	3,629*
Public R&D (%GDP)	0,615	0,440	0,511	2,983*
Openness economy	0,855	0,723	0,777	1,975*
Market potential	16.275,3	12.882,2	14.253,9	4,954*
Population density	422,7	313,6	357,7	2,822*

The variables[4] we test are often used in empirical agglomeration studies (Dogaru *et al.*, 2011). In addition to employment growth and productivity growth (in our case in the period 2000-2010), regional specific factors related to growth are frequently hypothesised to be in the size of economies (employment level and productivity level in a region), the degree of specialisation compared to the degree of diversity in a regional production structure (Frenken *et al.*, 2007), population density as

agglomeration indicator, the degree of openness of regional economies measured by imports and exports, the degree of market potential and knowledge economy indicators such as the level of public and private R&D. As these indicators have proven to be important for regional development, we test whether each of them differs over corridor-regions versus other regions.

The results suggest that corridor regions score significantly differently than non-corridor regions on many variables; for example, corridor regions show higher levels of employment, higher shares of public and private R&D, larger market potential, etc. Surprisingly, the growth rates are greater outside the corridors. Apparently, differences exist, which result in diverging growth patterns in different regions; an issue which deserves further attention. To cope with this, future EU spatial policy should focus more on the spatial implications of these regional differences. One way forward, and in line with our suggestion of capitalising on spatiality, would be to focus on place-based development.

2.5 Place-based development

We consider the arguments presented before especially relevant in light of the recent discussion on cohesion policy, agglomeration effects and place-based development in the EU (Barca *et al.* 2012). This discussion has evolved from the notion that in much EU policy, space-neutral 'one size fits all' policies remain the norm, despite theoretical and empirical advances in understanding the place-based underpinnings of present-day societal and economic processes. This difference is stressed in the space-blind versus place-based development debate (Barca *et al.* 2012, p. 135).

One could for example argue that the limited attention paid to spatial effects of sectoral policies (Barca *et al.* 2012, pp. 136-137; Dühr *et al.* 2007, p. 302) and the insensitivity to negative external effects can be interpreted as a space-neutral approach. A place-based approach, in contrast, would offer opportunities for inclusion of the often neglected role of space, by assuming that a geographical context matters in terms of social, cultural and institutional characteristics and by promoting the use of interaction between local groups and external elites as a vehicle to develop place-sensitive knowledge (Barca *et al.* 2012, p. 139). The place-based approach thus argues that sectoral space-neutral policies (by definition) will have important spatial implications that should be taken into account in sectoral decision-making (Barca *et al.* 2012, p. 140). We argue that a place-based approach could be beneficial when trying to (re)connect corridors to spatiality.

A specific example might be the attempts within the EU to reduce regional inequality by means of cohesion policy. This policy has long been based on generative assumptions regarding economic integration by means of the development of physical infrastructure (i.e. the 'eurocorridor' and TEN-T approach). The main critique, however, is that under the influence of agglomeration effects, cohesion policies seem to improve the already dominant position of EU's core economic areas (Farole *et al.* 2009), instead of stimulating the economic performance of peripheral lagging regions (Thissen *et al.* 2011). A reconsideration of EU cohesion policy, sensitive to the importance of agglomeration effects for spatial economic developments, is therefore often suggested (Barca *et al.* 2012, p. 473). Our explorative empirical results, and the

suggestion to capitalise on spatiality in corridors, can be viewed a first step in this process.

2.6 Towards a research agenda

This chapter has argued that a sector-transcendent and comprehensive spatial approach is still lacking in the area of European transport corridors. There appears to be a mismatch between corridors and spatiality. Both EU policy documents and the academic debate would gain by an analysis of transport corridors, where especially issues such as agglomeration effects, bottlenecks and quality of life are better assessed and contextualised. A preliminary empirical analysis of agglomeration economies in European transport corridors has been presented. We stress that policy can and should capitalise more on spatiality in corridors. Therefore, we consider the following aspects crucial when formulating a place-based research agenda for European transport corridor development.

First, we argue for a place-based analysis of the agglomeration effects occurring in corridors, with specific attention for spatial planning and corridors in relation to agglomeration economies. The right estimation and valuation of agglomeration (dis-) economies is crucial in the discussion on capitalising on place-based spatial concentration and on true identification of policy effects. This chapter has presented some preliminary findings as a first step. Future research could focus on the exact circumstances and condition which influence growth patterns, and compare the results between different corridor regions.

A second important issue that should be addressed in future research are the potential negative external effects of corridors, mostly resulting from bottlenecks, which have received only limited attention in this chapter. The European Commission (2011) stresses several measures needed to tackle and remove bottlenecks hampering the most efficient use of transport infrastructure and quality of life in the adjacent built environment. However, the current analyses of bottlenecks often remain stuck in space-neutral, sector-based suggestions for improvement (Witte *et al.* 2012, p. 64). Our recommendation for a place-based research agenda therefore concerns a comprehensive approach for the analysis of bottlenecks. Again, paying more attention to the spatiality of bottlenecks in corridors could contribute to effective solutions.

Finally, the complex relationship between corridors and spatiality needs further elaboration itself. It is not only the inception of a place-based, spatial perspective in the economic and infrastructural dimensions of corridors – thus potentially capitalising on spatiality in corridors – that matters. We also argue that there should be opportunities for (re)introducing the corridor concept in the "*current and on-going debates on urbanisation patterns and urban spatial structures*", which Priemus and Zonneveld (2003, pp. 168-169) already tried to do almost a decade ago. Research questions arise both in terms of land-use (e.g. corridor development in relation to land development) and in terms of governance and institutions (e.g. the multi-scalar, multi-sectoral and cross-border nature of corridors). There remains ample 'space' to reconnect the historical links between transport and land use.

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Notes

[1] Positive correlation between infrastructure investments and economic growth is sometimes found, but mostly explained through historical agglomeration processes rather than causal relationships (Spiekermann & Wegener, 1996, p. 37). It is sometimes questioned if causality exists at all.

[2] The underlying dataset has been collected by the PBL Netherlands Environmental Assessment Agency and is based on regionalised production and trade data for 256 European NUTS2 regions, 14 sectors and 59 product categories.

[3] The corridors of interest are selected by making use of a route comparison compiled by the European Commission. The frame of reference is the definition of the ERTMS Corridors, based on the ERIM network.

[4] Explanations on methodology and computation of the variables can be found in Dogaru *et al.* (2011).

3. European corridors as carriers of dynamic agglomeration externalities?

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Abstract

Transport corridors are viewed as a promising way forward in EU transport policy, assumed to contribute positively to regional economic development. However, the validity of this assumption is not evident. The aim of this chapter is to empirically test whether agglomeration economies in European transport corridor regions are positively related to indicators of regional economic development compared to regions outside the scope of corridors. The results build on the notion that the type of agglomeration economy in combination with the structure of the economy matters for prospects of structural economic growth in different regions. In this way, the analysis not only contributes to enhancing the empirical scrutiny of the corridor concept in EU transport policy but also provides new insights into how corridors contribute to regional economic growth. We find only limited evidence for a corridor effect across European regions on productivity and employment growth externalities. Instead, we find a large degree of spatial heterogeneity interacting with corridors – a heterogeneity that has been little recognized in EU policies. We suggest that recent attention to place-based development strategies may accord well with the kinds of agglomeration effects related to corridor development observed in this study.

Keywords

Spatial regime analysis, cohesion policy, place-based development

3.1 Introduction

Corridor development in the core transport network of the European Union is one of the objectives of EU transport policy (European Commission, 2011). Transport corridors, broadly defined as incorporating transnational transport networks of infrastructural, urban and economic activity (Priemus and Zonneveld, 2003), are

viewed as a promising way forward in EU transport planning. It is assumed in European policy making that a well-functioning transport corridor will contribute positively to regional economic development, especially in the vicinity of the main transport nodes of the corridor's network (European Commission, 1999). The corridor focus of much EU-induced policy, driven by agglomeration arguments regarding corridor-related projects, studies and policy initiatives, suggests that transport corridors may operate as independent economic clusters (Bathelt, 2005), while other research finds that transport corridors may merely reflect co-located agglomeration advantages of connected large urban regions (Louter, 1999). In this chapter, we test the hypothesis that corridors play a structuring role in agglomeration economies and growth potential, owing to their ability to connect urban economies with larger-scale development zones across European regions, and thus may be viewed as a planning instrument for European policy.

Theoretically, corridors can function as carriers of regional economic development in several ways. In recent New Economic Geography (NEG) theory, the effects of transport infrastructure on regional economic development are hypothesized to occur via agglomeration effects (Thissen *et al.*, 2013), with infrastructure investments trickling down to interregional trade and labour markets. Specifically, firms, because of improved infrastructure, see their products become more competitive in other regional markets and/or see products from other regional markets become more competitive in their own markets. Which effect predominates depends on the relative dependence of a region on trade and the size of the regional market, a question that has important implications for welfare gains of regions. Similarly, studies of location decisions of firms increasingly suggest that agglomeration effects in regional development occur as a result of improved physical connections between regions (De Bok and Van Oort, 2011, Pagliara *et al.*, 2013; Bowen and Leinbach, 2011; Moeckel, 2007; Holl, 2004). It is argued that transport and communication linkages may compensate for the relative absence of agglomeration in less central locations. Locations between the gravity centres of urban development potentially offer opportunities for economic development because agglomeration economies are nearby and can be 'borrowed', while agglomeration diseconomies are not dominant (Phelps *et al.*, 2001; Phelps, 2004). On a European regional scale, however, the relationship between corridor connectedness and agglomeration economies has not been tested systematically.

Corridor development in relation to economic development has long been a central focus of European policy as well. Infrastructure development is seen as a major instrument to connect urban regions, allowing people to take advantage of economic and social opportunities in connected places (European Commission, 1999). Attempts to create a "borderless" Europe at the beginning of the 1990s triggered the evolution of the "eurocorridor" as a comprehensive planning concept (Albrechts and Coppens, 2003; Priemus and Zonneveld, 2003). There was a strong belief that enhancing the accessibility of a region (by means of infrastructure investment) would also stimulate the region's economic performance. This led to the introduction of the Trans-European Transport Networks (TEN-T) in European infrastructure policy, with the expectation that physical integration would encourage economic integration. It is observed in the literature that for evidence-based policies on European development and planning to

succeed, more empirical support for the corridor concept is needed (Hansen, 1968; Spit, 1999; McCann and Shefer, 2004; Banister and Berechman, 2001; Davoudi, 2003). Recent reforms of European cohesion policy, such as the Europe 2020 proposal, embody much greater emphasis on competitiveness than previous cohesion programmes have, stressing that all regions in Europe can potentially contribute to economic growth. Currently, views on effective policy design to achieve this vary, ranging from place-based to people-based approaches (Barca *et al.*, 2012; OECD, 2011). Our analysis of agglomeration economies and corridors provides empirical evidence that may guide policies more effectively.

The chapter is structured as follows. The next section discusses theoretical perspectives of regional economic growth differentials and introduces various forms of spatial heterogeneity related to growth and agglomeration (notably, urban size and core-periphery structures in Europe). The section outlines hypothetical relationships between spatial structure and corridor development. The third section introduces the data, indicators and methods used in our empirical analyses. The fourth section presents the results of our empirical analyses, obtained using spatial econometric estimation techniques. The final sections summarize and discuss the results in light of EU policies, in particular, corridor policies, cohesion policy and place-based development strategies.

3.2 Conceptual framework and hypotheses

One's concept of transport infrastructure investment and its relationship with regional economic growth depends upon one's understanding of regional economic growth differentials (McCann and Shefer, 2004). This similarly applies to our understanding of the contribution of infrastructure investment to the realization of regional economic growth in corridors. This section will therefore explore the theoretical foundations of the determinants of regional economic growth, infrastructure and corridors in explaining the dispersion of economic activity and development across space. The section proposes testable hypotheses on spatial structure, corridors and economic development.

3.2.1 Convergence and divergence based views of regional development

In a traditional explanation, investments in infrastructure lead to transport cost reductions and therefore enhance productivity at the regional or local level, owing to increased efficiency. The resulting economies of scale in turn attract additional factors of production, which foster and sustain further economic growth. This can be summarized as the "convergence" argument. The bottom line is that capital accumulation and comparative advantage between regions eventually lead to a reduction in territorial disparities. This approach (i.e., the Heckscher-Ohlin model) is based on Ricardo's theory of comparative advantage (Farole *et al.*, 2011). The model is consistent with convergence-based EU infrastructure policy and stresses the beneficial effects of transport cost reductions in the consistent generation of regional economic growth (McCann and Shefer, 2004). It has been recognized, however, that this neoclassical approach to predicting the dispersion of economic activity across

space is flawed (Farole *et al.*, 2011). Both capital accumulation as the primary source of growth and the principle of comparative advantage leave much variance in regional economic growth unexplained. The implications for convergence-based EU infrastructure policy, which is largely based on the above premises, therefore do not come as a surprise. Empirical observations have shown that regional inequalities in Europe have not narrowed substantially, despite heavy infrastructure investment (Puga, 2002). There is a need for alternative models in explaining regional economic growth.

The convergence argument tends to ignore the possibility that economic development may cluster strongly in certain places, especially in urban regions. Clustering usually occurs because firms experience benefits from being located near one another (Frenken *et al.*, 2007). Following this argument, investment in infrastructure leads to increased accessibility to local or regional markets and therefore to the introduction of new competitors to such markets. This drives away weaker local or regional enterprises, reinforcing the already strong position of core economic areas relative to peripheral areas. To put it simply: roads can be used to travel in both directions (Puga, 2002). This is known as the "divergence" argument. The basic underpinning of this argument is the notion of cumulative causation: the efficiency of firms and workers increases in the proximity of large markets, and those large markets in turn tend to arise in places where many firms and workers locate. Two seemingly similar regions can thus end up as distinctive core and peripheral regions, leading to increased interregional disparities. As Farole *et al.* (2011) put it, "Economic integration is unleashing forces benefiting core regions within countries, often to the detriment of the periphery" (p. 1091). Several attempts have been made to integrate the tendency to generate core and peripheral regions in economic development processes into a consistent analytical framework. Agglomeration economies are often considered the main drivers of these processes (Puga, 2002).

3.2.2 Urban density, industrial structure and types of economic growth

Agglomeration economies are benefits firms enjoy from being located in close proximity to other firms. Consequently, divergence *between* regions contributes to increased urbanization *within* regions, as an outcome of the forces of agglomeration. As cumulative causation favours proximity and location as important determinants of regional economic growth, increased urbanization might be expected. Knowledge creation and human capital play crucial roles here, as these factors inhibit strong spatial bounding. Knowledge spill-overs between economic agents encourage growth and innovation, leading to external economies of scale. In other words, processes of divergence focus on the occurrence of agglomeration economies in core urban regions. Recent theories of agglomeration advantages have sought to formalize this phenomenon, the main contributor being New Economic Geography (McCann and Shefer, 2004). The New Economic Geography (NEG) literature is in line with empirical observations of growing interregional disparities in the EU territory, and hence the concentration of economic activity in core urban regions. It stresses the importance of agglomeration forces in explaining the dynamic and self-reinforcing

processes occurring in major urban regions (Dogaru *et al.*, 2011). This argument is similar to the divergence argument.

Studies in related economic geography research focus on the location decisions of firms, as explained above. In this more micro-economic based empirical literature, agglomeration economies are expected to be related to urban size and density as well as to the sectoral structure of economic activity in urban regions. Urban density leads to higher economic rents (for consumers measured in housing prices and for producers in real estate rents and prices), controlled for firm level or sector level sorting effects (Rosenthal and Strange, 2004; Koster, 2013). The degree of urbanization is therefore an important indicator related to economic performance. However, the industrial structure of cities and regions is also thought to be important in the generation and diffusion of growth opportunities. Agglomeration externalities are then seen to arise from disparities between localization economies, or Marshallian externalities, and urbanization economies, or Jacobs' externalities. (Beaudry and Schiffauerova, 2009; Frenken *et al.*, 2007). Localization economies can be summarized as the benefits derived from a group of (local) firms of the same sector (operating in narrowly defined similar industries) located in one another's proximity. The benefits result from either the size or number of firms; labour pooling and knowledge spill-overs play a key role. Localization economies are also known as Marshallian or specialization externalities. Urbanization economies can be summarized as the benefits derived from firms locating in proximity to a wide array of other, not necessarily related, firms. In this case, benefits result from spill-overs that occur *between* firms across a broad array of sectors (e.g., manufacturing, services, and retailing) rather than *within* sectors. Thus, these externalities may be available to all firms in dense urban regions, irrespective of their sectoral specialization. Urbanization economies can also be called Jacobs' or diversity externalities. The empirical evidence for both types of spatial-sectoral externalities-embedding is strong but sensitive to measurement issues (Beaudry and Schiffauerova, 2009; Brülhart and Mathys, 2009). In our empirical testing, we will use an indicator based on detailed industrial production data that reflects the degree of sectoral specialization and diversity in European regions.

A further issue causing heterogeneity in research outcomes in the dynamic externalities literature concerns the measurement of economic growth (Beaudry and Schiffauerova, 2009). Employment and productivity (output) growth measures show varying results. It is best to hypothesize growth in relation to sectoral externalities based on theory. An interesting theoretical contribution to the specialization-diversity debate is provided by lifecycle theory, which holds that industry evolution is characterized by product innovation in the first stage and by process innovation in the second stage (Frenken *et al.*, 2007). Two consequences arise from this: growth in variety is a necessary requirement for long-term economic development; and stabilization of variety induces productivity growth. Both are endogenous aspects of economic development. In a geographical framework, this translates into new lifecycles starting in urban environments and then moving to more rural environments over time ("urban product lifecycle"). In accordance with the economics of agglomeration, Jacobs' externalities are assumed to play an important role in urban areas in creating new varieties, new sectors and employment growth. When firms survive and become mature, they tend to standardize production and become more

capital-intensive and productive. The initial advantages of the urban agglomeration core can now become disadvantages: growth is difficult to realize *in situ* and physical movement becomes opportune when limited accessibility and high wages become disadvantageous. Growing firms are expected to "filter down" towards more peripheral locations and regions, where land, labour and transport costs are lower (Phelps *et al.*, 2001). In our empirical testing, we relate sectoral specialization and diversity to both regional employment growth and regional productivity growth, hypothesizing that employment growth and diversity go together, as do productivity growth and specialization.

3.2.3 Corridors versus cities as beneficiaries of agglomeration economies

The key issue in the analysis of corridors as agglomeration beneficiaries, is the spatial scale on which externalities occur. Especially relevant is the level of cities (urban regions) versus that of several connected urban regions (corridor). The filtering down process of economic activity over the life-cycle may take place on various spatial scales. Within urban regions, de-concentration from cities to wider regions may induce corridor development, as firms typically locate to accessible hotspots near or between larger urban cores.[1]

Opposing the corridor concept is the "necklace of cities" view: agglomeration externalities are limited by the extent of urban regions and are not spread across regions between urban concentrations. In Europe, the dominant medium-sized and multimodal character of urban regions prevails (Neal, 2013, OECD, 2012). The limited size of European urban regions has recently been identified as an advantage of place-based development strategies in the European Union. This debate is highlighted in the context of two major policy reports. In a recent World Bank (2009) report, it is argued that agglomeration combined with encouragement of people's mobility not only allows individuals to live where they expect to be better off but also increases income, productivity, knowledge, and aggregate growth. Consequently, development intervention should be space-neutral, and factors should be encouraged to move to where they are most productive. In reality, this applies primarily to large urban regions. In contrast, a place-based approach assumes that interactions between institutions and geography are critical to development and that many of the clues for development policy lie in these interactions. To understand the likely effects of a policy, the interactions between institutions and geography therefore require explicit consideration of the specifics of the local and wider regional context (Barca *et al.*, 2012, p. 140). Place-based development strategists claim that the polycentric nature of a set of smaller and medium-sized cities in Europe, each with their own peculiar characteristics and specialization in the activities to which they are best suited, creates fruitful urban variety, which enhances economic development. This implies that medium-sized city-regions have not declined in importance compared with larger urban ones, as indicated by monitoring publications by the OECD (2011, 2012).

Our analyses will treat the urban size structure of Europe carefully to assess the suggested benefits of economic development. Based on the theoretical and conceptual themes discussed, we derive the following testable hypotheses:

1. Regional economic growth in European corridors is higher than outside corridors because of agglomeration advantages;
   (1a) Productivity growth in European regions is related to regional sectoral specialization – more so inside than outside corridors;
   (1b) Employment growth in European regions is related to regional sectoral variety – more so inside than outside corridors;
   (1c) Productivity growth and employment growth in European regions are related to density – more so inside than outside corridors;
2. Agglomeration advantages in individual connected cities rather than in corridors themselves determine economic growth in corridor regions;
3. In the polycentric urban landscape of European regions, regions of all urban sizes (large, medium-sized and small) contribute to economic growth in corridors by means of agglomeration economies.

3.2.4 Corridor development and core-periphery structures in Europe

In Europe, filtering down processes might have taken place on a larger scale: from the economic core regions to the peripheral objective-one regions (Dogaru *et al.*, 2011). As peripheral regions are in general much more specialized than core regions (Combes and Overman, 2004), we expect the specialization-productivity thesis to hold especially in those regions, while the diversified-employment growth relation is expected to hold especially in core regions. However, there are additional arguments that suggest that core and peripheral regions in Europe matter for corridor and interregional infrastructure development.

Traditional arguments in support of infrastructure-based economic development strategies in the European Union are primarily based on the suggested exploitation of agglomerated economies of scale arising from improved transport infrastructure, leading to commodity price reductions (Vickerman *et al.*, 1999). Dühr *et al.* (2010) provide three arguments about why infrastructure investments and corridor development may also have backwash effects. First, while transport links between central and peripheral regions may make it easier for local firms to market their products outside their own regions, it also enables producers from central regions to access previously peripheral markets, exposing vulnerable local markets to competition (Puga, 2002; Sichelschmidt, 1999). Second, it is argued that a corridor effect will only benefit urban regions in the corridor-line but not in places and regions between urban regions, as there will be no onramps or "stops" in those intermediate locations. Alternatively, so-called "shadow-effects" occur when new transport infrastructure drives traffic away from older routes and nodes in central and peripheral regions, contributing to a decline in networks in (parts of) those regions (Dühr *et al.*, 2010). Third, it is argued that the presence of infrastructure alone does not in itself support economic development, as the problems of areas lagging behind or suffering from economic and industrial decline can be explained by many other factors (Thissen and Van Oort, 2010).

In fact, Dühr *et al.* (2010) suggest that infrastructure is only a small, almost negligible, contributor to growth compared to the presence of research and

development, a qualified labour force and positions in global value chains. It is argued that large increases in regional accessibility translate into only very small increases in regional economic activity, although this varies, depending on the already existing level of accessibility of a region. In regions in the European core with highly developed transport infrastructure, additional gains from accessibility seem limited. For regions of the European periphery with underdeveloped transport infrastructure, gains from accessibility can be substantial (ESPON, 2004). Ideally, transport improvements should be combined with other factors for growth and agglomeration externalities to take place. These considerations lead to two additional testable hypotheses:

4. In peripheral regions in Europe, the agglomeration advantages of corridors dominate disadvantages (backwash- and leaking effects, shadow effects, no-stops effects);
5. The agglomeration advantages of corridors in core European regions are small, because other (measured and unmeasured) factors influence economic growth to a much larger extent.

3.3 Data and methodology

To test our hypotheses, we use a spatial regime analysis, in which urban size, core-periphery structures on a pan-European scale and corridor "membership" of regions are used as differentiating regimes that are used to simultaneously estimate spatial econometric models in and outside certain categories of regions, to explain regional employment and productivity growth (Dogaru *et al.*, 2011; Frenken *et al.*, 2007). We introduce population density and market potential to capture scale economies (Bosma and Van Oort, 2012) and agglomeration indicators of specialization and diversification to identify the composite nature of growth externalities. This modelling framework enables us to differentiate between growth in corridors resulting from urban co-location and growth in corridors resulting from more functional (specialization- or diversity-based) clustering. It also enables us to differentiate the relationship between growth and agglomeration externalities in the European core from that in peripheral regions.

3.3.1 The definition of spatial heterogeneity regimes

To test the hypotheses, a unique dataset of 235 European NUTS2 regions is used.[2] For these regions, we measure all variables and define all regimes of spatial heterogeneous groups that are important within the theoretical framework presented. The three sets of regimes concern degree of urbanization, core-periphery structure and corridor "membership" (Table 3.1, Figure 3.1). The degree of urbanization over the 235 regions is determined by the distribution of classes distinguished in OECD (2011), comprising large (at least 3 million inhabitants), medium-sized (between 1.5 and 3 million inhabitants) and small (less than 1.5 million inhabitants) regions. Although this distinction differs from the one originally presented for all cities in the world (OECD, 2011; 2012), these cut-off points yield a distribution of European regions in this

chapter that is comparable to the OECD-distribution on a global scale. In our analysis, medium-sized and large regions are taken as the large urban regime, and small regions are taken as the small urban regime.[3] The degree of centrality and peripherality on a pan-European scale is measured by a population gravity equation using travel time. The resulting gravity values are split into two groups: regions within the core of Europe with high gravity values, and regions in the (relative) periphery of Europe with low gravity values (compare Capello *et al.*, 2008) (Table 3.1, Figure 3.2).

Table 3.1: Distribution of NUTS2 regions within the spatial regimes

	Medium to large urban regime (Urb.+)	Small urban regime (Urb.-)	**Total**
Corridor regions (Corr.+)	58	37	95
Non-corridor regions (Corr.-)	58	82	140
Total	116	119	235

	Core regimes (CP+)	Peripheral regime (CP-)	**Total**
Corridor regions (Corr.+)	62	33	95
Non-corridor regions (Corr.-)	55	85	140
Total	117	118	235

Figure 3.1: Distribution of 235 regions over large/medium sized and small urban regions

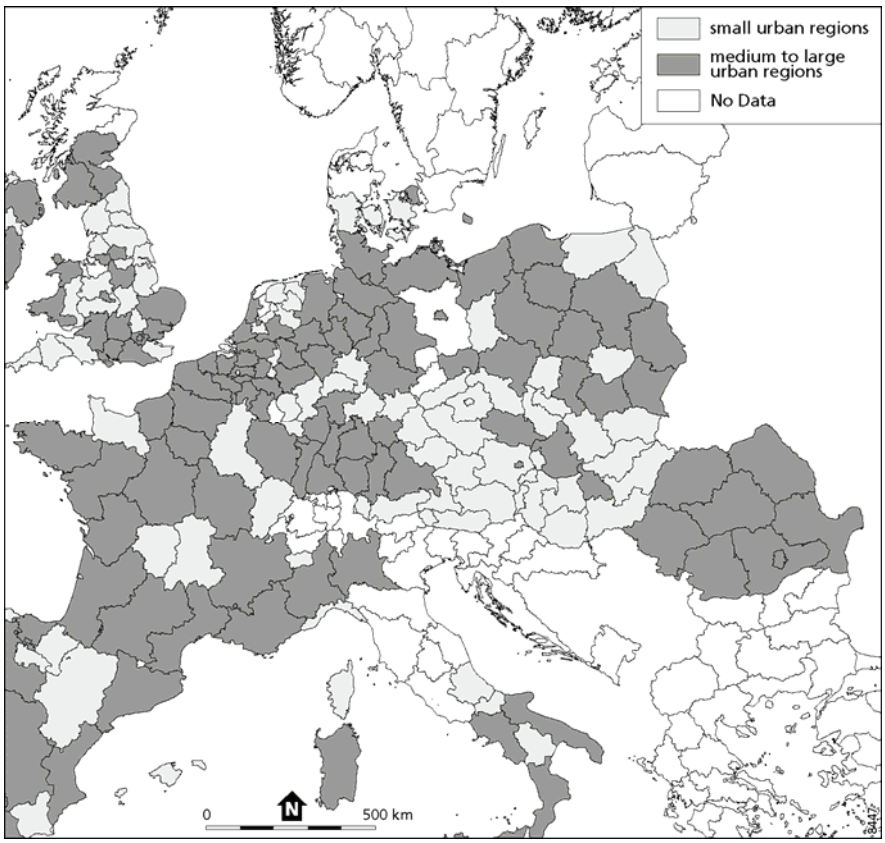
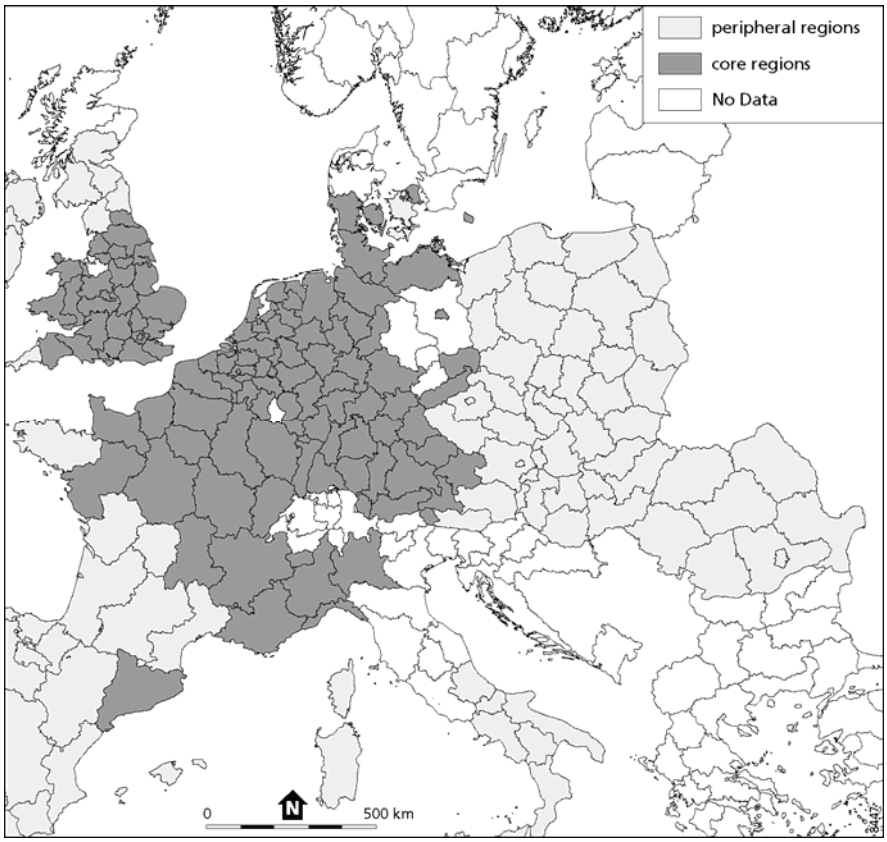
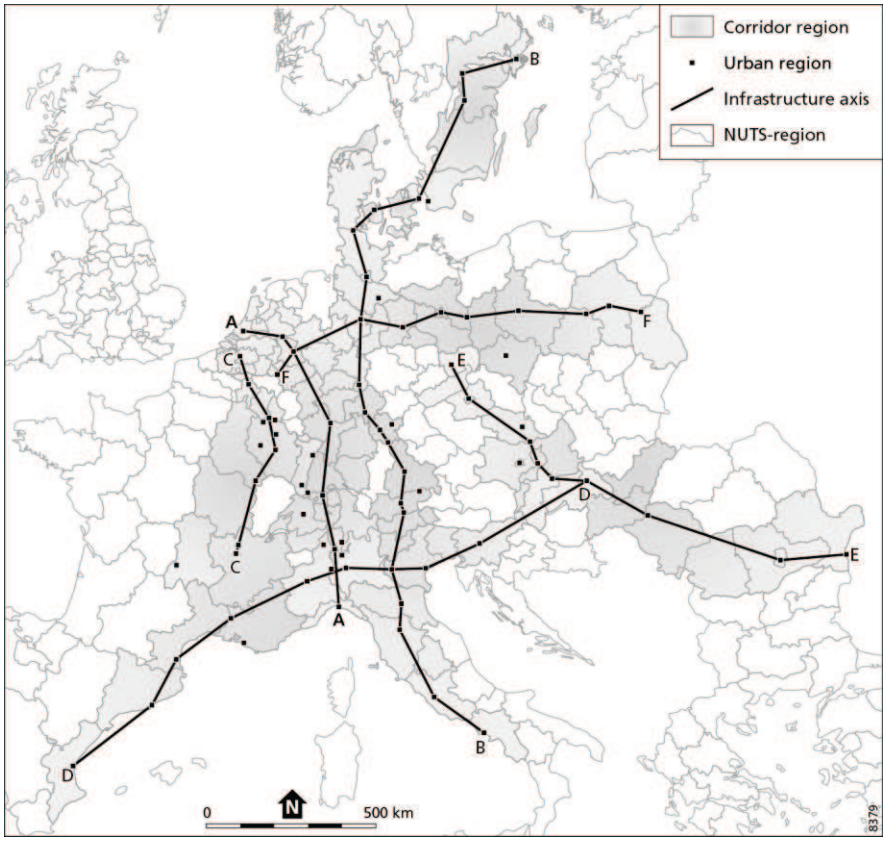


Figure 3.2: Distribution of 235 regions over core and peripheral regions (gravity value)



Finally, corridor-membership of regions has been constructed by analyzing an aggregated sample of six European transport corridors (Table 3.1, Figure 3.3).[4] The corridors of interest are selected by making use of a route comparison compiled by the European Commission (European Commission, 2008). As noted in the introduction, there is a large variety of corridor programmes in the European Union, each with its own definition of what constitutes a corridor. To date, the route comparison of the European Commission is the only practical definition of corridors in Europe. The advantage of the route comparison is that it provides an aggregated definition of different corridors. The frame of reference for this aggregated definition is the definition of the ERTMS Corridors, based on the ERIM network. Consequently, all corridor definitions stemming from related corridor programmes[5] are scaled relative to this aggregated definition. The geographical borders of transport corridors are defined by selecting the most important infrastructure connecting the most important urban regions between the origin and destination cities of the corridors and adding in all NUTS2 areas served by this core network.

Figure 3.3: NUTS2 regions of ERTMS corridors in Europe, based on the ERIM network



The influence of agglomeration, urbanization and scale economies on regional economic growth will thus be tested, both inside and outside the scope of different transport corridors and taking into account different types of urban regions in core and periphery regimes:

1. *Corridor* regions in European core and periphery regimes consisting of *small-sized* urban regions;
2. *Corridor* regions in European core and periphery regimes consisting of *medium- to large-sized* urban regions;
3. *Non-corridor* regions in European core and periphery regimes consisting of *small-sized* urban regions;
4. *Non-corridor* regions in European core and periphery regimes consisting of *medium- to large-sized* urban regions.

The independent variables on agglomeration, density and controls that are introduced in the regression modelling are summarized in Table 3.2. Data on employment and productivity are taken from the Cambridge Econometrics statistical database on European regions. The period of analysis for these growth variables is 2000-2010. Our analysis is restricted to this period because of data availability, especially for the explanatory variables for openness of the regional economy, the specialization-diversity index and the market potential variable (see the explanation in Table 3.2).[6]

Table 3.2: Descriptive statistics of variables used (n=235)

Variable	*Abbreviation*	*Minimum*	*Maximum*	*Mean*	*Std. dev.*
Employment growth	Empgr	-0,197	0,321	0,072	0,077
Productivity growth	Prodgr	-0,003	0,645	0,177	0,134
Employment level 2000	Emp00	15.816	5.371.400	852.206	680.388
Productivity level 2000	Prod00	3,278	68,498	37,598	15,570
Specialization-diversity	Spec	0,020	0,329	0,077	0,057
Private R&D (%GDP)	Priv	0,008	5,008	0,844	0,938
Public R&D (%GDP)	Pub	0,010	2,280	0,511	0,407
Openness economy	Open	0,393	4,396	0,777	0,458
Market potential	Pot	3.959,6	33.276,3	14.253,9	6.077,0
Population density	Dens	4,7	8.494,2	357,7	850,1
Educational level	Edu	5,488	45,818	20,467	7,886

The *degree of sectoral specialization* and diversity is an important variable in our models, as it is used to test our hypothesis regarding agglomeration. There is considerable debate regarding the measurement of these variables, as outcomes may be sensitive to measurement units of time and aggregation (Beaudry and Schiffauerova, 2009). The degree of regional specialization is measured by a detailed Theil (entropy) index over the location quotients of 59 products, including agriculture, manufacturing and services (Dogaru *et al.*, 2011; Thissen *et al.*, 2013). This unique dataset has been collected by the Netherlands Environmental Assessment Agency (PBL) and is based on regionalized production and trade data for 256 European NUTS2 regions, 14 sectors, and 59 product categories (compare Combes and Overman, 2004). Location quotients measure the relative specialization of a region in a certain sector as the percentage of production accounted for by the sector in a region relative to the percentage of production accounted for by that sector in Europe as a whole. This quotient measures whether a sector is over- or underrepresented in a region compared with its average representation in a larger area and thus indicates localization or specialization economies of agglomeration. The Theil coefficient then measures deviations from the European average distribution of production specialization in all sectors. A high score represents a large degree of sectoral specialization in a region, and a low score represents sectoral diversity.

Table 3.3: Descriptive statistics of the spatial regimes (mean values)

	Corr.+	*Corr.-*	*Urb.+*	*Urb.-*	*CP+*	*CP-*
Egr	0,062	0,079	0,065	0,078	0,064	0,080
Prgr	0,172	0,180	0,177	0,176	0,120	0,233
Emp00	1.040.998	724.097	1.300.586	415.128	1.008.069	697.662
Prod00	39,146	36,547	38,509	36,710	46,737	28,536
Spec	0,070	0,081	0,069	0,084	0,043	0,110
Priv	0,992	0,743	0,994	0,697	1,157	0,533
Pub	0,615	0,440	0,582	0,441	0,587	0,435
Open	0,855	0,723	0,752	0,801	0,654	0,899
Pot	16.275,3	12.882,2	15.492,6	13.046,4	19.298,4	9.252,1
Dens	422,7	313,6	481,2	237,2	534,0	182,9
Edu	20,350	20,546	21,742	19,223	22,633	18,319
N	95	140	116	119	117	118

We introduce several other variables in our cross-sectional growth models that potentially capture agglomeration externalities, and we control for other influencing factors (Table 3.2, Table 3.3). To avoid endogeneity, all explanatory variables are measured in the year 2000, as circumstances of 2000 can influence 2000-2010 period growth rates, whereas those in 2010 cannot.[7] The degree of population density is introduced, in addition to the specialization-diversity variable, to further capture agglomeration effects. In earlier research, this variable turned out to be important for European regional productivity (Ciccone, 2002) but much less so for employment growth (Marrocu *et al.*, 2012; Bosma and Van Oort, 2012). To test and control for either convergence or divergence, productivity and employment growth over the 2000-2010 period are related, respectively, to productivity and employment levels in 2000. This relationship is hypothesized to be negative (convergence) for productivity: a lower level in 2000 leads to higher growth over the 2000-2010 period, and vice versa (Marrocu *et al.*, 2012). For employment dynamics, a convergence process is much less obvious. Clusters and (high) skill-related agglomeration circumstances may cause cumulative employment growth, leading to divergence instead of convergence. Investment in Research & Development (R&D), both public and private, is calculated as a percentage of GDP from Eurostat statistics. Such investment is hypothesized to be positively related to economic growth.

Other explanatory variables derived from the literature (Bosma and Van Oort, 2012; Dogaru *et al.*, 2011), that may help explain regional growth are market potential, openness of the regional economy and the average educational level of the working population. The indicator of market potential results from a gravity model of regional production. This variable was introduced earlier to test for the occurrence of scale economies (Frenken *et al.*, 2007). A large market potential may lead to higher growth rates because of increased business and customer opportunities, potentially higher profits and more incentives for innovation and renewal.[8] The openness of the regional economy is captured by the share of imports and exports in total production in a region. For this variable, the PBL-database on European interregional trade is also used (Thissen *et al.*, 2013). High potential may also spill over into nearby regions or into the regional network of specialized and subcontracting industries and regions. The

share of tertiary education in the working population has been used in (e.g.) Brülhart and Mathys (2008) as an indicator of educational achievement. This is assumed to positively relate to economic growth, as more skilled people can be more productive, and agglomeration might attract more of these people.

From Table 3.3 it is clear that the regimes that we distinguish differ in terms of many of the variables introduced. Employment levels and productivity levels are considerably higher in corridor regions, urban regions and core regions than in their counterparts. Variations in productivity levels between core regions (46.7) and peripheral regions (28.6) are especially notable, while variations in employment and productivity *growth* are much less clear. Productivity growth in peripheral regions (0.23) is considerably higher than in core regions (0.12) in the 2000-2010 period, indicating convergence. And while employment in non-urban regions grows somewhat faster than in urban regions, differences in growth between corridor and non-corridor regions and between urban and non-urban regions are small. Compared to their counterparts, urban, core and corridor regions score high on R&D-indicators, market potential, sectoral diversity and density. Small differences between these categories of regions are found for openness of the regional economy and share of tertiary education (although the latter is considerably lower in peripheral regions).

To avoid multicollinearity in the regression modelling, correlations between all explanatory variables and Variance Inflation Factors for each variable are checked. None of the correlations is excessively high and none of the Variance Inflation Factors (see Appendix 2 and 3) exceed the critical threshold value of 5.0. As previous research has shown that spatial dependence between proximate regions is an important source of divergent growth opportunities in productivity and employment (Le Gallo *et al.*, 2011), we control for this in our analyses by introducing ML-estimation including spatial lags, using inverse distance weighting matrices.[9]

3.4 Results

This section discusses the modelling outcomes, presented in Appendix 2 and 3. The models are constructed in similar ways, starting with an OLS-model, then moving to a ML spatial-lag model that corrects for spatial dependence (the spatially lagged dependent variable is denoted as W_), and finally moving to a ML-spatial lag model that breaks down the observations over the various regimes that are estimated simultaneously. The model-fit usually improves over the successive modelling steps, with the significance of spatial regimes indicated by a spatial Chow-Wald test.

Appendix 2 presents the modelling results for productivity growth. The first column shows the results for the OLS-model. The productivity level is negatively related to productivity growth, indicating convergence. The degree of specialization is, as expected, positively and significantly related to productivity growth. Population density is not significantly related to productivity growth, confirming the ambiguous character of the relationship suggested in Bosma and Van Oort (2012). Because the OLS-model controls for proximity to other regions (as the ML-SL model does), the market potential variable is not significant. While private R&D is positively related to growth, remarkably, public R&D is negatively (and significantly) related to growth. Investment in private R&D is positively related to productivity growth, while public

R&D is negatively related. Public R&D may not positively affect growth because it is a (less productive) substitute for private R&D (compare Guellec and Van Pottelsberghe, 2001). Higher educational levels correlate significantly with higher productivity growth. The openness indicator turns out to be unrelated to growth – from Table 3.3 it is clear that there is little variation in this indicator across regions.

The second column in Appendix 2 re-estimates the equation, using Maximum Likelihood Estimation and including a spatially lagged variable of productivity growth, controlling for proximity of (growth in) other regions. The spatial lag variable is highly significant, indicating a high degree of spatial dependence. Once this variable is controlled for, most relationships found to be significant in the OLS-model are also significant in the present model. The market potential variable becomes significant in this model. The convergence indicator of the productivity level, the degree of sectoral specialization and the share of higher education remain significant – albeit all with somewhat lower coefficients. The population density variable remains insignificant.

The next columns in Appendix 2 present ML-estimations that correct for spatial dependence, using spatial regimes as structural breaks over the populations of regions. Columns 3 and 4 show the (simultaneously) estimated relationships for corridor and non-corridor regions. Remarkably, the spatial Chow-Wald test indicates that the two regimes do not differ significantly from one another. Except for private R&D, which is significantly related to productivity growth within corridor regions but not outside them, all variables are equally associated with growth both within and outside the corridors. This is important information for our hypotheses.

Columns 5 and 6 reveal that differences between urban and non-urban regimes differ significantly from one another. In particular, the relationship of market potential to growth in urban regions (significant and positive) differs from that in non-urban regimes (not significant). Public R&D shows the opposite relationship (negatively significant only in non-urban regions). Population density is positively (and significantly) associated with productivity growth in non-urban regions, but negatively associated with productivity growth in urban regions. Crowding as a negative agglomeration effect may overtake the positive effects of agglomeration in the latter case. The coefficient for higher education is higher in large and medium-sized urban regions than in small urban (or non-urban) regions.

Columns 7-10 show the interaction effects between the regimes of urban size and corridor "membership" regimes that differ significantly from one another. Urban regions in corridors show the highest coefficients of convergence (productivity level) and of higher education with productivity growth, followed by non-urban regions in corridors. Sectoral specialization is especially strongly associated with non-corridor regions (both urban and non-urban). The negative relationship between public R&D and growth is especially strong in non-corridor regions, while the positive relationship between private R&D and growth is especially strong in urban regions (both within and outside corridors). Productivity grows in corridor regions and urban regions for different reasons, but only the interaction of the typologies reveals this. Absent the urban dimension, corridors are not distinguished from non-corridor regions in terms of productivity growth and its spatial-economic determinants.

The last columns in Appendix 2 present results for ML-models using the core-periphery regimes. This regime (columns 11-12), as well as the regime interacted with

the corridor regimes (columns 13-16) differ significantly from one another (compare Dogaru *et al.*, 2011; Capello *et al.*, 2008 and Marrocu *et al.*, 2012). Remarkably, the specialization indicator is positively related to growth in peripheral regions, but is not significant in core regions. This dominant effect of specialization in peripheral regions also remains when peripheral regions are interacted with corridor regimes. The driving force in models 11-16 is therefore the specialization-productivity tandem in peripheral regions. The corridor-typology does not change this relationship.

Similarly to Appendix 2, Appendix 3 presents the results for employment growth models. In the first column, presenting the OLS-model, we see that the employment level is negatively associated with employment growth, indicating convergence. The coefficient and its significance are much smaller than in the productivity growth model, however. As hypothesized, for employment growth, the degree of sectoral diversity matters (as seen from the negative and significant coefficient for the specialization-diversity index). Remarkably, market potential negatively affects employment growth, indicating that more centralized regions do not profit in terms of employment growth. Recall that a central position in Europe is positively related to productivity growth. The spatially lagged version of this model in column 2 confirms the relationships of the OLS-model, with the spatial lag variable highly significant. Columns 2 and 3 show that for the employment growth model, corridor regions differ significantly from non-corridor regions, especially in the degree of sectoral diversity (in non-corridor regions), higher education levels (in non-corridor regions), openness of the regional economy (in non-corridor regions) and market potential (negative in non-corridor regions). Employment levels in 2000 are not significantly related to employment growth in either regime. As in the productivity growth model, population density does not appear to play a role in fostering employment growth. Remarkably, non-corridor regions are more conducive to employment growth than corridor regions.

As with the models of productivity growth, the introduction of a regime of urbanization and its interaction with corridor regimes changes the picture. In urban regions (column 5), the relationship between employment levels and growth is positive and significant, signalling divergence. In non-urban regions, the relationship is negative. The positive relationship of higher education with employment growth is clearly related to urban regions and not to rural ones. With respect to openness of the regional economy, the relationship is the other way around. Interacting urban regimes with corridor regimes shows the dominance of the urban distinction: in urban regions, the divergence process of employment growth is prominent. With respect to the relationship of higher education with employment growth, we find that the largest coefficient (and the most significant relationship) of education on growth is for urban regions outside corridors. Employment growth is thus especially dependent on urban contexts where pre-existing employment concentrations have relatively highly educated employees, while corridors appear to hamper this relationship more than they foster it. Columns 11-16 show the results of ML-models, distinguishing between core and peripheral regimes. In the latter regimes, the employment level variable is not significantly associated with employment growth. Diversity is associated with growth, especially in peripheral regions (inside and outside corridors). For higher education,

we find the same pattern. The core-periphery dimension dominates over the corridor dimension in determining the coefficients in these models.

The models of productivity growth in Appendix 2 range in explained variance (R2) from 74% to 86%. This rather high proportion is comparable to earlier models of European regional productivity growth (Marrocu *et al.*, 2012). The models of employment growth in Appendix 3 range in explained variance (R2) from 9% to 49%. This is in line with other employment growth models, which in general are much more difficult to predict with regional location factors (Van Oort, 2004; Beaudry and Schiffauerova, 2009).

3.5 Summary and conclusions

The outcomes show significant heterogeneity when applying varying spatial typologies to the relationship between agglomeration economies and growth differentials in Europe. Nevertheless, some important conclusions can be summarized. Remarkably, in both sets of models (of both productivity growth and employment growth), urban density was in general not found to be a significant contributor. This implies that dynamic agglomeration externalities in Europe may be better captured by sector composition (specialization and diversity) or by the concentration of skills (educational level).

For productivity growth, it was found that the corridor typology was not significantly different from the non-corridor typology. The variables were related to growth in nearly the same manner in both regimes. From Appendix 2, it is clear that educational level is generally more positively associated with productivity growth in corridor regions than outside those regions. The specialization indicator turned out to be more relevant for growth in non-corridor regimes. The outcomes suggest that urban and corridor regions perform very similarly on the key variables. However, based on the interactions between corridor typology and urban size typology, it was concluded that productivity grows in corridor regions and in urban regions for different reasons, a result revealed only by interaction of the typologies. Without the urban dimension, corridors are not distinguished from non-corridor regions in terms of productivity growth and its spatial-economic determinants. With respect to the interaction of corridors with the core-periphery dimension, we observed that the specialization indicator is positively related to growth in peripheral regions and not significant in core regions. This dominant effect in peripheral regions remains in place when peripheral regions are interacted with corridor regimes. The driving force behind the mixed core-periphery and corridor models is the specialization-productivity tandem in peripheral regions. The corridor-typology does not alter this dominant relationship. We thus find little evidence for a corridor effect on productivity growth externalities. Rather, the urban and (core-) periphery dimensions dominate.

With respect to employment growth (Appendix 3), we find different relationships that lead, however, to similar conclusions. We find, especially in *non*-corridor regions, that the relationship between sectoral diversity and education with employment growth is significant. Interacting urban regimes with corridor regimes shows the dominance of the urban distinction: in urban regions, the divergence process of employment growth is prominent. With respect to the relationship between higher

education and employment growth, we find that the largest (and most significant) coefficient is for urban regions outside corridors. Employment growth is thus especially dependent on urban contexts with pre-existing concentrations of relatively highly educated employees, and corridors appear to hamper this relationship more than they foster it. With respect to the interaction of corridors with core and peripheral regions, we find that diversity is associated with growth, especially in peripheral regions (inside and outside corridors) and for higher education, we find the same pattern. The core-periphery dimension dominates over the corridor dimension in determining the employment growth relationship.

Using these outcomes, we return to our formulated hypotheses. The first, general hypothesis states that regional economic growth is higher in European corridors than outside them because of agglomeration advantages (1). Three nested hypotheses were formulated with respect to the indicators we discussed in more detail. Productivity growth in European regions is indeed related to regional sectoral specialization, but there is little evidence that this relationship is systematically stronger inside corridors than outside them (1a). Similarly to productivity growth, we find that employment growth in European regions is generally related to regional sectoral variety, but again, the relationship is not systematically stronger inside corridors than outside them (1b). Finally, productivity growth and employment growth in European regions are not systematically and strongly related to population density – either inside or outside corridors (1c). We thus find little support for our first hypothesis regarding the special function of corridors in economic growth due to agglomeration advantages. On the contrary, the results question the added value of corridors for growth and agglomeration.

Our second hypothesis states that agglomeration advantages are more strongly related to connected cities than to corridors themselves in determining economic growth in corridor regions. This was proposed based on the observation that corridors may function as connective devices for some types of agglomeration effects and that large urban regions can especially profit from this effect. The suggestion that agglomeration may evolve at some point into congestion only applies to urban regions and is thus unrelated to whether a region is part of a corridor. Some of our research outcomes, especially in the employment growth models, hint at such a relationship – notably the divergent employment level-growth relationship in large urban regions, especially urban corridor regions. With respect to productivity growth, peripheral and small urban regions appear to be more suited to productivity growth than larger urban regions. Recall that large urban regions and core-regions already have high levels of productivity (Table 3.2), implying that production in such regions is relatively efficient and making further productivity growth more difficult (Fare *et al.*, 1994). Corridors and urban regions are evidently not related to each other in a very clear-cut way. Agglomeration externalities may become network externalities, diffusing over urban space in much more complex ways than (corridor) proximity suggests (Ponds *et al.*, 2010).

The third hypothesis suggests that in the polycentric urban landscape of European regions, regions of all urban sizes (large, medium-sized and small) contribute to economic growth in corridors by means of agglomeration economies. This hypothesis can be confirmed with the recognition that such heterogeneity exists

outside corridors as well. This is an important outcome for European cohesion and competitiveness strategies and policies.

Our fourth hypothesis, based on Dühr *et al.* (2011) and focused on peripheral regions in Europe, states that the agglomeration advantages of corridors dominate disadvantages (caused by backwash- and leaking effects, shadow effects, and no-stops effects). A comparison of outcomes in peripheral regions within and outside corridors and in large, medium-sized and small urban regions shows that the significance and positive signs of agglomeration variables in relation to growth do not differ very much, but that, except for the convergence indicator, no systematic negative evidence of agglomeration in relation to growth is found. This confirms the hypothesis, although the corridor effect appears to be a product of (urban and core-periphery) composition effects rather than a genuine corridor effect.

Finally, we hypothesized that the agglomeration advantages of corridors in core European regions are small because other (measured and unmeasured) factors influence economic growth to a much larger extent. While this is true for population density in relation to both employment growth and productivity growth, and for diversity in relation to employment growth, we find significant and substantial effects with respect to the other variables – especially educational level and specialization-diversity. These and other factors may (co-evolvingly) influence the results, and more robustness tests of time effects, scale effects and possible aggregation bias are needed.

3.6 Discussion

This chapter has focused on the relationship between corridor development and regional economic growth. In general, we observe a Europe in which different regions develop at different rates, and where corridors predominantly function as connecting devices to access large market potential and high levels of knowledge and R&D investment. Productivity growth in European regions appears to be embedded in smaller and medium-sized regions in the periphery of the continent.[10] Employment growth is more urban-attached but shows less clear signs of convergence (indeed, the data often suggest divergence). The remark that governments have no clear indication of which way to push in seeking efficiency (Puga, 2002, p. 392) is thus pertinent. The results present a differentiated and complex picture of growth patterns within and outside corridors and within and outside large urban regions across the European continent. In addition, they shed new light on the intertwining of corridor regions with different types of urban environments and regions.

The lessons for policy are important but depend on what goals are pursued, by whom and by what means. The results presented are especially relevant in light of discussions of EU cohesion policy, agglomeration economies and place-based development, as the results show a highly varied picture of corridor effects. Corridor regions may contribute to convergence and economic growth but only under certain circumstances and in certain regions (e.g., in corridors convergence contributes to productivity growth, but not employment growth). When we also include the effects of urban size and core-periphery structures, the conditions become even tighter: what is beneficial in some corridors and some urban regions is not necessarily beneficial in other regions, even when the same conditions apply.

For example, whereas corridors profit from the presence of small urban regions in achieving productivity growth due to increased market potential, the same does not hold for large urban regions. In this case, the absence of corridors is more desirable in achieving productivity gains through increased market potential. With respect to private R&D investment, however, the combination of corridors and large urban regions appears to work best. We argue that a place-based approach that takes into account these regional differences and requirements so that each region has its own specific approach to economic development is recommended. Other recommendations for further research concern the study of industries instead of regional aggregates, robustness analysis of time- and scale- varying dynamics, and testing for network effects of firms and entrepreneurs in (corridor) regions.

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Notes

[1] De-concentration need not involve the qualitative separation of functions in which more innovative firms remain in city centres and productive firms move out. Instead, suburbanization of economic activity may involve all types of activities (Phelps, 2004; Green Leigh and Blakely 2013).

[2] Data are used for Austria, Belgium, the Czech Republic, Germany, Denmark, Spain, Finland, France, Greece, Hungary, Ireland, Italy, the Netherlands, Poland, Portugal, Romania, Sweden, Slovakia and the United Kingdom. For reasons of optimal data comparability, small modifications were made to the regional divisions in Belgium, Sweden and the United Kingdom. Data from regions in Norway, Switzerland, Slovenia and Luxembourg are missing.

[3] Mimicking the distribution as suggested by the OECD and imposing it on the NUTS2-regional level in the EU implies that some capital regions (e.g., Bratislava, Stockholm) do not appear as large urban regions, while some large-surface regions (e.g., regions in Romania, France and Spain) do. Because much of our data is merely available at the NUTS2-level, we cannot distinguish cities on a lower spatial scale. Combining population data with density and functions may be an alternative way to capture the urban structure of Europe – but for now we wish to test the logic suggested by the OECD. In addition, density is one of our main explanatory variables in all models – imposing it on the regimes would introduce it on the left-hand side of our equations.

[4] Three corridors have a north–south orientation; the other corridors are orientated from West to East. Among the corridors identified is Corridor A, connecting Rotterdam (Netherlands) to Genoa (Italy). The second corridor (B) ranges from Stockholm (Sweden) to Napoli (Italy); the third north–south corridor (C) runs from Antwerp (Belgium) to Lyon (France). The fourth corridor (D) has a west–east orientation, stretching from Valencia (Spain) to Budapest (Hungary). The fifth corridor (E) connects the urban regions of Dresden (Germany) and Constanta (Romania). The final corridor (F) ranges from Aachen (Germany) to Terespol (Poland).

[5] Included in the comparison are the TEN-T Priority Axes, RNE corridors, CER Business Cases for a Primary European Rail Freight Network and TREND. The recently defined Core Network Corridors from the Connecting Europe Facility of the European Commission are not yet included. We intend to incorporate these in follow-up empirical research.

[6] Explanation of the variables:
Employment growth = ln(emp10-emp00)
Productivity growth = ln (prod10-prod00)
Employment level 2000 = number of employed persons in 2000
Productivity level = labour productivity level in 2000 (all economies)
Specialization-diversity = entropy measure over 59 location quotients of sectoral production (> = specialized, < = diversified), 2000
Private R&D = percentage of GDP spent on R&D in firms in 2000
Public R&D = percentage of R&D spent on R&D in universities and non-profit institutes in 2000
Openness economy = (exports + imports) as percentage of total trade, 2000
Market potential = gravity value on production with travel time distances, 2000
Educational level = share of tertiary education in working population, 2000

[7] We realize that endogeneity may still be an issue in the models, as some explanatory variables (like educational level) may be partly determined by employment growth and productivity growth.

[8] Recall that the core and peripheral European regimes are based on this potential value as well. When using those regimes in models, the market potential variable is left out.

[9] Squared inverse distance weights do not capture the spatial dependence in our models for productivity growth and employment growth any more effectively.

[10] Productivity levels are generally higher in European cities (Bosma & Van Oort 2012, OECD 2012), but growth and level analysis show different outcomes in Europe.

4. Perspectives on bottlenecks in the European transport network

Witte, P., Wiegmans, B., Oort, F. van & T. Spit (2012), Chokepoints in corridors: Perspectives on bottlenecks in the European transport network. Research in Transportation Business & Management 5, pp. 57-66.

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Abstract

Intermodal transportation is often hampered by bottlenecks in transportation networks. One might therefore expect a large amount of academic and policy research to be available that clearly identifies the characteristics of these problems. However, this is not the case. The knowledge presented is rather fragmented and the range of the bottlenecks presented is wide. It fails to grasp the full extent of the problem and especially the cumulating and culminating effects of bottlenecks, for the scope of the research is often limited to a one-sided (logistics) perspective. A theoretical framework has been created to explore the multiple dimensions of bottlenecks. Empirical results show that a customer perspective, which emphasises the importance of the perspective of direct users of transport infrastructure, is the most prominent aspect lacking in the present understanding of bottlenecks. Furthermore, findings suggest that the conception of bottlenecks should be extended by incorporating other (often sectoral) dimensions to tackle the cumulating and culminating effects of bottlenecks. To conclude, an integrative perspective on the analysis of bottlenecks can add important insights to the present body of knowledge. This can be considered crucial information for policymakers as well as private parties dealing with bottlenecks in theory and in daily practice.

Keywords

Inter-sectoral coordination; European transport infrastructure; mixed scanning methodology; bottlenecks conception

4.1 Introduction

The existence of bottlenecks in the European transport network is a persistent issue in European (spatial) policy. Recently, the European Commission (2011) adopted a proposal called 'Connecting Europe' to transform the existing European transport infrastructure into a unified transport network. This new core network will 'remove bottlenecks, upgrade infrastructure and streamline cross-border transport operations for passengers and business throughout the European Union' (2011, p. 1). This proposal can be viewed as a continuation of the policy on the 'Trans European Transport Networks' (TEN-T), which has been in operation since the beginning of the 1990s.

The possibility of upgrading the existing transport infrastructure to help remove bottlenecks has been extensively studied in recent years. At first sight, a lack of attention to transport bottlenecks therefore seems not to be the issue at hand. However, the upgrading of existing infrastructure is only part of the solution. And a lack of capacity in the infrastructure network – the reason for upgrading the infrastructures – is only part of the problem. This chapter argues that a lack of understanding of the scope, complexity and cumulative effects of bottlenecks is the most prominent aspect currently missing in the analysis of bottlenecks in the European transportation network.

The traditional understanding of transport bottlenecks is predominantly limited to a (technical or managerial) sectoral perspective. Of particular concern within this understanding are the capacity constraints of transport infrastructure. The technical capacity of transport infrastructure can be defined as follows, adapting Rothengatter's (1996) definition of the theoretical capacity of a rail network: '*the maximum quantity of freight which can be operated on a link, depending on a number of factors such as the type of vehicles, the speeds, the mix of transport modes as well as the operation and scheduling systems*' (p. 51). This closely relates to a literal definition of a bottleneck as a narrow section of road or a junction that impedes traffic flow (see: Oxford Dictionary).

Despite the attention to transport bottlenecks, academic research thus far has largely failed to develop a comprehensive, consistent and especially an integrative framework to analyse and evaluate bottlenecks in transport networks (a notable exception being Rothengatter, 1996). The urgency of resolving bottlenecks in European transport networks has heightened the need for innovative solutions. However, as will be pointed out here, this is easier said than done, since transport bottlenecks have become so much interrelated with a multitude of economic, spatial and governance issues. This has thus far only been partly understood by academics, policymakers and private parties in dealing with transport bottlenecks in their daily practice. The aim of this chapter is therefore to shed more light on the complexity of the sectoral bottlenecks and their development into comprehensive problem areas in which the problematic characteristics of old (sectoral) and new (comprehensive) bottlenecks cumulate and culminate.

The chapter will be organised as follows. The second section will review the traditional perspective on transport bottlenecks, and outline three additional perspectives from a theoretical point of view. This will result in a holistic approach for

analysing bottlenecks, especially in the field of intermodal transportation. The third section will discuss the mixed scanning methodology, which will be used to test the framework in an empirical setting. The fourth section will outline the results of the empirical analysis. The final section puts forward implications for managerial practice and contributions to scholarly knowledge.

4.2 Conceptual framework

This section will discuss different perspectives on transport bottlenecks. An extensive literature review has been performed, especially covering the most recent period between 1995 and 2011.[1] The contributions stem from both transport-related and more spatial- and economic-oriented resources. This has generated a conceptualisation consisting of four common, distinctive perspectives on bottlenecks (Figure 4.1). The first is infrastructure (I), including the physical (A) and organisational (B) dimension. The second is spatial structure (II), consisting of the functional (C) and morphological (D) structure. The third is governance structure (III), dealing with the political (E) and institutional (F) structure. The fourth is economic structure (IV), taking into account the market conditions (G) and financial aspects (H). Within each perspective and type, numerous bottlenecks can be found (Appendix 4).

4.2.1 Infrastructure (I)

The infrastructure perspective largely coincides with the 'traditional' understanding of bottlenecks. In this chapter, the subdivision in physical and organisational structure which is common in definitions of infrastructure will be used to explain the different bottlenecks involved in the infrastructure perspective.

First, physical bottlenecks (A) will be discussed. The most common bottleneck within this category is congestion. Congestion involves many dimensions, various spatial scales and multiple transport modes (Chapman *et al.*, 2003, p. 185; Rodrigue, 2004, pp. 158-159). Congestion should not be confused with another important type of bottleneck in the physical transport infrastructure: capacity constraints. Capacity constraints amount to the mere technical capacity of a certain piece of infrastructure (Rothengatter, 1996), whereas congestion also originates from other issues besides capacity constraints, such as accidents and bad weather.

Examples of other physical bottlenecks are missing links in the network, resulting in reduced efficiency for the whole network (Maes *et al.*, 2009, p. 6; Peters, 2003, p. 330), additional time and risk costs involved with transhipment from one mode to the other (Van Klink and Van den Berg, 1998, p. 3) and time-based constraints such as waiting time at terminals (Notteboom and Rodrigue, 2009, p. 11).

Closely related to physical bottlenecks are organisational bottlenecks (B), relating to the organisational facilities of infrastructure. When they are analysed in relation to the physical domain, an interesting discussion comes to the fore. Apparently, there is a frequent call for harmonisation and standardisation, originating from, for instance, policymakers who try to implement innovative concepts such as 'integrated supply chain management'. However, as Maes *et al.* (2009) point out: '*it seems that logistics and industrial companies hardly work together to organise*

logistics more efficiently ... Some parties think of shifting traffic to off-peak hours, although not everyone is in favour of this solution. Terminal operators for example stated that longer terminal opening hours were proved not to be profitable ... Also changing delivery times at the industrial clients was shown not to be easy ... [O]nly a minority is able to change them' (pp. 1, 15).

The problems with harmonisation and standardisation reinforce other bottlenecks related to the organisational infrastructure, which all influence the efficiency of transport networks: for instance, the adaptation of freight loads to regulatory constraints (Rodrigue *et al.*, 2010, pp. 521-522). Furthermore, as Rothengatter (1996) already stressed, the measure of bottlenecks is a challenge in itself; data is not collected on a European basis and results differ from country to country. It goes without saying that a more holistic approach is desired to overcome these and other problems. Therefore, the additional perspectives of spatial, governance and economic structure will be presented.

4.2.2 Spatial structure (II)

The second perspective concerns the spatial structure of transport networks. Providing a clear-cut definition of spatial structure is difficult in this case, since most definitions apply to the complex nature of urban spatial structures, whereas this chapter is merely interested in a practical definition of 'space' as such. Therefore, the definition of spatial structure used is based on a definition from a specific case; a Belgian municipal structure plan: '*the interpretation of the coherence between the morphological and functional structure*'. The functional structure covers aspects related to land use, plus the planning processes underlying the actual land use. The morphological structure covers the unplanned, external conditions or surroundings, especially those in which people live or work.

First, bottlenecks related to the functional structure (C) will be discussed. Actual land-use bottlenecks can be summarised as 'pressure of space on the transport network' (Hesse and Rodrigue, 2004, p. 181). One of the main issues is the lack of land for expansion in traditional port areas. This leads to changing port–city relations and expansion of ports towards the coast (Wiegmans and Louw, 2011, p. 581). Furthermore, it leads to 'port regionalisation' processes in the hinterland of the ports (Notteboom and Rodrigue, 2005, p. 300). When these processes are unbalanced, bottlenecks such as congestion might simply move from the traditional port areas to the coastal expansion sites or to the hinterland. This might bring about spatial relocation patterns, influencing the relative importance and internal spatial configuration of logistics areas (Notteboom and Rodrigue, 2005).

Bottlenecks related to the planning process are especially difficulties of involving private parties in the financing of transport infrastructure. Issues in this case are the diversity of actors and the risk-avoiding behaviour of private parties. Other constraints relate to multiple ownership of land or fragmented land ownership (e.g. Louw, 2008, p. 69). Issues in this case are the behavioural characteristics of land owners and the institutional context of land ownership. Other friction factors are 'unwillingness', being either local opposition to port development (Notteboom and Rodrigue, 2005, p. 300), or the unwillingness of private actors to feed knowledge on

infrastructure into the planning process (Curtis, 2008, p. 108). It goes without saying that these bottlenecks related to the planning process are highly interrelated.

With regard to the morphological structure (D), two types of bottlenecks emerge. The first type can be characterised as traffic externalities, in most cases implying environmental effects. The externalities consist of the degradation of urban landscapes, use of space by traffic, road safety (i.e. accidents), air pollution and other types of environmental pollution, traffic noise, etc. (Banister, 2000, pp. 116-117). This bottleneck can also run in the other direction: environmental protection making an extension of, for example, road capacity practically infeasible (Rothengatter, 1996, p. 67).

The second type of morphological bottleneck concerns 'inescapable' physical barriers, in which path-dependent development has a crucial part to play. An example is the passage through the Alps to reach the seaport of Genoa in Italy, by means of the hinterland connections of the Port of Rotterdam; tunnels are still being constructed and the topography does not allow for very high speeds (Van Klink and Van den Berg, 1998, pp. 6-7). Other contextual constraints are local specificities such as existing infrastructures, urban morphologies and landscape structures (Bertolini *et al.*, 2005, pp. 213-214). In these examples, the effect of time is essential: planned activities from the past can have unplanned, morphological effects in the present and in future situations.

4.2.3 Governance structure (III)

The third perspective is related to the governance structure. Governance structure will be defined as the exercise of political authority and the use of institutional resources to manage society's problems and affairs (based on World Bank, 1991, p. 1). Thus, governance structure can be divided into political structure and institutional structure.

With regard to the political structure (E), different bottlenecks emerge. A first issue is the lack of knowledge of politicians and the subsequent use of planning methodology in practice, an example being the implementation of policy relating to the integration of land use and transport (Curtis, 2008). As Peters (2003, p. 317) suggests, European Union (EU) transport investments lack consistency and sustainability owing to the existence of partially complementary, partially competing development objectives.

The political priorities resulting from this simplification can be viewed as an additional bottleneck. Examples are the low priority of freight transportation on the core European transport network and the tendency to over-dimension projects once they are on the maps (Peters, 2003, p. 332). Furthermore, planning processes in transport corridors are often characterised by a narrow focus on bottlenecks and a rather defensive attitude taken by regional and local governments (Romein *et al.*, 2003, p. 211).

The second dimension of the governance structure is the institutional structure (F). This type closely relates to the organisational bottlenecks mentioned before. In this chapter, organisational bottlenecks concern friction factors with regard to the organisational facilities in infrastructure (formal, hard structures). Institutional bottlenecks are defined broader and thus cover also the way people (or firms, public

bodies, etc.) make use of these facilities (informal, soft structures). The difference is purely theoretical. In practice, it is not surprising to find that examples of bottlenecks concern both organisational and institutional structures.

First, institutional fragmentation can be regarded as a serious bottleneck. Institutional fragmentation occurs in situations where different procedures do not fit with each other. This is the case in the European rail system, for instance, where a host of different technical systems is used by national rail companies simultaneously (Priemus and Zonneveld, 2003, p. 169). A related issue of fragmentation is the transnational nature of transport corridors, cutting through regional and national administrative borders (Romein *et al.*, 2003, p. 207).

Another example of the institutional bottleneck is the reluctance of logistics companies to change their market behaviour to fit with transport concepts. As a concrete case, one can point to suggestions in transportation studies to improve interoperability, efficiency and information on goods flows by, for instance, introducing longer or double-stack trains, sharing information in the supply chain, or the like. This will surely help to improve the efficiency of transportation networks, but one should not neglect the enormous investments required from the logistics companies to achieve this efficiency. Who is going to pay? Will logistics companies still perceive interoperability as a problem when such large investments are required, in a context of already low profit margins? What becomes evident is that a lack of harmonisation and standardisation is often the result of rational (cost) considerations on the part of the logistics and industrial companies. Because of ongoing contractual agreements and very minor profit margins, there is a very limited incentive to change the ways in which logistics are being organised. Logistics companies will probably not change their organisation overnight to implement yet another new transport concept.

Finally, the influence of overlapping or conflicting rules and legal systems can be regarded as an institutional bottleneck. One can think of administrative bottlenecks with regard to European legislation, an (old) example being regulations on free competition hindering efficient intermodal transportation (Van Klink and Van den Berg, 1998, p. 8). Also, unintended policy effects can be regarded as an institutional bottleneck. Recent discussions stress the unforeseen effects of EU cohesion policy, that is, insensitivity to the contexts and needs of specific regions by neglecting the diverse effects of infrastructure investments. This is causing negative hub-effects and not helping to achieve the European goals of diminishing regional inequalities (Farole *et al.*, 2009).

4.2.4 Economic structure (IV)

The final perspective is the economic structure. The definition of economic structure used in this chapter, based on a definition provided by the Dutch Ministry of Transport (Rienstra and Visser, 2010, p. 11, author's translation), is the availability, quality, spatial distribution and cohesion of production functions, including infrastructures. To be more specific, economic structure will be divided into market factors (i.e. conditions) and financial factors (i.e. availability and allocation of resources).

Bottlenecks related to market conditions (G) can be characterised as the influence of competition and market principles on the one hand, and the effects of

agglomeration externalities on the other. In the first case, one can point to operational and commercial barriers obstructing access to infrastructure: '*This issue is taken up because absence of coordination in path allocation makes cross-border traffic arrangements unnecessarily complex and adds to physical obstacles to rail operations and unnecessary delays*' (European Commission, 2007, p. 5). Another example is the existence of monopolistic structures in transportation networks.

Regarding agglomeration externalities, bottlenecks that can be identified are to be found at the 'break-even point' where positive agglomeration effects turn into negative agglomeration effects. There are limits on the degree to which agglomeration contributes to economic growth, particularly in metropolitan areas, where congestion and environmental degradation can become important problems when this 'turning point' is reached (Farole *et al.*, 2009, p. 8). Other aspects which influence the occurrence of positive agglomeration effects are, among many, a well-functioning infrastructure and proximity to markets. When insufficient attention is paid to these specific growth- and location factors, this can lead to processes of lock-in and the limited adaptive flexibility of an economy (Farole *et al.*, 2009, p. 34).

Bottlenecks related to financial factors (H) consist of both the basic availability of financial resources and the costs and effects of the actual allocation of these resources. Concerning the availability of financial resources, one should not be surprised that the recent economic downturn is regarded by some researchers as an external factor which is disturbing and damaging the already declining funding activities of governmental bodies. If investing in transport infrastructure occurs nevertheless, there are oftentimes many problems (Flyvbjerg, 2009). Examples include the costs of investments (Marvin and Guy, 1997, p. 2026), diverse effects of over- or under-building of infrastructure (McCann and Shefer, 2004, p. 179) and the unlikelihood of short-term returns on infrastructure investments (Van Klink and Van den Berg, 1998, p. 3).

4.2.5 Cumulative effects of bottlenecks

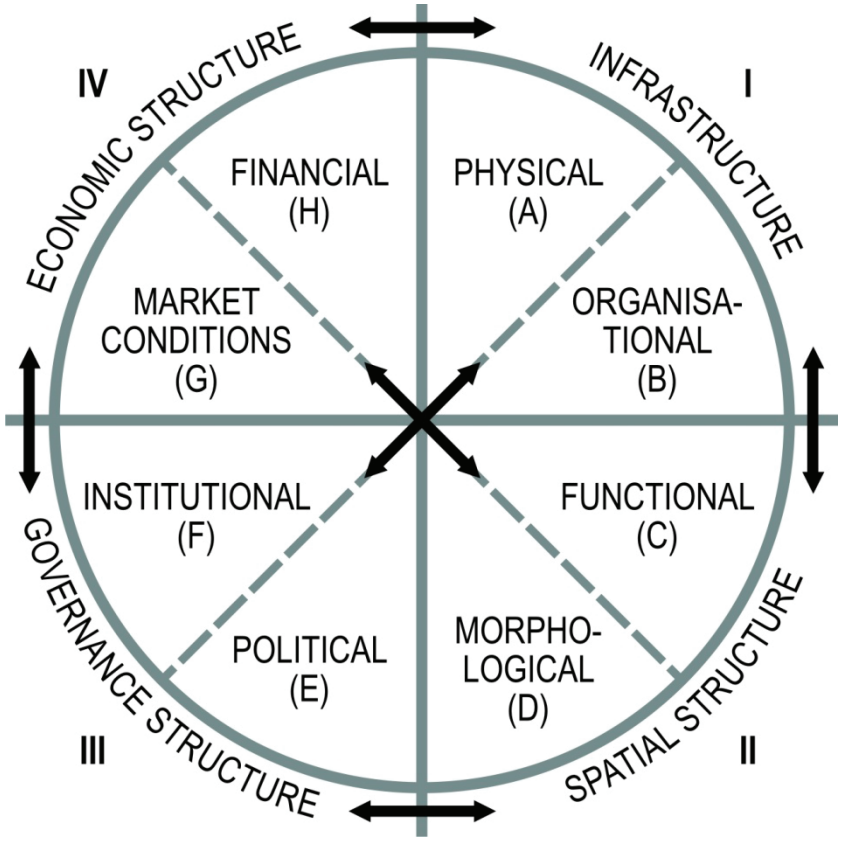
As has become clear from the previous discussion, in many cases bottlenecks appear to be interrelated, leading to cumulative effects. It is worth mentioning the concept of logistical friction as introduced by Hesse and Rodrigue (2004, p. 179) at this point. Friction factors can be understood as factors impeding the (most efficient) circulation of freight. This bears similarities to the understanding of bottlenecks in this chapter. The different perspectives of bottlenecks therefore essentially are friction factors which cumulate to create a bottleneck. Logistics friction as a multidimensional concept is not unlike the conception of bottlenecks introduced in this chapter; it may therefore help to better understand the occurrence of cumulative effects of bottlenecks.

The strongest relations can be found between the traditional, infrastructural perspective on bottlenecks and virtually any one of the additional perspectives on bottlenecks. Infrastructure and spatial structure are connected for instance by the integration of transport infrastructure in the urban fabric and local environments. The negative external effects created by traffic externalities are another example. The pressure of space on transport, for example through the effects that the operation of

real estate markets has, is also illustrative. Finally, the negative impacts of environmental protection on the transportation network can be mentioned.

The relation between infrastructure and economic structure has also been pointed to before. One can think of the friction between policy documents aiming at the introduction of new concepts such as integrated supply chain management, the competitive considerations of logistics companies and the financial consequences that could possibly follow a decision to implement such concepts. This also links closely to the relations existing between infrastructure and governance structure. In this case, the correlation between technical and organisational chokepoints (electric power compatibility, waiting times, and interoperability) and the political and institutional embeddedness of these chokepoints comes to the fore. Similarly, relations can be drawn between all perspectives and dimensions discussed previously. The case of harmonisation and standardisation can exemplify the (close) connectedness between all perspectives involved, and thus showcase the cumulative effects of bottlenecks. On basis of the foregoing, an integrative conceptual framework is designed (Figure 4.1).

Figure 4.1: Conceptual framework for bottlenecks in the European transport network



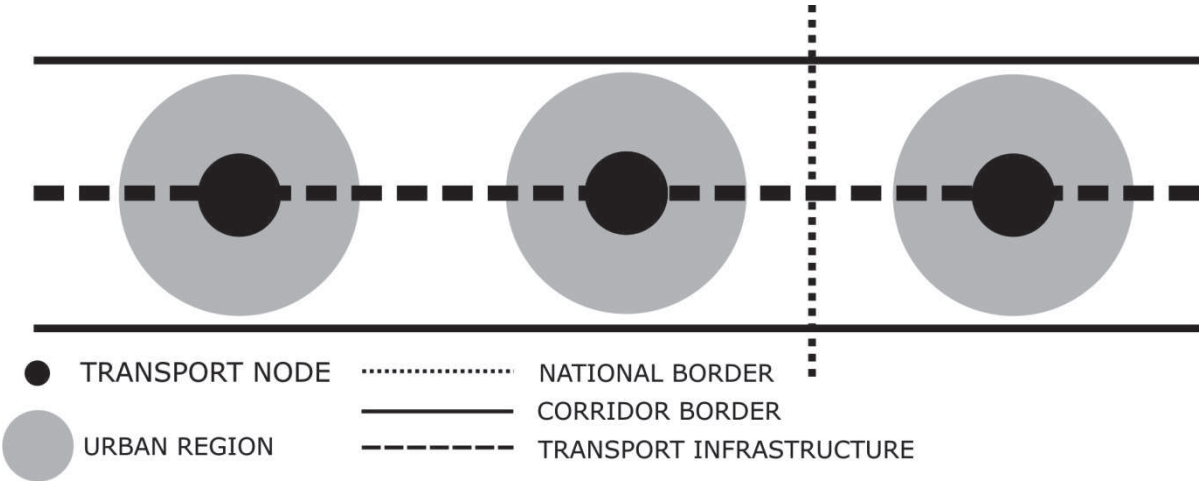
This conceptual framework can be understood as a wheel, which consists of a number of different spokes. The wheel consists of four quadrants (i.e. the perspectives), and each quadrant of two types (i.e. the dimensions). Returning to the concept of logistical friction, it should be stressed that there are many different friction factors hampering the most efficient movement of freight. Each spoke in the wheel can therefore be understood as a friction factor cumulating to create a bottleneck. The main argument here is that in attempting to solve a bottleneck, it is not sufficient to consider only one

dimension. Because of the cumulative effects of bottlenecks, all types of friction factors should be considered. The arrows in the model represent the connectedness of all the different perspectives involved.[2]

4.3 Methods

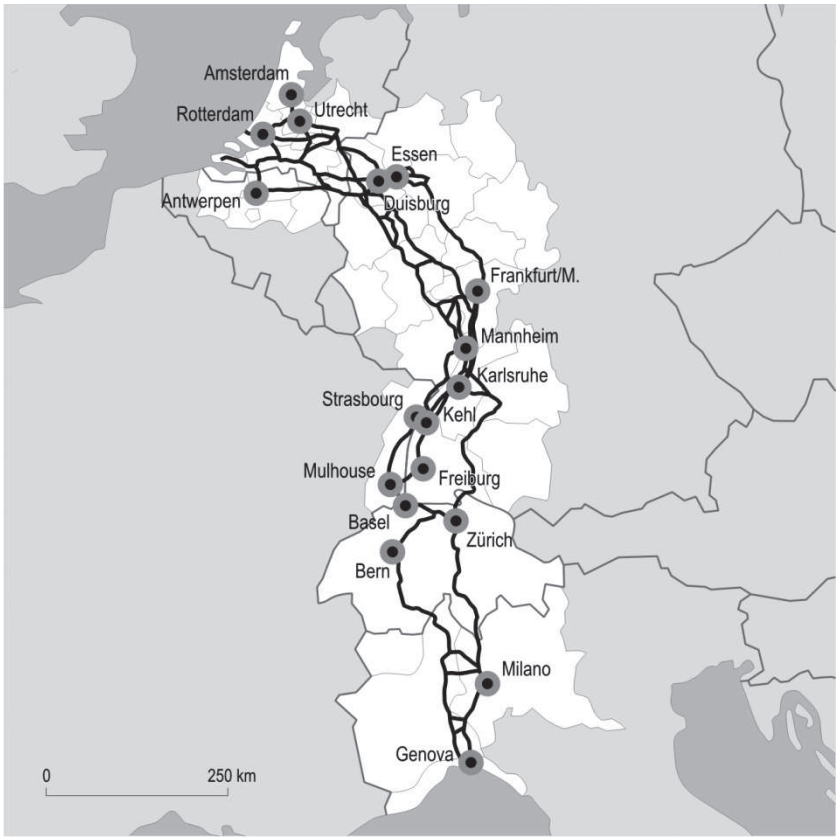
The conceptual framework will be tested in an empirical setting by zooming in on the TEN-T Corridor 24 transportation network. Corridor 24 is one of the major transport corridors in north-western Europe, stretching from Rotterdam to Genoa. Transport corridors can be defined, following Priemus and Zonneveld (2003), as bundles of infrastructure (roads, railways, waterways) connecting two or more urban regions (p. 167). Transport corridors are concerned with connections (i.e. transport nodes) that use different modes (road, rail, barge or intermodal) and include both passenger and freight transport (Figure 4.2).

Figure 4.2: Transport corridor conceptualisation



This empirical application deals with the European area interested in the development of the intermodal transport corridor linking the transport nodes of Rotterdam and Genoa. This space hosts a number of the most densely populated urban regions in Europe (Figure 4.3). What becomes evident is that different spatial scales are at stake on the Corridor 24 transport network. The transnational transport corridor scale (macro), as well as the urban region and the local transport node scale (micro), are of importance. Therefore this chapter needs a methodology that is suitable for both the macro and the micro level of analysis at the same time, since neither of the two levels is able to capture the full complexity of the transport bottlenecks occurring on transport corridors.

Figure 4.3: Corridor 24 and its environment



At least two types of methodology meet these requirements: Etzioni's 'mixed scanning' methodology and Coleman's 'micro–macro' diagram. The latter type of methodology, however, implicitly favours the macro scale over the micro scale, because of the difficulties involved in empirically proving the feedback loop from the micro to the macro level. On the other hand, the requirements practically coincide with the overall principle of Etzioni's framework: a broad, strategic analysis of the main bottlenecks on the transport corridor will provide a definition of specific problem areas which require a more detailed examination. This chapter will therefore use mixed scanning methodology.

This type of methodology was originally introduced by Amitai Etzioni (1967, 1986). Despite the fact that the origins of this type of methodology range back for nearly half a century, the methodology is still often used in decision-making and planning. Etzioni, introducing mixed scanning in a time of theoretical debate between rational comprehensive planning and incremental planning, used the metaphor of a weather observation system to explain the logic and relevance of his framework. Where a rationalist would examine the entire sky and an incrementalist would focus on certain, specific areas, the mixed scanning approach uses two cameras: a broad angle to cover all parts of the sky, but not in great detail, and a second camera to focus on those areas revealed by the first camera to require a more in-depth examination (Etzioni, 1967).

Thus, in a mixed scanning framework, there is a hierarchical division between fundamental decisions and incremental decisions, between a strategic level and a detailed level, and so on. The high-order and low-order decisions or levels are

interrelated. As Etzioni (1967, p. 388) argues: *'Most incremental decisions specify or anticipate fundamental decisions'*; and *'the cumulative value of the incremental decisions is greatly affected by the related fundamental decisions.'* According to Etzioni, each of the two elements in mixed scanning helps to reduce the effects of the particular shortcomings of the other, which is an important practical advantage of using the mixed scanning approach and applying the approach to different contexts.

When applying the mixed scanning framework to this chapter, one could argue that a broad, strategic analysis of the transport capacity of the transport corridor will fail to take into account specific, interrelated chokepoints at the local level. For example, the impact of noise protection measures resulting from national legal structures. At the same time, a regional strategy for a certain transport node will neglect the impacts of border-crossing problems on the transport corridor at the transnational level. Mixed scanning is able to tackle these problems.

This chapter makes use of data obtained from recent empirical research on the Corridor 24 transportation network. Two different studies are at the core of the data.[3] The aim of the first study (Bottleneck Survey) was to identify general (macro) bottlenecks for the Corridor 24 regions. First, the perception of bottlenecks inside the logistics sector was assessed by a survey among logistics experts. The goal of the survey was to gain first-hand information on the influence that bottlenecks have for companies with regard to the accessibility of regions. Then, thirteen in-depth interviews were held in the Karlsruhe region and Upper Rhine area. The target groups of the interviews were forwarders, port authorities, railway companies, logistics associations and Chambers of Commerce.

The aim of the second study (Regional Workshops) was to be open to all the institutions and citizens interested in the Corridor 24 transportation network by activating a network of strategic decision makers and stakeholders and starting up a series of workshops to share information and collect expectations on a regional (micro) scale. In this way nine Regional Workshops have been carried out.[4] About three hundred people, including regional and local planning authorities, transport authorities, logistic and transport entrepreneurs, research institutes and experts, local companies and global corporations, associations of citizens, port authorities and political decision makers, participated.

These studies provide this chapter with a selection of both general (macro) bottlenecks in the transport corridor (Bottleneck Survey) and problems in specific locations (micro) along the Corridor 24 transport network (Regional Workshops). These results can be used to assess the conceptual framework of this chapter in practice, since the framework can be applied to the transnational corridor scale (macro) as well as to the specific local scale (micro). It needs to be stressed that these results can only be used to gain a first, indicative impression of the empirical validity of the conceptual framework, since the empirical research carried out has not been specifically aimed at testing in a rigorous, quantitative way.[5]

4.4 Findings and discussion

This section will first discuss the empirical results on macro-level bottlenecks, before elaborating on bottlenecks occurring on a micro level. As mentioned before, the macro-level analysis is based on the general outcomes of the Bottleneck Survey. With regard to the micro-level analysis, the bottlenecks mainly originate from the specific results of the Regional Workshop and follow-up interviews in Rotterdam, the Netherlands.

4.4.1 Macro-level analysis

First, bottlenecks relating to infrastructure (I) were found in the macro-level analysis. Examples of bottlenecks indicated in the physical structure (A) included an important lack of rail transport capacity (e.g. on the Upper Rhine, from Frankfurt to Basel), missing links such as a lack of evasion routes for trucks (e.g. missing bridges, need for enlargement of motorway lanes), problems with transhipment (e.g. lack of flexibility in barge-to-rail transition) and competition between freight transport, long-distance and short-distance passenger transport operating on the same lines causing conflict. This coincides with many of the bottlenecks identified in the conceptual framework.

In the case of organisational structure (B), an interesting example of problems with harmonisation and standardisation concerned the observations made by some of the respondents regarding the concept of 'just-in-time' production. It was stated that railway is not reliable and flexible enough to live up to the requirements of just-in-time-production, and even if industries were to demand multi-modal logistics services in the future, only a few logistics enterprises would be able to deliver. Many enterprises do not have the required know-how and access to other carriers apart from road traffic, and cooperation with parties who have access to this knowledge contains in itself the danger that a competitor in the market obtains information about supply chains and volumes of cargo. It seems that the safe-keeping of market-sensitive information is valued over integration in the supply chain and increased efficiency.

The second perspective is the spatial structure (II). The macro-level analysis revealed the following bottlenecks relating to the functional structure (C). It was stated that the lack of space in the German railway network for trains to pass each other, the absence of space in inland ports to set up new plants and the enlargement of inland ports are among the main bottlenecks. It was doubted that public–private partnership projects would contribute to a solution, for the objectives of private management (to be as fast as possible) are in many cases not consistent with efficient traffic flows. Finally, it was suggested that the usability of locations for the logistics sector is restricted, since some municipalities are reluctant for logistics service providers to settle in their areas. Municipalities fear the negative effects of increased traffic volume and diminishing property values. Whether these suggestions are entirely correct is doubtful, for logistics investments may also bring about positive externalities at the local and regional scale, but when a perception is settled and proven hard to change, this may even be a bottleneck in itself.

Regarding the morphological structure (D), the following bottlenecks come to the fore. The main suggestion can be summarised as 'an important lack of noise

protection'. It was stated that it is necessary to pay attention not only to economic and logistics issues, but also to noise protection near housing areas adjacent to transport infrastructure. Examples included several locations in Germany: Rastatt, Muggensturm, Ettlingen, Stutensee-Friedrichstal and the Middle-Rhine Valley between Koblenz and Bonn. Another example of morphological bottlenecks were 'temporary bottlenecks', such as high and low tides in the inland waterway system and the occurrence of accidents. This at first sight confirms the divide made in the conceptual framework between traffic externalities on the one hand and inescapable, physical effects on the other.

Governance structure (III) is the third perspective. Bottlenecks in the political structure (E) revealed by the macro-level analysis included in general a lack of cooperation. It was suggested that there is no unity in promoting transnational concepts (e.g. the EU aim 'Motorways of the Sea') and that there are too many different interests and political hindrances (e.g. bad political climate on a national level) to implement innovative, international projects. A good example, according to the respondents, is the Rhine–Rhone canal in France: most politicians perceive this project from a national perspective, whereas an international approach could help link the European waterways from the Mediterranean to the North Sea. As in the case of the conceptual framework, simplification, the setting of wrong priorities and divergent effects of decisions are suggested to be at the core of the political bottlenecks.

With regard to the institutional structure (F), most of the respondents noted the lack of a coordinated European transport policy coordinated with national policies. They suggested that the lack of a homogeneous legal framework leads to problems, especially at the national borders (e.g. incompatible noise regulations). Legal 'bypasses' such as the obtaining of exceptional approvals were regarded as complex, time-consuming and inflexible. As with the bottlenecks in the conceptual framework, legal barriers, conflicting rules and institutional fragmentation play a key role.

The final perspective is the economic structure (IV). Among the macro-level bottlenecks related to market conditions (G) are the small number of providers of logistics services. It was stated that smaller providers cannot be booked directly, but only via large providers who favour their own partners. Another example of bottlenecks is reluctance to cooperate with competitors to achieve flexibility in the supply chain.

The final example resulting from the macro-level analysis concerns the bottlenecks in the financial structure (H). In general, it was believed that the public budget for transport investments is not sufficient, leading to a lack of investment in transport infrastructure. On top of this, the current recession brings about additional problems. The respondents shared the view that customers are disorganised, staff is too much reduced, professional competence and entrepreneurship is missing and companies are taking a short-term view, thinking only about their own problems. The mentality of 'saving at all costs' is setting the wrong priorities, it was concluded. The bottlenecks identified relate well to the conceptual framework, for both the availability of financial resources as such and the diverse effects of (a lack of) investment were stressed.

4.4.2 Micro-level analysis

One of the key findings of the micro-level analysis is that a customer perspective, which stresses the need to perceive bottlenecks from the point of view of direct users of transport infrastructure, is the most prominent aspect lacking in the present understanding of bottlenecks.[6] This has close links to the issues regarding harmonisation and standardisation to achieve integration in the supply chain (I-B), versus institutional fragmentation (III-F) and market conditions (IV-G). It has been extensively discussed before, both in the conceptual framework and in the macro-level analysis. The lack of a customer perspective plays a key role in the discussion of all the bottlenecks identified in the micro-level analysis.

In the Dutch context, a number of issues related to infrastructure (I) were identified. With regard to the physical (A) point of view, issues identified were a lack of long tracks at the starting points of freight routes, a lack of sufficient capacity along the way (i.e. too many trains are operating on the same tracks), a lack of long tracks at the train stops along the way and too many different systems. From a customer point of view, the previous physical problems result in several organisational (B) problems: transporters cannot operate trains with a length of over seven hundred metres, they need very expensive engines regardless of the distance travelled, they have to make needless stops and they cannot make ideal circulations because of timetables and working conditions of engine drivers.

Related to bottlenecks in infrastructure are bottlenecks in spatial structure (II). The morphological structure (D) is of special interest in this case. It appears that many present-day bottlenecks result from past path-dependent choices that are reflected in the present spatial, morphological structure. Examples of specific bottlenecks in the Netherlands include different security systems along the A15 highway, 1.500-volt 'islands' (compared to 25 kV continuous-flow electricity systems), too short tracks on Maasvlakte–Oost and Waalhaven (Rotterdam), limited transport capacity 'at the doorstep' and a lack of tuning between limited slot-capacity and the ideal of an accurate 'estimated time of arrival'. In part these bottlenecks can be considered as 'accessibility problems' in traditional port areas. A lack of accessibility can also be characterised as a bottleneck in the functional structure (C).

When extending the analysis to include a cross-border corridor perspective, bottlenecks in infrastructure are complemented by bottlenecks in governance structure (III). Problems identified in the NewOpera report include insufficient cross-border coordination for slot reassignment; a lack of harmonisation in train numbering, tracing and handling; a lack of supporting tools to manage traffic; a lack of knowledge of trains' priorities; and a lack of punctuality (Castagnetti, 2007, p. 62). The key finding of this research report is that technical improvements on the corridors will be nullified if driving rules, working patterns and safety standards are not standardised.

Of course, there are many programmes and actions going on to tackle these problems. However, as the experts have repeatedly stressed, as long as 'the customer' does not take part in these projects, effects will be small. A promising solution would be to classify and deliver programmes and actions according to the customer's preferences. This is, however, easier said than done; projects often diverge and there are no strict deadlines for realisation of such projects. The issue is closely related to

the political (E) and institutional (F) bottlenecks. A recent example is the discussion with respect to the creation of a third track in Germany between Emmerich and Oberhausen to better connect the dedicated Dutch freight transport railway line 'Betuweroute' to the German hinterland. Whereas the Dutch government has speeded up the procedure for implementation of this project, the German procedure is running parallel, but without strict deadlines for implementation, owing to national political reasons. This is likely to hamper the implementation of fluent cross-border freight transport in the short term.

Finally, as was the case in the conceptual framework and macro-level analysis, in the micro-level analysis the different perspectives seem highly interrelated, leading to the cumulative effects of bottlenecks. As an illustration, the bottlenecks in the economic structure (IV) will be discussed, since the overlaps with other perspectives are many. For example, to upgrade the present level of service in railway freight transport operations (organisational structure – B), several measures are needed (e.g. improvement of reliability, shorter travel times). What is required to achieve these improvements is, for instance, an attitude shift from reactive to proactive on the part of the infrastructure managers, railway undertakings and terminal operators (institutional structure – F) and a close cooperation between various traffic managers (market conditions – G).

Besides, heavy investments are required (financial structure – H) to further improve the functioning of the present transport infrastructure network (physical structure – A). Examples include the implementation of the ERTMS security system at the Kijfhoek shunting yard (near Rotterdam, Netherlands) or near the Zevenaar border (close to Emmerich, Germany). But who will pay? The experts have agreed that there is a need for an 'integral corridor director' to mediate in such issues. Ideally, 'the market' should initiate such a director, but in certain cases, the experts concluded, 'the market' also profits from suboptimal solutions. There appears to be a lack of involvement; no one is willing to invest. This is a clear example of the hindering effects of market conditions and the financial structure in improving efficiency in the Corridor 24 transport network.

4.5 Implications for scholarly knowledge and managerial practice

Intermodal transportation is often hampered by bottlenecks in transportation networks. So far, the understanding of these problems has remained largely incomplete. Policy documentation is often limited to include only sectoral perspectives on bottlenecks. Especially in times of economic downturn, a sectoral perspective is often favoured over a holistic approach towards bottlenecks, for reasons of efficiency. One can think here of the traditional emphasis on the literal definition of bottlenecks, that is, the mere capacity constraints and congestion occurring in the infrastructural networks.

What has become clear, however, is that bottlenecks can no longer be viewed as mere capacity constraints of infrastructure networks. Instead, they should be interpreted as being integrative, complex problems, operating on the cutting edge between transportation, spatial planning, environmental issues, economic development and transnational governance. In other words, more attention should be paid – both in

research and in practice – to the cumulating and culminating (friction) effects of bottlenecks, operating as comprehensive problem areas.

This chapter suggests that bottlenecks emerge from different sectoral perspectives. Moreover, these perspectives are highly interrelated. Based on these suggestions, a conceptual framework has been developed to identify and analyse bottlenecks in a more holistic way. This can be considered a useful tool to the further development of scholarly knowledge on this topic. The most important insight for managerial practice in applying this framework is that when using a limited, sectoral perspective on bottlenecks one loses track of the possible added value of sector-transcendent analyses. This will ultimately lead to inefficient use of transportation networks.

The conceptual framework has been tested in an empirical setting by using mixed scanning methodology. It is interesting to find that a vast majority of the theoretical findings on bottlenecks can be confirmed when zooming in on the empirical results of the specific bottlenecks occurring on this transport corridor, on both a macro scale and especially a micro scale. Of course, the conceptual framework is in need of further empirical assessment to achieve full empirical validity, which is an important point for the future research agenda.

A suggestion to enrich the scholarly knowledge on bottlenecks might be to rate the (lack of) importance of different types of bottlenecks as perceived by the direct users of transport infrastructure (logistics companies, port authorities, other relevant stakeholders, etc.). In this way it would be possible to arrive at a better understanding of the relative value of bottlenecks (i.e. the distribution of the fields in the model and the direction and magnitude of the arrows). This would also be an interesting way of asking private companies valuable information on bottlenecks without having to ask them for sensitive data or information. This method could result in a clear and easily interpretable framework for managerial practitioners to deal with comprehensive bottlenecks. Follow-up research in our opinion also includes an extension of the results from a European scope to a worldwide consideration of transport bottlenecks.

These first indicative findings still support the notion that the conceptual framework presented in this chapter can be considered a useful tool for future research on bottlenecks. The framework provides the present body of scholarly knowledge and managerial practitioners with a new conception of the possibilities of inter-sectoral coordination. This provides interesting opportunities for reconsidering the position of spatial planning in future policy regarding European transportation networks.

Acknowledgements

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Notes

[1] Systematically scanning online search engines for recent electronic publications in the fields of economics, transportation, spatial planning and public policy resulted in a dataset of over 250 publications (academic papers as well as European policy reports). These publications mainly dealt with issues such as infrastructure, land use, land development, logistics, transport nodes, transport corridors, transport economics, transport geography and transport policy. Scanning these documents on common terms such as bottlenecks, chokepoints, barriers, hindrances or impediments resulted in a list of over fifty contributions. Of this list, only a selection is dealt with in the chapter for reasons of space limitation; a full list of references is available upon request.

[2] There is no specific order in arranging the quadrants in the model, nor in the length or magnitude of the arrows. The model is used merely as a visualisation of the complex overlaps of bottlenecks.

[3] The research has been carried out in the context of the INTERREG IVB funded project 'CODE24'. The authors have especially been involved in the Regional Workshops. The Bottleneck Survey has been analysed on basis of the final report and thus can be considered a secondary source of data.

[4] The workshops took place in Rotterdam (Netherlands), Antwerp (Belgium), Essen, Frankfurt, Mannheim and Karlsruhe (Germany), Zurich (Switzerland) and Milan and Genoa (Italy), thus covering the entire space belonging to Corridor 24. The authors participated in the workshop in Rotterdam, Netherlands. The overall results however are shared with all partners in the Code 24 project and can therefore be used for analysis in this setting.

[5] The conceptual framework presented before has been created independently from carrying out the empirical work. Questionnaires and in-depth interviews were therefore not specifically aimed at testing the framework in an empirical context.

[6] These findings have resulted from the Regional Workshop in Rotterdam, complemented with follow-up in-depth interviews with logistics experts from the Port of Rotterdam Authority. Nine experts participated in the Regional Workshop, including representatives of the Dutch Ministry of Transport, the Port of Rotterdam Authority, public and private institutions in the management of Dutch railway systems and universities.

5. Governing inland ports: A multi-dimensional approach to addressing inland port-city challenges in European transport corridors

Witte, P., Wiegmans, B., Oort, F. van & T. Spit (2014), Governing inland ports: A multi-dimensional approach to addressing inland port-city challenges in European transport corridors. Journal of Transport Geography, accepted for publication.

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Abstract

Inland ports have been put forward as crucial linkages for efficient global freight transport and corridor development. However, the present understanding of inland ports appears to be limited to network-based views with a maritime port focus (Outside-In), in which inland ports play second fiddle. We argue that inland ports as independent structures (Inside-Out) deserve equal consideration and that in addition to the transport dimension, the spatial, economic and institutional dimensions of inland ports are vital and should not be neglected. The goal of this chapter is to apply the concept of port-city challenges to inland ports. The results of an institutional analysis of Dutch case study evidence show that challenges facing inland ports and cities take many forms but that all share a commonality in the trade-offs between positive and negative externalities. We observe different governance strategies in coping with these trade-offs and find that a pro-active stance towards zoning contributes to efficiently accommodating mutually exclusive dimensions of inland port development.

Keywords

Inland port, port-city challenge, inside-out, port system development, transnational corridor, institutional analysis

5.1 Introduction

In recent years, inland ports have received a steadily increasing stream of attention, likely as a result of the increasing focus on multimodality and transnational corridor development (Van Klink & Van den Berg, 1998; Rodrigue, 2004; Notteboom & Rodrigue, 2005). Advances in the conceptualisation of inland ports have included the consideration of inland ports as a next step in the evolution of port systems (Hesse & Rodrigue, 2004; Notteboom & Rodrigue, 2005; Monios & Wilmsmeier, 2012), the

active role of inland terminals in supply chains (Rodrigue & Notteboom, 2009a) and the positioning of inland ports within hinterlands and corridors (De Vries & Priemus, 2003; Romein *et al.*, 2003; Pain, 2011; Wilmsmeier *et al.*, 2011). Inland ports are thus put forward as crucial linkages for efficient global freight transport and corridor development.

However, the present understanding of inland ports is limited to network-based views with a maritime port focus, in which inland ports play second fiddle. This is called the Outside-In approach, implying that development is driven by the seaport. In contrast, we argue that inland ports as independent structures deserve equal consideration. This perspective is called the Inside-Out approach, in which the directional development is driven by the inland port itself (Wilmsmeier *et al.*, 2011). We argue that the limited reflection on the roles, conceptualisations and strategies of inland ports (Van Klink & Van den Berg, 1998; Rodrigue *et al.*, 2010; Pain, 2011; Monios & Wilmsmeier, 2012) is making the process of corridor development vulnerable. That is, inland ports might be the 'weakest link' in a corridor,[1] hampering its general efficiency and possibly the balance between positive and negative externalities of corridor development, because the weakest link determines the value of the entire chain.

Of special interest in this chapter, therefore, are the challenges that exist between inland ports and their urban surroundings at the local and regional levels. These 'port-city challenges'—paying closer attention to spatial, economic and institutional effects of expanding both cities and ports (in addition to the attention to the transport dimension)—have been elaborated upon in the context of maritime ports (Wiegmans & Louw, 2011; Daamen & Vries, 2013). The goal of this chapter is to apply the concept of port-city challenges to inland ports. Thus, the Outside-In-driven port-city challenges concept is combined with the Inside-Out directional development of inland ports. The questions addressed are the following: *"What inland port-city challenges can be identified and in what ways are these challenges shaping inland ports' governance strategies in European transport corridors?"*

This chapter is organised as follows. The next section presents the conceptual framework, in which port system development, port-city challenges and inland ports are explained. The third section provides details on the methodology used and introduces the case study areas. The fourth section presents an inventory of challenges emerging in the management of inland ports. The final section concludes by highlighting how inland port-city challenges are shaping governance strategies.

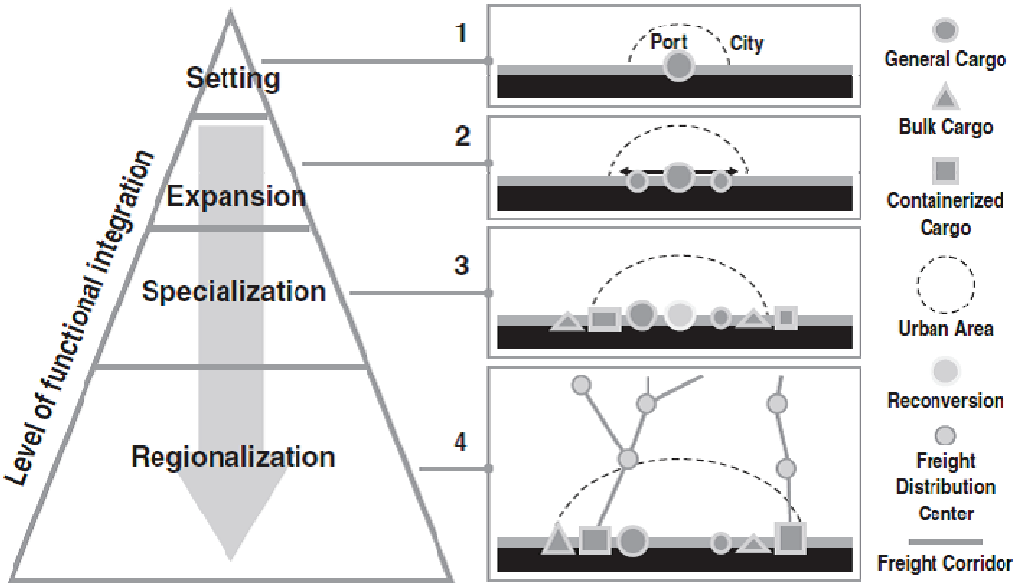
5.2 Port system development and inland port-city challenges

5.2.1 A history of port system development

In many transportation studies, the classical models of Taaffe *et al.* (1963) and Bird (1971), or extensions of these models (e.g., Hayuth, 1981; Barke, 1986) are used to explain the current state of affairs regarding the expansion and development of port systems. In recent years, the model proposed by Notteboom & Rodrigue (2005) on port regionalisation has been the most prevalent in this respect. In this section, we propose an additional phase to be added to that model.

The regionalisation phase follows the classical stages of setting, expansion and specialisation of seaports in the Bird model (Figure 5.1). This additional phase is explained by the notion that seaports (as 'traditional' locations) are under pressure because of continuing growth, leading to increasing densities, land restrictions and congested traffic (e.g., Notteboom, 1997). The increasing size of distribution facilities at seaports raises many conflicts in terms of land-use planning, infrastructure provision and the environment (Hesse, 2004). Such facilities—however desirable they may be–can no longer be located within seaports and certainly not within core urban regions in the vicinity of these seaports. Consequently, there is a need for inexpensive land to accommodate the growing locational needs of these distribution facilities.

Figure 5.1: Port regionalisation and inland accessibility



Source: Notteboom & Rodrigue (2005)

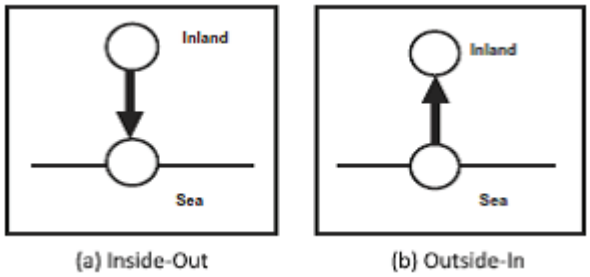
Typical of the regionalisation phase is the consideration of the inland dimension as a driving factor in port development dynamics. A reorientation of freight distribution from the seaports to favourable locations in the hinterland (i.e., inland ports) is often suggested to relieve congestion at seaports. Inland ports are thus claimed to be gaining increasing importance as distribution facilities (e.g., Hesse, 2004, Hesse & Rodrigue, 2004). As a result, corridors and inland ports might develop into cornerstones of inland accessibility because corridors provide a cluster advantage for bundling cargo volumes and because inland ports can function as satellite terminals to relieve congestion at seaports.

Recently, Wilmsmeier *et al.* (2011) have argued that the land-side of seaports is becoming more important as a port selection factor, as hinterlands have become more complex and overlapping. As a result, inland ports have an important role as active nodes in shaping the transportation chain within largely static corridors.[2] This process is called 'directional development' (Figure 5.2) and consists of two types of inland port development strategies: Inside-Out (development is driven by the inland port itself) and Outside-In (development is driven by the seaport—which is the most

common approach at the moment). The 'directional development' approach offers potential as a (regionalised) conceptualisation of inland ports, beyond the traditional satellite and empty depot functions (Rodrigue *et al.*, 2010). This chapter is mainly interested in the Inside-Out development of inland ports because this approach can shed more light on the exact nature of challenges emerging in the context of inland ports.

This idea is further developed by Monios & Wilmsmeier (2012), who highlight the different levels of integration and cooperation within port development and call for more nuance regarding the influence of spatial and institutional aspects of port development. Attention is drawn to a gap in the literature between traditional port development theories such as the port regionalisation concept, and the spatio-temporal development directions of inland ports in the hinterland. There is insufficient insight in the drivers of development (i.e., the actors in the inland ports) and the direction of development (i.e., Inside-Out), which addresses a need for a more integrated approach across local, regional and national boundaries to proactively influence inland port development.

Figure 5.2: Directional development of inland ports

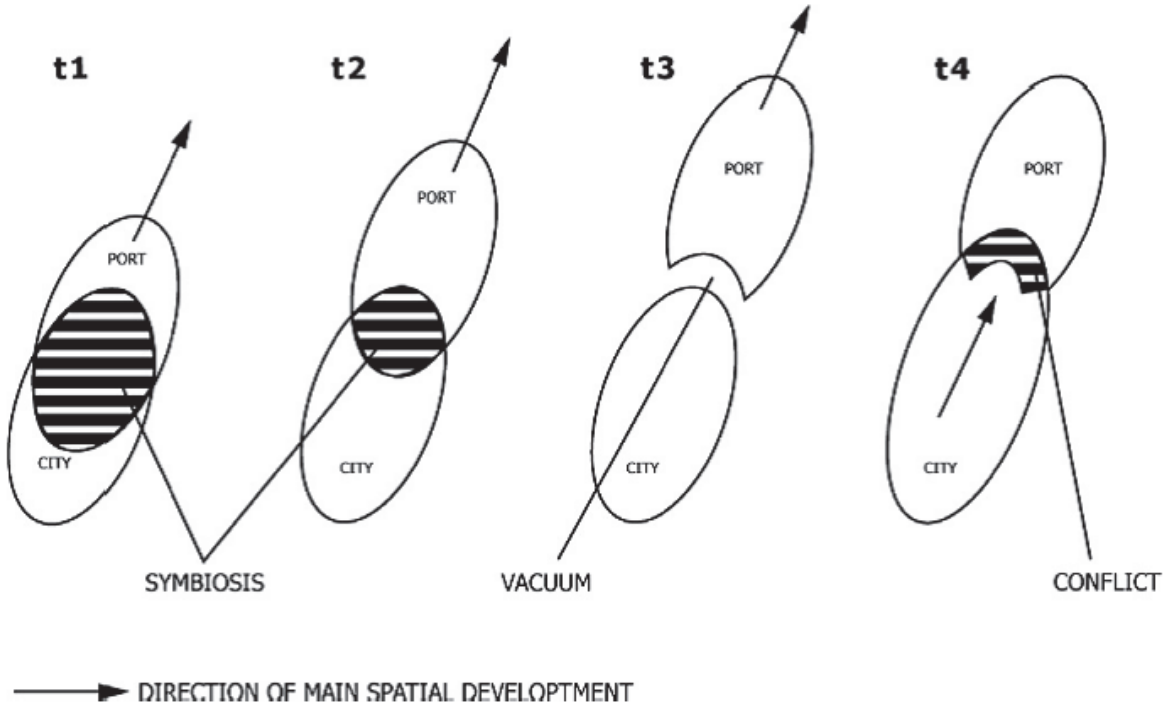


Source: Wilmsmeier et al. (2011)

5.2.2 Port-city challenges and the regionalisation of seaports

In addition to the inland dimension of seaports, other authors highlight the port-city challenges arising in seaports themselves (Figure 5.3). The starting point of Wiegmans & Louw (2011) is the necessary expansion of seaports to accommodate increasing cargo volumes. This accommodation is, however, becoming more difficult, as different spatial, environmental and port systems tend to intertwine because of the simultaneous expansion of both cities and ports. As a consequence, challenges arise from new types of land use, such as waterfront development, which are increasingly encroaching on seaport areas. Wiegmans & Louw (2011) suggest a new phase to be added to the Bird model, in which there is more attention paid to the intertwining of land-use, ecological, environmental and transportation interests within the port-urban interface.

Figure 5.3: Port-city challenges



Source: Wiegmans & Louw (2011)

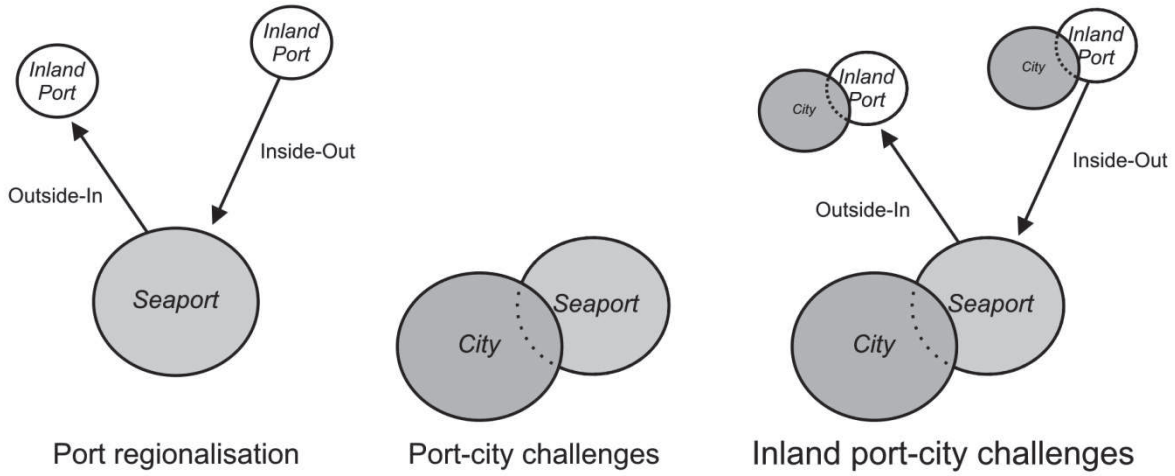
Daamen & Vries (2013) further develop this idea of port-city challenges, especially in the case of port development versus waterfront development. In this case, attention is focused on the institutions and governance processes behind spatial projects in port cities. In the researchers' view, the port-city interface is well known to be where conflicts between port and urban forces are played out and take physical shape. Laws and regulations, which dominate the spatial outcomes of conflicts in governance processes between cities and ports, are preventing integration of port and urban functions (Daamen & Vries, 2013). In light of recent sustainability agendas in particular, governance processes in port areas thus need to find a balance between the diverging interests of economic, transport, spatial and environmental values. We argue that this balance is not merely reflected in formal laws and regulations, but can be extended to more informal institutional structures as well. For instance, stakeholder research in the European transport network has revealed that fragmentation of both formal (e.g. incompatible noise regulations) and informal institutional structures (e.g. reluctance of stakeholders to cooperate), are among the most important bottlenecks hampering further policy integration and the overall efficiency of the network (Witte *et al.*, 2012; 2013).

These outcomes will form the backbone of the methodology and empirical analysis presented in this chapter. Accordingly, we will use an institutional analysis (following the 'institutionalist turn' in port literature, as is prevalent in the works of, e.g., Jacobs, 2007, Jacobs & Hall, 2007 and Daamen & Vries, 2013) to gain insight into the ways in which different policy documents (thus looking beyond formal laws and regulations and also focussing on informal institutional structures) seek to

influence the spatial outcomes (i.e., the balance between transport, economic, spatial and institutional effects) of governance processes between cities and inland ports. This institutional perspective will be explained in greater detail in the next section.

In summary, the port system development literature indicates that two major consequences arise from the growth in cargo volumes and the expansion of distribution facilities both at seaports and in the hinterland. First, corridors and inland ports are gaining increasing attention as potential cornerstones of inland accessibility, with the potential to accommodate increasing freight flows and relieve congestion at seaports. This is part of the port regionalisation concept. Second, seaports themselves are increasingly facing port-city challenges, as diverging land-use claims at the port-urban interface tend to overlap. To date, however, hardly any attention has been paid to the possibility that port-city challenges may also arise between *inland* ports and cities within transnational corridors (Figure 5.4, Table 5.1). We seek to contribute to filling this gap by means of this chapter.

Figure 5.4: Port regionalisation, port-city challenges and inland port-city challenges



Source: Adapted from Wilmsmeier et al. (2011) & Wiegmans & Louw (2011)

Table 5.1: Academic attention to regionalisation and port-city challenges

	Seaport focus (Outside-In)	**Inland port focus (Inside-Out)**
Regionalisation	Notteboom & Rodrigue (2005)	Wilmsmeier *et al.* (2011) Monios & Wilmsmeier (2012)
Port-city challenges	Wiegmans & Louw (2011) Daamen & Vries (2013)	*Inland port-city challenges*

5.3 Confronting multi-dimensional inland port-city challenges

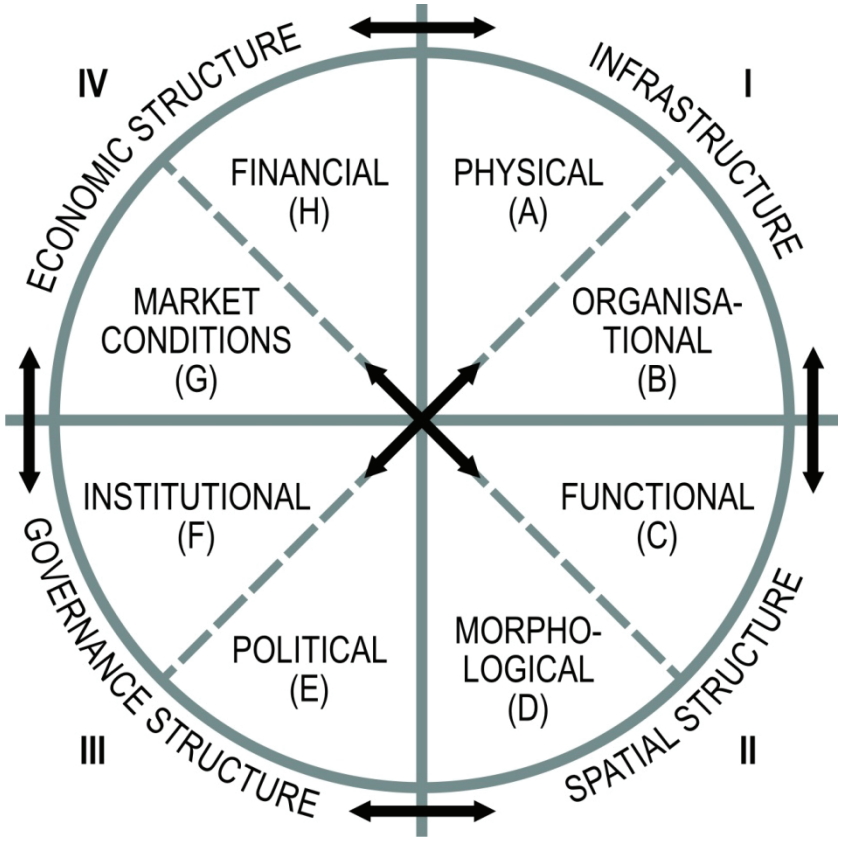
5.3.1 Analytical framework

The specific context of inland ports (Inside-Out) is vital to identifying the nature of inland port-city challenges and possible solutions, especially when considering the implications of the 'weakest link' idea for corridor development in general. Therefore, we aim to identify inland port-city challenges by means of case study research. We perform a qualitative content analysis of both sectoral and integrative policy documents of municipalities, regions and provinces in which the role and positioning of inland ports is discussed. We explore the ways in which inland port-city challenges take physical shape as revealed preferences in such policy documentation (Appendix 5). This enables us to go into detail about the exact nature of the challenges (Inside-Out) and the ways in which these challenges are shaping inland ports' governance strategies.

As mentioned previously, Daamen & Vries (2013) stress that laws and regulations dominate the spatial outcomes of governance processes between cities and ports and prevent the integration of port and urban functions. We aim to apply this notion to the case of inland ports by means of an *institutional* analysis of development strategies for inland ports. As explained before, our understanding of institutions transgresses the formal domain of laws and regulations, and also focuses on informal institutional structures such as policy documents and development strategies.[3] We thus adhere to the notion that the understanding of 'institutions'—the structures and mechanisms of cooperation between individuals or groups—should involve a consideration of informal rules and norms as well as formal rules and law. This type of institutional analysis is closely linked to the regulative pillar of institutions (including rule setting and sanctioning), as developed by Scott (2001).

To be able to analyse the policy documentation on inland ports in a structured and systematic manner, we make use of a recent contribution by Witte *et al.* (2012), who developed an integrated framework for the analysis of bottlenecks in intermodal transportation. Their analytical framework (Figure 5.5) consists of four general dimensions of bottlenecks (infrastructure, spatial structure, governance structure, and economic structure), which are then subdivided into eight specific areas of interest. The advantage of this approach is that it covers the diverging transport, economic, spatial and institutional dimensions in one coherent framework. The integrative nature of this framework helps us to better frame and understand the multiple dimensions of inland port-city challenges.

Figure 5.5: Conceptual framework for inland port-city challenges



Source: Witte et al. (2012)

To further operationalise this framework, the policy issues for inland ports, as defined by the NVB Dutch Inland Ports Association (NVB, 2004), are translated into specific indicators (both nominal and ratio variables). In this way, the added value of incorporating multiple dimensions of inland port development can be observed (Table 5.2). The infrastructure dimension describes the general characteristics of inland ports. The spatial structure reveals the extent to which land-use claims and actual plan-making with respect to inland port areas converge or diverge, and how these similarities and difference influence the surroundings. The governance structure sheds light on the question of how policy makers and politicians value the importance of inland ports in their policies and how this differs over various scales of cooperation. Lastly, the economic structure positions the inland ports according to their market and investment potential.

As the analytical framework proposed by Witte *et al.* (2012) has not been subject to large-scale quantitative empirical validation and as the issues of NVB (2004) might have changed over time, we do not rely on a *deductive analysis* only (Appendix 6). This implies that we do not use this analytical framework as an established set of rules, but rather as a guideline to structure further empirical testing from a top-down perspective. The deductive analysis is based on a combination of the framework of Witte *et al.* (2012), case study material derived from NVB (2004) and additional data obtained from policy documents (Appendix 5) and CBS Statistics Netherlands databases. In addition, we also perform a complimentary *inductive*

analysis of the presence of inland ports' issues in policy documents. This means that we check these documents from a bottom-up perspective for the occurrence of statements related to inland ports, thus regardless of an analytical framework to structure the analysis. Furthermore, this is the only type of analysis that can shed light on the exact ways in which inland port-city challenges take physical shape as revealed preferences in policy documentation (Inside-Out). The inductive analysis is based on policy documents and development strategies (Appendix 5).

Table 5.2: Indicators of multi-dimensional inland port-city challenges

Dimension	Area of interest	Indicator
Infra-structure	Physical	Accessibility (vessel class/depth)
		Capacity (tonnage, TEU)
	Organisational	Level of service (availability public quay, overdue maintenance, presence of safety procedures)
Spatial	Functional	Land-use claims (industry/logistics/residential/leisure/nature)
		Plan-making (industry/logistics/residential/leisure/nature)
	Morphological	Space for development (financial/physical/institutional)
		Negative externalities (noise/air/visual)
Governance	Political	Policy attention (yes/no)
		Sense of urgency (yes/no)
	Institutional	Coordination structure (horizontal/vertical)
		Network cooperation (local/regional/inter-regional/national/EU)
Economic	Market	Market potential (firm establishments/employment level)
		Range (local/regional/inter-regional/national/EU)
	Financial	Investment ambitions (yes/no)
		Investment schemes (yes/no)

Source: Adapted from NVB (2004) and Witte et al. (2012)

5.3.2 Selection and characterisation of the case study areas

Rodrigue *et al.* (2010) present some guidelines to help in distinguishing the scope of inland ports. There should be a link with the handling of containers (i.e., Notteboom & Rodrigue, 2009b), a link with a seaport by means of a corridor (i.e., De Vries & Priemus, 2003; Notteboom & Rodrigue, 2005) and some critical mass to achieve economies of scale (compare Wiegmans *et al.*, 2009).

Because of their high degree of compliance with this definition and because of the practical advantage of data availability, we chose to limit our analysis to inland ports in the Netherlands. The advantages of focusing on the Dutch context are the vicinity of the Port of Rotterdam as a large seaport, the sophisticated inland navigation network, the positioning of many Dutch regions within transnational corridors,[4] sufficient critical mass (as the Dutch economy is relatively open and dependent upon trade), the recent development of several container terminals and the legal and formal possibilities for various governing bodies (i.e., municipalities, regions and provinces) playing an active role in defining the policy context of inland ports. With respect to the

generalisation of our results, as inland ports within the same transnational corridors are likely to share some commonality in their respective issues (for example: inland ports operating on the same waterway are intrinsically linked to the same geographical area, thus share a mutual interest in this area's issues), it is also probable that we can draw some general conclusions that are relevant to European corridor development, beyond the specific case study context of the Netherlands. For instance, inland ports in the Dutch-German border region might find a commonality in dealing with trans-border water management issues along the river Rhine.

We have made some adaptations to the theoretical definition to make the inland ports concept of practical use for this chapter. First, instead of solely focusing on the handling of containers, we include cases that cover the variety of inland port types, as defined by NVB (2004). Second, all cases that are included have a link to the seaport of Rotterdam by means of a corridor. Third, the critical mass is measured by selecting cases that have a transhipment of over 0.5 million tons of goods per year. Furthermore, our selection was sensitive to an equal distribution over the four most important provinces of the Netherlands in terms of inland navigation, different degrees of urbanisation, variety in types of goods, different functional ranges and different degrees of containerised transport (see Table 5.3, Table 5.4 and Figure 5.6).[5] The final selection of the case study areas included Alphen aan den Rijn and Dordrecht in the province of Zuid-Holland, Nijmegen and Wageningen in the province of Gelderland, Venlo and Gennep in the province of Limburg and Moerdijk and Tilburg in the province of Noord-Brabant.

Table 5.3: Basic characteristics of the case study areas

Inland Port	**Typology**					**Transhipment (tons/year)**	**Types of goods***	**Population density (km^2)**
	Agro-business	Industrial	Container	Sand/Grit	Multi-functional			
Moerdijk	X	X	X		X	7.356.000	8	229
Dordrecht		X			X	5.140.000	9	1.469
Gennep				X	X	2.665.000	4	364
Nijmegen	X	X	X		X	2.506.000	7	3.081
Wageningen	X				X	1.344.000	5	1.215
Tilburg			X			859.000	3	1.770
Venlo			X			728.000	1	800
Alphen		X	X		X	626.000	1	1.324

* Number of goods categories based on the NTSR classification exceeding a transhipment of 100.000 tons a year per category

Source: Adapted from NVB (2004) and CBS Statistics Netherlands data

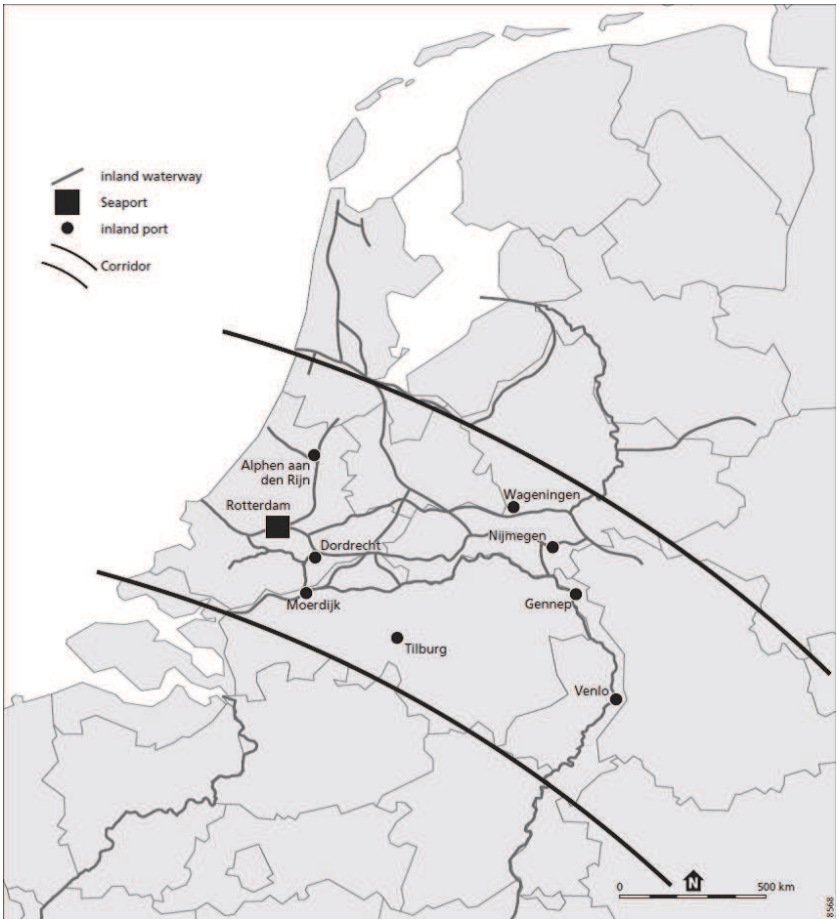
Table 5.4: Functional distribution of the case study areas

	Regional range	National range	European range
No container facility	Gennep Wageningen	X	Dordrecht
New container facility	*Tilburg**	Alphen aan den Rijn *Nijmegen**	X
Existing container facility	Tilburg	Nijmegen	Moerdijk Venlo

* Development of a new container facility next to an existing container facility

Source: Adapted from NVB (2004) and data from the Dutch Centre for Expertise and Innovation in Inland Navigation

Figure 5.6: Spatial distribution of the case study areas



5.4 Inland port-city challenges in the Netherlands

For each case study area, a brief description of the context is given before moving on to discussing the results of the deductive and inductive analyses. Lastly, some conclusions are drawn on basis of the overall findings across the case studies.

Alphen aan den Rijn

In Alphen aan den Rijn, a new container terminal has been developed on the urban fringe, and the original inland port near the city centre will be redeveloped into a residential and leisure area. The multifunctional container terminal is important for goods distribution in Zuid-Holland and is leading to conflicts with residents, who complain about the increasing noise pollution in their surroundings.

The deductive results indicate that the inland port of Alphen is still in an early phase of development in terms of its accessibility, capacity and level of service. The port is developing into a large-scale facility on the infrastructural level, as highlighted by high ambitions on the governance and economic levels. There is political attention and a sense of urgency; there are investment ambitions and schemes; and the inland port has a functional range up to the national level. Potential challenges arise when comparing the present land-use claims and the envisioned plan-making. Space should be made available for nature development, and the noise nuisance is not addressed by plan-making on the residential level.

The inductive analysis confirms this discrepancy: a strong infrastructural focus on accessibility and modal shift is combined with notions on the economic potential and the sustainability agenda, while specific attention to quality of life in the direct surroundings is absent, and local spatial planning problems remain underrepresented. The policy documents are rather general with respect to inland navigation, and an integrative vision or development strategy on the port level is lacking.

Dordrecht

Dordrecht has a longstanding relation with goods transportation and needs to accommodate increasing traffic flows coming from Rotterdam and going to the hinterland. This hub function poses challenges to efficiently accommodating heavy industrial activity within a densely populated urban setting.

The multifunctional inland port of Dordrecht is a good example of a highly developed port with good accessibility, capacity and level of service. Upon initial examination, no spatial conflicts can be identified from the deductive analysis because the land-use claims and plan-making are in accordance. Although negative externalities and a lack of physical space for development are a continuous threat, there is sufficient policy attention and a sense of urgency to address these problems. The port of Dordrecht has a functional range from the local to the international level, and a variety of legal structures are in place.

The picture hardly alters when the inductive results are considered. Specific regional governance structures operating in the logistics sector can be identified. There is attention to the multi-functional nature of water (i.e., distribution, leisure, nature). The municipality and province share a proactive and positive zoning policy with respect to heavy industrial areas, focusing strongly on preventing mutually exclusive land-use functions. The informal development strategy for the port in particular considers all relevant dimensions and by doing so is sensitive to a number of inland navigation issues.

Nijmegen

Nijmegen is facing numerous and often conflicting spatial claims in the vicinity of its inland port. The development of a large-scale residential and leisure area close to the Rhine river is a potential challenge to the port's activities, including those of the newly built container terminal.

The results of the deductive analysis indicate that the inland port of Nijmegen ranks well in terms of accessibility and capacity. In addition, the port is important on the national level, and its market potential is considerable. However, problems become apparent when the spatial and governance structure are taken into account. First, there is a discrepancy between the land-use claims and the plan-making; space should be created for residential development. Next, there is no (financial, physical or institutional) space available for the port itself, and a sense of urgency is lacking. Lastly, negative externalities pose a serious threat to the port's activities.

These challenges are also reflected in the results of the inductive analysis. Although there is a plethora of policy documents, the importance of the port as a goods distribution facility of national importance is not properly reflected in these documents. There is a top-down attitude in the policy documents, but on a local level, the port is hardly considered in strategic policy-making. In contrast, local integrative policy is focused on developing residential and leisure functions in the vicinity of the port.

Wageningen

Wageningen's inland port has a strategic location in the inland navigation network, but the pre- and end-haulage in the region is leading to traffic conflicts on the local level. The results of the deductive analysis indicate that the inland port of Wageningen is mainly focused on agro-business, and its functional range is limited to the local and regional levels. This is also reflected in relatively modest transhipment figures. However, plan-making is not in line with land-use claims, and although there is physical space for development, this development is not supported by financial and institutional back-up, such as a political sense of urgency or investment schemes. Negative externalities are especially discernible through the conflicts between freight traffic and residential- and leisure-based traffic on local roads.

The results of the inductive analysis are consistent with those of the deductive analysis. Although the strategic location of Wageningen in the inland navigation network is acknowledged, little attention is paid to the future development of the port. There seems to be no institutional space for physical expansion of the port activities. The visual appearance of the port area is in conflict with the 'green' ambitions of the municipality. Despite the evident relation between transport, economy and environment, the regional and provincial integrative visions do not facilitate the positioning of the port in the wider inland navigation network and transnational corridors.

Venlo

The inland port of Venlo is well-known as an example of 'best practices' with respect to its extended gate function for Rotterdam (Rodrigue & Notteboom, 2009a, Rodrigue *et al.*, 2010, Monios & Wilmsmeier, 2012). The challenge for Venlo lies in a structural shortage of space for expansion of port activities (e.g., the development of a new barge container terminal) and difficulties in translating this need into efficient policy.

The deductive results show that the importance of the port of Venlo is crystallised in its national to transnational level of functional range and cooperation. There has been substantial investment and development over the years, in the rail and barge terminals, for instance. This 'asset' is not hampered by conflicts in terms of land-use or widespread negative externalities. While there is sufficient political attention, a sense of urgency and institutional space to develop the port activities, the physical space for expansion and investment schemes are points of concern. These limitations are claimed to be the results of 'sticky' formal public policy procedures (NVB, 2004).

The inductive analysis does not indicate any large-scale challenge for the port of Venlo. The municipal integrative vision mentions that the port of Venlo's development process has been relatively tranquil and that a transparent and stepwise development of the port's area has prevented any large conflicts. The physical and organisational structure of the port as a multimodal freight transport node is well established in the policy documents. The economic and multimodal potential resulting from this structure is shared on all governmental levels. There is attention to changing institutional and market conditions resulting from infrastructure development, and the diverging interests of employment, accessibility and environmental impact are integrated in one strategic approach.

Gennep

The case of Gennep is a remarkable one: the small-sized and mono-functional nature of the port contrasts with its considerable importance for the (inter)-regional economy in terms of capacity and transhipment. The capacity of the port is in the top 20 for ports in the Netherlands, but the policy attention and sense of urgency are low. In addition, as the deductive results show, despite its transhipment capacity, no spatial conflicts come to the fore, and negative externalities are not reported. This is partly rooted in the accepted functionality of the port as a regional distribution centre for sand and grit. On the other hand, the nearby port of Cuijck is attracting more attention due to its newly established container facility.

This tranquillity is confirmed by the results of the inductive analysis. The integrative and sectoral municipal visions and the regional vision pay no attention at all to the port of Gennep. The provincial integrative vision hardly performs any better; the regional distribution function of Gennep is described in literally one sentence. The provincial sectoral vision states that the municipality of Gennep has tried to achieve some form of inter-regional cooperation to facilitate the port, but this has failed. In general, no conflicts can be discerned, and the status quo is preventing the possible shortage of physical space for expansion from turning into a future challenge.

Moerdijk

Moerdijk's port has grown considerably over the years and is now the largest inland port in the Netherlands in terms of transhipment capacity. A development strategy for the port of Moerdijk is currently being designed. An initial statement of the Committee of Recommendation is that the adjacent town of Moerdijk should be sacrificed to make future growth of the port activities possible. This recommendation is facing heavy local resistance.

The results of the deductive analysis indicate that Moerdijk is an important inland port, given its large capacity, its network cooperation on different scales and its transnational functional range. The spatial structure, however, reveals that future growth of the port will not be uncontested, for all possible functions are considered but not all functions have a land-use claim yet. At the same time, there is both (physical, financial and institutional) space for development and the political ambition and sense of urgency to do so. With investment ambitions and investment schemes in place, the future of Moerdijk is aimed at further development of the port.

The results of the inductive analysis reveal that the port is well embedded in the municipality's integrative vision; the port and town of Moerdijk are intrinsically linked to one another. Surprisingly, the port and town are dealt with more or less separately in the policy documents. For example, improving the potential of water for both port-related businesses and leisure use is encouraged without considering the conflicts that may arise when confronting these possibly conflicting demands. Another example is the residential (waterfront) development, which is planned only 300 metres from the port area. The buffer area between the two consists of a forest, which should also be redeveloped for leisure and tourism use. At the same time, expansion and intensification of the port area is advocated. The upcoming port development strategy is supposed to cover the challenges arising from these conflicting types of land use.

Tilburg

In Tilburg, an additional barge container terminal has been developed to accommodate increasing freight flows. The results of the deductive analysis are somewhat similar to those for Alphen aan den Rijn; Tilburg is an inland port that is still progressing in terms of its capacity, accessibility and level of service. The focus of the port is on the local and regional levels, and the spatial structure appears uncontested. There is an investment scheme on the provincial level which is, surprisingly, not explicitly linked to significant policy attention or a sense of urgency on the municipal level. The location of the new container terminal on an industrial site is preventing excessive local negative externalities.

The municipality intends to have a 'strong focus' on accommodating the increasing flows on the inland navigation network and claims to have a unique selling point in their strong industrial and logistics sectors, but this is not adequately translated into policy documentation. However, some physical measures to better accommodate inland shipping are planned and others have been carried out. Points of concern are the location of industrial areas on the urban fringe and the ambition of the municipality to ensure rural accessibility for leisure purposes. On a provincial level, modal shift and logistics integration are advocated, and an investment scheme is planned to achieve these ambitions.

Conclusions

The conclusions to be drawn from both the deductive analysis results (Appendix 6) and the inductive analysis results (Table 5.5) take shape in two ways: across the dimensions and across the cases. This section provides insights into the multi-dimensional nature of the challenges and the ways in which these challenges are shaping inland ports' governance strategies.

*Table 5.5: Inductive assessment of multi-dimensional inland port-city challenges**

	Alphen	Dordrecht	Nijmegen	Wageningen	Venlo	Gennep	Moerdijk	Tilburg
Infrastructure – Physical	+	+	-	-	+	+	+	+
Infrastructure – Organisational	+	+	-	X	+	X	X	+
Spatial – Functional	-	+	+	+	+	X	-	-
Spatial – Morphological	-	+	+	+	+	X	+	-
Governance – Political	+	X	X	+	X	X	X	X
Governance - Institutional	-	+	X	-	+	X	X	+
Economic – Market	+	+	-	-	+	+	+	-
Economic – Financial	X	+	X	-	+	X	-	+

* X = not present, - = present, negative attention, + = present, positive attention

First, we have observed the added value of our analytical framework in identifying the multi-dimensional nature of inland port-city challenges and the ways in which these challenges are related to one another. The results of the deductive analyses indicate that challenges arise mainly in terms of conflicting land uses. For example, a common thread running through the case studies is the conflicting functions of water (e.g., the expansion of port activities versus residential and leisure purposes). In addition, the relation between infrastructure and spatial structure is often problematic. The results of the inductive analyses indicate that better consideration of the governance dimension (which is most often absent in the case studies considered) might help to ease the conflicts between transport and land use. Consequently, it can be concluded that the challenges that have been identified have specific forms but in general share the same principle: conflicts between land use and plan-making that result in imbalances with respect to the positive and negative externalities of inland ports. This situation bears similarities to the conclusions of Wiegmans & Louw (2011) and Daamen & Vries (2013) in the context of seaport areas.

Second, the inductive analysis results reveal several ways in which the challenges facing these inland port-cities are shaping inland ports' governance strategies (Table 5.5). First, some inland ports have a proactive stance towards zoning, and by conducting zoning efficiently, they can accommodate mutually exclusive dimensions. These include the 'best practice' case studies of Dordrecht and Venlo. Here we observe a growing awareness of the diversity of inland ports' issues when policy documentation is more specifically aimed towards a development strategy for

an inland port. The second way in which the challenges facing inland port cities are shaping inland ports' governance strategies implies a prioritisation that does not favour further development of the port's (infrastructure) functions, as is the case in Nijmegen and Wageningen. Alphen aan den Rijn, Moerdijk and Tilburg are a third type in the sense that no explicit choice with regard to inland port development has been made, as reflected in a fragmented attitude towards the different dimensions. Lastly, Gennep has a neutral (or even largely non-existent) way of managing the future development of the inland port. Thus, we conclude that the lack of urgency and the reactive stances of some governments towards the challenges facing inland port-cities are themselves challenges to the future development of inland ports.

5.5 Capitalising on inland ports

In this chapter, we have argued that the growing importance of inland ports within port system development is leading to the emergence of multi-dimensional challenges between inland ports and cities in the hinterland. This notion results from two types of extensions to the port regionalisation model of Notteboom & Rodrigue (2005). First, whereas that model has a strong Outside-In focus, we have addressed inland ports as independent structures and thus from an Inside-Out perspective (Wilmsmeier *et al.*, 2011, Monios & Wilmsmeier, 2012). Second, the emergence of port-city challenges in seaports (Wiegmans & Louw, 2011, Daamen & Vries, 2013) might also be applicable to the context of inland ports. Thus, the combination of an Inside-Out perspective on regionalisation and attention to port-city challenges in the context of inland ports arguably adds to the literature the suggestion of a next phase in port system development, i.e., inland port-city challenges (compare Figure 5.4, Table 5.1).

The emergence of inland port-city challenges is especially relevant in light of the 'weakest link' principle in corridor development. If inland ports are the weakest links in corridors, hampering the general efficiency of corridors and the balance between positive and negative externalities, this also influences the value of the entire chain. Consequently, if inland ports are important to the general efficiency of corridor development, it follows that there should be sufficient attention paid to the challenges that may exist in the context of inland ports and the ways in which inland ports' governance strategies are sensitive to the independent role (Inside-Out) of inland ports. An institutional analysis of policy documents in eight case study areas in the Netherlands has been carried out to explore the extent to which this is the case. However, we have to be careful in generalising these findings, given the institutional fragmentation mentioned before; especially when involving cross-border transport. Although we have found that reflecting on sectoral and integrative policy documents can help to explain governance challenges for inland ports on the Dutch part of the corridor, this does not imply that the same also holds true for other parts of the corridor located in other countries. Therefore, it would be highly interesting for future research to perform a cross-national comparison of the level of policy integration in different countries along the corridor, and the effects that this will have for inland ports' governance strategies.

The conclusions to be drawn on basis of this chapter are twofold. First, with regard to the multi-dimensional nature of inland port-city challenges, it can be

concluded that the challenges all take specific forms but generally share the same principle: conflicts between land use and plan-making that result in imbalances with respect to the positive and negative externalities of inland ports. Second, with regard to the ways in which these challenges are shaping inland ports' governance strategies, it can be concluded that a lack of urgency and reactive policies are themselves a challenge that must be faced in the future development of inland ports. Our impression is that the relevant governing bodies should take a proactive stance towards zoning to clarify a port's future, even when this implies a prioritisation that does not favour further development of the port's functions. Our results show that the relation between transport and land use is an obstinate one and that the trade-off often is one between supra-regional benefits and local to regional negative externalities. It is the responsibility of governing bodies to bridge this gap between transport and land use and invest in 'sustainable' governance structures that are suitable for addressing the multi-dimensional challenges that present-day inland ports and cities face.

Acknowledgements

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Notes

[1] Following the theoretical advances on the positioning of inland ports within corridors (e.g. Notteboom & Rodrigue, 2005; Rodrigue & Notteboom, 2009a; Wilmsmeier *et al.*, 2011), we conceptualise inland ports as links within a transportation chain (i.e. corridor), thus having a functional relationship either with each other, or with the main seaport within a corridor.

[2] This implies that functional relationships between inland ports and the main seaport in a corridor are not fixed, but may change over time due to the directional development of a specific inland port. This however does not abandon the conceptualisation of a corridor as a chain of interlinked inland ports. Rather, it stresses that the chain itself remains intact, but the direction and geographical range of the links within the chain may vary.

[3] The difference between formal and informal in this case is mainly that informal institutional structures have no legally binding nature, in contrast to formal structures. We expect that in policy documents – because of the lacking of a strict, legal framework – stated preferences for inland ports' development strategies are most likely to be found.

[4] The corridor of interest in this paper is the transnational transport corridor (TEN-T Corridor 24) connecting the main seaports of Rotterdam (Netherlands) and Genoa (Italy). This corridor is widely considered as one of the most influential and historic corridors in the European transport network in terms of economic, spatial and transport development (Schönharting *et al.*, 2003).

[5] Accordingly, the final selection of case study areas reflects a distribution of the inland ports covering the southern range of the Dutch inland navigation network. This part of the network fits well within the geographical scope of the appointed corridor, Corridor 24, with an orientation of the inland ports on the port of Rotterdam as the main seaport within this corridor. The northern range of the Dutch inland navigation network – including the port of Amsterdam as main seaport – is more focused on the Hamburg-Bremen range and the Core Network Corridor connecting Amsterdam (Netherlands) to Warsaw (Poland), and is therefore excluded from this analysis.

6. Understanding the costs and revenues of land development

Buitelaar, E., Witte, P & T. Spit (2014), Understanding the costs and revenues of land development. An empirical analysis into the financial effects of location features. Journal of Property Research, submitted.

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Abstract

There is much case study research into the factors that influence the (financial) costs, revenues and results of land development. What is virtually absent in the literature is large-scale quantitative research in which costs and revenues of land development are systematically related to location features. This chapter reports on research in the Netherlands in which multivariate regression analyses have been carried out on a Dutch dataset to estimate the relative impact of these location features on the costs and revenues of land development. The research shows that much of the financial variance can be explained by basic location features. In particular, previous land use (brownfield versus greenfield) seems to play a key role in understanding the financial structure of land development.

Keywords

Land development, bid-rent curve, institutional economics, brownfield, greenfield

6.1 Introduction

Land and property development have come under pressure since the start of the global financial crisis in 2008.[1] Many land development projects have been put on hold because of a decline in property and housing demand (and through that, a decline of prices), leading to problems with regard to the financial feasibility of these projects. However, the financial feasibility of land development is not only a function of global events. Moving down to the local level, we observe that different location features shape costs and revenues in the development process. For instance, the policy shift from greenfield to brownfield development that occurred in many countries is assumed to have a negative impact on the financial feasibility of land development (Adams and Watkins, 2002). But also other location factors, such as zoning and soil conditions, might affect the costs and revenues. The question to be addressed in this chapter is: how do different basic location features affect the costs and revenues, and hence the

financial result, of land development? Although in principle every land development project is different, we aim at finding commonalities.

The *process* of land development in general has received much scholarly attention in recent decades (e.g. Healey and Barrett, 1990; Healey, 1991; Healey, 1992; Gore and Nicholson, 1991; Van der Krabben, 1995; Guy and Henneberry, 2002; Verhage, 2002; Buitelaar, 2004). Most of this knowledge is based on *institutional* analyses. These studies try to research the question (conceptually or empirically), of how the behaviour of actors such as developers is shaped and changed through local development institutions and the wider institutional context.

Studies on the (financial) *outcome* of land development are less present and in those financial analyses that do exist (e.g. Verhage, 2002; Needham *et al.*, 2003) case study research seems to be the norm (with Korthals Altes, 2010, as a notable exception). While case study research is superior in identifying causal mechanisms, it is less suitable for analysing the extent to which certain phenomena take place. In other words, it is aimed at depth, not breadth.

In this chapter we analyse a large number of land development projects (89) in the Netherlands. In particular we focus on the (financial)[2] costs and revenues of these developments in relation to a number of location features. These features are the location in relation to the urban centre, the size of the regional economy, the land-use designation (zoning), the size of the development site, whether it is greenfield or brownfield development and the soil type. These variables have been identified on the basis of the literature (Section 6.2). Where other studies have focused on one feature, such as previous land use (brownfield versus greenfield development) (Adams and Watkins, 2002) or land ownership constraints (Louw, 2008; Adams *et al.*, 2002), we focus on the relative impact of the earlier mentioned location features on the costs and revenues of land development.

On the basis of multivariate regression analyses, we have searched for associations between the costs and revenues on the one hand and location features on the other. For our analysis, we use a unique and very precise dataset of land accounts in the Netherlands. Unlike in other countries, in Dutch location development projects there is often a clear distinction between the stage in which the land is serviced and the property development stage (Verhage, 2002)[3]. Since the Second World War, the servicing of land in the Netherlands is often carried out by local authorities;[4] they buy the land, service it for development and then sell it off to parties that take care of the actual property development (Needham, 1997)[5]. Although this division is typically Dutch, the costs and revenues of land development and the location features that are associated with these are likely to apply elsewhere as well.

Based on our analysis, we find that costs and revenues are primarily driven by the location of a site within the urban area, the size of the regional economy the previous land use of the site (is it greenfield or brownfield land?) and land-use zoning. Soil conditions and the scale of development play no or hardly any role. For the balance of land accounts only the question of whether it is greenfield or brownfield land has a significant effect. Due to residual calculation of land values, land assembly costs and land revenues largely balance each other out.

In the next section we will explore the relevant literature on urban economics and land development, which will result in a number of hypotheses that are to be

tested. Section 6.3 unfolds the way the data were assembled, the structure of the dataset and the research method we used. After the elaboration on the results of the empirical study, a reflection on the costs and revenues of land development and the financial feasibility is made in the final section.

6.2 Urban economics and land development

Land prices are determined by the interaction between demand and supply. The demand for land for development is a demand for a factor of production. This is what is called 'derived demand'; the demand for land depends on the demand for the final good or service (for instance a house) that is to be produced (Evans, 2004; Oxley, 2004; Wyatt, 2013). This the basis of Ricardo's theory of land rents. He argues that the use of land and its revenue, determines the value of land, not the other way around: *"The price of corn is not high because a rent is paid, but a rent is paid because the price of corn is high"* (Ricardo, 1821: 63).

Although Ricardian land rent theory was initially developed as a positive theory to explain land values it is being applied in many countries, such as the United Kingdom and the Netherlands (Morley, 2002; Buitelaar, 2010; Wyatt, 2013), as a decision-making tool, to estimate land values by both demanders and suppliers. This method has become known as the residual land valuation method (Wyatt, 2013): the land value – the residual - is what results when the costs of development are deducted from its revenues. This implies that when the land has to be assembled for housing development, for instance, the expected house prices or rents have to be reduced by the building (and the additional) costs, the costs of servicing the land, of plan-making, of preparatory research, and so on. This is shown, in simplified form, in Table 6.1. Demanders use residual valuation to determine what they are able and willing to pay maximally, while suppliers use it to decide on their minimum asking prices.

When application of the residual valuation method becomes widespread, as it has become in many countries, Ricardo's positive theory of land rents becomes confirmed and reproduced. In other words, it then becomes a self-fulfilling prophecy. This land rent theory is therefore (together with Alonso's land rent theory) the theoretical basis for the hypotheses that are posed in this chapter.

Table 6.1: The residual valuation approach and land development

Real estate price (sales price or net future income from rents)
Minus
Building and additional costs
Equals
Balance building account
Equals
Price of serviced land
Equals
Land revenues
Minus
Land production costs * Costs of preparatory research * Costs of servicing the land * Plan-making and process costs * Costs of infrastructural works outside the site * (Other costs)
Equals
Balance land servicing account
Equals
Price of unserviced land

Table 6.1 also shows the earlier mentioned typically Dutch distinction between the land servicing process and the actual building process. The implication is that there are usually two analytical distinctions in the building chain where it makes sense to estimate the residual land value: at the stage of the building account and, earlier, at the stage of the land account.[6] On the land account, the price of unserviced land – also called 'raw' building land – is a cost, while the price of serviced land, land that is ready for property development, represents revenue. Table 6.2 shows the costs and revenues on a land account.

Table 6.2: The land servicing account

Costs	**Revenues**
Land assembly costs (price of unserviced land)[7]	Land revenue (price of serviced land)[8]
Costs of servicing the land[9]	Gap funding (e.g. subsidies)[10] *
Plan-making and process costs[11]	
Costs of infrastructural works outside the site[12]**	
Costs of research[13]**	
Balance	

* In the analysis this is left out of the equation because it is a function of the costs, revenues and the balance.

** In the analysis these are left out of the equation because its share in the total amount of costs is only marginal (2,6% and 1% respectively). In addition, in the literature there is hardly any attention for these types of costs, which makes hypothesising on their relationship with location features rather difficult.

The implication of a residual approach is that most costs and revenues are the result of decisions with regard to the location and the content of the plan. Mainstream urban economics helps to make that connection. We assume that on an aggregate level the financial patterns follow a logic that is close to the assumptions of neoclassical urban economics.

In this section we will hypothesise on the relation between location factors and the various items of the land account (the balance, the land revenues, the land assembly costs, the costs of servicing the land, and the plan-making and process costs). The location factors are categorised into contextual factors, plan-related factors and site-specific constraints. By contextual factors we mean factors that deal with the location of the site within its context, particularly in relation to the economic centre. Plan-related factors concern basic decisions with regard to the content of the land-use plan for a particular site, such as zoning and the scope of the plan area. Site-specific factors relate to features of the site before (re)development has taken place (the existence of buildings and the condition of the soil). Notwithstanding this analytical distinction, we acknowledge that in practice the boundaries between the categories are sometimes arbitrary and blurred. For instance, the location decision of a development project is part of the plan-making process, hence fusing contextual and plan-related factors.

6.2.1 Contextual factors

Where Ricardo's theory focused primarily on the fertility of land in relation to its value, Von Thünen focused on the importance of distance (Von Thünen, 1842). The greater the distance from the place of production to the market (the centre), the greater the transportation costs and the lower the land rents. This idea was advanced by Alonso (1964). Based on theoretical predecessors such as Von Thünen, he developed a theory in which the land rent that firms would be prepared to pay, given a particular profit level, is made dependent on the distance to the economic centre. This relationship is depicted by the so-called bid-rent curve, an L-shaped curve, which shows decreasing land rents with increasing distance. In addition, bid-rent curves become steeper with a decrease in distance to the centre, since there is substitution of land by capital near the centres. In other words, plots are more intensively used – this takes the shape of taller buildings and higher densities – which gives rise to higher land values. Different land uses have different curves with different coefficients (e.g. McDonald and McMillen, 2007; Evans, 2004). Yet, the bottom line of the argument here is that the distance from the economic centre has an effect on land values and therewith on land accounts.

The closer a location is to the economic centre, the higher the rents. In the case of land development projects it might be assumed that both the land revenues and the costs of land assembly per square metre[14] might be higher when the site is closer to the centre. This should be the case both when the centre of an urban area is considered and when the (economic) centre of a country is considered. For instance, land values in Manhattan are higher than in Queens, while in New York as a whole land values are higher than in Houston. Consequently and residually, there should be no effect on the financial balance of a land development project, since both land assembly costs and

the revenues are expected to increase with a decrease in distance to the centre at the same rate.

6.2.2 Plan-related factors

Zoning

Alonso's bid-rent curve suggests that land use is a function of distance to the centre. Although in practice land-use patterns do resemble neoclassical bid-rent curves – the most profitable land uses are indeed often located in city centres – empirical conformance to this theory is not self-evident and automatic. In many countries, land uses are designated by government and therefore also follow a political logic. Land-use zoning affects costs and revenues. There is now a large literature on the effect of land-use restrictions on house prices (Pollakowski and Wachter, 1990; Quigley and Raphael, 2005; Glaeser, Gyourko and Saiz, 2008).

In the Netherlands, land that is designated for housing generally has a higher price than land that is designated for an industrial estate (Pols *et al.*, 2009). In addition, based on empirical research, areas with mixed land uses can be assumed to have higher land prices than mono-functional housing areas (Koster and Rouwendal, 2010). However, when land prices are derived from residual valuation, there should be no effect on the financial balance of the development project.

Also, we expect that the land servicing costs and the plan-making (including the process) costs of housing areas and mixed-use areas are higher than those of industrial estates, because quality requirements for housing and its public space are generally higher than for business- and industrial estates. This is assumed because local policy makers and politicians are likely to be more concerned about the value of housing, because the electorate is too (Fischel, 2001).

Size of the plan area

In urban economics it is often stated that the bigger the city, the lower the costs of public services, such as infrastructure and utilities, per capita (e.g. Carruthers and Ulfarsson, 2003). This is due to 'economies of scale', which are the cost advantages that occur with an increase in scale (McDonald and McMillen, 2007). Following this economic rationale, it might also be assumed that the costs of servicing land and the plan-making and process costs per square metre decrease with an increase in the size of a plan area. In the Netherlands, this is often the argument that local authorities use for acquiring and servicing great tracts of land (Needham, 1997). On the other hand, there is a potential danger that with an increase in the size of the site the span of control becomes so great that economies of scales turn into diseconomies.

6.2.3 Site-specific factors

Greenfield or brownfield

It has often been argued that brownfield development is more costly and less profitable than greenfield development (e.g. Adams and Watkins, 2002). This is mainly because the costs of demolishing structures are higher on brownfield sites than on greenfield sites (if indeed there are any). Also, it might be assumed that the process costs (i.e.

transaction costs) are higher on brownfield sites because a greater number of stakeholders (such as land owners and tenants) are involved. In addition, brownfield sites can be assumed to have higher land values and land acquisition costs because they are generally closer to urban amenities. In addition, land assembly costs might be higher because in some cases the use value of previously developed land is higher than the residual value of the planned, new land use (Buitelaar and Segeren, 2011). As a result, it might be expected that the financial balance of a brownfield redevelopment is worse than that of the development of a greenfield site.

In addition, although it might be assumed that on brownfield sites existing facilities (such as roads, utilities and sewerage) can be used, at least partly, for the new development, the costs of remediation of soil contamination and the demolition of existing structures are likely to exceed. Otherwise, not that many policy makers would implement some form of brownfield-first policy.

Physical geographic constraints

When a site was not previously developed, it does not imply that development and building can be considered as a straightforward process. In development projects, especially in terms of the cost of development, the suitability of the soil for building is pivotal. Physical constraints to building such as water, the solidness of the soil and the ruggedness are to be considered (e.g. Saiz, 2010). Recent research shows that such physical constraints can hamper housing supply significantly and therewith have an effect on house prices: the more stringent these constraints are, the higher the house prices (e.g. Saiz, 2010; Glaeser, Gyourko and Saiz, 2008). However, in general physical constraints do not necessarily make building impossible. Technically much is possible; however, not without costs. Therefore, it seems reasonable to assume that the more stringent the physical constraints are, the higher the land servicing costs become.

In the case of the Netherlands, ruggedness is not much of an issue since the country is virtually flat. On the other hand, a large part of the country lies below sea level and has a clay or peat soil. These are conditions that require greater investments into land servicing, such as drainage works and the elevation of land, than is the case with a sandy soil (Wigmans, 2002). Overall, the variance in soil conditions in other, bigger countries is arguably greater than in the Netherlands.

Table 6.3 gives an overview of the hypotheses that have been derived from the literature exploration above, in relation to the operationalisation of variables as is explained in the next section.

Table 6.3: Hypotheses[15]

Contextual factors
The land assembly costs and the land revenues increase with a decrease in distance to the economic centre of a country and a city
Plan-related factors
Zoning
Mixed-use sites have higher land assembly costs and revenues than housing sites, which have higher costs and revenues than industrial estates
Mixed-use sites and housing sites have higher land servicing costs and plan-making and process costs than industrial estates
Size of the plan area
The land servicing costs and the plan-making and process costs decrease with an increase in the size of the plan area
Site-specific factors
Greenfield or brownfield
Brownfield sites have higher land assembly costs and land revenues than greenfield sites
Brownfield sites have a worse financial balance than greenfield sites
Brownfield sites have higher plan-making and process costs than greenfield sites
Brownfield sites have higher land servicing costs than greenfield sites
Physical geographic constraints
Peat-soil sites and clay-soil sites have higher land servicing costs than sand-soils sites

6.3 Research approach

6.3.1 Dataset

For the analysis we use a unique dataset consisting of publicly available land accounts, which have recently become available through a change in the law. With the introduction of the renewed Dutch spatial planning act[16] in 2008, cost recovery of public expenditures by local authorities has become mandatory when a land-use plan allows for building activities. In that case, the land-use plan needs to be accompanied by a development plan in which the costs and revenues of development are outlined and which prescribes precisely how much of the costs should be recovered and from whom. A land account, which includes the costs and revenues of the development, is required as part of that development plan. The land account consists of a combination of actual and estimated costs and revenues.

A development plan is not required when cost recovery has been accounted for differently, for instance through a bilateral and voluntary agreement between the local authority and the developer(s). These agreements are not publicly available, because these are agreements under private law and do not fall under the regime and obligations of the Dutch planning act. Since the assembly of land accounts associated to private agreements requires the consent of the contracting parties, we focus solely on development plans with publicly available land accounts. We have assembled all development plans that were adopted in the first two years after the introduction of the act (1 July 2008 till 1 July 2010). This led to a dataset of 89 development plans, accompanied by land accounts. According to the PBL Netherlands Environmental

Assessment Agency (2012), this is 3-4% of all land-use plans that include building activities in the Netherlands.

6.3.2 Representativeness

Experts on land development projects in the Netherlands could argue that there are at least two potential limitations using these land accounts in comparison to all other land accounts. First, one can argue that the costs and revenues of those land accounts are inaccurate because they are appraised values – at least partly – instead of real prices. However, this is valid for land accounts in general. Moreover, land accounts in our dataset have been drawn up relatively closely to the final stage of the land development project, just before the start of actual building activities. Prior to the adoption of the development plan, a number of costs have already been incurred (e.g. research costs) and will therefore not change anymore.

A second, though related, critique might be that land accounts of development plans might coexist with other 'real' or 'shadow' land accounts, which remain hidden from the public. This might be the case for land acquisition 'costs' which in the system of the planning act are estimated land values instead of real land prices, even when the land has already been bought. However, it is hard to assess whether this leads to an under-or overestimation of land assembly costs; that depends on the timing of land acquisition. The closer to the recent global financial crisis land assembly took place, the more likely it is that actual land prices are higher than the estimated residual values, and vice versa. Other than the land acquisition costs, there is no reason to assume that there are 'shadow' accounts that would differ a lot from the ones that are publicly available. The law provides checks and balances to provide as accurate figures of costs and revenues as possible.

Due to the specific nature of each development project, we expect the sample to deviate from the total population of land accounts in two ways. First, we expect that the development plans in the dataset concern relatively large areas. The larger the plan area, the more landowners it will have, the more difficult it will be to establish a development agreement on cost recovery. Looking at the average size of the development projects in the dataset, which is almost 60 hectares (Section 6.3.3), it does indeed appear that the sample consists of relatively large sites. Second, we expect all contributions to cover the costs of large infrastructure works to be relatively low, because there are strict formal limitations on the extent to which these costs can be recovered from developers. In that sense, in bilateral agreements there is more freedom as to what to recover from developers.

Unfortunately, it is not possible to test these expectations empirically on all development sites in the Netherlands, since these variables are not available for all the land accounts. However, it is possible to shed some light on the representativeness of the dataset, by comparing the geographical distribution of land-use plans combined with development plans on the one hand with all land-use plans that allow for building on the other. In order to test the geographical representativeness we distinguished between three regions in the Netherlands, which are commonly used: the Randstad, the intermediate zone and the peripheral zone (Van Oort, 2004).[17] By using the goodness-of-fit test, we estimated whether the geographic distribution of the sample differs from

the total population in a statistically significant way. This is the case.[18] There is a slight overrepresentation of locations in the Randstad, the economic core of the Netherlands where the biggest Dutch cities are, including Amsterdam, Rotterdam, Utrecht and The Hague. This might indeed indicate that there is an overrepresentation for larger sites, since major (re)developments tend to be primarily located in that part of the country.

This bias is not problematic in terms of policy and academic relevance, since these larger and more complex locations are at the heart of public policy and scholarly attention (Flyvbjerg, Bruzelius and Rothengatter, 2003; Oosterlynck *et al.*, 2011). Another unproblematic bias in the light of an international audience is the fact that the developments in the dataset are mainly private developments. In addition, there are some public-private developments and no public developments. This makes the findings more interesting for most western countries – the Netherlands is the deviant case (Needham, 1997) – where little public development occurs.

6.3.3 Operationalisation of variables

On the basis of the literature review, a number of location features have been derived that, in theory, influence the costs and revenues of land development (Section 6.2). The first feature is the distance of a site to the centre of an urban area. We decided to choose a centre area instead of one single coordinate. The reason is that in bigger cities there are areas that are close to or within the central area but not necessarily close to that one single centre point. We decided to determine centre areas on the basis of concentration of shops. In the Netherlands Locatus identifies a hierarchy of shopping areas. We selected those areas of 100 shops or more, amounting to a total of 137 (shopping) centre areas.[19] After that the distance between the development site and the urban centre has been measured by using GIS-coordinates. On average the distance is 5,28 km (standard deviation: 3,49).

Distance to the centre of a city accounts for intra-urban differences between sites. But bid-rent curves also apply at higher spatial scales. To capture interregional economic differences we compared the size of regional economies, in terms of the gross regional product per capita (at a NUTS 2 level). The average gross regional product is € 34.333 per capita (standard deviation: € 6.325).

With respect to the variable ‘zoning’, a distinction has been made between mixed-use zones, residential zones and industrial estates (including offices), based on the dominant land use on a site. This has been determined on the basis of plan documents. Mixed-use areas mainly concern integrated land development projects at central locations. The sample contains 34 residential areas (38,2%), 26 business or industrial areas (29,2%) and 29 mixed-use areas (32,6%).

To assess whether economies of scale occur with respect to costs for land servicing and costs concerned with the planning process, we take into account the size of the plan area, measured in hectares. The average size of the plan areas is 59,2 hectares (standard deviation: 92,6 hectares).

In the previous section we explicitly distinguished between two different types of site-specific constraints. First, we made a distinction between greenfield and brownfield land. In the case of greenfield sites, land changes from vacant,

undeveloped land to land with structures on it.[20] On a brownfield site, however, there is redevelopment. The attribution to greenfield or brownfield land has been done on the basis of plan documents and aerial photographs. This leads to 31 brownfield sites (34,8%) and 58 greenfield sites (65,2%).

Second, we want to look at the effect of the soil on the land servicing costs. A GIS analysis of soil maps has been created to attribute a soil type to a plan area. We have distinguished between two categories: peat and clay soil on the one hand and sand soil and urban land on the other. Peat and clay soil often coincide with low altitude – in many cases these soil types are below sea level – which may be considered to have a large impact on the costs associated with elevating and draining the land compared to sand soil and urban land. There are 24 cases of peat and clay soil in the sample (27%). The remaining 65 cases concern sand soil and urban land (73%).

In Section 6.2, we introduced our selection of costs and revenues that have been subject to further statistical analysis. These are the balance, land assembly costs, land servicing costs, plan-making and process costs and land revenues. Table 6.4 presents descriptive statistics of these items. Perhaps surprisingly, the average balance is negative. This is primarily caused by the brownfield sites in the sample. Those usually have a negative balance (Van Hoek, Koning and Mulder, 2011). In the case of the Netherlands, the deficits could occur at such a large scale because of the abundant availability of central-government subsidies until recently (Renes and Ruijs, 2009).

Table 6.4: Descriptive statistics of the dependent variables (per square metre)

Costs and revenues	*N*	*Average*	*Standard deviation*
Balance (excluding gap funding)[21]	85	-13,92	72,51
Land revenues	87	134,73	101,95
Land assembly costs	85	66,31	60,58
Land servicing costs	75	44,68	37,29
Plan-making and process costs	76	16,28	12,60

6.3.4 Method

In the next section, the relation between location features and the costs and revenues of land development projects will be discussed. To this end, we use multivariate linear regression analyses. Because the dependent variables are measured in Euros per square metre, ordinary least squares (OLS) regressions are appropriate. One condition for such analyses is that there is no 'multicollinearity'. We checked this by using the variance inflation factor (VIF). In general, values lower than 5 are acceptable. In our case, all VIFs are below 2. Therefore, based on this condition in all models all independent variables that have been derived from the literature could be included.

We estimated five regression models, with five different dependent variables (Appendix 7).[22] To correct the results for heteroscedasticy, the models have been estimated with robust (White) standard errors. This means the variables have been corrected for vertical outliers. In addition, two control variables have been included. The first concerns a dummy variable to control for the fact that some land accounts use nominal values for costs and revenues while others use net-present values. The second

concerns year dummies to control for differences in the time value of money which results from the fact that the development plans and land accounts have been adopted in different years (2009 and 2010).

6.4 Results

The results of the regression analyses are presented in Appendix 7. They are discussed in the same order that we used in the introduction of the hypotheses in Section 6.2.

Contextual factors

In Section 6.2 we stated that the closer a location is to the economic centre of a country and an urban area, the higher the rents. We hypothesised that higher rents in the economic centre, following the residual approach, would lead to higher land revenues and higher land assembly costs. The hypotheses are confirmed by the results. Land revenues and assembly costs increase with a decrease in distance to the urban centre and with an increase in the size of the regional economy (the gross regional product per capita). As expected these 'contextual' factors have no influence on the land account's balance.

Zoning

We suggested that land-use zoning affects costs and revenues in general. We indeed observe that land revenues and land assembly costs of industrial estates are significantly lower than those of mixed-use zones and residential areas. Second, we expected that land servicing costs and plan-making and process costs of residential and mixed-use zones would be higher than those of industrial estates because of higher quality requirements with regard to residential and mixed-use areas. Also these hypotheses are confirmed by the findings from the regression analyses.

Size of the plan area

Based on mainstream economic thinking, we expected 'economies of scale' to occur with regard to land servicing costs and plan-making and process costs. The results do not show any statistically significant relationship between the size of a plan area and the land servicing and process costs (per square metre). Arguably, at a certain point – a certain size - development projects get a span of control that is too big, which leads to diseconomies of scale.

Greenfield or brownfield

The assumption that developing brownfield sites is more costly and less profitable than developing greenfield sites has been stated often. And indeed, this is confirmed by our data. First, the costs of plan-making and the process costs are higher, probably because of the involvement of a greater number of stakeholders on brownfield sites than on greenfield sites. Second, brownfield sites have, as expected, higher land revenues and land assembly costs and a worse financial balance, as compared to greenfield sites. As argued before, the difference might be due to the relatively high use value – compared to the residual value of the new land use – of land on brownfield sites. In addition, brownfield sites are usually closer to the urban centre than greenfield sites; following

the logic of the bid-rent curve, this proximity is likely to lead to higher land values. Our third hypothesis has also been confirmed. As expected land servicing costs are higher on brownfield sites than on greenfield sites. The potential benefits of making use of existing facilities (e.g. roads and sewerage systems) are outweighed by the relatively high soil remediation and demolition costs on brownfield sites.

Physical geographical constraints

Another site-specific factor that has been taken into account is the suitability of the site for building. Because, in theory, these constraints might limit housing supply, house prices might be positively affected by them. Our results, however, show no significant relationship between soil type and land servicing costs. This might have to do with the fact that, compared to other countries, the variance in soil conditions in the Netherlands is not too great.

6.5 Reflections on land development

In this chapter we used a unique dataset to make a quantitative analysis of how location features are related to the financial side of land development projects. Many of the relationships turned out to be as we expected. For instance, the financial differences between brownfield and greenfield sites are in line with what is written about the financial feasibility and the progress of the redevelopment of brownfield sites (Adams and Watkins, 2002).

The most striking deviation from the expected pattern is the fact that there are no economies of scale. Larger sites do not economise on costs, probably because potential scale advantages are eliminated – due to the greater number of landowners and other stakeholders involved in many large-scale projects – by the large span of control of larger sites. This is interesting in a public policy context, since governments and developers use the 'scale argument' for the advocacy of these large-scale projects or 'megaprojects'. However, this needs to be seen in the light of a sample of land development projects that is biased towards the larger and more complex projects. The possible effect of a larger span of control on scale advantages also calls for a reflection on the way public agencies make their land-policy decisions, particularly with regard to the scope of development.

Another important observation is that the distance to the (urban and national) centre and land-use zoning does affect land assembly costs and land revenues, but has no effect on the financial balance. What can we learn from this? The research results demonstrate the use of residual valuation as a land appraisal method. It is a method that maximises land values. However, this has an effect not only on revenues, but also on the (land assembly) costs. Hence, there is no or hardly any effect from location factors on the financial result of land development (Appendix 7). Although a widely accepted method to determine land values, the value–maximising mechanism of the residual value method has its drawbacks. The result of residual valuation is that early in the development process, initial land owners capitalise on value increases that are expected to be realised at the end of the process. This is not problematic in cases of market growth, which occurred in many countries early in the first decade of this century. In that situation, actual land revenues often outweigh the initially estimated

revenues. The difference leads to a positive financial result that can be captured by the developing party, which then has an incentive to continue and complete the development process. However, in a deteriorating market we see the reverse. Because of a residual calculation, and maximisation of the land values, expected land revenues often turn out to be higher than actual revenues at the end of the process. This leads to financial deficits, and therefore to delay, postponement and the abandonment of development projects.

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Notes

[1] In the autumn of 2008 the global financial crisis took off with the fall of Lehman Brothers.
[2] Probably needless to say, but a financial analysis is distinct from an economic analysis, such as a cost-benefit analysis (CBA).
[3] Morley (2002) shows that in the UK these two are often integrated.
[4] It had started already in the second half of the nineteenth century, in order to facilitate the urban extension of the overpopulated Dutch medieval cities. This development took off on a large scale after the Second World War to facilitate the reconstruction of cities and to address the great housing need.

[5] It needs to be noted that the system in which Dutch municipalities act as a land developer has come under pressure in the last decade (Buitelaar, 2010).
[6] Here we follow the translation used by Needham (2007).
[7] Land assembly costs concern the sum of appraised land values, demolition costs and the costs involved with the removal of property rights from the land within the plan area.
[8] Land yields concern the sum of appraised land values of serviced land.
[9] Land servicing consists of remediation of soil contamination and ground works such as draining, grading, elevating or excavating land. Furthermore, costs involved with providing utilities and site infrastructure are also included.
[10] Gap funding (additional funding) can come from the municipal account or from subsidies of other tiers of government (provinces, central government or the EU).
[11] These are costs associated with the municipal bureaucracy and the plan-making process.
[12] These are costs for facilities, such as infrastructure, that are necessary for the development but lie outside the plan area.
[13] Research in land development can be related to ground work, acoustics, environmental issues, archaeology, and so on.
[14] When costs and revenues are discussed we relate them to the size of the site (in square metres).
[15] Yield and costs are all per unit, in this case per square meter.
[16] The old spatial planning act of 1965 was replaced.
[17] Van Oort distinguishes these on the basis of a geographic gravity model.
[18] Chi-square: 13,155 (p: 0,001).
[19] Note that in the Netherlands, unlike many other countries, there are no out-of-town shopping areas of that size.
[20] Except for agricultural land.
[21] The external funding has been deducted because including it would conceal the 'real' financial gap and the effect location features have on that.
[22] Land assembly costs, land servicing costs, costs of infrastructure works, plan-making and process costs and land yields.

7. Concluding on corridor development

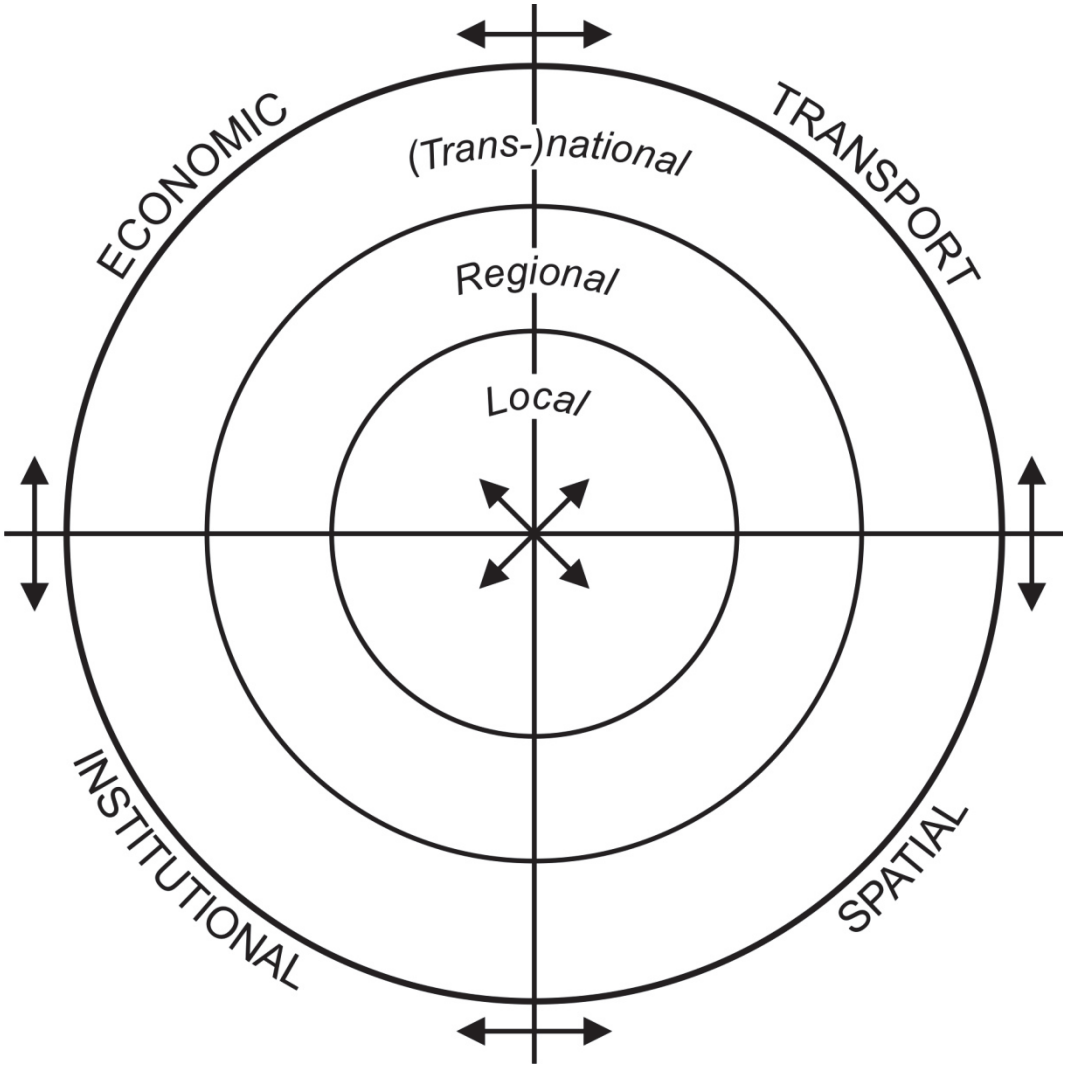
In this final chapter, the most important conclusions are presented. First, a brief reflection on the introduction, based on the conceptual framework, restates the main structure and content of this dissertation (Section 7.1). Also, the main findings of each chapter are detailed and reflected upon (Section 7.1.1–7.1.5). Next, the conclusions are positioned in the context of European policy on corridor development, with attention to the implications of this dissertation for the integration argument in such policies (Section 7.2). Finally, some remarks regarding limitations, possible biases and future research are put forward (Section 7.3).

7.1 A retrospective view on corridor development

This dissertation has centred on the observation of a discrepancy between the call in policy making and in academic debate for an integrated approach towards the development of European transport corridors, and the often isolated, local and sectoral-based practices of corridor development on the European transport network itself. It has been suggested in this dissertation that present-day corridors in Europe can be seen as integrating both multiple dimensions (i.e. transport, spatial, institutional and economic) and multiple spatial scales (i.e. local, regional and [trans-]national). Therefore, the question is put forward as to whether corridors can have a problem-solving capacity that transgresses local and sectoral levels. In other words, whether an integrated conceptualisation of corridor development has added value for European policy makers in their current and future governance practices regarding corridors and corridor development in Europe is explored.

Based on an overview of present-day issues in corridors, it is suggested that for the added value of an integrated approach towards corridor development to be a plausible hypothesis, knowledge is lacking on different problem areas. Consequently, this dissertation has aimed to fill these gaps by providing theoretical and empirical advancements on some of the issues. Five major problem areas have been put forward, which have been the focus of Chapters 2–6. These contributions have covered a variety of dimensions and scales, within certain chapters as well as between different chapters. The coherence of the contributions is visualised once more in the conceptual framework (Figure 7.1). For instance, whereas the economic dimension is most prevalent on the regional level, the spatial dimension is most often of relevance in combination with the local level.

Figure 7.1: Conceptual framework



The remainder of this chapter will discuss the main findings from each of these chapters (Section 7.1.1–7.1.5). For each chapter, the relevance of the problem area will be positioned in relation to the research question, followed by the most important conclusions from that chapter. The conclusions will be related to the theoretical perspective that was chosen for each chapter, and the conclusions will be discussed on a level of abstraction that is somewhat higher compared to the chapters themselves. This provides the foundations for discussing the answers to the main research problem of this dissertation; in other words, the extent to which the findings contribute to the integration argument can be assessed (Section 7.2). On basis of these outcomes, it can be concluded whether the added value of an integrated approach towards corridor development is provable, and whether this leads to a restating of the importance of corridors in current European policy objectives.

7.1.1 Conceptualising Corridors (Chapter 2)

Chapter 2 has set the agenda for the remaining chapters regarding the opportunities and challenges for integrated corridor development in Europe. It is argued – in line with initiatives such as ESPON (Dühr *et al.*, 2007) – that the spatial component in most corridor-related studies on a European scale remains under-researched, while integrating spatial structure with corridors provides interesting common ground for future research and practice. Whereas knowledge on corridors and challenges that corridors are facing are largely resulting from sectoral perspectives, this chapter has focused on an integrated approach to corridor development that might be more sensitive to the multi-dimensional and multi-level nature of present-day corridors in Europe, and the implications that this might have for governance strategies and (transnational) spatial planning. The following research question has been addressed:

"To what extent can capitalising on the spatial structure of corridors contribute to governance strategies for addressing present-day issues in European corridors?"

A first conclusion regarding governance strategies for corridors is that the continuing sectoral-based practices of corridor development in Europe are not surprising. Although attention to corridor development over the years has become common and accepted in the (sectoral-based) academic field of transportation (Hesse & Rodrigue, 2004) and in European policy (European Commission, 1999; 2011), the spatial (integrated) component remains largely absent. This observation is in line with the traditional sectoral-based versus integrated approach debate in spatial planning (Spit, 1998; Janssen-Jansen, 2004; Van Ark, 2005; Waterhout, 2007; Vigar, 2009): the self-evident efficiency of sectoral-based planning and decision-making is positioned against the perceived complex and time-consuming nature of an integrated approach, owing to difficulties in coordination, measurement of effects and the absence of a clear framework.

A second conclusion regarding the contribution of a spatial perspective on corridors is that a lack of knowledge regarding certain aspects of corridor development (e.g. the spatial and economic effects of expansion along infrastructure axes) is preventing widespread acceptance of the integration argument. As a result, spatial planners have been sceptical towards the added value of an integrated approach to corridor development. This is to some extent, however, a counter-intuitive outcome given the possibilities that an integrated approach offers for spatial planners (Priemus & Zonneveld, 2003). These include the impact of corridors on spatial development patterns and transnational governance challenges resulting from that, the contribution of multi-dimensional, multi-scalar planning to the solving of institutional fragmentation in corridors, and the potential of spatial planning to offer a renewed perspective on the question of externalities in the light of European corridor development.

A third conclusion is that the explorative empirical evidence provided in this chapter is favourable towards an integrated approach to corridor development. A clear link between space, economy and transport in relation to corridors has been shown and has been backed up by significant empirical outcomes, indicating the importance of

corridor regions in terms of economic potential relative to non-corridor regions. These positive outcomes might explain why many current European policy programmes are favourable towards the contribution of corridor development to achieving regional economic growth. This should, however, also be positioned in the light of the recent place-based development debate. Place-based development has evolved from the notion that in much EU policy, space-neutral 'one size fits all' policies remain the norm. In contrast, a place-based approach offers opportunities for inclusion of the often neglected role of space, by assuming that a geographical context matters in terms of social, cultural and institutional characteristics and by promoting the use of interaction between local groups and external elites as a vehicle to develop place-sensitive knowledge (Barca *et al.*, 2012).

In summary, the contribution of this chapter can be seen as an extension to the work of Priemus and Zonneveld (2003), Albrechts and Coppens (2003), Chapman *et al.* (2003), Romein *et al.* (2003) and De Vries and Priemus (2003). The conclusions of this chapter reflect that since their Special Issue on the governance of corridors was published in the *Journal of Transport Geography* in 2003, little has happened in the academic debate on the relation between spatial structure and corridor development. Thus, when recalling the research question, the spatiality of corridors has thus far only been partly addressed in corridor governance strategies. Although this chapter has provided theoretical and empirical support for the advantages of an integrated approach to corridor development, in practice European corridor development remains largely sector-based, which probably results from the lack of an empirical foundation for corridor development as a spatial phenomenon. Therefore, additional insight is desired with regard to a sophisticated analysis of the potential and challenges of corridor development at different spatial scales and within different dimensions. This back-up is provided for in Chapters 3 to 6.

7.1.2 Coping with Corridors (Chapter 3)

Chapter 3 has focused on the question of whether corridors have a special function in regional economic growth due to agglomeration advantages, and whether corridors can consequently be seen as a useful planning instrument to help connecting urban regions into large-scale development zones across Europe. The starting point was the often-heard assumption in policy documents that corridor development contributes to regional economic growth (e.g. European Commission, 1999; 2011), in contrast to the notion that the impact of corridors on regional economic development lacks substantial empirical support. This has resulted in the following research question:

"In what ways do agglomeration economies influence regional economic growth and to what extent does this differ over various types of European corridors?"

Corridors have been absent in the agglomeration debate, although corridors link larger urban agglomerations and may facilitate larger markets and knowledge spill-overs (McCann & Shefer, 2004; Frenken *et al.*, 2007; Thissen *et al.*, 2013). This chapter has contributed to this hypothesis by means of an empirical analysis of the economic potential of corridors, and the added value of the corridor concept for explanations of

regional economic growth in terms of positive externalities and spill-overs. The main problem to be addressed is whether corridors may operate as independent economic clusters (Bathelt, 2005), thus showing functional (specialisation- or diversity-based) clustering, as opposed to merely reflecting co-located agglomeration advantages of connected large urban regions (Louter, 1999).

The foremost conclusion to be drawn based on the empirical material is that there is little empirical support for a corridor effect on productivity and employment growth externalities. In other words, the results seriously question the provability of the added value of corridors for growth and agglomeration. However, general relations between agglomeration economies and regional economic growth have been found that are in line with accepted insights from NEG theorising (compare for example Van Oort, 2004; Frenken *et al.*, 2007; Capello *et al.*, 2008; Beaudry & Schiffauerova, 2009; Dogaru *et al.*, 2011; Bosma & Van Oort, 2012; Marrocu *et al.*, 2012).

At least five problems regarding the supposed contribution of corridors (i.e. independent clustering effect) to achieving regional economic growth have been found. First, corridor regions cannot be distinguished from non-corridor regions in terms of spatial-economic determinants of productivity growth without incorporating the urban dimension in the same analysis. Second, whereas diverging specialisation effects between core and peripheral regions were observed, corridors are not the driving force of this effect. Third, non-corridor regions are more conducive to employment growth than corridor regions. Fourth, employment growth is especially dependent on urban contexts, and corridors appear to hamper this relation more than they foster it. Finally, both the urban dimension and the European core-periphery dimension dominate over the corridor dimension in determining the decisive coefficients of much of the modelling.

Thus, recalling the research question, it can be concluded that the outcomes show significant spatial heterogeneity when applying varying conceptions of space to the relationship between agglomeration economies and growth differentials in Europe. Remarkably, there is little support for the special function of corridors in economic growth due to agglomeration advantages; although the magnitude and direction of agglomeration effects generally are as expected, the findings either are not systematically stronger inside corridors than outside them, or are not a result of a genuine corridor effect altogether. The limited corridor effect was already confirmed on a local to regional scale by Bruinsma *et al.* (1997), Louter *et al.* (1999) and Van Oort and Raspe (2005), but now also has empirical validity on the European regional scale. Still, the scale problem is a recurring issue in measuring agglomeration effects (Frenken *et al.*, 2007) and deserves further elaboration. Other specific measurement issues such as the cut-off points of certain spatial regimes (of corridors and the size of cities) and robustness analyses of time- and sector-varying dynamics should be considered in future research.

The findings have important implications for European policy objectives regarding corridor development and regional economic growth, because the variety that has been shown is little recognised in EU policy. Since a Europe in which regions develop at different rates has been observed, the remark of Puga (2002) that governments have no clear indication of which way to push when seeking efficiency still holds. The results show a highly varied picture of corridor effects with tight

conditions: what is beneficial in some corridors and urban regions is not necessarily beneficial in other regions, even when the same conditions apply. In other words, the type of agglomeration economies in combination with the structure of the economy matters for prospects of structural economic growth in regions. This confirms the recently suggested need for a place-based approach in regional development policy in Europe (complementary to a generic, people-based approach) that takes into account these regional differences and requirements, so that each region has its own specific approach to economic development (Thissen & Van Oort, 2010; Barca *et al.*, 2012).

Whereas the empirical evidence presented in Chapter 3 is in contrast to the positive stance towards the relatedness between space, economy and transport in relation to corridors as was initially put forward in Chapter 2, this does not imply that the corridor concept therefore is irrelevant. Although the empirical support for the economic potential of corridors and resulting positive externalities are not strong, and the added value of the corridor concept in explaining the spatial heterogeneity of structural growth patterns is not proven, corridors can still be seen as connecting devices between urban regions sharing commonalities in their transport and land-use problems. This provides the outlook for the conclusions of Chapters 4 to 6.

7.1.3 Chokepoints in Corridors (Chapter 4)

Chapter 4 has analysed the one-dimensional understanding of the scope, scale, complexity and cumulative effects of bottlenecks in the European transport network. It is found that policy has been insensitive to the observed multi-dimensional nature of bottlenecks. Although the existence of bottlenecks is acknowledged as a persistent issue in European policy (European Commission, 1999; 2011), the possible solutions do not sufficiently take into account the full scale and scope of the existing bottlenecks. Theoretically, the contribution of this chapter can be seen as an extension of the bottlenecks perspective provided by Rothengatter (1996) and as a complementary perspective to the work of Hesse and Rodrigue (2004) on friction effects. Consequently, the following research question was put forward:

"What are the most important dimensions of bottlenecks in transportation and to what extent can these bottlenecks be identified in European corridors?"

On basis of a substantive literature review, an integrated analytical framework has been developed to analyse and evaluate the complexity of bottlenecks. This has provided the answer to the first part of the research question. The inevitable interrelatedness between multiple sectoral bottlenecks, and their development into integrative, comprehensive problem areas which was consequently shown, is related to the integrative versus sectoral-based perspective discussion as was put forward in Chapter 1. Given the empirical material supporting the highly interrelated nature of bottlenecks, it is even more remarkable to observe that the academic community thus far has largely failed to develop such a comprehensive, consistent and especially an integrative framework to analyse and evaluate these bottlenecks. The main conclusion thus is in favour of the integration argument: bottlenecks can no longer be viewed as mere capacity constraints of infrastructure networks (sectoral perspective), but instead

should be interpreted as being integrative, complex problems, operating on different scales and dimensions, including transportation, spatial planning, environmental issues, economic development and transnational governance.

The empirical evidence is surprisingly consistent in supporting the integration argument regarding bottlenecks – which provides the answer to the second part of the research question. The empirical micro- and macro analyses – in conformance with the literature review – showcase the interrelated nature of bottlenecks. At the same time, this also highlights the compliance between theory and practice. The strongest argument in favour of an integrative view is the impact of institutional structures and market conditions on the other dimensions of bottlenecks, and hence the deliberate influencing of the overall efficiency of the transportation networks and corridors. An integrative understanding of bottlenecks helps to understand the factors underlying these processes (e.g. the difference between public and private goods and the discussion between positive and negative externalities). On the basis of various examples extracted from the empirical analyses, it is stressed that an isolated transport perspective on bottlenecks fails to take into consideration the full scale and scope of the issues at hand and therefore cannot hold without considering the other dimensions of bottlenecks. In other words, in attempting to solve a bottleneck, it is not sufficient to consider only one dimension.

Although the empirical research was not specifically aimed at ranking the importance of the various dimensions of bottlenecks, still some important comments with regard to prioritisation can be made. First, it was shown that attempting to solve bottlenecks using an integrative perspective is also a question of 'expectation management'. Whereas harmonisation and standardisation of procedures in order to increase efficiency is advocated (institutional dimension), the availability of resources and know-how is often problematic. This is even more so since the recent economic downturn (economic dimension). Second, the integration argument is devalued by a deliberate choice to neglect other dimensions. In other words, prioritisation is also a matter of political choices. Institutional and market forces may be responsible for reluctance on the part of private actors to attempt integration. Finally, prioritisation may be influenced by functional and organisational dependencies (e.g. the effects of technical improvements will be marginal when the right organisational measures are not in place).

A final remark relates to the implications of the findings for European policy. Throughout this chapter insensitivity regarding the multi-dimensional nature of bottlenecks has been observed, which ultimately influences the efficiency of the entire transport network. This observation is in line with the insensitivity in European policy to the context and needs of specific regions, neglecting the diverse effects of infrastructure investments. So, again the importance of place-based development strategies is stressed (compare Chapter 2 and Chapter 3) in dealing with these issues. It is argued that the inevitable interrelatedness between the various scales and dimensions of bottlenecks is vital in understanding the cumulative effects of bottlenecks. This opens up possibilities for the role of spatial planning in transportation issues, which is the focus of Chapter 5.

7.1.4 Challenges in Corridors (Chapter 5)

Chapter 5 has addressed – following the implications of Chapter 4 – the heightened need for empirical support regarding the supposed multi-dimensional nature of issues in global freight transportation and corridor development. Within Europe, the port and inland navigation network can be seen as the backbone on which these global freight transportation issues take physical shape. Especially when considering the 'weakest link' principle, the functioning of inland ports is of importance for the overall efficiency of corridors. For years, however, the port system development literature (e.g. Notteboom, 1997; Van Klink & Van den Berg, 1998; Hesse & Rodrigue, 2004; Rodrigue, 2004; Notteboom & Rodrigue, 2005; Wiegmans *et al.*, 2009) has shown a strong focus on the maritime context within a network-based perspective (Outside–In). In contrast, it is argued that inland ports are growing in complexity and importance, and that port system development literature should also be sensitive to the independent role and structure of inland ports in transportation networks and corridors (Inside – Out). Thus, the attention should focus more on the challenges that possibly exist within the context of inland ports, and the ways in which these challenges are influencing the independent role of inland ports and the shaping of inland ports' governance strategies. This is expressed in the following research question:

"What inland port-city challenges can be identified and in what ways are these challenges shaping inland ports' governance strategies in European corridors?"

The results have both theoretical and practical implications. With regard to the theoretical implications, the classical theoretical transportation models of Taaffe *et al.* (1963) and Bird (1971), and extensions to these models (Hayuth, 1981; Barke, 1986), have been used as a starting point for discussing port system development concepts. In recent years, these models have been elaborated upon by, among others, Notteboom and Rodrigue (2005), Wilmsmeier *et al.* (2011) and Monios and Wilmsmeier (2012). Two major consequences arising from the growth in cargo volumes and the expanding of distribution facilities both in the seaports and in the hinterland can be observed, which are reflected in the theoretical models. These are the increasing importance of inland ports as cornerstones of inland accessibility (i.e. port regionalisation), and the increasing extent to which seaport areas are facing port-city challenges (Wiegmans & Louw, 2011; Daamen & Vries, 2013). However, on basis of the 'weakest link' principle and the directional development debate (Outside–In/Inside–Out), the research shows that two problems emerge. First, in the port regionalisation concept insufficient attention is paid to the independent role of inland ports (i.e. Inside–Out). Second, there is hardly any consideration of the possibility that port-city challenges may also arise between inland ports and cities within transnational corridors. This chapter thus has contributed to the ongoing discussion in literature a next step in port system development, that is, the emergence of inland port-city challenges.

With regard to the practical implications, an empirical analysis of inland ports' development strategies has been performed, using an institutional methodological approach which is in accordance with the recent 'institutionalist turn' observable in port literature (e.g. Jacobs & Hall, 2007; Daamen & Vries, 2013). The research

approach opens up possibilities to shed more light on the exact nature of the challenges emerging in the context of inland ports (Inside–Out). The results can also be seen as an empirical follow-up to the analytical framework which was presented in Chapter 4, because the framework has been tested systematically, using both deductive and inductive types of analysis. The most important conclusions to be drawn – in accordance with the research question – are related to the multi-dimensional nature of the inland port-city challenges on the one hand, and the ways in which these challenges are shaping inland ports' governance strategies on the other.

One of the conclusions is that all dimensions of the analytical framework have been found in practice. This highlights that the framework is of added value in identifying the multi-dimensional nature of inland port-city challenges and the ways in which these are related to one another. Next, it is shown that challenges arise when these dimensions tend to overlap (in particular, industrial and distribution functions versus residential, leisure and nature functions). Although the challenges between inland ports and cities that have been identified all take a specific form, a commonality has been found in the unbalance regarding the supra-regional benefits and local to regional negative externalities of inland ports. This probably results from difficulties in the trade-off between land-use functions in plan-making (e.g. the conflicting functions of water, or the problematic relation between infrastructure and spatial structure). A better consideration of the governance dimension of the analytical framework might help to ease such conflicts between transport and land use. These findings are in line with the work of Wiegmans and Louw (2011) and Daamen and Vries (2013) in the context of seaports.

This closely relates to another conclusion: several governance strategies have been observed which inland ports use in dealing with the emergence of inland port-city challenges. It is found that a pro-active and positive stance towards zoning contributes to efficiently accommodating mutually exclusive dimensions of inland port development. An interesting finding in this respect is the importance of institutions and the dominance that the institutional dimension can have over other dimensions. This can either be positive, thus contributing to the efficiency of inland ports, or negative, thus hampering the further development of inland ports. This finding is in line with the stated importance of institutional forces and the implications for the prioritisation of certain issues or dimensions, as was mentioned in Chapter 4. In other words, the willingness or reluctance of actors and institutions to interfere in inland port development might either stimulate or hamper the overall efficiency of inland ports and transport corridors.

7.1.5 Capturing value in Corridors (Chapter 6)

Chapter 6 has drawn into attention the financial feasibility of land development projects in the light of both the recent global economic collapse (Buitelaar & Witte, 2011) and local forces such as the policy shift from greenfield to brownfield development (Adams & Watkins, 2002) that occurred in many countries. In particular, the possible implications for the practice of integrating land use and transport in land development projects where a node-place synergy can be achieved are of interest (Bertolini & Spit, 1998; Bertolini & Dijst, 2003; Peek *et al.*, 2006). In a context of

corridor development, this especially applies to railway station areas (Kooijman & Wigmans, 2003; Majoor, 2006; Haywood & Hebbert, 2008; Peek & Louw, 2008; Reusser *et al.*, 2008), and the possibilities of value capturing (Debrezion *et al.*, 2007; Enoch *et al.*, 2005; Van der Krabben *et al.*, 2008). To gain insight into possible contributions to corridor development from the land development processes, the financial feasibility of land development projects and the extent to which this can be explained by basic location characteristics has been explored. This can be captured in the following research question:

"How do location factors influence the costs and benefits of land development and what does this imply for perspectives of value-capturing in European corridors?"

The contribution of this chapter to the academic debate is not specifically aimed at a theoretical contribution on land development, but more at an empirical validation on the basis of large-scale, quantitative data-material of a number of theoretical insights derived from among others Ricardian land rent theory and Alonso's bid rent curve. Many of the conclusions of this chapter therefore do not really come as a surprise. It was found that the financial *structure* (i.e. costs and revenues) of land development projects is primarily driven by the location of a site within the urban area, the size of the regional economy, land-use zoning and the previous land-use of the site (greenfield/brownfield). The latter in particular is consistent with earlier findings (Adams & Watkins, 2002). With regard to the financial *feasibility* (i.e. the balance) of projects, only the question whether it is greenfield or brownfield land has a significant effect. Furthermore, the findings reflect the effects of the residual valuation method as a plan-making tool. For example, the land assembly costs balance the land revenues.

It is thus concluded that much of the variance in the financial structure and feasibility of land development projects can be explained by basic location characteristics. However, some remarkable observations can be made nonetheless, which provide the answer to the first part of the research question. First and foremost, the most striking finding is that economies of scale hardly play a role in the financial structure of land development. Apparently, larger sites do not economise on costs, probably because potential scale advantages are eliminated by the large span of control of larger sites. A reason can be the greater number of landowners and other stakeholders involved in many large-scale (infrastructure) projects. This outcome is interesting in a policy context, since governments and developers use the 'scale argument' in order to advocate these 'megaprojects' (compare Priemus, 2007; Flyvbjerg, 2009). It seems that in these cases the span of control of large sites becomes so great that economies of scale turn into 'diseconomies'. It is interesting to notice that this finding seems to be pleading against the integration argument presented in Chapter 1, for one can argue that if the balance between positive and negative externalities is in danger this impacts the overall efficiency of corridor development.

Additionally, the factors that hamper the financial feasibility of land development projects (i.e. multiple landownership, mixed-use zoning, brownfield redevelopment, large-scale planning, and a focus on the intra-urban and interregional economic centres) are exactly those factors that are considered crucial in corridor development. In other words, the problematic financial feasibility of land development

projects is inconsistent with the benefits of integrated area development in relation to corridor development, implying that value capturing is hard to realise. This is not problematic in cases of market growth; however, in a deteriorating market it leads to financial deficits, and therefore to delay, postponement and abolition of development projects. With regard to the second part of the research question, value capturing for the less- or non-profitable land uses early in the process might be negatively impacting on the financial feasibility of development projects as a whole. This is especially true when the value is maximised due to residual valuation and in relation to the positive and negative leverage effects resulting from market dynamics. The importance of this conclusion must not be underestimated, especially with regard to corridor development, because corridor development depends heavily upon the success of profitable large-scale development projects.

7.2 Integrated corridor development reconsidered

In Chapter 1, the question was put forward whether an integrated conceptualisation of corridor development has added value for European policy makers in their current and future governance practices regarding corridors and corridor development in Europe. This dissertation has therefore examined whether the added value of the integration argument is provable and whether this leads to a restating of the importance of corridors for present-day European policy objectives. This has resulted in the following main research question:

"To what extent can integrated corridor development be of added value for European policy makers in their governance practices regarding European corridors?"

The remainder of this section provides an answer to this question. The section will be organised as follows. First, the arguments pro and contra integration will be outlined. Next, a discussion on some interesting and unexpected findings of this dissertation will follow. This can be considered a stepping stone towards the future reflections.

7.2.1 Evidence pro and contra the integration argument

A first notion regarding this dissertation's contribution to the integration debate is that the findings in principle are uniform, but that they are also contradictory in the sense that some evidence that supports the integration argument is provided, and other evidence is provided that refutes the integration argument. In other words, it is shown that integrated corridor development is inconsistent within itself, which affects the problem-solving capacity of the corridor concept. Thus, when this is related to the integrated versus sectoral-based discussion, a definite answer cannot be provided regarding, for instance, the opportunities of an integrated corridor authority, relative to the efficiency of local and sectoral-based solutions for corridor issues. However, some indications can be given regarding the dimensions and scales on which integrated corridor development is or is not of added value for corridor governance practices.

The arguments that plead for the integration argument in corridor development can be extracted from Chapters 4 and 5. First, from Chapter 4 it was concluded that

many policy documents are insensitive towards the multi-dimensional nature of bottlenecks, while the theoretical and empirical evidence presented in that chapter clearly pointed at the inevitable interrelatedness of the multiple dimensions of bottlenecks. Moreover, Chapter 5 provided additional empirical support for this analytical framework of cumulative bottlenecks by showcasing the multi-dimensional nature of challenges existing between inland ports and cities along corridors. This has proven the added value of the multi-dimensional framework for the integration argument in corridor development. Finally, it should be noted that Chapters 4 and 5 share a commonality in the sense that the relevance of the integration argument is especially emerging from the traditional, transport-oriented starting point of both chapters. In other words, integration 'works' when the initial situation is dominated by a sectoral transport-oriented perspective (compare for instance the case study in Appendix 1).

The other side of the integration debate is formed by evidence that is pleading against the existence of any added value in integrated corridor development. The findings presented in Chapter 3, in particular, have made clear that the initial support for the integration argument in Chapter 2 should be refuted, since the empirical evidence consistently invalidated the importance of corridors for growth and agglomeration. A clustering effect in corridor regions is observable, but the corridor itself cannot be considered exclusively responsible for this. Thus, viewed from the economic dimension, the added value of the integration argument is not proven.

The same goes for the evidence stemming from the spatial dimension (Chapter 6). Although large-scale infrastructure projects are claimed to be at the heart of successful corridor development, these projects also happen to bear numerous characteristics that hamper the financial feasibility of land development projects as a whole. Economies of scale cannot ease this, for they hardly play a role in the financial structure of land development. As a result, value capturing – especially in low-profit-margin markets such as freight transportation – is hard to realise, whereas this practice was at first seen as a promising tool in the light of land-use transport integration and node-place synergies.

This implies that the added value of the integration argument in corridor development at least is not uncontested. Rather, when the findings from the economic and spatial dimension are confronted with each other, this provides an additional argument against integration. The factors that could benefit integration in the economic dimension hamper integration in the spatial dimension, and vice versa. In the economic dimension, it was shown that proximity of large urban regions in the core economic centres of Europe stimulates regional economic growth in corridor regions. However, when considering the spatial dimension, the closer to the intra-urban or interregional economic centre a site is, the more difficult the financial feasibility of the land development project becomes. Such conflicting factors are difficult to match with the integration argument. This reinforces the conclusion from the institutional dimension (Chapter 1) that the sectoral-based practices of corridor development in Europe are not really surprising but are rather very realistic, especially in the light of the recent economic downturn. The findings are also in line with the observations of Chapman *et al.* (2003), although the contexts and time period differ.

The overall conclusion concerning the integration argument in corridor development therefore is that the contribution of an integrated approach to efficient corridor development is certainly not self-evident, but is not irrelevant either. To get back to the questions as were posed in Chapter 1: does the empirical evidence support the integration argument? Partly. Is the added value of the integration argument provable? It depends. Does this lead to a restating of the importance of corridors in European policy? Yes and no. Are corridors stimulating or hampering European policy objectives regarding territorial cohesion and decreasing regional disparities? Both.

The findings are not conclusive in supporting either side of the integration argument. However, in general this dissertation has contributed to nuancing the debate regarding corridors and integration. It is shown that, although the empirical evidence in some cases is contradicting the integration argument in corridor development (Chapters 3 and 6), corridors can still be seen as useful linkages between regions sharing a commonality in their respective issues (Chapters 4 and 5).

7.2.2 Place-based development and the importance of institutions

The mixed nature of the findings regarding the integration argument implies that current policy regarding corridor development might be poorly informed on the variety of scales and dimensions that are of relevance in corridor issues. This was already partly reflected in the discrepancy between the initial support for the integration argument in Chapter 2, and the counter-evidence provided in Chapter 3. Moreover, it is shown that the occurrence of positive and negative externalities on different scales and dimensions is creating different spatial challenges that need to be addressed. These and other issues that have been pointed out throughout this dissertation indicate the importance of context and institutions for efficient corridor development. Although integration in some cases is beneficial, and although corridors in some cases provide common ground for interregional to transnational problem-solving, it can be argued that for truly efficient corridor policy to succeed, more attention should be paid to place-based development strategies and the importance of institutions. In other words, the argument against integration might be substituted by the argument in favour of place-based development.

The strongest arguments in favour of place-based development were presented in Chapter 3. The strong influence of spatial heterogeneity on patterns of structural economic growth in European regions can be put forward in this respect. Although the corridor concept is not leading, more attention could be paid to the variety of spatial concepts that together explain the complexity of the economic structure of European regions. For instance, it is shown that a combination of corridor, urban and core/periphery interpretations of spatial structure captures a large degree of the variance in explaining economic growth patterns. This variety up to now finds little recognition in European policy-making; more attention to the place-based dynamics of regions might contribute to efficient cohesion and regional integration policy. The importance of contextualisation has also been put forward in Chapters 2, 4 and 5. This recurrence, moreover, highlights the importance of the *institutional* context.

7.3 Future reflections

The integrated versus sectoral-based perspective debate that has been put forward in Chapter 1 has been at the heart of this dissertation. In this final section, some future reflections will be made regarding the contribution of the integration argument to the positioning of corridors in European policy, and the implications of transnational corridor development for multi-level governance strategies. Along the way, limitations, possible biases and further research questions following this dissertation will also be discussed.

It can be concluded that the contribution of the integration argument to the positioning of corridors within European policy can be regarded as limited. In terms of economic and spatial development, the added value of integration is hard to prove. On the other hand, integration poses promising common ground for regions sharing a commonality in their respective transportation issues. For instance, inland ports in the Dutch-German border region might find a commonality in dealing with trans-border water management issues along the river Rhine.

Nevertheless, one could question whether the corridor concept is a proper reflection of the spatial reality and whether corridors as a spatial phenomenon can be legitimised (Chapter 2). What could be really interesting in this respect is a consideration of the 'why' question. The findings have not yet provided enough insight in the reasons *why* the corridor concept has difficulties in becoming a mainstream and accepted spatial concept (compare Pain, 2011). Is it because of conceptual ambiguity with regard to the multi-dimensional nature of corridors? Is it because of the transnational scale at which corridors usually operate? Is it because of institutional fragmentation? These questions could be the starting point for future research into the contributions of the corridor concept to achieving European policy objectives. In particular, the findings of this dissertation might contribute to the formulation of new corridor studies under the umbrella of the Connecting Europe Facility and the tender which is ongoing for studies on the Core Network Corridors, following the revision of the TEN-T guidelines.

On the basis of the findings of Chapter 3, the contribution of the corridor concept to achieving these policy objectives at least seems to be limited. However, some critical remarks should be made. This dissertation has worked with a rail-based definition of six corridors stemming from 2008, whereas the current (2013) European policy regarding the core network corridors has defined nine corridors on the basis of different criteria. This might prove to bias some of the findings when mirrored against future findings. Another point of concern is the level of analysis. This dissertation has analysed the impacts of corridors on growth and agglomeration on the NUTS2 level, while other research argues that agglomeration effects are most prominent on a very small-scale, localised level of analysis (e.g. four-digit zip codes). Finally, some measurement issues (including the relation between corridor regions and urban regions) and robustness analyses of time- and sector-varying dynamics are factors that should be taken into account in future research.

A practical consideration is what implications transnational corridor development can have for multi-level governance strategies (for example, in an EGTC/European Grouping of Territorial Cooperation). What does the possible added

value of transnational corridors mean for policy and practice on the national, regional and local levels? This dissertation has put to the fore the relation with positive and negative externalities and the importance of public–private constellations in this respect (Chapters 4–6). On basis of the findings of Chapter 5, it was argued that many challenges in corridor development in the end reflect imbalance regarding the supra-regional benefits on the one side and local to regional negative externalities on the other. This is an important outcome that should be considered in policy-making for corridors on different spatial scales. An interesting point for future research concerns the 'break-even point' where positive externalities turn into diseconomies. With respect to the public–private constellations that are of importance in corridors, future research could focus on the contribution of corridors in avoiding the unplanned extension of urban areas, on the question of whether corridors can manage without public interference, or even whether the governance of corridors is needed at all (compare for instance Schönharting *et al.*, 2003; Chapman *et al.*, 2003).

Finally, when recalling the title of this dissertation, some knowledge regarding several problem areas of corridor development has been chronicled, but this dissertation has not been able to cover all aspects and dimensions of the conceptual framework which was presented at the beginning of this story. A noble task for future story-tellers therefore is to further scrutinise this framework by adding some chapters to *The Corridor Chronicles* regarding the question of what spatial scale should be matched to what dimension to achieve successful, place-based European corridor development.

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Appendices

Appendix 1: The CODE24 project

This dissertation is part of a European project called '*Corridor 24 Development Rotterdam–Genoa: Joint regional development for the north–south corridor*'. The project will be referred to as 'CODE24'. CODE24 was approved under the Strategic Initiatives Framework of the INTERREG IVB NWE programme. The project thus receives 50% funding from the European Union.

Project description

This project will cover the economically important trans-European transport network TEN-T 24, stretching from Rotterdam to Genoa. The focus will be on the interconnection of economic development and spatial, transport and ecological planning. Corridor 24 covers a number of the most important economic regions in Europe. The major European north–south transport axis across the Netherlands, Germany, Switzerland and Italy links the North Sea port of Rotterdam and the Mediterranean port of Genoa. Its catchment area comprises approximately 75 million inhabitants and operates 700 million tons of rail freight a year.

The opening of the Lötschberg Tunnel in 2007 and the Gotthard Tunnel (expected in 2017) and the parallel expansion of the feeders will further improve the importance of Corridor 24. Nevertheless, some major bottlenecks and a lack of trans-regional coordination still threaten the potential of the axis, limiting its economic and spatial development. The specific interest of this project will thus be the interconnection of land use and transportation issues in planning for transport corridors, focusing on spatial integration and the mobilisation of actors and stakeholders at the local and regional levels.

Project goals

CODE24 aims at a coordinated transnational strategy to support the improvement and the development of the corridor. The overall objective of the project is to ensure and, if possible, to enhance the transport capacity of the entire transport corridor, by means of spatial integration and the development of a common strategy. Hence the project slogan: '*One Corridor, One Strategy*'. The economic performance (e.g. freight transport, logistics networks) should be ensured and the negative impact on the environment and population reduced to a minimum.

The project aims to generate a trans-boundary spatial and temporal overview for expansion and future operation of the transport corridor as well as for urban development in the catchment area of the corridor. By focusing on regional aspects in the corridor area and joint development strategies, the project will strengthen the position of regional actors and stakeholders. It will provide planning tools and tailor-made solutions to remove major bottlenecks and enable pro-active stakeholder participation. This encompasses both the development of the railway system and a sustainable spatial development.

Project partners and relevance

In this research project, many public and private stakeholders have been involved. Among them are port authorities (Port of Rotterdam, Port of Mannheim, Port of Strasbourg and Port of Genoa), regional public institutions (Rhein-Neckar, Ruhr, Karlsruhe, Frankfurt/Rhein-Main, Mannheim and Lahr), universities (Duisburg-Essen, Zürich, Kehl and Utrecht) and (private) research institutes (Uniontrasporti, SiTI, TransCare and PTV).

The economic potential of the corridor of interest in this project, 'Corridor 24', is of relevance to society at large. Examples include the associated economic benefits of knowledge spill-over occurring on this corridor, the nature and effects of infrastructure investments, and negative external spatial and environmental effects resulting from transport bottlenecks. It is because of the complexity of these issues that so many different partners are involved in this project.

Work Packages and Actions

The project consists of four different Work Packages and nineteen corresponding Actions, which together will contribute to achieving the before-mentioned project goals (Table A1).

Table A1: CODE24 Work Packages and Actions

Work Package 1	**Spatial and Infrastructural Development**
Action 1	Corridor Info System
Action 2	Railway and Settlement Development Dynamic Visualisation Tool
Action 3	Collaborative Assessment Process
Action 4	Planning Pilot Actions: Test-planning as informal planning procedure
Work Package 2	**Environmental Aspects and Noise Reduction**
Action 5	Management of ecological compensation measures
Action 6	Planners' Toolbox for innovative noise protection
Work Package 3	**Increasing Regional Economic Benefits**
Action 7	Effectiveness and spatial impact of logistic clusters
Action 8	Linking the terminal ports to the hinterland
Action 9	Costs and effects of bottlenecks along the corridor
Action 10	Online rail transport spot exchange
Work Package 4	**Communication, Acceptance and Interregional Cooperation**
Action 11	General project communication
Action 12	Project events, conferences, workshops and seminars
Action 13	Regional Workshops and Regional Round Tables
Action 14	CODE24 Mobile Exhibition
Action 15	Feasibility of a European Grouping of Territorial Cooperation
Project extension	
Action 16	Inland ports development
Action 17	Increasing network accessibility by including high speed rail
Action 18	Multimodal network node
Action 19	EGTC Inception phase

CODE24 case study: Integrated corridor development in practice

A recent example of the integrated nature of European corridor development is the discussion with respect to the creation of a third railway track in Germany between Emmerich and Oberhausen to better connect the dedicated Dutch freight transport railway line Betuweroute to the German hinterland. This railway line has a strategic importance as a freight corridor connecting the port of Rotterdam to the Ruhr region in Germany. Whereas the Dutch government has speeded up the procedure for implementation of this project, the German procedure is running parallel, but without strict deadlines for implementation, for national political reasons. This is likely to hamper the implementation of fluent cross-border freight transport in the short term.

The German rail operator Deutsche Bahn has therefore developed a project to upgrade the railway line to three tracks and eliminate most of the crossings. According to German law, the new development should provide the necessary compensations to communities, including noise reduction measures (i.e. noise walls). However, due to the topographical structure of the area and the type of settlements, these walls need to be high (often between two and six metres). This has encountered the opposition of communities that see the proposed solution as a further disturbance to their living conditions rather than betterment of them.

At first sight, this seems to be merely a transportation issue; there is a lack of capacity on the German part of the network following the Betuweroute, so an additional railway track is needed at one specific section of the network. However, closer examination also reveals problems with respect to transnational governance: political resistance to the project, and differences in institutional structures and procedures which hamper efficient cross-border cooperation. Moreover, the German section of the line presents several additional problems that need to be solved: some fifty level crossings along the line, the insufficient capacity of the stations (e.g. Oberhausen) or sub-optimal employment of the nodes, and disturbances to the surrounding settlements (e.g. noise, dangerous materials, fragmentation of communities).

First of all, it should be noted that many aspects are interrelated in this case. What at first sight seems to be a mere transportation issue also appears to have clear spatial, environmental, political and institutional dimensions. In addition, the issues occur on multiple levels of scale. On a local level, the project of the Deutsche Bahn is facing heavy resistance because of the visual impact of the noise walls. On the other hand, from a transnational corridor perspective, this area is of crucial importance to achieve efficient goods travel from the Betuweroute to the German hinterland. Thus, different issues interfere at different spatial scales. This calls for a set of strategic measures.

A second point of concern is the modal competition this area is facing. On the one hand, the creation of a third track to solve the problems should be measured against the alternative costs of expanding the German motorway network. The recent policy attitude towards achieving modal shift from transport by road to rail and inland navigation is helpful and strategic in this respect, to strengthen the insufficient and difficult links between the railway and the inland ports in this region. On the other hand, inland navigation itself via the river Rhine can also be seen as a competitor to rail transport for this area. Moreover, this line is in competition with other corridor

routes that also show high rates of tons/km and with other projects that also opt for German federal funding. In this way, economic potential can also be included as a factor of importance, to add to the complexity of the area.

To contribute to a solution, an informal test-planning procedure called 'Ideenwerkstatt Fortsetzung der Betuweroute' has been promoted by the regional association of Ruhr together with the municipalities along the German part of the Betuweroute. The aim of this informal procedure is to elaborate alternatives to high noise barriers that separate entire settlements as a foreign body structure and to find alternative, innovative and original solutions. Three cities in the 'Kreis Wesel' region, Dinslaken, Wesel and Hamminkeln (Mehrhoog), were selected as pilot areas where these attempts would take place.

Two strategic questions can be posed regarding this region. First, should the project concentrate only on the creation of a third track and the realisation of noise protection on a local scale to solve the bottlenecks, or are there more strategic interventions to be implemented in this region? Second, is noise protection the only way to tackle the existing environmental bottlenecks, or can the upgrading of the railway station areas and their surroundings lead to synergies on a regional scale that can be seen as a form of compensation?

In the first question, the negative external effects which tend to aggregate on a low spatial scale (i.e. noise nuisance, safety and visual quality of the localities involved) are measured against possible positive spill-over effects which tend to aggregate on a higher spatial scale (e.g. corridor development and related regional economic growth). The second question makes use of a growth management perspective: in this case, compensating noise nuisance with the creation of synergies at railway station areas. In this way, the attempt is made to solve transport, spatial and environmental issues on a local scale by seeking economic potential on a regional to transnational (corridor) scale. The research problem thus evolves from a short-term technical transportation issue to a problem of long-term economic development and possible planning interventions.

In summary, the strategic questions that were posed with regard to the corridor issues in the region of Wesel have contributed to the creation of a regional and integrated perspective on the future development of the region. With such a strong focus on the local noise problem, the regional development perspective had been lost. This is not to say that technical solutions to technical bottlenecks are therefore irrelevant, but by adopting this integrated perspective new opportunities and development alternatives have come to the fore. In this way, the idea that the integration of multiple sectoral perspectives in European freight corridors may create an added value has been backed up by some explorative case study findings from the practice of Corridor 24.

Appendix 2: Modelling outcomes for productivity growth (2000-2010)

	OLS	ML - SL	ML-SL Regimes		ML-SL Regimes		ML-SL Regimes			
			Urb.+	Urb.-	Corr.+	Corr.-	C+U+	C+U-	C-U+	C-U-
Constant	0,533**	0,040	-0,206	0,293*	-0,005	-0,111	0,275	-0,375	-0,541**	0,345
	(3,564)	(0,319)	(-1,153)	(1,692)	(-0,022)	(-0,703)	(0,945)	(-0,970)	(-2,457)	(1,641)
Productivity level (ln)	-0,174**	-0,138**	-0,164**	-0,122**	-0,178**	-0,113**	-0,173**	-0,166**	-0,137**	-0,114**
	(-16,030)	(-14,973)	(-11,867)	(-9,088)	(-10,590)	(-9,843)	(-7,667)	(-6,103)	(-7,718)	(-7,745)
Specialization-diversity (ln)	0,047**	0,036**	0,042**	0,028**	0,030**	0,047**	0,025	0,034*	0,058**	0,028**
	(4,901)	(4,490)	(3,666)	(2,570)	(2,410)	(4,537)	(1,603)	(1,832)	(3,885)	(2,127)
Population density (ln)	0,006	0,002	-0,009*	0,017**	-0,005	0,004	-0,014	0,001	-0,005	0,017**
	(1,145)	(0,490)	(-1,679)	(2,558)	(-0,700)	(0,699)	(-1,555)	(0,113)	(-0,782)	(2,095)
Market potential (ln)	0,017	0,039**	0,079**	0,001	0,060**	0,054**	0,030	0,099**	0,123**	-0,005
	(0,952)	(2,552)	(3,658)	(0,032)	(2,071)	(2,765)	(0,869)	(1,988)	(4,420)	(-0,199)
Public R&D (ln)	-0,012**	-0,009**	-0,002	-0,011**	-0,005	-0,008	-0,010	0,002	0,017*	-0,014**
	(-2,406)	(-2,169)	(-0,272)	(-2,238)	(-0,642)	(-1,599)	(-0,753)	(0,210)	(1,664)	(-2,673)
Private R&D (ln)	0,013**	0,009*	0,018**	0,004	0,019**	0,006	0,023**	0,021	0,018**	0,004
	(2,365)	(1,889)	(2,581)	(0,688)	(2,194)	(1,156)	(1,974)	(1,630)	(2,213)	(0,547)
Openness economy (ln)	-0,015	-0,011	-0,004	-0,021	-0,022	-0,009	-0,010	-0,029	0,027	-0,021
	(-0,938)	(-0,827)	(-0,223)	(-1,031)	(-1,148)	(-0,476)	(-0,438)	(-0,801)	(1,031)	(-0,889)
Higher education (ln)	0,061**	0,056**	0,071**	0,039**	0,055**	0,039**	0,066**	0,037*	0,035	0,027
	(4,520)	(4,903)	(4,210)	(2,771)	(3,229)	(2,358)	(2,679)	(1,808)	(1,431)	(1,354)
W_productivity growth	N/A	0,962**	0,965**		0,965**		0,968**			
		(37,403)	(39,592)		(39,627)		(44,224)			
Adjusted R2	0,740	0,814	0,833		0,827		0,856			
Spatial Chow-Wald test			25,711	(0,002)	16,851	(0,051)	67,980	(0,000)		

* p<0.1; ** p<0.05; t-values in parentheses. Coefficients that significantly differ over regimes are shaded.

Appendix 2 (continued): Modelling outcomes for productivity growth (core-periphery)

	ML-SL		ML-SL				VIF's
	Regimes		Regimes				
	CP+	CP-	C+CP+	C+CP-	C-CP+	C-CP-	
Constant	0,163	0,428**	0,146	0,515**	-0,296	0,409**	
	(1,209)	(6,606)	(0,964)	(4,249)	(-0,859)	(5,551)	
Productivity level (ln)	-0,110**	-0,125**	-0,082**	-0,181**	-0,009	-0,104**	2,625
	(-3,492)	(-11,751)	(-2,346)	(-8,273)	(-0,133)	(-8,473)	
Specialization-diversity (ln)	0,002	0,057**	-0,010	0,042*	-0,012	0,053**	2,236
	(0,134)	(5,438)	(-0,539)	(1,623)	(-0,544)	(4,872)	
Population density (ln)	0,007	0,008	-0,001	0,010	0,006	0,001	1,715
	(1,116)	(1,349)	(-0,119)	(0,988)	(0,747)	(0,089)	
Public R&D (ln)	-0,012**	-0,009	-0,010	-0,014	-0,006	-0,014**	1,291
	(-2,148)	(-1,308)	(-1,057)	(-1,018)	(-0,854)	(-2,011)	
Private R&D (ln)	0,009	0,011**	0,004	0,037**	0,014	0,007	2,325
	(1,163)	(1,987)	(0,364)	(2,663)	(1,425)	(1,304)	
Openness economy (ln)	-0,001	-0,002	0,069**	-0,048*	-0,054	0,005	1,704
	(-0,002)	(-0,111)	(1,934)	(-1,942)	(-0,841)	(0,260)	
Higher education (ln)	0,063**	0,041**	0,041**	0,061*	0,072	0,026	1,612
	(3,835)	(2,575)	(2,096)	(1,785)	(1,323)	(1,515)	
W_productivity growth	0,945**		0,946**				
	(25,404)		(25,614)				
Adjusted R2	0,824		0,850				
Spatial Chow-Wald test	20,800	(0,008)	64,890	(0,000)			

* p<0.1; ** p<0.05; t-values in parentheses. Coefficients that significantly differ over regimes are shaded. Market potential as a variable is omitted (because it is an integral part of the CP-regime).

Appendix 3: Modelling outcomes for employment growth (2000-2010)

	OLS	ML - SL	ML-SL Regimes		ML-SL Regimes		ML-SL Regimes			
			Urb.+	Urb.-	Corr.+	Corr.-	C+U+	C+U-	C-U+	C-U-
Constant	0,466**	0,372**	-0,407	0,806**	0,222	0,429**	-0,295	0,436	-0,200	0,810**
	(2,550)	(2,301)	(-1,527)	(3,534)	(0,804)	(2,188)	(-0,819)	(0,888)	(-0,507)	(2,911)
Employment level (ln)	-0,012*	-0,012*	0,053**	-0,041**	-0,014	-0,009	0,050**	-0,053**	0,041*	-0,026**
	(-1,740)	(-1,905)	(3,406)	(-3,819)	(-1,474)	(-1,181)	(2,531)	(-2,945)	(1,771)	(-1,989)
Specialization-diversity (ln)	-0,022**	-0,016*	-0,020	-0,031**	0,005	-0,034**	-0,020	0,021	-0,021	-0,060**
	(-2,154)	(-1,767)	(-1,589)	(-2,471)	(0,361)	(-3,033)	(-1,162)	(1,067)	(-1,262)	(-3,911)
Population density (ln)	-0,000	0,001	-0,010	0,009	0,004	0,004	-0,004	0,007	-0,010	0,010
	(-0,068)	(0,149)	(-1,522)	(1,165)	(0,455)	(0,567)	(-0,432)	(0,568)	(-1,150)	(1,033)
Market potential (ln)	-0,044**	-0,037**	-0,060**	-0,046**	0,003	-0,072**	-0,054*	0,042	-0,085**	-0,094**
	(-2,325)	(-2,256)	(-2,621)	(-2,003)	(0,010)	(-3,379)	(-1,686)	(0,869)	(-2,844)	(-3,315)
Public R&D (ln)	0,003	0,003	0,007	0,007	0,010	-0,000	-0,005	0,023**	-0,010	0,001
	(0,495)	(0,677)	(-0,779)	(1,134)	(1,119)	(-0,039)	(-0,360)	(2,210)	(-0,904)	(0,165)
Private R&D (ln)	0,005	0,005	0,005	0,008	0,014	-0,002	0,014	0,022*	-0,001	-0,002
	(0,948)	(0,999)	(0,643)	(1,229)	(1,568)	(-0,501)	(1,206)	(1,747)	(-0,156)	(-0,286)
Openness economy (ln)	-0,002	0,004	-0,014	0,042**	-0,008	0,045**	-0,015	0,025	-0,015	0,080**
	(-0,168)	(0,326)	(-0,830)	(2,268)	(-0,463)	(2,374)	(-0,697)	(0,819)	(-0,507)	(3,289)
Higher education (ln)	0,044**	0,037**	0,073**	0,024	-0,014	0,096**	0,025	-0,028	0,130**	0,078**
	(3,112)	(2,946)	(3,946)	(1,498)	(-0,769)	(5,428)	(0,897)	(-1,173)	(5,104)	(3,422)
W_employment growth	-	0,957**	0,958**		0,955**		0,959**			
		(31,928)	(33,013)		(30,626)		(33,834)			
Adjusted R2	0,087	0,317	0,389		0,374		0,468			
Spatial Chow-Wald test			32,930	(0,000)	27,325	(0,001)	75,025	(0,000)		

* p<0.1; ** p<0.05; t-values in parentheses. Coefficients that significantly differ over regimes are shaded.

Appendix 3 (continued): Modelling outcomes for employment growth (core-periphery)

	ML-SL		ML-SL				VIF's
	Regimes		Regimes				
	CP+	CP-	C+CP+	C+CP-	C-CP+	C-CP-	
Constant	0,129	-0,157	0,224	-0,307	0,038	-0,209*	
	(1,023)	-1,337	(1,440)	(-1,057)	(0,148)	(-1,691)	
Employment level (ln)	-0,008	-0,157	-0,009	0,008	-0,014	-0,015*	1,339
	(-0,873)	(-1,337)	(-0,809)	(0,408)	(-0,800)	(-1,796)	
Specialization-diversity (ln)	-0,009	-0,034	0,014	-0,075**	-0,033	-0,029**	2,272
	(-0,621)	(-1,497)	(0,670)	(-3,101)	(-1,491)	(-2,516)	
Population density (ln)	0,012*	-0,001**	0,007	-0,010	0,014	0,008	1,792
	(1,743)	(-3,235)	(0,753)	(-0,943)	(1,526)	(1,041)	
Public R&D (ln)	0,008	-0,003	0,018*	-0,020	0,001	0,005	1,311
	(1,362)	(-0,460)	(1,805)	(-1,333)	(0,192)	(0,687)	
Private R&D (ln)	-0,002	0,002	-0,001	0,028**	-0,004	-0,007	2,083
	(-0,231)	(0,306)	(-0,132)	(2,356)	(-0,364)	(-1,154)	
Openness economy (ln)	0,034	0,006	0,012	-0,023	0,052	0,046**	1,387
	(1,230)	(0,409)	(0,345)	(-1,130)	(0,732)	(2,472)	
Higher education (ln)	-0,031*	0,088**	-0,027	0,034	-0,005	0,118**	1,545
	(-1,786)	(5,377)	(-1,294)	(0,965)	(-0,078)	(6,535)	
W_employment growth	0,949**		0,951**				
	(26,950)		(28,322)				
Adjusted R2	0,416		0,474				
Spatial Chow-Wald test	55,979	(0,000)	88,284	(0,000)			

* p<0.1; ** p<0.05; t-values in parentheses. Coefficients that significantly differ over regimes are shaded. Market potential as a variable is omitted (because it is an integral part of the CP-regime).

Appendix 4: Transport bottlenecks in literature and practice

Table A2: Transport bottlenecks found in literature

Type and dimension[1]	**Bottlenecks**	**Scope** *Local*	*Regional*	*National*	*Trans-national*	**Mode** *Rail*	*Road*	*Inland waterway*	*Inter-modal*	**# of sources**
Infrastructure (I)	Congestion	X				X	X	X	X	5
Physical (A)	Capacity constraints	X				X	X	X	X	4
	Missing links				X				X	2
	Electric power compatibility				X	X				1
	Transhipment	X	X				X		X	2
	Waiting time	X	X				X		X	2
	Conflicts long/short distance traffic		X			X	X			1
Organisational (B)	Harmonisation and standardisation	X	X				X		X	2
	Definitions				X				X	3
	Efficiency				X	X				2
	Level of service	X				X				1
	Linguistic problems				X			X	X	2
	Working conditions	X						X		1
Spatial (II)	Pressure of space on transport	X	X		X		X		X	3
Functional (C)	Spatial relocation	X			X				X	1
	Land for expansion	X						X	X	1
	Real estate markets		X						X	1
	Site requirements	X							X	2
	Private sector involvement	X			X				X	3
	Land ownership	X							X	2
	Unwillingness of actors	X							X	3
Morphological (D)	Traffic externalities	X	X			X	X		X	5
	Physical barriers	X			X	X	X			3
	Path dependency		X			X	X			2
Governance (III)	Lack of knowledge									3
Political (E)	Simplification				X					1
	Priorities		X		X	X			X	3
	Effects of decisions	X			X	X	X			5

Table A2 (continued): Transport bottlenecks found in literature

Type and dimension[1]	**Bottlenecks**	**Scope** *Local*	*Regional*	*National*	*Trans-national*	**Mode** *Rail*	*Road*	*Inland waterway*	*Inter-modal*	**# of sources**
Governance (III)	Institutional fragmentation				X				X	1
Institutional (F)	Border crossings				X				X	2
	Sectoral fragmentation			X						2
	Legal barriers			X					X	1
	Conflicting rules				X				X	3
Economic (IV)	Competition and market behaviour	X			X	X		X	X	4
Market conditions (G)	Agglomeration effects	X	X			X	X		X	5
Financial (H)	Availability financial resources		X	X	X					3
	Effects of investments	X	X						X	6

1 The table only lists scopes and modes as found in the literature review; in reality, more combinations are possible.

Appendix 4 (continued): Transport bottlenecks in literature and practice

Table A3: Transport bottlenecks found in practice

Type and dimension	**Bottlenecks**	**Mixed scanning**		**Mode**			
		Macro	*Micro*	*Rail*	*Road*	*Inland waterway*	*Inter-modal*
Infrastructure (I)	Congestion		X	X			
Physical (A)	Capacity constraints	X	X	X		X	
	Missing links	X			X		
	Electric power compatibility		X	X			
	Transhipment	X		X		X	X
	Waiting time	X	X	X	X		X
	Conflicts long/short distance traffic	X		X			
Organisational (B)	Harmonisation and standardisation	X	X	X	X		X
	Definitions						
	Efficiency	X	X	X			
	Level of service		X	X			
	Linguistic problems		X	X			
	Working conditions	X	X	X	X		
Spatial (II)	Pressure of space on transport	X	X	X			X
Functional (C)	Spatial relocation	X		X		X	X
	Land for expansion	X	X			X	X
	Real estate markets						
	Site requirements		X	X			
	Private sector involvement	X		X	X		
	Land ownership						
	Unwillingness of actors	X	X	X			X
Morphological (D)	Traffic externalities	X		X			
	Physical barriers	X	X	X		X	
	Path dependency						

Table A3 (continued): Transport bottlenecks found in practice

Type and dimension	**Bottlenecks**	**Mixed scanning**		**Mode**			
		Macro	*Micro*	*Rail*	*Road*	*Inland waterway*	*Inter-modal*
Governance (III)	Lack of knowledge		X	X			
Political (E)	Simplification	X				X	
	Priorities	X	X	X		X	
	Effects of decisions	X	X	X			
Institutional (F)	Institutional fragmentation	X	X	X			X
	Border crossings	X	X	X			
	Sectoral fragmentation						
	Legal barriers	X	X	X			
	Conflicting rules	X	X	X			
Economic (IV)	Competition and market behaviour	X	X	X		X	X
Market conditions (G)	Agglomeration effects						
Financial (H)	Availability financial resources	X	X	X			
	Effects of investments	X	X	X			

Appendix 5: Availability of inland ports' policy documentation

Table A4: Availability of inland ports' policy documentation

	Alphen	Dordrecht	Nijmegen	Wageningen	Venlo	Gennep	Moerdijk	Tilburg
Provincial integrative vision	X	X	X	X	X	X	X	X
Provincial sectoral vision	X	X	X	X	X	X	X	X
Regional vision		X	X	X		X		
Municipal integrative vision	X	X	X	X	X	X	X	X
Municipal sectoral vision	X		X	X	X	X	X	
Integrative vision inland port			X	X				
Development strategy inland port		X			X		X*	

* At the time of writing, the municipality of Moerdijk, together with the Port of Moerdijk and the province of Noord-Brabant is developing a strategic vision for the Port of Moerdijk. Although a first version of the vision is available, this information has not been used extensively in the analysis.

Provincial integrative visions

- Zuid-Holland (2013), *Visie op Zuid-Holland*
- Gelderland (2005), *Streekplan Gelderland*
- Limburg (2011), *Provinciaal Omgevingsplan Limburg*
- Noord-Brabant (2011), *Structuurvisie ruimtelijke ordening*

Provincial sectoral visions

- Zuid-Holland (2004), *Provinciaal Verkeer- en Vervoersplan*
- Zuid-Holland (2006), *Beleidsnota Provinciale Vaarwegen en Scheepvaart*
- Gelderland (2004), *Provinciaal Verkeer- en Vervoersplan*
- Limburg (2007), *Provinciaal Verkeer- en Vervoersplan*
- Limburg (2008), *Netwerkanalyse vaarwegen en binnenhavens*
- Limburg (2012), *Havennetwerkvisie Limburg*
- Noord-Brabant (2004), *Provinciale Visie Brabantse Vaarwegen*
- Noord-Brabant (2006), *Provinciaal Verkeer- en Vervoersplan*

Regional visions

- Drechtsteden (2003), *Mobiliteitsplan*
- Drechtsteden (2008), *Ruimtelijk Economische Visie*
- Stadsregio Arnhem Nijmegen (2011), *Integrale Visie*
- Wageningen, Ede, Rhenen en Veenendaal (2005), *Regionale Structuurvisie*
- Bergen, Gennep, Mook en Middelaar (2010), *Strategische Regiovisie*

Municipal integrative visions

- Alphen aan den Rijn (2013), *Ontwerp Structuurvisie Alphen aan den Rijn*
- Dordrecht (2013), *Ontwerp Structuurvisie Dordrecht*
- Nijmegen (2010), *Structuurvisie Nijmegen*
- Wageningen (2013), *Ontwerp Structuurvisie Wageningen*
- Venlo (2009), *Ruimtelijke Structuurvisie*
- Gennep (2012), *Structuurvisie buitengebied gemeente Gennep*
- Moerdijk (2011), *Structuurvisie Moerdijk*
- Tilburg (2005), *Ruimtelijke structuurvisie Tilburg*

Municipal sectoral visions

- Alphen aan den Rijn (2013), *Structuurvisie Verkeer en Vervoer*
- Nijmegen (2010), *Beleidsvisie Havens en Kaden*
- Wageningen (2013), *Gemeentelijk Mobiliteitsplan*
- Venlo (2013), *Gemeentelijk Verkeers- en Vervoerplan*
- Gennep (2012), *Gemeentelijk Verkeers- en Vervoerplan*
- Moerdijk (2007), *Lokaal mobiliteitsplan*

Integrative visions inland port

- Nijmegen (2003), *Koersdocument Koers West*
- Nijmegen (2003), *Masterplan Revitalisering Noord en Oostkanaalhavens*
- Wageningen (2003), *Plan van Aanpak Herontwikkeling Rijnhaven*

Development strategies inland port

- Dordrecht (2002), *Ontwikkelingsvisie Shipping Valley*
- Venlo (2011), *Binnenhavenvisie Venlo. Ontwikkelplan Industriehaven Venlo*
- Moerdijk (2013), *Concept Havenstrategie Moerdijk*

Appendix 6: Deductive analysis of multi-dimensional inland port-city challenges

			Zuid-Holland		Gelderland		Limburg		Noord-Brabant	
			Alphen	Dordrecht	Nijmegen	Wageningen	Gennep	Venlo	Moerdijk	Tilburg
Infrastructure - Physical	Accessibility	Vessel class	IV	VIc	Va	Va	Va	Va	VIc	III
		Depth (m)	3,2	10,0	4,6	3,0	5,5	5,5	11,0	2,4
	Capacity	Tonnage (x 1.000)	626	5.140	2.506	1.344	2.665	728	7356	859
		Container TEU (NUTS3)	113	3.979	21.721	5.455	29.814	29.814	10.264	21.444
Infrastructure - Organizational	Level of service	Public quay available		X	X	X		X		
		Overdue maintenance	-	X	X	X	-	X	-	-
		Safety procedures	X	X	-	-	-	-	X	-
Spatial – Functional	Land-use claims	Industrial	X	X	X	X	X	X	X	X
		Distribution	X		X	X	X	X	X	X
		Residential	X	X						
		Leisure		X		X		X		
		Nature							X	
	Plan-making	Industrial	X	X	X		X	X	X	X
		Distribution	X	X	X		X	X	X	X
		Residential		X	X				X	
		Leisure		X		X		X	X	
		Nature	X			X			X	
Spatial – Morphological	Space for development	Financial	X	X			-		X	-
		Physical	X			X	X		X	X
		Institutional	X	X			X	X	X	X
	Negative externalities	Noise	X	X	X	X	-	X	X	-
		Air	X	X	X	X	-		X	-
		Visual			X	X	-			-

Appendix 6 (continued): Deductive analysis of multi-dimensional inland port-city challenges

			Zuid-Holland		Gelderland		Limburg		Noord-Brabant	
			Alphen	Dordrecht	Nijmegen	Wageningen	Gennep	Venlo	Moerdijk	Tilburg
Governance – Political	Prioritization	Policy attention	X	X	X			X	X	
		Sense of urgency	X	X				X	X	
Governance – Institutional	Coordination structure	Horizontal		X	X					
		Vertical	X	X	X	X	X	X	X	X
	Network cooperation	Local	X	X	X	X	X	X	X	X
		Regional	X	X	X	X	X	X	X	X
		Inter-regional	X							
		National	X	X	X			X	X	
		European		X	X		X	X	X	
Economic– Market	Market potential	Firm establishments	5.220	7.635	10.085	2.155	1.140	6.435	3.315	13.690
		Employment level	32.420	87.430	100.590	17.400	7.580	60.680	22.230	123.140
	Functional range	Local	X	X	X	X	X			X
		Regional	X	X	X	X	X			X
		Inter-regional	X	X	X					
		National	X	X	X			X		
		European		X				X	X	
Economic– Financial	Investment potential	Ambitions	X	X	X		X	X	X	
		Schemes	X	X			-		X	X

Appendix 7: Results of regression analyses

Variables	(1) Balance (excluding gap funding)	(2) Land revenues	(3) Land assembly costs	(4) Land servicing costs	(5) Plan-making and process costs
Distance to urban centre	0,842	-6,121**	-3,658***	-1,229	-0,625*
	(1,872)	(2,416)	(1,261)	(1,308)	(0,327)
GRP per capita	0,001	0,005***	0,002*	-0,000	0,000
	(0,001)	(0,002)	(0,001)	(0,001)	(0,000)
Residential zoning (0/1)	21,513	22,190	14,630	-12,311	0,602
	(18,466)	(24,735)	(15,529)	(11,114)	(3,202)
Industrial zoning (0/1)	27,386	-44,032*	-25,493**	-31,689***	-7,130**
	(17,622)	(23,459)	(12,274)	(9,890)	(3,086)
Size of the plan area	-0,019	-0,072	-0,091	-0,059	-0,030
	(0,086)	(0,134)	(0,066)	(0,056)	(0,019)
Brownfield (0/1)	-56,486***	68,176***	62,352***	30,514***	11,448***
	(19,857)	(23,677)	(16,254)	(10,564)	(3,400)
Peat and clay soil (0/1)	-14,288	-1,036	3,992	5,183	0,258
	(10,868)	(19,237)	(10,734)	(6,886)	(2,252)
Control variables					
Nominal value (0/1)	-18,930	-4,560	4,572	-7,607	-2,376
	(18,575)	(18,657)	(13,712)	(9,863)	(2,394)
Year 2010 (0/1)	8,741	11,383	5,612	7,888	2,904
	(16,158)	(22,002)	(12,544)	(8,356)	(2,598)
Constant	-102,670*	61,992	64,488	94,450***	26,907***
	(52,002)	(69,496)	(43,049)	(22,840)	(6,748)
Observations	85	87	85	75	76
R-squared	0,200	0,324	0,443	0,389	0,425
Log Likelihood	-474,7	-508,3	-444,1	-358,8	-278,8

Robust standard errors in parentheses
*** p<0,01, ** p<0,05, * p<0,1

Summary

This dissertation aims to clarify the added value of an integrated perspective on corridor development in Europe. As is shown in *Chapter 1*, knowledge on corridors has been developed in a sectoral manner for many years, despite a growing call for an integrated analysis of corridor issues. The integration argument is however lacking specific knowledge on different problem areas. The question therefore remains to what extent an integrated analysis would be beneficial to resolve persistent corridor issues such as the existence of bottlenecks. This dissertation is sensitive to the multi-dimensional nature of corridors and explores the extent to which the various problem areas of corridors (i.e. transport, spatial, institutional, and economic) contribute to an integrated analysis of corridor issues at different spatial scales (i.e. local, regional, [trans-]national). Whether the added value of the integration argument is provable and whether this leads to a restating of the importance of corridors for present-day European policy objectives is also examined. This has resulted in the following main research question:

"To what extent can integrated corridor development be of added value for European policy makers in their governance practices regarding European corridors?"

In answering this research question, *Chapter 2* has analysed the institutional structure of corridors, which has set the agenda for the remaining chapters regarding the opportunities and challenges for integrated corridor development. For after half a century of corridor development in Europe, the corridor concept is well-established in the academic discourse on transportation. Transport corridors have also been common practice in European transport policy since the creation of a borderless Europe in the 1990s. What is largely lacking in present-day research on European transport corridors, however, is a consideration of a sector-transcendent and comprehensive spatial approach. This chapter argues that adopting such an approach is beneficial to a valued analysis of European transport corridors, especially in the light of EU cohesion policy, agglomeration effects and place-based development. Also, negative external effects of persisting bottlenecks on welfare and quality of life in transport corridors should be better assessed and contextualised. This chapter therefore suggests that policy can and should capitalise more on the spatial structure of corridors.

In contrast, *Chapter 3* has focused on the economic structure of corridors. Transport corridors are viewed as a promising way forward in EU transport policy, assumed to contribute positively to regional economic development. However, the validity of this assumption is not evident. The aim of this chapter is to empirically test whether agglomeration economies in European transport corridor regions are positively related to indicators of regional economic development compared to regions outside the scope of corridors. The results build on the notion that the type of agglomeration economy in combination with the structure of the economy matters for prospects of structural economic growth in different regions. In this way, the analysis not only contributes to enhancing the empirical scrutiny of the corridor concept in EU transport policy but also provides new insights into how corridors contribute to regional economic growth.

This chapter only finds limited evidence for a corridor effect across European regions on productivity and employment growth externalities. Instead, a large degree of spatial heterogeneity interacting with corridors is found – a heterogeneity that has been little recognized in EU policies. It is suggested that recent attention to place-based development strategies may accord well with the kinds of agglomeration effects related to corridor development observed in this study.

In the next two chapters, corridor development in Europe has been analysed starting from a transport-oriented perspective. First, bottlenecks have been the most prominent feature of *Chapter 4*. For intermodal transportation is often hampered by bottlenecks in transportation networks. One might therefore expect a large amount of academic and policy research to be available that clearly identifies the characteristics of these problems. However, this is not the case. The knowledge presented is rather fragmented and the range of the bottlenecks presented is wide. It fails to grasp the full extent of the problem and especially the cumulating and culminating effects of bottlenecks, for the scope of the research is often limited to a one-sided (logistics) perspective. A theoretical framework has been created to explore the multiple dimensions of bottlenecks. Empirical results show that a customer perspective, which emphasises the importance of the perspective of direct users of transport infrastructure, is the most prominent aspect lacking in the present understanding of bottlenecks. Furthermore, findings suggest that the conception of bottlenecks should be extended by incorporating other (often sectoral) dimensions to tackle the cumulating and culminating effects of bottlenecks. To conclude, an integrative perspective on the analysis of bottlenecks can add important insights to the present body of knowledge. This can be considered crucial information for policymakers and private parties dealing with bottlenecks in theory and practice.

Second, *Chapter 5* has addressed the heightened need for empirical support regarding the supposed multi-dimensional nature of issues in global freight transportation and corridor development, in which inland ports have been put forward as crucial linkages. However, the present understanding of inland ports appears to be limited to network-based views with a maritime port focus (Outside-In), in which inland ports play second fiddle. It is argued that inland ports as independent structures (Inside-Out) deserve equal consideration and that in addition to the transport dimension, the spatial, economic and institutional dimensions of inland ports are vital and should not be neglected. The aim of this chapter is to apply the concept of port-city challenges to inland ports. The results of an institutional analysis of Dutch case study evidence shows that challenges facing inland ports and cities take many forms but that all share a commonality in the trade-offs between positive and negative externalities. Different governance strategies are observed in coping with these trade-offs and it is found that a pro-active stance towards zoning contributes to efficiently accommodating mutually exclusive dimensions of inland port development.

Finally, the focus of *Chapter 6* has been on the spatial structure of corridors. There is much case study research into the factors that influence the (financial) costs, revenues and results of land development. What is virtually absent in the literature is large-scale

quantitative research in which costs and revenues of land development are systematically related to location features. This chapter reports on research in the Netherlands in which multivariate regression analyses have been carried out on a Dutch dataset to estimate the relative impact of these location features on the costs and revenues of land development. The research shows that much of the financial variance can be explained by basic location features. In particular, previous land use (brownfield versus greenfield) seems to play a key role in understanding the financial structure of land development. What is especially interesting, however, is the observation that the factors that hamper the financial feasibility of land development projects are exactly those factors that are considered crucial in corridor development. This finding seems to be pleading against the integration argument presented in the first chapter. In *Chapter 7*, the findings of *Chapter 2* to *Chapter 6* have therefore been related to the research question as was posed in *Chapter 1*.

To conclude, this dissertation has focused its attention on the question whether the added value of an integrated approach towards corridor development is provable. On basis of five contributions that cover a variety of dimensions and scales in corridor development (*Chapter 2–6*), it has been shown in *Chapter 7* that integrated corridor development is inconsistent within itself, which affects the problem-solving capacity of the corridor concept. One side of the debate highlights the inevitable relatedness of the multi-dimensional nature of corridor issues. It is also stressed in this respect that integration 'works' when the initial situation is dominated by a sectoral transport-oriented perspective. The other side of the debate is largely based on the observation that the empirical evidence consistently invalidated the importance of corridors for growth and agglomeration. Evidence from the spatial dimension also is in conflict with integration, because the factors that are important for integration are the same factors which hamper the financial feasibility of land development projects. These findings are difficult to match with the integration argument, which reinforces the conclusion from the institutional dimension that the sectoral-based practices of corridor development in Europe are not really surprising.

The overall conclusion concerning the integration argument in corridor development therefore is that the contribution of an integrated approach to efficient corridor development is certainly not self-evident, but not irrelevant either. The findings are not conclusive in supporting either side of the integration argument. However, in general this dissertation has contributed to nuance the debate regarding corridors and integration. It is shown that, although the empirical evidence in some cases is contradicting the integration argument in corridor development, corridors can still be seen as useful linkages between regions sharing a commonality in their respective issues. Although integration in some cases is beneficial, and although corridors in some cases provide common ground for interregional to transnational problem-solving, it is argued that for truly efficient corridor policy to succeed, more attention should be paid to place-based development strategies and the importance of institutions.

Samenvatting

Het doel van dit proefschrift is om inzicht te krijgen in de meerwaarde van een integraal perspectief op corridor ontwikkeling in Europa. Zoals in *Hoofdstuk 1* naar voren is gebracht, is kennis over corridor ontwikkeling sinds jaar en dag op sectorale wijze verzameld en ontwikkeld, ondanks een toenemende vraag van Europese beleidsmakers naar een meer integrale benadering van corridor vraagstukken. Er ontbreekt echter specifieke kennis op verschillende probleemgebieden om een integrale benadering van corridor vraagstukken aannemelijk te maken. Het blijft daarom de vraag in hoeverre een integrale benadering van corridor vraagstukken potentie heeft om bij te dragen aan ruimtelijke oplossingen voor hardnekkige corridorproblemen, zoals het bestaan van knelpunten ('*bottlenecks*') in intermodaal goederenvervoer. In dit proefschrift wordt daartoe een multi-dimensionaal raamwerk aangedragen, dat kan bijdragen aan een integrale analyse van verschillende probleemgebieden van corridors (dat wil zeggen op het gebied van transport, ruimte, instituties en economie), op verschillende ruimtelijke schaalniveaus (lokaal, regionaal en [trans-]nationaal). Er wordt onderzocht of de meerwaarde van het integratie argument aantoonbaar is, en of dit vervolgens leidt tot een herwaardering van het belang van corridors voor hedendaags Europees (ruimtelijk) beleid. Dit heeft geleid tot de volgende centrale onderzoeksvraag:

"In hoeverre kan integrale corridor ontwikkeling van toegevoegde waarde zijn voor de strategieën van Europese beleidsmakers met betrekking tot Europese corridors?"

Om deze vraag te kunnen beantwoorden, is in *Hoofdstuk 2* gestart met het analyseren van de institutionele dimensie van corridors. Dit heeft het routeboek voor de resterende hoofdstukken bepaald wat betreft de kansen en uitdagingen voor integrale corridor ontwikkeling. Het is gebleken dat na een halve eeuw van corridor ontwikkeling in Europa het concept 'corridor' goed vertegenwoordigd is in het academische transportdiscours. En transport corridors zijn sinds het wegvallen van de Europese binnengrenzen in de jaren '90 van de vorige eeuw ook gemeengoed geworden in het Europese transportbeleid. Waar het echter aan ontbreekt in het huidige onderzoek naar Europese transport corridors is een inachtneming van een sectoroverstijgend en omvattend ruimtelijk perspectief op corridors. In dit hoofdstuk wordt aangedragen dat het toepassen van een dergelijk perspectief van toegevoegde waarde is voor een weloverwogen analyse van Europese transport corridors, in het bijzonder in de context van Europees cohesiebeleid, het optreden van agglomeratie effecten en de opmars van het idee van plaatsgebonden ontwikkeling ('*place-based development*'). Daarnaast draagt een dergelijk integraal perspectief bij aan het beter beoordelen en contextualiseren van negatieve externe effecten van hardnekkige transportknelpunten op welvaart en kwaliteit van leven in corridors. Dit hoofdstuk ondersteunt daarom de boodschap dat (Europese) beleidsmakers meer zouden kunnen en moeten inzetten op de ruimtelijke dimensie van Europese transport corridors.

Daarentegen wordt in *Hoofdstuk 3* eerst de economische dimensie van corridors aan het voetlicht gebracht. Transport corridors worden namelijk gezien als een

veelbelovende stap voorwaarts in Europees transportbeleid, onder de aanname dat corridors positief bijdragen aan regionaal-economische ontwikkeling. Echter, de geldigheid van deze aanname wordt niet overtuigend ondersteund door empirisch materiaal. Het doel van dit hoofdstuk is daarom om empirisch aan te tonen of agglomeratie effecten in regio's die behoren tot Europese transport corridors al dan niet positief gerelateerd zijn aan indicatoren van regionaal-economische ontwikkeling, in vergelijking met regio's die buiten de invloedsfeer van corridors vallen. De resultaten van dit hoofdstuk bouwen voort op het idee dat het type agglomeratie effect in combinatie met de structuur van de regionale economie doorslaggevend is voor toekomstige patronen van structurele economische groei in verschillende regio's. Op deze manier dragen de resultaten niet alleen bij aan het verstevigen van de empirische basis van het corridor concept in Europees transportbeleid, maar wordt tegelijkertijd nieuw inzicht verschaft in hoe corridors al dan niet bijdragen aan regionaal-economische groei van regio's. In dat opzicht wordt er slechts beperkt ondersteunend bewijsmateriaal gevonden voor een positieve bijdrage van corridors op productiviteit- en werkgelegenheidsgroei (plus effecten daarvan) in Europese regio's. Daarentegen wordt een grote mate van ruimtelijke verscheidenheid gevonden, die interacteert met het beoogde corridor effect – een verscheidenheid die tot op heden onvoldoende erkend wordt in Europees beleid. Er wordt daarom voorgesteld dat de recente aandacht in beleid voor plaatsgebonden ontwikkelingsstrategieën goed kan samenvallen met de invloed van verschillende typen agglomeratie effecten gerelateerd aan corridor ontwikkeling, zoals die in dit hoofdstuk aangetoond zijn.

In de volgende twee hoofdstukken worden corridors benaderd vanuit een transport-geörienteerd vertrekpunt. Te beginnen in *Hoofdstuk 4* met de betekenis van knelpunten ('*bottlenecks*') voor corridor ontwikkeling. Effectief intermodaal goederenvervoer wordt in veel gevallen namelijk belemmerd door de aanwezigheid van knelpunten en het optreden van flessenhalseffecten in het Europese transportnetwerk. Het valt daarom te verwachten dat er een scala aan academisch en beleidsmatig onderzoek beschikbaar is dat op heldere wijze deze problemen karakteriseert en in kaart brengt. Dit blijkt echter niet het geval te zijn; het begrip van deze knelpunten is tot dusver incompleet gebleken. De beschikbare kennis over knelpunten is gefragmenteerd, en de spreiding van de geïdentificeerde knelpunten is breed. De beschikbare kennis over knelpunten slaagt er niet in om de volledige omvang van het probleem te vatten, met in het bijzonder aandacht voor de cumulerende en culminerende effecten van die knelpunten. Dit lijkt voort te komen uit het eenzijdige (logistieke) perspectief dat in veel studies gehanteerd wordt. Om die reden wordt er in dit hoofdstuk een sectoroverstijgend theoretisch raamwerk aangedragen dat het multi-dimensionale karakter van knelpunten centraal stelt. De empirische bevindingen uit dit hoofdstuk tonen op systematische wijze aan dat een zogenaamd 'klantenperspectief', dus een perspectief dat het belang van directe gebruikers van infrastructuur centraal stelt, het meest prominente aspect is dat momenteel ontbreekt voor een adequaat begrip van knelpunten. Daarnaast wordt gesuggereerd dat het begrip van knelpunten uitgebreid zou moeten worden door meerdere (sectorale) dimensies toe te voegen, om zodoende de cumulerende en culminerende effecten van knelpunten het hoofd te bieden. Concluderend kan gesteld worden dat een integraal perspectief op de analyse van

knelpunten belangrijke nieuwe inzichten kan toevoegen aan de bestaande kennis over die knelpunten. Hier zouden zowel beleidsmakers als private partijen die zich bezighouden met goederenvervoer hun voordeel mee kunnen doen in de dagelijkse ruimtelijke praktijk.

Vervolgens wordt in *Hoofdstuk 5* stil gestaan bij het ontbreken van een empirische basis voor de veronderstelde multi-dimensionale problematiek van mondiaal goederenvervoer en corridor ontwikkeling, waarbij binnenhavens naar voren worden geschoven als cruciale verbindingen voor efficiënt transport. Desalniettemin blijft het huidige begrip van de positionering van binnenhavens beperkt tot een netwerk-gebaseerd perspectief met een dominante focus op maritieme havens ('van buiten naar binnen'). Hierbinnen is weinig ruimte voor het onafhankelijk functioneren van binnenhavens. In dit hoofdstuk wordt voorgesteld dat deze benadering van binnenhavens ('van binnen naar buiten') een gelijke behandeling verdient; als aanvulling op het netwerkperspectief uit de transportdimensie zou er gelijke aandacht moeten zijn voor de ruimtelijke, economische en institutionele dimensies van binnenhavens. Met andere woorden, het doel van dit hoofdstuk is om het (maritieme) concept van conflicten tussen haven en stad ('*port-city challenges*') toe te passen in de context van binnenhavens. Resultaten van een institutionele analyse van case study materiaal uit Nederland tonen aan dat conflicten tussen binnenhavens en steden vele vormen kunnen aannemen. Een gemeenschappelijke deler is echter de middenweg die vaak gekozen wordt tussen positieve en negatieve externe effecten van binnenhavens op het nabijgelegen stedelijk gebied. In de resultaten worden verschillende '*governance*' strategieën waargenomen, die allen op een eigen manier invulling geven aan de balans tussen positieve en negatieve externe effecten. In de regel wordt een proactieve houding ten aanzien van (her-)bestemming aangemoedigd om tot een effectieve afstemming van verschillende ruimtevragende functies te komen bij de ruimtelijke ontwikkeling van binnenhavens.

Ten slotte heeft *Hoofdstuk 6* zich gefocust op de ruimtelijke dimensie van corridors. Er wordt veel geschreven en gesproken over de financiële (on)haalbaarheid van gebiedsontwikkeling. Tegelijkertijd ontbreekt het in de literatuur vaak aan een kwantitatieve, empirische basis voor de beweringen. In dit hoofdstuk is geprobeerd om aan de hand van een dataset bestaande uit grondexploitaties van Nederlandse gebiedsontwikkelingsprojecten op een systematische, kwantitatieve manier de grondexploitatiekosten, de opbrengsten en de exploitatiesaldi te verklaren. Het onderzoek toont aan dat veel van de variatie in de financiële onderbouwing van gebiedsontwikkelingen verklaard kan worden aan de hand van basale gebiedskenmerken. De ligging binnen het stedelijk gebied en de relatie van het huidige gebruik tot het oorspronkelijke grondgebruik dragen in het bijzonder bij aan het verklaren van de financiële (on)haalbaarheid van gebiedsontwikkelingsprojecten. Wat daarentegen bijzonder interessant is, is de observatie dat de factoren die de financiële haalbaarheid van gebiedsontwikkelingen in het geding brengen, juist die factoren zijn die van belang zijn voor succesvolle corridor ontwikkeling. Deze uitkomst lijkt in contrast te staan met het integratie argument dat in *Hoofdstuk 1* naar voren is gebracht.

Daarom worden in *Hoofdstuk 7* de bevindingen van *Hoofdstuk 2* tot en met *Hoofdstuk 6* gespiegeld aan de onderzoeksvraag zoals die gesteld is in *Hoofdstuk 1*.

Concluderend heeft in dit proefschrift de vraag centraal gestaan in hoeverre een integrale benadering van corridor ontwikkeling een toegevoegde waarde heeft die empirisch aantoonbaar is. Op basis van vijf bijdragen – die gezamenlijk een breed scala aan dimensies en ruimtelijke schalen van corridor ontwikkeling bestrijken (*Hoofdstuk 2–6*) – is aangetoond dat integrale corridor ontwikkeling intern inconsistent is, wat het probleemoplossend vermogen van het corridor concept danig ondermijnt. De ene kant van het debat wordt gevormd door het benadrukken van de onoverkomelijke verwantschap van corridor vraagstukken, gegeven het multi-dimensionale karakter van corridors. In dit verband wordt er ook op gewezen dat integratie 'werkt' wanneer de uitgangssituatie wordt gedomineerd door een sectoraal georiënteerd transport perspectief op corridor ontwikkeling. De andere kant van het debat is grotendeels gebaseerd op de observatie dat het aangedragen empirisch materiaal op consistente wijze het belang van corridors voor economische groei en positieve agglomeratie effecten weerlegt. Resultaten vanuit de ruimtelijke dimensie van corridors zijn ook in conflict met het integratie argument, gezien de factoren die belangrijk zijn voor integratie gelijk zijn aan de factoren die de financiële haalbaarheid van gebiedsontwikkelingsprojecten negatief beïnvloeden. Deze uitkomsten zijn lastig te koppelen met het integratie argument. Dit versterkt de conclusie vanuit de institutionele dimensie van corridors dat de sectoraal georiënteerde praktijk van Europese corridor ontwikkeling niet verrassend is.

De slotconclusie wat betreft het integratie argument moet daarom luiden dat de toegevoegde waarde van een integrale benadering voor efficiënte corridor ontwikkeling zeker niet vanzelfsprekend, noch algeheel irrelevant is. De bevindingen zijn niet onweerlegbaar ondersteunend vóór of tegen het integratie argument. In het algemeen kan echter wel gesteld worden dat de uitkomsten van dit proefschrift bijdragen aan een nuancering van het debat over de meerwaarde van integrale corridor ontwikkeling. Er is aangetoond dat – hoewel de empirische bevindingen in sommige gevallen contrasterend zijn aan het integratie argument – corridors desalniettemin gezien kunnen worden als nuttige schakel tussen regio's die overeenkomsten delen in hun respectievelijke ruimtelijke vraagstukken. Ten slotte – hoewel integratie in sommige gevallen heilzaam kan zijn, en hoewel corridors in sommige gevallen gemeenschappelijke grond bieden voor het transnationaal oplossen van ruimtelijke vraagstukken – wordt er benadrukt dat er meer aandacht zou moeten zijn voor strategieën die gebaseerd zijn op de principes van plaatsgebonden ontwikkeling en het belang van instituties om tot daadwerkelijk efficiënt beleid te komen aangaande Europese corridor ontwikkeling.

Curriculum Vitae

Patrick Albert Witte (1988) was born in Den Helder and spent his childhood on the island of Texel, where he finished college in 2006. He completed his Bachelor's study in Human Geography and Planning at Utrecht University (2006–2009), where he also obtained his testimony at the Honours College Geosciences (2007–2009) and graduated cum laude from his Master's study in Urban and Regional Planning (2009–2010). Before starting his PhD study, Patrick worked in a stationery shop on Texel for nearly seven years, worked as a student assistant at Utrecht University and worked as a trainee at the PBL Netherlands Environmental Assessment Agency. During his PhD study (2010–2013) he participated in various academic courses and was awarded the first prize for best PhD poster on seaport research during the first Erasmus SmartPort conference (2012). He has recently obtained a Postdoc position in the Urban and Regional Planning section of Utrecht University. For the next years, he will be working on infrastructure planning and integrated area development within the framework of the research programme 'Governance for Sustainable Spatial Development'.

Alongside his working and marital life, Patrick's main passion is endurance sports such as running, walking and cycling. He regularly participates in running events and has a 'Dream of a Lifetime' to finish the 60K ultra run 'De Zestig van Texel'. Between 2003 and 2010 he completed the 60K walking trail 'Rondje Texel' seven times. Since 2011, Patrick has been actively involved in the committee for road and recreational running events of the 'Phoenix' athletics association in Utrecht. In 2012 he cycled 475K from Texel to Limburg to traditionally pick up his bride from her parental home in Palemig, Heerlen. Patrick is also interested in Christianity and travelling. In 2010 he performed charity work and participated in a missionary work project in Berehove, Ukraine. He currently lives in Ede with his wife Lisan, raising their young Golden Retriever, Lewis.