EXPLORING THE MUTUAL RELATIONSHIP BETWEEN AIR PASSENGER TRANSPORT AND ECONOMIC DEVELOPMENT

A QUANTITATIVE STUDY AT VARIOUS SPATIAL SCALES

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Exploring the mutual relationship between air passenger transport and economic development

A quantitative study at various spatial scales

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PREFACE

Ik herinner het me nog goed, een willekeurige zondagmorgen (een van de vele), ergens aan de landingsbaan van Zaventem in Steenokkerzeel: vliegtuigen spotten met mijn papa en broers. De ronde snuit van de 737, de staartmotor van de Tupolev, de 4 motoren van de 747, ... Dit werd steevast gevolgd door een tripje naar de luchthaven, waar we met een cola vanuit de cafetaria naar de taxiënde en opstijgende vliegtuigen keken. Als kind vond ik het zo fascinerend allemaal. Ik wist echter nog niet dat diezelfde vliegtuigen een kleine 20 jaar later zo'n grote rol zouden hebben gespeeld in de voorbije 4 jaar van mijn leven.

Het leek als kind allemaal heel simpel: viegtuigen stegen op en landden, en mensen vlogen met de luchtvaartmaatschappij van hun land, zoals Sabena. Alleen Amerika had verschillende maatschappijen, maar ja, dat was ook wel een heel groot land... Zoveel jaren –en een doctoraatsstudie later- blijkt het allemaal net dat ietsje ingewikkelder te zijn. Ik weet er nu natuurlijk meer van dan vroeger, maar het luchtvaartlandschap is ook gewoon erg geëvolueerd en complexer geworden. Termen als deregulering, allianties, code-sharing, ... worden steeds meer relevant. Nieuwe luchtvaartmaatschappijen verschijnen en verdwijnen weer. Ook de luchthaven van Zaventem heeft een ware metamorfose ondergaan. Eén ding is echter gelijk gebleven: ik heb nog altijd een speciaal gevoel als ik in een luchthaven ronddwaal, en kan nog steeds genieten van het 'vliegtuigkijken', al is dat nu vaak met een koffie in de hand, terwijl ik zelf aan de gate aan het wachten ben tot ik aan boord kan gaan.

En koffie heb ik vaak nodig gehad tijdens mijn doctoraat... Het is een heel leerrijk proces geweest, al was het niet altijd even makkelijk. Veel mensen stonden echter achter mij en hebben me gesteund en gestimuleerd. En die personen wil ik uiteraard bedanken. In de eerste plaats zijn dat mijn twee promotoren, Prof. Ben Derudder en Prof. Frank Witlox, die mij gedurende die vier jaar alle kansen hebben gegeven om mijn onderzoek tot een goed einde te brengen, elk op zijn eigen manier. Ik wil Ben bedanken om mij toch altijd te stimuleren als ik weer eens mijn eigen analyses afkraakte, en om in die vier jaar tijd uit te groeien van een promotor naar een echte 'begeleider'. Ik wil Frank bedanken voor de wijze waarop hij, vanuit zijn jarenlange ervaring en met een zekere kalmte en rust, alles 'piece of cake' kon laten lijken (wat het uiteraard allesbehalve was). In het bijzonder wil ik ook Professor O'Connor van Monash University in Melbourne bedanken om tijdens de latere jaren van mijn doctoraat steeds klaar te staan met gepast advies: Thank you, Prof. O'Connor for giving me the much-needed advice in the last years of my PhD. Bovendien zijn er ook nog mijn lieve collega's van binnen de SEG, maar ook van in de 'refter op het tweede verdiep', waarmee ik vele ontspannende

lunches en ‘taartjes van de week’ heb mogen doorbrengen. Hierbij moet ik zeker ook Helga en Nathalie vermelden, die ik met hun organisatietalent en relativeringsvermogen als de twee ‘sterke madammen’ van de geografie beschouw, en die steeds een luisterend oor voor mij hadden.

Uiteraard zijn er ook nog de mensen die net iets dichter bij mij staan, mijn familie en vrienden. Ik wil eerst en vooral mijn ouders bedanken voor hun onvoorwaardelijke steun, zeker in de momenten dat ik het moeilijk had. Als kind zei ik vaak heel naïef dat ik ‘de beste mama en papa in de hééél wereld’ had, en met volwassen worden besef ik dat dat niet gelogen was. Dan zijn er ook nog mijn broers Yves en Kristof. Bedankt, Yves, om als trotse grote broer steeds klaar te staan met goede raad, en bedankt, Stof, om me steeds weer aan het lachen te kunnen brengen, zeker tijdens die laatste maanden (wieziterieropmijnestoel?). Als laatste zijn er ook nog mijn vrienden, zowel die ‘van de geografie’ en die ‘van SFI’, met wie ik al jaren fantastische momenten beleef (en er hopelijk nog veel zal mogen beleven).

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CHAPTER 1

Introduction

1.1 General aim of this dissertation

The overall aim of this dissertation is to contribute to ongoing research on the reciprocal and complex relationships between air passenger transport[1] and economic development. It is generally acknowledged that air passenger transport contributes to the economic development in countries and regions. Hence, just like other transport infrastructure investments such as road and rail transport, it is therefore a quite often used policy instrument to stimulate economic growth and development (Berechman, 1994). Air transport does not only contribute to the economic welfare of individuals (ATAG, 2012) and the productivity level of companies through the provision of better connectivity and enlarged markets (Zak and Getzner, 2014), but it can also stimulate trade (Cristea, 2011) and is indispensible for tourism (Lim, 1999). However, to date relatively little attention has been devoted to (i) the fact that air passenger transport does not always lead to economic growth and development, just as other transport infrastructure investments do not always fulfill the proposed expectations, and (ii) the endogeneity (i.e. simultaneous causality) in the relationship between air passenger transport and economic development, which instigates air passenger transport as well. These are two important observations that need to be taken into account when considering and estimating the importance and relevance of air passenger transport as a method for stimulating development at multiple spatial levels. This dissertation tries to contribute to the scienitific litearture by addressing both issues. This is achieved by considering the heterogeneity and the causal linkages in the air passenger transport-economic development relationship with the overall aim to gain a deeper insight in the link between air transport and economic development, especially in the light of air transport's use as a policy instrument for development.

[1] Although air freight transportation also interacts strongly with economic development, the focus in this dissertation is on air passenger transport. Air passenger transport is the preferred mode of long-distance international travel and in this way links and affects distant places and people across all aspects of the economy, while the characteristics of the relationship between air cargo transport and economic development are mostly linked to trade. Additionally, long distance freight transport is generally transported through ships, road and rail, while air cargo is often restricted to specific goods (e.g. high-value goods and perishables).

Against the backdrop of globalization and liberalization processes, I will approach the relationships between air passenger transport and economic development from different geographical perspectives and by using different quantitative methods. The main objective is thus not only to contribute to a more refined understanding of the general interaction between air transport and economic development, but above all to gain insight into some of its regional articulations.
In addition to using standard regression-type analyses that allow verifying the interaction between air passenger transport and economic development, I introduce the Granger causality method which allows deepening our understanding by bringing the element of mutual causality to the fore. In this way, I focus on four general research objectives throughout this dissertation: (i) discern some of the determinants of, and their respective importance for, air passenger transport, (ii) study in what ways and to what extent air passenger transport influences economic development, (iii) reveal some of the signs of causality between economic development and air passenger transport, and (iv) determine some of the intervening factors in this relationship. These objectives are translated into a series of more detailed research questions, which I address at the end of this introductory chapter.

To this end, this introductory chapter is organized as follows. First, I illustrate the context in which the relationships between air passenger transport and economic development should be understood. Key processes are economic development in its own right, increased market integration, air transport liberalization and technological advances in the air transport industry. This is followed by the theoretical framework, on the basis of which I spell out the variegated spatial expressions of the relationship between air passenger transport and economic development. Drawing on this literature review, the chapter concludes with an overview of the structure of dissertation, which will be organized around the research questions.

1.2 The context: Four major drivers

In this dissertation, I define four major processes that have contributed to the expansion of air passenger transport. These are economic development, economic integration, air transport liberalization and technological improvements in the air transport industry. These will be discussed in this section, before setting out the theoretical framework of the relationships between air passenger transport and economic development in 1.3.

1.2.1 Economic development

There is an obvious two-way relationship between air passenger transport and economic development. After World War II, air passenger transport grew at an increasing rate (Figure 1.1). In this way, it became a prominent transport mode, enveloping the world gradually with an extensive – albeit uneven distributed- air transport network, providing increasing connectivity between states, regions and cities. Air transport has become essential for business in increasingly integrated markets at various scales: it improves access to markets, facilitates trade and stimulates investments and employment. Air transport is also indispensable for tourism, as estimations indicate that about half of international tourists travel by air (ATAG, 2014). According to ATAG (2014), aviation's global economic impact - the combination of direct, indirect, induced and catalytic effects- was estimated at US $2.4 trillion for 2012, which is equivalent to 3.4% of global Gross Domestic Product. These kinds of numbers illustrate that the aviation industry has enabled economic growth at the aggregate level. In turn, growth in the worldwide economy, which was characterized by scale increases, generated the need for more air passenger travel and increasing international connections; and this can be provided through an extensive air transport network.

This overall mutual relationship is also articulated at other geographical levels. On the one hand, air transport influences urban and regional economic development in several ways: it increases consumer welfare benefits in regions through increased availability of transport and travel connections, it is indispensable for tourism, and it enhances the productivity level of companies located in the region due to increased accessibility to and from other markets, and it attracts investments (ATAG, 2012). On the other hand, the socio-economic profile of a city, region or country is critical for the generation of air transport (Goetz, 1992). Well over 50 years ago, Taaffe (1956, 1962) already pointed to the close parallels between the US urban system and the distribution of air traffic. He emphasized that larger cities and cities with specific functions, such as commercial or holiday centers, were characterized by larger passenger volumes. Also Barnes (1946, as cited in Derudder and Witlox, 2014) predicted that:

> *The growth in the volume of air travel has permitted the inauguration of express services which, with the availability of large long-range equipment, will encourage direct and nonstop services between the major metropolitan centers. For the future […] carriers will be offering two types of services: the conventional services between all important cities and direct nonstop express services wherever the traffic volumes justify.*

In other words, the economic growth in cities has always been closely related with the development of air transport infrastructures connecting them (Derudder and Witlox, 2014). Since then, many researchers –transport economists, geographers, and sociologists alike- have reiterated this mutual relationship between the provision of air transport connectivity and urban and regional development (Button and Lall, 1999; Irwin and Kasarda, 1991; O'Connor and Scott, 1992).

It is however essential to see this mutual relationship in a wider framework – there are number of processes shaping its contours. Globalization processes, for example, influence the way in which cities and regions are interconnected, and therefore influence the need for air transport connections between those cities or regions. In the same way, regulation and liberalization of the air transport industry determines the development of air transport networks, which has implications on which cities or regions are being served. Both globalization and liberalization have facilitated the substantial increase of air passenger traffic, although this influence and increase is not distributed evenly. This increase has become possible in the realm of technological innovation in the air transport sector.

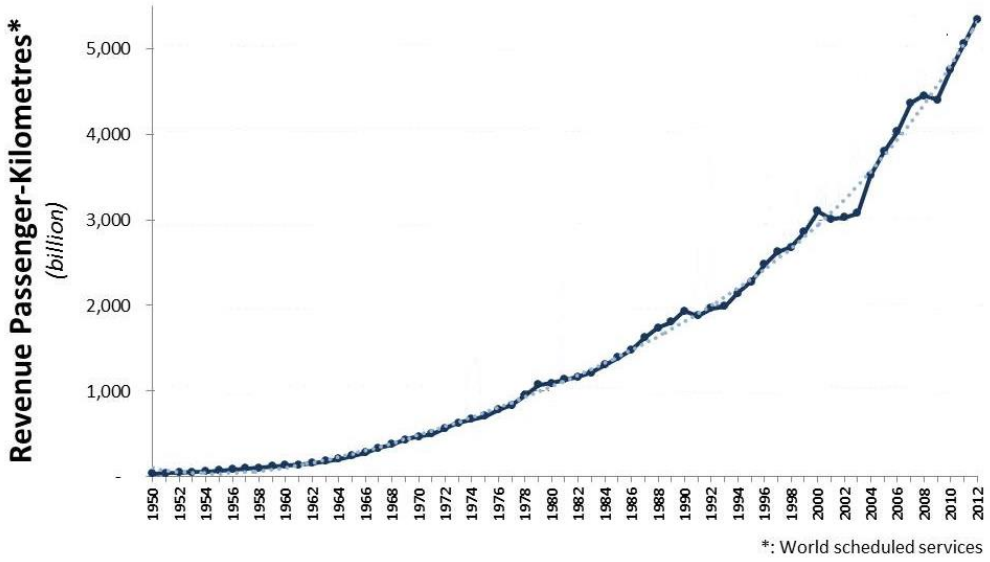

Figure 1.1 Evolution of air passenger traffic (1950-2012) in Revenue Passenger-Kilometres
Source: ICAO, 2014. Retrieved from: http://www.icao.int/sustainability/Pages/Facts Figures_WorldEconomyData.aspx

It is necessary to specify what is actually meant with 'economic development' as it is used in this dissertation, as this is a broad term that does not have a single, unique definition. The definition of the International Economic Development Council (IEDC, s.d.) probably best approximates the meaning of economic development adopted throughout this dissertation: '*Economic development*

can be described as a process that influences growth and restructuring of an economy to enhance the economic well being of a community'. The World Bank (2003) states that *'the main indicator of economic development is increasing GDP per capita, reflecting an increase in the economic productivity and average material wellbeing of a country's population'*[2]. However, in this dissertation, economic development will not only be measured through GDP per capita, but also through increases in international trade flows (Chapter 4), and employment growth (Chapter 5)[3]. As such, the concept should be seen here as an expansion of the economic activity at different scales: the international, national or regional scale. It is, in this sense, closely related to economic growth, which Berechman (1994: 354) defines as '*a process of increase in the level of output per capita [...] given the inputs'.* But unlike economic growth, which is generally a short run concept, economic development is a long term commitment and implies a restructuring of the economy (Worldbank, 2003). This is an important notion in this dissertation: air passenger transport *can* (subject to certain conditions) change the structure of an economy and a major purpose of this dissertation is to identify those conditions. Focus lies on the '*economic* well-being', but air transport has of course also negative impacts, such as the ecological impact from the greenhouse gas emissions of aircrafts, and negative environmental consequences at the urban and regional level, such as from infrastructure expansion (e.g. noise) (Berechman, 1994). Additionally, it should be emphasized that the advantages of air passenger transport are not equally spread and is often only beneficial for a small part of the population.

1.2.2 Increased interconnectedness through economic integration and upscaling

The literature argues that the need for air passenger travel has increased in the last decades, due to processes of 'globalization' (Cidell, 2006). Globalization is a complex conception, and generally refers to processes that embody a transformation in the spatial organization of relations and transactions, generating transcontinental or interregional flows and networks of activity, interaction and power. This transformation comprises a broadening, deepening and speeding up of world-wide interconnectedness in all aspects of life, from the cultural to the economic, the financial to the environmental (Held and McGrew, 2000). This definition is however very broad and in this

[2] The World Bank approaches economic development from a country perspective. The World Bank defines 'economic development' as the '*qualitative change and restructuring in a country's economy in connection with technological and social progress'.*

[3] GDP per capita is a variable that is available and comparable on a wide scale and is therefore often used as a proxy to quantify economic development (Fernandes and Pacheco, 2010). In the same way, also trade, employment and investment are regularly used to represent economic development (Nijkamp, 1986). This dissertation employs GDP per capita, trade and employment as proxies for economic development, due to the availability of reliable data sources in each of the different chapters.

dissertation I predominantly focus on economic globalization, which is the increasing *economic integration* and *interdependence* of national, regional and local economies across the world through a stretching and an intensification of cross-border movement of goods, services, technologies, people and capital (Dicken, 2011). The world-wide (air) transport systems in turn increase the velocity of the diffusion of these goods, information, capital, and people, and enable globalization (Button, 2008; Cidell, 2006).

Especially the period after World War II is of interest here, as it is a period in which the air transport industry began its continued expansion, which was not solely driven by economic development (as measured through GDP, cf. 1.2.1). Cidell (2006) has argued that particularly the emergence and multiplication of the transnational organization of firms, a typical feature of economic integration, and the simultaneous increase in trade have been more relevant for increases in air transport. Transnational companies (TNC) and trade are interconnected as (i) TNCs are characterized by increasing complexity and geographical fragmentation of their production networks (Dicken, 2011), (ii) their intra-firm trade has intensified and been transferred over increasing distances (Feenstra, 1998), and as such (iii) they have become responsible for two-thirds of world exports of goods and services, and also international trade flows. Foreign direct investment, of which TNCs are a major source (e.g. when setting up an affiliate), has even grown faster than trade, in particular from the 1980s onwards (Held and MGrew, 2000). In the TNCs's business networks, efficient processing and transmitting of information and face-to-face contacts are extremely important (Dicken, 2011). As the activities of TNCs are geographically very dispersed (e.g. tendency to separate production from management functions, cf. Bel and Fageda, 2008), air passenger transport is crucial for these interpersonal contacts. Dicken (2011) explicitly links the emergence of TNCs and the take-off of commercial jets as they both occur in the same time frame: '*it (cf. the jet) enabled unprecedentedly rapid individual travel over vast distances, allowing face-to-face meetings at times and in places hitherto unrealistic [...] jet transport made possible the coordination and control of geographically dispersed operations. Direct control at a distance became a reality*'. Also for trade in general, Poole (2013) recognizes that air passenger travel is essential: '*business travel is a necessary input to international trade, and business travel may also be generated by trade*'.

These processes could only have occured because of the partial reduction of trade and investment barriers. At the same time, barriers to the movement of freight and people through the air decreased, among else through liberalization in the air transport sector (cf. 1.2.3) and technological improvements (cf. 1.2.4).

All this indicates that economic integration has grown at a much faster rate than economic development as such, and has been a factor accounting for the intensification of air passenger transport across national and regional boundaries.

1.2.3 Liberalization of the air transport industry

Growth of trade and investment was facilitated by the liberalization of the world economy through the reduction of trade and investment barriers. This did not only affect the demand for air passenger transport, but also the organization of the air transport industry, through air transport liberalization.

The liberalization of the air transport market started in the United States with the Air Deregulation Act in 1978, which had profound implications for domestic airlines and passengers (Budd and Goetz, 2014). The abolition of governmental controls on market entry, frequency, capacity and pricing had several implications. One major result was an increase in competition on many domestic routes, which drove down air fares on those routes, and which was intensified by the rise of low-cost carriers (LCC) (Bowen, 2010). Another major outcome was that passengers enjoyed better service levels because of among things higher frequencies, more routes and frequent flyer programs (Fu and Oum, 2014). These latter benefits arose due to the development of hub-and-spoke networks, which is discussed later on in this chapter. These two trends together increased demand for air travel. Additionally, to be able to cope with the higher competition environment, airlines were forced to rationalize their operations (e.g. through consolidation, Computer Reservation Systems). These efficiency gains have been passed on to the passengers as lower air fares, which subsequently raised demand. Button (1998), for example, estimated that domestic US passenger traffic during 1979-1988 grew by 55 percent. This heightened growth has, in turn, implications on economic growth.

These effects of liberalization on economic growth and development have not only occurred in the US, but equally in other countries where liberalization took shape: urban regions' surrounding airports receiving more traffic have profited through direct, indirect, induced and catalytic effects (which will be spelled out in more detail later in this Chapter), while countries as a whole have prospered through stimulation of trade and tourism. However, liberalization's positive indirect impact on economic growth through the chain illustrated in Figure 1.2 is distributed unevenly across countries and regions, and has sometimes proved to be outright negative. For instance, remote regions in the United States of America that were protected by regulation prior to liberalization, suddenly faced dangers of being cut-off, and instruments needed to be developed to re-secure air passenger travel, such as the Essential Air Service Program (EAS) that subsidizes carriers to provide minimal service on specific routes (Braathen, 2011).

Liberalization	⇨	Additional air services (increased competition, and lower air fares)	⇨	Traffic growth	⇨	Economic growth

Figure 1.2 The influence of air transport liberalization on economic growth (based on InterVISTAS, 2006)

After liberalization, airline networks have tended to consist of two main forms: point-to-point and hub-and-spoke networks. Today, point-to-point routes are generally performed between cities where the demand is large enough to execute direct flights[4], such as New York - London (cf. Barnes, 1946), and are also associated with LCCs. Initially, the 'no frills' approach of these LCCs -such as fleet simplicity, fast turnaround times, minimal flight service, and emphasis on secondary airports- lowered their operation costs and enabled them to offer lower fares than the already established full-service carriers (FSC). Currently, the LCC-business model has evolved and has become more differentiated. Some LCCs also implement hub-and-spoke networks, for example, and increasingly serve major airports (Cook and Goodwin, 2008; Dobruszkes, 2013). It must also be noted that liberalization has led to the opening up of new niche markets in some cases (Dobruszkes, 2006). These are routes that are served by only one airline, and that can be cheap or -on the contrary- quite expensive, even if they are being served by an LCC. The increased competition, due to the entrance of these LCCs and other new airlines, made many airlines disappear through bankruptcies, mergers, and acquisitions (Goetz and Sutton, 1997). This consolidation resulted in a limited number of major FSCs that have survived.

The remaining FSCs are continuously forced to look for improved efficiency and productivity in order to reduce costs. One strategy was the reinforcement of hub-and-spoke networks. In these networks, passengers departing from a non-hub (spoke) city bound to another spoke are first flown to the hub[5] where they connect to a second flight to the destination (Cook and Goodwin, 2008). Hence, airlines "bundle" traffic at a hub airport by drawing on a number of incoming flights to provide passengers for outbound flights, this within a limited time span to minimize connection time (Bowen, 2010; Burghouwt, 2007). Four important advantages spring from this strategy, of which the three first concern economies of density. Lower per passenger costs are obtained by (i) attaining higher load factors and (ii) using larger aircraft, enabled by the "bundling" of passengers. An example is Delta Airlines, who receives passengers from other US airports at its Atlanta hub in order to serve its trans-Atlantic markets (e.g. Amsterdam), with higher load factors and larger aircraft than would have been the case with flights from the other US airports separately. Because of the bundling of those

[4] The majority of the world origin-destination markets is too small for a direct, point-to-point service.
[5] Some itineraries in multi-hub systems require passenger connections at two hubs.

passengers, airlines are also (iii) able to offer higher frequency services, which can be advantageous in gaining market share (Bowen, 2014). A fourth -scope- advantage is (iv) the ability of airlines to serve more city-pair markets through the spokes than would be possible based on solely local demand at the hubs (Oum et al., 2009; Tierney, 2014). The increased connectivity advantage at hub airports is important in the location decision of(inter)national firms seeking high accessibility (e.g. Hakfoort et al., 2001). However, also the connectivity of the spoke airports in the network is increased: the opening up of one more route from the Delta Airlines Atlanta hub, for example, does not only increase the connectivity at the hub airport, but also at the multiple other spoke airports in the network.

The formation of these networks led to dominance of certain FSCs[6] on particular routes with lay-over at their hub airports: operators were able to keep passengers on their own services rather than lose them to interline connections to another airline, *inter alia* by offering lower fares on their own services than can be obtained by transferring to or from another carrier at the hub (Doganis, 2010). This can lead to monopolies: once airlines have established dominance at a hub through control of a disproportionate share of the flights offered and traffic uplifted, it is very difficult for another airline to set up a rival hub at the same airport, because it is unlikely to get enough runway slots to offer a similar range of destinations (Doganis, 2010). In turn, this monopoly can increase fares on certain routes (Goetz and Sutton, 1997), and can be seen as one of the negative outcomes of air transport liberalization.

The European Union (EU) mimicked US's example in the late 1980s, although European air transport liberalization was implemented more gradually with three packages in 1988, 1990 and 1992 (Burghouwt, 2007; Burghouwt et al., 2003). Each package increasingly liberalized restrictions on market entry, airfares, capacity, routes and schedules (Hakfoort, 1999). By 1997, this process culminated in a single aviation market, when cabotage rights were granted to the EU community carriers (Oum et al., 2009). Most of these carriers also underwent privatization, and were no longer strictly 'national carriers'. Just as in the US, the liberalization process has led to more competition, the entrance of LCCs, lower airfares and increased passenger numbers. It also improved connections between European regions, leading to increased inward investment, tourism and related employment (ELFAA, 2004), which is illustrated in Figure 1.2. The spatial hubbing strategy was already established in Europe before deregulation started[7], and it intensified afterwards (Burghouwt

[6] Especially considering that many airlines have relied upon mergers and acquisitions to expand their networks (Bowen, 2010).

[7] This followed from the system of bilateral air service agreements that originally required airlines to only operate from their national home base (Burghouwt and de Wit, 2005).

and de Wit, 2005). This intensification increased the connectivity of many European now-hub airports and cities, which may positively contribute to the economic development in and around these cities. Additionally, this single European market contains little advantages for global air travel from and to Europe. This still mainly rests on bilateral agreements between separate European and other countries, except for the US with which Europe signed an open skies agreement in 2008 (Debbage, 2014).

The air transport industry in other world regions remains, in relative terms, more tightly regulated, most often through bilateral air service agreements (ASA) that designate (mostly) national carriers to fixed routes with fixed capacity, frequencies and airfares (ELFAA, 2004). The Asia-Pacific market, for instance, is still more regulated than the American or European (Bowen, 2000), although bilateral agreements have become more liberal, and efforts towards liberalization have been made through the Australia-New Zealand Single Aviation Market Arrangements in 1996 and multilateral open skies agreements, such the ASEAN Multilateral Agreement on Air Services in 2009 (Findlay and Goldstein, 2004). The increasing competition and the emergence of LCCs in the region have, just as in North-America and Europe, led to the expansion of air travel and lower airfares (Forsyth et al., 2006).

In Latin America, restrictive bilateral agreements dominate, despite two open multilateral agreements being signed in the 1990s. In some deregulated domestic markets such as Argentina, Bolivia, Ecuador and Venezuela re-regulation occurred in the 21st century (Lohmann and Lipovich, 2013). Hence, despite attempts at liberalization and the presence of LCCs, there is still scope for a more open market that would likely lead to lower airfares and growth in demand.

The liberalization process has advanced more slowly on the African continent. The Yamoussoukro Declaration of 1988 -a multilateral agreement allowing exchange of up to fifth air traffic rights among the 54 signing countries with the aim of creating a unified African aviation market- became fully binding in 2002, but it failed to be effectively implemented (Doganis, 2010; Schlumberger, 2010). In fact, bilateral ASAs dominate, which results in poor connectivity, reduced competitiveness and quality of intra-continental routes, and a high cost of travel. Likewise, the penetration of low-cost airlines in the African air traffic market is significantly less than in any other world region (Pirie, 2014). Africa's general lack of an integrated transportation infrastructure has long been identified as a major obstacle for the continent's economic growth (Bassens et al., 2012).

The Middle Eastern air transport system was heavily regulated well into the 21st century, with widely divergent levels of liberalization existing within the region (O'Connell and Williams, 2010). LCCs have only entered the market recently, and more liberal intraregional agreements are also quite new, which suppresses the intra-regional competition and makes air transport in the region still expensive.

Passenger growth in the Middle-East is primarily the consequence of the airports serving as intermediary hubs on global routes between the Americas, Europe, Australia, and Asia, allowed after the negotiation of sixth freedom rights between countries in these regions and Middle-Eastern countries (Alkaabi, 2014; Vespermann et al., 2008).

International air passenger traffic still tends to be dominated by relatively restrictive bilateral ASAs, although many agreements have adopted liberalized elements and even have an open skies character (Debbage, 2014). The first open skies agreement between the US and The Netherlands was signed in 1992, and cleared the path for a worldwide deregulation wave. In 2008, for example, the agreement of an Open Aviation Agreement between the US and the EU as a whole went into force[8] (Oum et al., 2009). Open skies agreements remove most restrictions on the designation of carriers, on the routes flown between countries, and on capacity and frequency (O'Connor, 1998). They have given cause for the formation of global strategic and/or marketing alliances, which airlines have embarked upon to circumvent ownership and effective control restrictions that were associated with the global open skies agreements, and to suppress airfares while increasing yields (Doganis, 2010). Presently, three global alliances exist in passenger transport: Star Alliance, SkyTeam and Oneworld. Their main goal is being present in different geographical areas to provide worldwide network coverage and to benefit from the large size and scope advantages, of which cost reduction is one (Lipovich, 2014). Cost reduction is obtained in three principal ways. First, the greater spread of their network, and the increased market power and the resulting higher traffic volumes produce economies of density, which leads to lower unit costs through increased frequencies and higher load factors. Second, airlines can profit from shared use of the fixed costs such as airport terminals. Third, joint procurement of external services and goods, such as ground handling, maintenance, and joint purchase of aircrafts or computer reservation systems also decreases total costs.

We can conclude that despite the fact that worldwide liberalization has increased competition, reduced overall airfares and stimulated air traffic (Button, 2009; Oum et al., 2009; Piermantini and Rousova, 2008), its articulations are much more complex. The decrease in airfares, for instance, is mainly felt in larger markets that are characterized by more competition (Goetz and Sutton, 1997), while on thin routes or routes with airline monopolies, fares will be higher (Fuellhart et al., working paper). Liberalization in the U.K. airline industry, for example, resulted in increased competition on the dense routes out of London Heathrow, with increased frequencies and volumes, better cabin service, and cheaper fares, while competition on other routes in the U.K. tended to be uneven (Graham, 1993). Another example is the 'Southwest" effect in the US, where markets that Southwest

Airlines enter see an increase in traffic and a decrease in average airfares, while surrounding airports suffer traffic losses and airlines serving those airports have to increase fares on their routes to maintain yields (Vowles, 2001).

1.2.4 Technological improvements

The increased integration and interconnectedness of the economy through air passenger transport was facilitated through the technological advances in the air transport industry, which made possible the movement of higher volumes of air passenger traffic over larger distances. In the 1930s, the range of aircraft was very limited so that only short routes could be flown in one haul, but for longer routes (e.g. in Southeast Asia, cf. O'Connor, 1995) intermediate stops were needed (Derudder and Witlox, 2014). After World War II, the technical capabilities of the aircraft improved substantially – with the introduction of the turbo-propeller aircraft- and as a corollary flying ranges increased, although the routes between major destinations still had a linear structure, with stop-overs on the longer distances. Throughout the 1960s and 1970s, however, aircraft technology started to permit long haul routes, through the arrival and technological improvements of the jet aircraft. This supported the development of an air transport network structure that better reflected the size and function of markets as predicted by Barnes (1946, cfr. Paragraph 1.2.1), extending the point to point connections previously shortened due to technology (Derudder and Witlox, 2014). By the 1970s, jet service had been extended to most major world markets, although in an uneven distribution (Bowen and Rodrigue, 2013). Jets flew at increasing speeds with increasing capacities, which also radically increased the productivity of airlines and caused air fares to fall (Bowen, 2010): measured in terms of revenue per ton-kilometre, air transport costs dropped by 92 per cent between 1955 and 2004 (Hummels, 2007).

In summary, economic growth and integration, air transport liberalization, and technological evolutions in the air transport industry constitute the key processes through which the intrinsic link between air passenger transport and economic development has unfolded since WWII. While the world economy was characterized by integration and upscaling, air transport liberalization and technological innovations have removed some associated barriers, so that integration and upscaling could flourish. In the next section, the concrete expression of the association between air transport and economic development is scrutinized, at both aggregated and other spatial dimensions.

[8] The US-EU Air Transport Agreement covers an estimated 60% of global air traffic (Geloso Grosso, 2010)

1.3 Theoretical framework

1.3.1 Economic development and air passenger transport at an aggregate scale

The demand for air transport services is closely tied to the overall development of the economy. This is presently clearly visible in the Asia-Pacific region, where the strong growth in GDP, personal income, trade and FDI-flows is being accompanied by a strong increase in air travel, making the region the largest market for air passenger transport in the world (O'Connor and Fuellhart, 2014). The link also comes to the fore when observing the impact of economic crises on air transport: the Asian financial crisis of 1998 was translated into a sharp drop in passenger numbers from and within the region (Chin et al., 1999). In some economies, this downturn was more seriously felt than in other countries (e.g. Indonesia), and the response to this drop also differed considerably (Rimmer, 2000).

Based on Gillen (2010), I suggest four main forces that influence the total[9] demand for air travel. Except for the obvious effect of population, the other three are macro-economic forces, transport costs, and additional forces.

Macro-economic forces are particularly important in this dissertation and can be represented by GDP growth, growth in income, in trade in goods and services and foreign direct investment (Graham, 2006; Rimmer 2000)[10]. Some main trends are that:

- Countries with higher GDP levels and GDP growth generate higher air passenger traffic volumes and growth (Bowen, 2014; Button, 2008; Gillen, 2010; Oum et al., 2009). Boeing (2008, as cited in Oum et al., 2009) predicts that two-thirds of the worldwide air traffic growth can be attributed to GDP growth. It is generally accepted that air travel grows faster than GDP (Doganis, 2002).
- Higher incomes are generally associated with relatively higher demand for air transport (Brons et al., 2002; Mutti and Murai, 1977), although air travel does not grow increasingly with wealth (Gillen, 2010). On the other hand, the income elasticity of the demand for air passenger transport is higher for countries with lower incomes (BTCE, 1995). This implies that marginal increases in income are being translated into higher rates of additional outbound air travel in countries with lower income levels than with higher income levels.

[9] In contrast with the demand for particular routes (O'Connor, 2001).

[10] The literature sometimes discerns demand for business travel from demand for leisure travel, because the relevance of the determinants can differ (Graham, 2000). For instance, demand for business travel tends to be less sensitive to changes in airfare than demand for leisure travel (Brons et al., 2002). However, GDP, personal income, travel costs and trade seem to be important for both types of travel.

Along with a country's or region's GDP, personal income is often considered the most important determinant for air travel demand (Tretheway and Oum, 1992), and is particularly important for leisure demand (Crouch, 1995; Crouch et al., 1992; InterVISTAS, 2007; Lim, 1999, 2006; Prideaux, 2005). It is often proxied through GDP per capita[11].

- The role of trade for air freight transport is self-evident, but it is also linked to air passenger transport (Button, 2008; Gillen, 2010). This was already hinted at in paragraph 1.2.2. Key is that international goods trade has become increasingly dependent on the transmission of tacit information, since it began to incorporate the complex movement of components along spatially dispersed global production networks[12]. Simultaneously, the co-ordination tasks grew, and this strengthened the need for face-to-face contact which can be realized through air passenger transport (Cristea, 2011; Storper and Venables, 2004). International trade in services equally demands interpersonal contact and movement of producers or consumers: consumers moving to the location of the producer (as in the case of tourism) or factors of production may have to move across national boundaries to the place of consumption (such as consultant serving a client) (Stern, 2000). Air passenger transport can facilitate this.

Air transport costs -articulated through the airfares- are determined by a broad range of factors, of which the most frequently cited are: distance (Eilat and Einav, 2004; Lim, 1997; Tretheway and Oum, 1992), fuel prices (Ringbeck et al., 2009), degree of air transport liberalization (Dobruszkes, 2009), and airline competition (Marín, 1995). The transport costs are negatively linked to the demand (Gillen, 2010).

The additional forces refer to factors that are not always that straightforward and easy to quantify, such as cultural and mental proximity, which can be translated into -for example- language similarities, or a shared history through a colonial past (Lim, 1997; Reyes, 2013). These are more tacit influences and relate to a series of integration forces between countries that lead to additional demand for air travel. They will not be discussed in detail in this dissertation.

On the other hand, air passenger transport influences the global and national economies in its own right and acts upon GDP, investment and trade through the aggregated effect of direct, indirect, induced and catalytic impacts[13]. For instance, in a 10-year time span (1995-2004), the European Union's GDP was boosted by 4 percent under influence of air transport liberalization and subsequent growth in air traffic (Cooper and Smith, 2005). Key arguments are that air passenger transport (i)

[11] Income itself is a subjective variable and is not precisely measurable (Lim, 2006).

[12] The term 'global' does not necessarily imply that such networks actually span the entire world. Rather, it suggests that they are highly geographically extensive and functionally integrated across national boundaries (Dicken, 2011).

enables companies to exploit economies of scale as it enables them to serve more, and more distant, markets, and (ii) facilitates face-to-face contacts (Tornqvist, 1973). This enables the spatial diffusion of technologies, knowledge, and organizational strategies from abroad, which stimulates aggregate productivity and GDP (Barnebeck Andersen and Dalgaard, 2011).

As for trade, personal communication between trade partners –through air travel- is vital for companies to promote their business globally, for creating trading opportunities, but also for maintaining trade relations (Cristea, 2011; Piermantini and Roussova, 2008; Poole, 2013). In the same way, air passenger transport influences foreign direct investments (Hansen and Gerstein, 1991). Other research focuses especially on how air passenger travel stimulates tourism (Chew, 1987; Prideaux, 2000). From a societal point of view, air transport liberalization brought consumer welfare benefits for individuals: the availability of affordable travel connections increased, which in turn enabled consumers to travel more (influencing the GDP at the destinations), or -when maintaining identical travel regimes- to spend the extra budget elsewhere in the origin economy, stimulating it.

Although this overview illustrates that there is a large strand of literature that is devoted to the links between air passenger transport and economic development, little research has investigated or proven the causality in these relationships. Exceptions have been Kulendran and Wilson (2000), who suggest that there is a causal relationship between air transport and trade between Australia and four of its largest trading partners, and Fernandes and Pacheco (2010) who apply a similar approach when investigating the causal link between air passenger transport and GDP in Brazil. This dissertation wants to contribute to filling this research gap by taking into consideration the causality between air passenger transport and economic development at the aggregate level in Chapter 4.

1.3.2 Regional expressions of the link between air transport and economic development

A relationship characterized by reciprocity

The reciprocal associations between air passenger transport and economic development can equally be investigated at the regional level. Figure 1.3 summarizes (i) the effects air transport services can have on the airport and its immediate surroundings, but also on the economic acticity in the wider region, and alternatively (ii) the effects that the wider region can have on the demand for air passenger services. The influence of air transport on regional economic development unfolds along two lines. First, there are the direct, indirect and induced effects (Hakfoort et al., 1998). The **direct effects** are the immediate effects of air transport (ATAG, 2014), such as the impact on employment

[13] These impacts will be discussed in the following paragraph on a more regional level.

(e.g. ground handling, catering) at the airport. **Indirect effects** are felt in the industry supply chain and include employment and activities of suppliers to the air transport industry, such as the local businesses around an airport (e.g. nearby hotels, IT and accountancy for the airlines). Both effects are felt in the small spatial unit surrounding the airport, in contrast with the **induced impacts**, which are the secondary effects that result from the spending by those directly or indirectly employed in the air transport sector (InterVISTAS, 2006). In this way, businesses that are not directly linked with the airport, and often not in the near vicinity of the airport, benefit from its presence. The availability of air transport services can affect the wider economy of urban areas as well, by influencing the GDP of a region, or the employment and income levels, but also tourism (Ishutkina and Hansman, 2009). These **catalytic impacts** constitute the core of a large part of this dissertation, as we are interested in the deep seated effects of air transport services in an array of other economic activity.

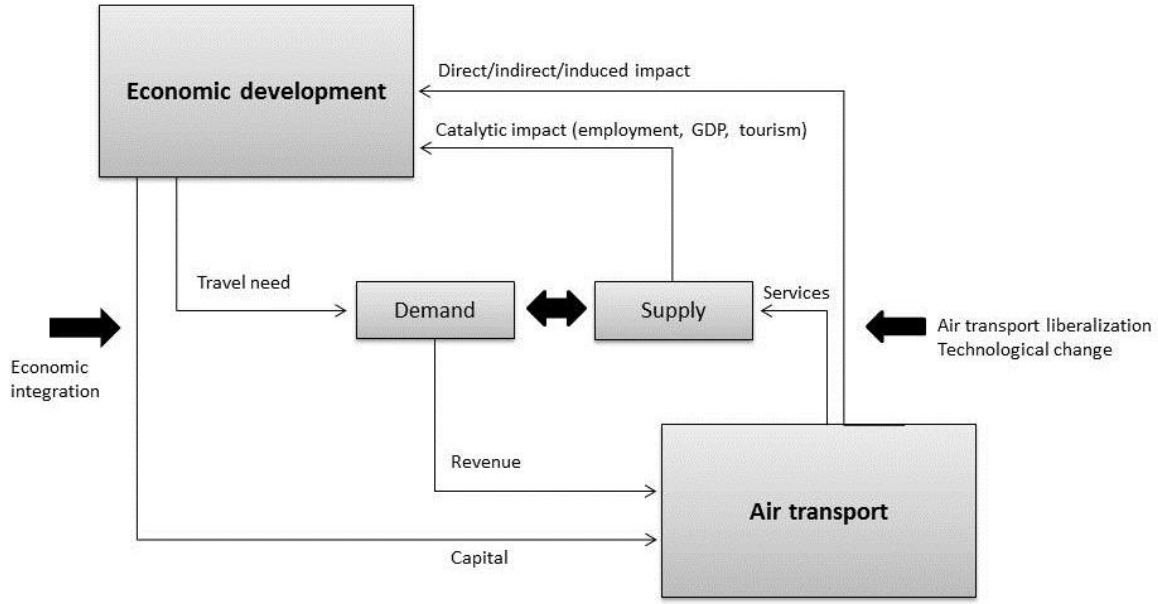

Figure 1.3 The reciprocal relationship between air transport and regional economic development (adapted from Hansman, 2005)

One can say that catalytic effects are the 'spin-off' effects of the air transport industry on other industries, whereas the direct, indirect and induced effects are related to the air transport industry itself (ATAG, 2012). InterVISTAS (2006) summarizes the difference between direct/indirect/induced impacts on the one hand and catalytic effects on the other hand as follows: if infrastructure investments are injected into an area (such as a new air service connection), then *'the region responds immediately with changes in expenditure, but the structure of expectations and the economic base remain unchanged'*, while *'catalytic impacts represent a dynamic adjustment, in*

which the underlying fabric of the region adjusts over time'[14]. Because catalytic effects cannot be immediately linked to air transport and airports, they are difficult to investigate, and particularly to quantify: they interact with other aspects that influence the regional development, such as the labour supply in a region and the investment climate of a region.

In contrast with the direct, indirect and induced effects, the catalytic impacts are enabled because airlines supply the *services*, which in turn depend on the demand for air transport from urban regions. At the same time, this system has to be seen in the wider framework of air transport liberalization and technological improvements in the air transport industry, which facilitate the way in which air transport services are provided. Liberalization, for instance, enables airlines to enter particular routes, expand these routes and lower air fares, which can result in higher travel demand and higher passenger numbers. In the same way, lack of air transport liberalization can have the opposite effect.

On the other hand, the socio-economic characteristics of a region also influence the demand for air transport services. For example, the central European region (the 'European diamond'), which comprises countries with the highest GDP levels in the European Union, generate higher air traffic levels compared with the rest of Europe (Dobruszkes, 2011). The revenue resulting from the flights created through this demand makes it possible for airlines to supply flights. Hence, the wider economy of a region provides the capital, enabling air transport services. The demand for air travel has been augmented by increased integration of regions in the world economy: the increasing interconnectedness of the world has stimulated the need for transport. However, the level of integration, and as a corollary, demand for air transport services varies among regions.

Identifying the research issue

Each of the separate relationships in the system depicted in Figure 1.3 has been studied extensively. For instance, there's the literature investigating the direct, indirect and induced effects of air transport, which usually relies on input-output analyses to quantify them (Ishutkina and Hansman, 2009). These studies focus on specific airports or airport complexes, and are often commissioned by governmental organs or airport-operators (e.g. Hakfoort et al., 2001 for Amsterdam Schiphol Airport; Economic Development Research Group, 2013 for San Francisco International Airport). Given that this dissertation will focus on the systematic relation between air passenger transport and the

[14] This refers back to how economic development was defined in 1.2.1 and confirms how air transport can change the structure of the economy

broader regional economic development, and that results obtained in the mentioned studies are often very case-specific, they will not be elaborated here.
Instead, interest goes to two other links. First, there are the regional catalytic effects of air passenger services on economic development. The focus here lies on how air passenger transport can be perceived as an 'enabler' of wider regional development, and although regional development is essentially a *multidimensional* concept, its study is very often limited to employment, production or income indicators (Nijkamp, 1986). Second, the socio-economic function of a region (population, employment, GDP) determines in turn the need for air passenger services.

The research on the wider impact of air passenger transport on regional development can be divided into two strands. First, there are methods such as cost-benefit analysis (Pearce and Nash, 1981) or general equilibrium-modelling. These express in monetary value the impact (in terms of marginal cost and benefits) of, for instance, increases in air passenger transport on the economic welfare of passengers (e.g. due to lower air fares, increasing choice of destinations). Also the wider economic benefits, such as additional increases in GDP or additional gains in employment due to growth in aviation, can be monetarized. Advantages of these methods is the fact that net- instead of gross-effects of (improvements in) air passenger transport are calculated, revealing marginal effects. One of the main disadvantages, however, is that these analyses require many different input-values that need to be expressed in monetary values, which brings a level of uncertainty (e.g. over- or underestimation of values) (ECMT, 2001; Grant-Muller et al., 2001). The need for a large amount of quantifiable input measures also require a large variety of available and reliable data sources. The latter is not evident given the objective of this dissertation to make a large-scale and systematical assessment of the reciprocal relationship between air passenger transport and economic development. In the same way, these analyses also shed little light on the causal mechanisms in this reciprocal relationship (Lakshmanan, 2011). From this point of view, preference goes to a second set of methodologies, which enable to measure the contribution of air passenger transport on economic development and *vice versa*, and this across multiple spatial levels and from different geographical angles. Regression-types of analyses, including Granger causality analysis that takes endogeneity into account, are key examples. These methods are preferred over input-output models that monetarize costs and benefits of air passenger transport, among other things because they give plausible results with the available data in large-scale analyses as presented in this dissertation. However, a disadvantage of these methods is their tendency to measure gross- instead of net-effects. This bears a risk of overestimating effects, something we need to take into account when interpreting the results from the analyses used in the different chapters.

Table 1.1 gives an extensive overview of the literature that implements the second type of methodology dealing with the reciprocal relationship between air passenger transport and economic development on a regional level. To reveal the key issues for the research, I have divided the literature into four strands: (i) literature investigating the association between air transport and regional development through qualitative methods or bivariate regression analyses (e.g. Alkaabi and Debbage, 2007), (ii) literature examining the determinants of air passenger transport (volumes) in metropolitan areas (e.g. Dobruszkes, 2011), (iii) literature examining the influence of air transport on regional development (e.g. Button and Taylor, 2000), and (iv) literature exploring the causal link between regional development and air transport (e.g. Neal, 2012).

At least three important observations can be made based on a close reading of the table.
First, the current literature is heavily skewed to research on metropolitan areas (MAs) in the US. Research on European urban regions is scarce, while research on urban regions in other world parts seems to be missing. According to Dobruszkes et al. (2011), the main reason behind this lies in the difficulty of finding homogeneous regional data in a multinational context. Worldwide, data on economic development (such as employment and GDP) are still primarily collected on country-level, which contrasts with the US, where data are also being systematically collected on the level of the MAs. Moreover, in the US, most of the airports serve a distinct city with limited ground transport options, while e.g. European airports are surrounded by multiple cities, creating overlapping catchment areas. Second, there is strong evidence of the significant positive link between air passenger transport and economic development, which is pictured in Figure 1.3. Third, employment[15] is the most common cited indicator for economic development (e.g. Cattan, 1995; Goetz, 1992; Green, 2007), because it is perceived as a relatively robust and measurable indicator of a region's economic success (Button and Taylor, 2000). Other indicators are GDP (Dobruszkes et al., 2011; Mukkala and Tervo, 2013) and location of headquarters (Bel and Fageda, 2008; Dobruszkes et al., 2011). These last two points will be discussed in more detail here, as they directly inform the research questions addressed in this dissertation.

Second, a variety of methodologies have been applied for investigating the link between air passenger transport and regional development, depending on the scope of the study. Simple descriptions, correlation or simple regression analyses suffice if one wants to indicate the mere association between air passenger transport and economic development. Multiple regression analyses become a key tool when determining the main factors for air travel demand, and when

estimating the impact of air passenger travel on regional employment or GDP. In such studies, the common problem of endogeneity, which implies a strong interdependence between air transport and regional development, has to be considered (Blonigen and Cristea, 2013). Endogeneity means that air passenger transport stimulates regional development, but that regional development also simultaneously stimulates air passenger travel (Fig 1.3): the relationship is "circular and cumulative" (O'Connor and Scott, 1992: 251).

Generally, two ways of dealing with this endogeneity seem to be commonly adopted: the use of lagged independent variables in the regression analyses when using time series data (Button and Taylor, 2000), and the use of instrumental variables when using cross-sectional data (Brueckner, 2003; Green, 2007). The latter indicates that variables are used that affect the independent variable (e.g. air passenger transport) without being correlated with the dependent variable (e.g. an indicator for regional development).

These two methodologies are also used in the literature that acknowledges the mutually *causal* link between air passenger transport and economic development, but here another methodology comes to the fore: Granger causality analysis. In Granger analysis, causality is defined in terms of predictability, as a chronological precedence of one thing before the other (Neal, 2012): air passenger transport 'causes' economic development if previous values of transport significantly contribute to subsequent development levels. The fundamental question in these causal investigations of the transport-development link is which of the two possible directions is the dominant direction. Most of the authors seem to agree that 'causality' rather runs from air transport to development, although Mukkala and Tervo (2013) contest this and find more convincing evidence for the reverse relationship.

[15] The catalytic employment in measured in most of the literature

Table 1.1 Overview of the literature investigating the relationship between air passenger transport and economic development on the regional level

	Literature	Region	Methdology	Results
A	Goetz, 1992	US MAs, 1950-1997	Bivariate regression analysis	Positive relation between air passengers per capita and both previous and subsequent levels of employment, no direction of causality
	Debbage, 1999 Debbage and Delk, 2001	US urban-airport complexes 1973-1995 and 1973-1996	Case study review, no quantitative methodology	Correlation between air services volume and administrative and auxiliary employment
	Alkaabi and Debbage, 2007	US MAs with hub airports, 1999	Bivariate regression analysis	Linear relationship between number of air passenger enplanements, and employment and number of companies in the PST- and high-technology sector
B	Cattan, 1995	European cities, 1988	Multiple linear regression (gravity model)	Cities' share of tertiary activity in the national economy influence the air passenger volume
	Liu et al., 2006	US mMAs, 1999	Logistic regression	% workforce in professional, services and technical sector (PST) and management is a predictor for being a major air traffic market
	Dobruszkes et al., 2011	European MAs, data from 2003 to 2008	Multiple regression	GDP and economic decision power (number of (sub)headquarters and a measure for level of tertiary activity) influence number of seats (total and international)
C	Button and Taylor, 2000	US MAs, 1996	Multiple linear regression analysis with lag	Air services (volume, number of destinations) to the EU influence 'new employment' (electronics, IT, telecom, management and services…)
	Brueckner, 2003	US MAs, 1996	Multiple linear regression, with instrumental variables	Increase in passenger enplanements leads to increase in employment in services sector, not in the manufacturing sector
	Green, 2007	US MAs, 1990-2000	Multiple linear regression, with instrumental variables	Boardings per capita and origin passengers per capita increase employment growth, stronger in hub airports
	Percoco, 2010	Italian provinces, 2002	Two step procedure (tobit-model + instrumental variables), controlling for endogeneity	Significant influence of air passenger transport (passenger volume and movements) on employment in the services sector
	Blonigen and Cristea, 2013	US MAs 1969 - 1991	Regression models, Instrumental variables	Growth in air passenger traffic lead to growth in employment (especially in wholesale and retail)
	Sheard, 2013	US MAs, 2007	Instrumental variables (two stage least squares), controlling for endogeneity	Air passenger volume has a positive effect on tradable services, and a negative effect on manufacturing
D	Irwin and Kasarda, 1991	US MAs, 1950-1980	Multiple linear regression models, non-recursive models controlling for endogeneity	Changes in the structure of the US airline network are a cause rather than a consequence of employment in manufacturing and producer services growth

	Ivy et al., 1995	US MAs, 1978-1988	Multiple regression models with lags	Changes in air service connectivity of US metropolitan areas influence employment levels in professional employment (=administrative and auxiliary sectors) (more than the reverse)
	Button and Lall, 1999 Button et al., 1999	US MAs, 1994	Multiple linear regression model, Granger causality analysis	Increase in traffic at hub airports has a positive effect on high-tech employment. Granger analyses of two case study areas indicate a causal relationship from air traffic to employment, not vice versa
	Bel and Fageda, 2008	European MAs, data from 1992 to 2004	Multiple regression that allows for possible endogeneity (two-step GMM). Use of lagged values for the air services indicator	The availability of long-haul air services is a causal determinant for headquarters location. The number of large firms' headquarters (proxy of size for tertiary activities) is significant for the frequency of intercontinental non-stop flights.
	Neal, 2012	US MAs, 2001-2008	Multiple regression models with lags	Number of air passengers 'causes' employment in the creative sector and vice versa
	Mukkala and Tervo, 2013	European MAs, 1991-2010	Heterogeneous Granger causality analysis	Homogenous causality from employment growth to air passenger volume. Causality from passenger volume to employment growth and GDP (PPS) in peripheral regions, but not in core regions

Note: A: literature investigating the link between regional development and air transport; B: literature investigating how regional development influences air transport, C: literature investigating the influence of air transport on regional development; D: literature investigating the causal link between regional development and air transport

1.4 Overview of this dissertation and research questions

In the introduction, four main research objectives were formulated: (i) discern some of the determinants of, and their respective importance for, air passenger transport, (ii) study in what ways and to what extent air passenger transport influences economic development, (iii) reveal some of the signs of causality between economic development and air passenger transport, and (iv) determine some of the intervening factors in this relationship. Against the backdrop of the contextual and theoretical framework that were sketched here, a series of interrelated research questions can be formulated in the light of the four research objectives.

The remainder of this dissertation is structured in four chapters, which can be situated along two axes: a scalar axis and a methodological axis (Fig 1.4). The scalar axis indicates that the transport-development link is investigated from different geographical perspectives: from an aggregate level in Chapters 2 and 4 to a more regional level in Chapters 3 and 5. The methodological axis shows the scope (and hence also the used methodology) of each chapter. Chapters 2 and 3 focus on the association between air passenger transport and economic development, and therefore regression-type analyses are applied. Chapters 4 and 5 investigate the element of causality in the relationships, which is realized through Granger causality analyses.

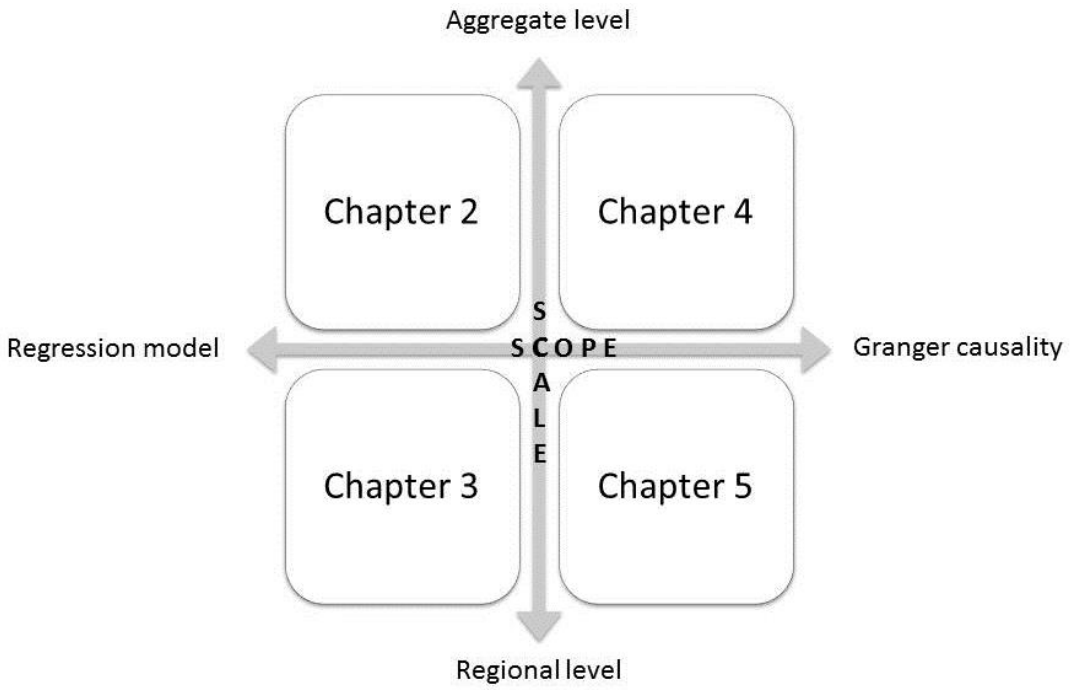

Figure 1.4 Conceptual model of the outline of this dissertation

In the **second Chapter**, the dimensions of some of the main determinants underlying Asia-Pacific tourism demand to Australia between 1990 and 2010 are scrutinized and quantified with a multiple regression analysis. Tourism demand and air travel demand are reciprocally and intricately linked (Duval, 2013; Graham, 2010) and this link is reinforced when studying the Asia-Pacific tourism demand to Australia as over 99% of international visitors arrive in Australia by air. I put disposable income -approximated by GDP per capita- forward as an indicator for economic development and raise following research question: *Does the level of GDP per capita of a country constitute a determinant for the demand for international tourism?* This is complemented with an indicator for air travel costs -distance-, and population size as a control variable. Air transport costs are perceived as determined by air transport liberalization processes and fuel prices, which gives rise to following research question: *What influence do air transport liberalization and fuel prices exert on the demand for air travel, and especially on the link between air passenger transport and economic development?* All of this is gauged through 5-year intervals in the time frame 1990 to 2010, which permits to monitor *changes* in the absolute and relative importance of these factors.

In the **third Chapter**, the transport-development relationship is perceived from the opposite angle and from a different geographical scale: it investigates how air passenger transport influences the presence of services in urban regions. This Chapter draws on the research of the Globalization and World Cities Research network, GaWC)[16], by looking at a particular kind of services: advanced producer services (APS). With a multiple regression analysis that models the influence of passenger volumes, population, urban primacy and national regulation on the level of APS-provision in the urban regions, I raise following research question: *To what extent does air passenger transport explain the presence of APS-services in metropolitan regions?* It is important to see the relationship in the light of each city's regulatory context.

The next two chapters focus on the causal relationship between air passenger transport and economic development by shifting along the methodological axis towards Granger causality. As such, the **fourth Chapter** focuses on the causal relationship between air passenger transport and goods trade between Asia-Pacific countries and raises following questions: *Does air passenger transport lead to goods trade between Asia-Pacific countries? Does goods trade lead to air passenger transport? Or do air passenger transport and goods trade share a mutual causal relationship?* Because Heterogeneous Time Series Cross Section Granger causality was used, it was possible to discern variations in the air transport-trade relationship among the Asia-Pacific countries. In this context, an additional research question can be formulated: *Is Granger causality analysis a proper*

econometric method to investigate the perceived causal link between air passenger transport services and trade?

In the **fifth Chapter**, the same methodology is applied to investigate the causal relationship between air transport services and employment in European NUTS2-regions between 2001 and 2011. Answers are sought to following research questions: *Does air passenger transport lead to employment in European metropolitan regions? Does employment in those regions underlie the generation of air passenger travel? Is there a difference in the link when it comes to manufacturing and services employment?* This latter question originates from the fact that current literature perceives the link between air passenger transport and employment in the services sector greater than with employment in the manufacturing sector (Brueckner, 2003).

The **sixth and final Chapter** of this dissertation reports the main findings and conclusions that can be drawn from the combined research findings of the chapters, gives some critical reflections on the used data and methods and puts forward some avenues for further research.

The second, third, fourth and fifth chapters are scientific papers, of which the third and the fourth chapters have already been published in The Professional Geographer and Journal of Transport Geography respectively. The second chapter has been submitted to Asia Pacific Viewpoint, while the fifth Chapter is a working paper, but is ready to be submitted to European Urban and Regional Studies. The first and final Chapter of this dissertation are my own work, and I've performed all of the analyses in the other Chapters. The writing of these Chapters happened in cooporation with the co-authors, although Chapter 5 is almost completely my own work.

Throughout these chapters, the relationship between air passenger transport and economic development is investigated on different levels in order to not only contribute to a more refined understanding of the general interaction between air transport and economic development, but to gain insight into some of its regional articulations as well. In the same way, the relationship is being explored at different spatial angles: Chapters 2 and 4 focus on the Asia-Pacific region, while Chapter 3 covers metropolitan regions across the world, and Chapter 5 focuses on Europe. This broad geographical scope results from two separate reasons. First, and foremost, three of the four key processes[17] (economic development, increased integration and air transport liberalization) mentioned in section 1.2 are articulated in rather different ways across these regions. The liberalization process, for example, has evolved differently and is at different stages in various world

[16] For an elaborate description of the methodology of the GaWC, I refer to the work of Taylor et al. (2002).
[17] Technological improvements are rather spread evenly.

regions: while the European Union is characterized by a Single Aviation Market, the Asia-Pacific air transport market is less unified. It is likely that these differences will have its repercussions on the air passenger transport-economic development relationship. I found it interesting to focus on these different world regions separately throughout the chapters in order to reveal these possible differences in the relationship.

The second reason is related to data limitations. First, economic development is a multidimensional concept (Nijkamp, 1986), and is often represented by several variables (e.g., income levels or employment). I wanted to grasp this multidimensionality by incorporating several of its articulations, also at the regional level. However, it is difficult to find homogeneous and comparable data in a multinational context at this level. In Chapter 3, this was tackled by making use of a GaWC-developed measurement of the presence of services to cover worldwide metropolitan regions, while in Chapter 5 statistics on employment from the statistical European office Eurostat were used. In the same way, some difficulties arose for quantifying air passenger transport to meet the purpose of each Chapter. Chapter 2 required specific data on Asia-Pacific tourists in Australia, which was solved by using Australian passenger cards, while Chapters 3 and 4 required data covering multiple regions and countries during longer time periods. In these Chapters, the Sabre and OAG databases were used respectively. In Chapter 5, Eurostat-data were used to cover comparable statistical areas in Europe. Each of these different measurements has its limitations and advantages, and these are discussed in the different chapters.

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CHAPTER 2

Shifting Patterns and Determinants of Asia-Pacific Tourism to Australia, 1990-2010

Van De Vijver, E., Derudder, B., O'Connor, K., and Witlox, F., 2014. Shifting Patterns and Determinants of Asia-Pacific Tourism to Australia, 1990-2010. *Manuscript submitted for possible publication in Asia Pacific Viewpoint.*

Abstract

Australia is a major international holiday destination, with growing numbers of tourists each year. Especially travel demand from Asia-Pacific countries has increased in the period between 1990 and 2010, which has led Australian policy-makers to believe the Asia-Pacific region will be the largest growth market for holiday tourists over the next years. This article first presents an overview of the evolution and shifting geographical patterns of Asia-Pacific tourism to Australia, and relies on this to explore the major determinants underlying these changes using a bootstrapped loglinear multiple regression analysis. Results indicate that income (GDP per capita) remains the most important factor explaining tourism demand. Its high, but declining, elasticity suggests that countries with higher per capita income produce higher levels of tourism towards Australia, but that the Australian holiday market is becoming increasingly mature. As a consequence, further 'organic' growth of tourism because of expected income growth in Asia-Pacific cannot simply be assumed. Distance, as a proxy for travel costs, has a large negative elasticity that has slightly increased over time. We consider two major forces that have influenced this variable: air transport liberalization reduces 'distance', but these effects have been off-set by oil prices, which increase 'distance'. The latter could impose an impediment to future tourism growth, especially if liberalization in the region is delayed. Population, used as a control variable in our analysis, confirms the accuracy of our model with its elasticity of 1. The paper is concluded with an outlook on some possible opportunities and challenges for future tourism demand to Australia.

2.1 Introduction

Tourism is a crucial industry for the Australian economy. In 2012-2013, tourism would account for 6% of total GDP and 8% of Australia's employment (Kookana et al., 2014). The Australian government tries to monitor, and more importantly, stimulate these developments in several ways. Within the context of the National Long-Term Tourism Strategy, Tourism Australia -the government agency responsible for promoting Australia to the world as a destination for business and leisure travel- has launched the *Tourism 2020 Strategy*. In this strategy, growth and competitiveness of the tourism industry is sought by focusing on six strategic areas. One major strategic area is to 'Grow demand from Asia' (http://www.tourism.australia.com/statistics/tourism-2020.aspx), which reflects the emerging importance of this region as a source market for tourism to Australia: between 2010 and 2020, Asia is expected to contribute more than half of the projected growth in international visitors, with especially China assuming a central place in the Australian strategy as it is projected to produce 42 percent of the expected growth (Tourism Australia, 2011).

The emerging focus on Asia is also reflected in the way in which Tourism Australia organizes its global marketing strategy. To promote *Tourism 2020* internationally, the agency focuses the majority of its global marketing resources on those markets representing the greatest potential for tourism growth over the next few years (http://www.tourism.australia.com/markets/market-strategy.aspx). Whereas the Americas and Europe are seen as two large, but largely stable and homogenous markets, the Asian market receives a more differentiated treatment. Greater China (China and Hong Kong) is thought to form a separate market, as are Japan and Korea. Other specific markets in the region are New Zealand, South Asia, and Southeast Asia. Although some of this differentiation reflects distance (long-haul versus short-haul flights needed to make the connection) and cultural heterogeneity, it is likely that this also reflects a shift in strategy where fast-growing markets receive extra attention. The increasing importance of Asia-Pacific as a source market for Australian tourism raises a number of questions, and in this paper we will focus on two of these. First, what have been the major evolutions and changing geographical patterns in Asia-Pacific tourism to Australia over the past decades? And second, building on this straightforward overview, what are the main factors that have been driving the changing demand for Asia-Pacific tourism to Australia?

In this article, we focus on 21 Asian countries (determined by data availability) and New Zealand, and identify this as 'Asia-Pacific'. Our analysis of the factors underlying demand for tourism will focus on three often-cited indicators in air travel demand research at large: income, distance and population. Tourism demand and air travel demand are reciprocally and intricately linked in general terms (Duval, 2013; Graham, 2010), but this is even more so the case for Australia. Debbage (2002) stresses

that in the literature transport is often conceptualized as the critical element effectively linking tourist demand or origin areas with key supply or destination areas. This is certainly true in our study: international aviation services are extremely critical to Australia's tourism industry, as over 99 per cent of international visitors (and therefore tourists), travel to and from Australia by air (BTCE, 1992). In the travel and tourism demand literature, higher incomes are generally associated with relatively higher demand for air transport (Brons, et al., 2002; Mutti and Murai, 1977), while larger distances - implying higher costs- are negatively linked to the demand (Gillen, 2010). Population acts as an obvious control variable, as – all other things being equal – larger populations obviously lead to proportionally higher demand. These factors are especially relevant for the *Asia-Pacific* demand. First, many Asia-Pacific countries have experienced strong overall economic growth, which has been an important determinant in producing higher than average outbound tourism growth (Graham, 2006)**.** Second, the middle class, the largest group of (new) tourist (cf. Robinson and Goodman, 2013: 1) has been burgeoning in Asia-Pacific, particularly in China, India and Indonesia.

In this article, we use multiple regression analysis to model how these three factors have been underlying Asia-Pacific tourism to Australia between 1990 and 2010. Crouch et al. (1992) suggest that regression analysis provides a suitable means of estimating international tourist flows. By combining income, population and distance as explanatory variables in this analysis, our methodology combines a geographic and an econometric approach: whereas geographers mostly use geographic and demographic factors in gravity-type models, econometricians usually focus on factors that influence the nature of the demand curve, such as income and price (Crouch et al., 1992). Importantly, studying the period between 1990 and 2010 through 5-year intervals allows us to monitor *changes* in the absolute and relative importance of these factors: shifting absolute importance will be gauged through unstandardized beta coefficients, which can be interpreted as elasticities[18] (e.g. assessing the changing absolute importance of distance in the face of changes in the air transport market); shifting relative importance will be gauged through standardized beta coefficients (e.g. assessing the changing relative importance of distance compared to the other variables). Nonetheless, as we will see, in spite of changes in the absolute and relative importance of these variables, their combined explanatory power remains high, which corroborates our focus on this limited set of straightforward indicators. Although forecasting in the strict sense is very difficult given the changing importance of these factors over time, our results allow formulating a number of anticipated changes and associated suggestions for Australian tourism policy.

The remainder of the article is organized as follows. First, we formally define tourism as to be able to operationalize it for the sake of quantitative research. This is followed by a detailed overview of the (changing) patterns of Asia-Pacific tourism to Australia, as well as a discussion of the hypothesized key drivers of these flows. Second, we describe our data and methodology, after which we discuss the results and implications of our regression analysis. The article is concluded with a summary of our main findings, indicating the limitations of our approach and outlining some possible avenues for further research.

2.2 Asia-Pacific Tourism to Australia

2.2.1 Functional Definition of Tourism

In the literature, the definition of what constitutes 'tourism' is not clear-cut. The World Tourism Organization (WTO, 1991) defines tourism as '*the activities of a person travelling outside his or her usual environment for less than a specified period of time and whose main purpose of travel is other than [the] exercise of an activity remunerated from the place visited'*. As a consequence, tourism is perceived as a broad concept, sometimes subsumed under the more general numerator of 'travel'. This convergence is amplified by the fact that the connection between travel and tourism is often complex, as one trip can have multiple purposes (Lassen, 2006). For example, people that are travelling for work-related purposes occasionally extend their journey for a vacation, just as people that are spending their holidays in Australia sometimes visit friends and family during their trip. This intertwining makes it difficult to distinguish the determinants for air travel from those for tourism, especially because virtually all international tourists in Australia arrive by air. Consequently, despite the focus on tourism in this paper, references to the general air travel demand literature are self-evident.

In this paper, we define *tourists* as those passengers arriving in Australia with the *prime* purpose of spending their holiday. We used data from incoming passenger cards, collected by the Australian Department of Immigration and Citizenship. On these cards, travelers can indicate their main purpose of visit to Australia: convention/conference, business, visiting friends and relatives, holiday, employment, education, and other and not stated. We will focus on the arrival cards mentioning holiday as the primary purpose for visiting Australia.

[18] Because we work with log transformations of the original variables.

2.2.2 Evolution of Tourism to Australia

Data from the Australian Bureau of Statistics (2014) reveal that the total volume of air travel to Australia has risen about fivefold between 1985 and 2010: whereas about 2.809.700 passengers arrived in 1985, this volume grew to 14.221.700 in 2010 (Figure 2.1). O'Connor and Fuellhart (2014) have shown that the Asia-Pacific region is now the main focus of Australia's international aviation, surpassing the passenger movement on the traditional European and North American routes. Figure 2.2 illustrates the relative growth of all international arrivals, and total arrivals and holiday arrivals from the 22 selected Asia-Pacific countries between 1985 and 2010. It can be seen that the volume of Asia-Pacific holiday arrivals exhibit larger levels of growth, especially in the 1990s (B. Faulkner, 1988; H.W. Faulkner, 1990). This coincides with high economic growth rates in general, and disposable income in particular, in the developed and newly industrialized countries in that region (Lim, 1997). However, Faulkner (1990) suggests that the heightened Asia-Pacific travel demand had already started in the beginning of the 1980s, and intensified in 1983 because of the floating Australian Dollar in that same year: a more favorable exchange rate made it cheaper to travel to Australia, thus boosting Asia-Pacific demand for tourism to Australia. A first small downfall occurred in 1989 and was caused by a combination of events, such as the relative cost increase in Australian holidays compared to the preceding years and the sudden absence of previously held 'hallmark events' such as the Bicentenary, World Expo and the America's Cup in 1988 (Faulkner, 1990). Figure 2.2 clearly shows that the Asian financial crisis, which began in 1997, brought a strong downturn in Asia-Pacific tourism (Li, 1998). The devaluation of, for example, the Thai Baht and the Indonesian Rupiah, resulted in more expensive holidays, reducing the affordability of overseas travel in general and Australia in particular (Chin et al., 1999). After a minor growth spurt in 1999-2000, a short negative spell occurred from 2001 to 2003, associated with lower worldwide travel rates resulting from 9/11 and the SARS-epidemic of 2003, which hit the Asia-Pacific travel market very hard. More recently, the global economic crisis of 2008 caused a new downfall, resulting in persistently low growth rates in tourism demand from Asia-Pacific. Overall, Figure 2.2 shows that crisis events, particularly economic crises, have a large influence on the geographies of holiday travel (Hall, 2010; Prideaux and Witt, 2000); general patterns of air travel demand to Australia are much less strongly affected by these crises.

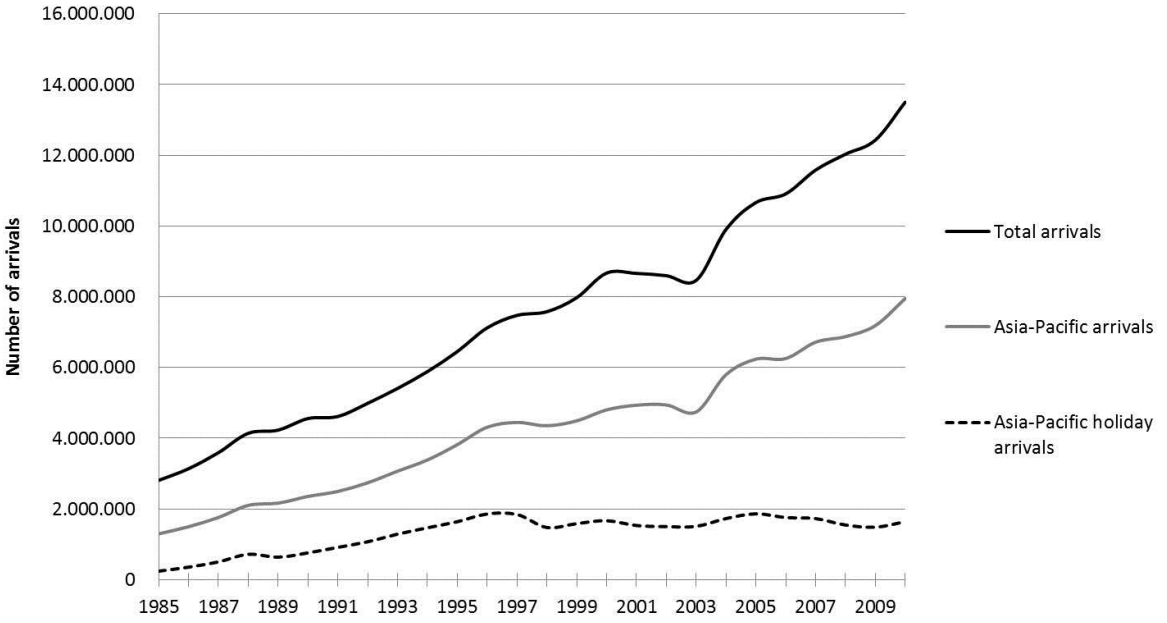

Figure 2.1 Absolute growth in total international arrivals, Asia-Pacific arrivals and Asia-Pacific holiday arrivals

Source: Australian Bureau of Statistics (2014)

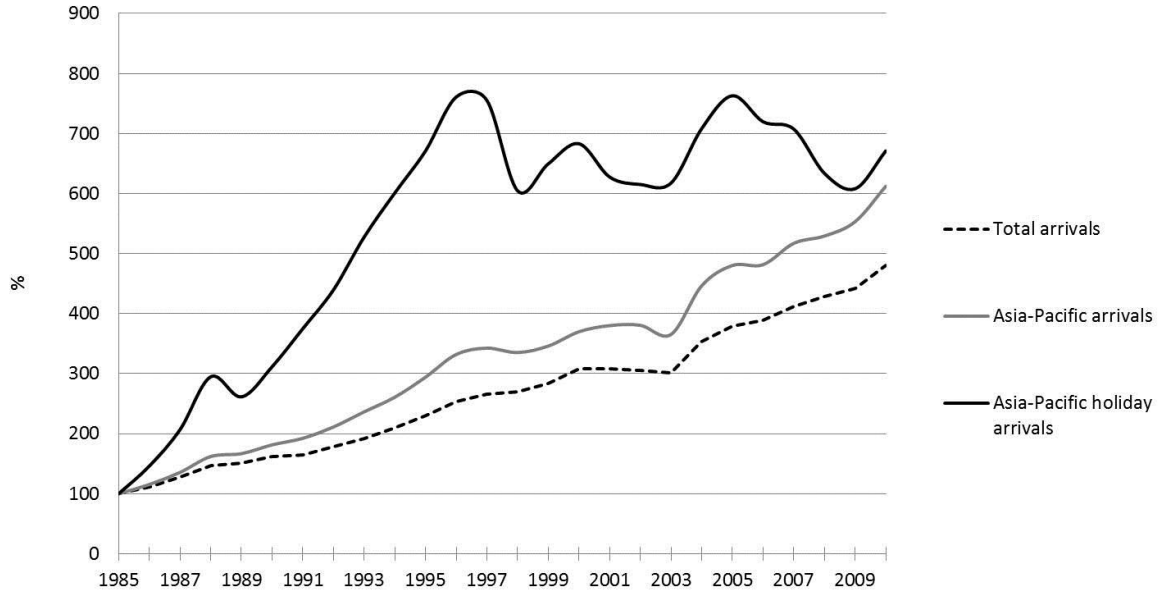

Figure 2.2 Index of relative change in total international arrivals, Asia-Pacific arrivals and Asia-Pacific holiday arrivals with a base year of 1985=100

Source: Australian Bureau of Statistics (2014)

Table 2.1 presents a geographical breakdown of the number of tourist arrivals in Australia for the 22 countries in 1985, 1990, 1995, 2000, 2005 and 2010. Figures 2.3a-2.3d illustrate the absolute growth figures from 1990 to 2010 for respectively South Asia, the more central Asia-Pacific countries with large tourist numbers, the more central Asia-Pacific countries with smaller tourist numbers, and the Southeastern countries of Asia-Pacific.

Table 2.1 Breakdown of holiday arrivals according to country in 1985, 1990, 1995, 2000 and 2005 in absolute figures

	1985	**1990**	**1995**	**2000**	**2005**	**2010**
Bangladesh	60	120	240	850	620	980
Brunei Darussalam	630	930	3.130	3.080	3.090	3.090
Cambodia	0	20	170	290	880	1.710
China	840	3.700	9.870	40.660	126.910	204.710
Hong Kong (SAR of China)	10.660	26.130	75.510	83.300	78.190	69.270
India	1.750	3.260	4.560	13.640	20.890	26.910
Indonesia	6.560	17.930	89.480	44.220	34.840	54.620
Japan	78.010	417.300	697.560	608.080	562.770	293.880
Laos	20	10	40	290	350	420
Macau	120	310	1.010	1.290	1.040	1.470
Malaysia	15.860	22.290	63.550	90.420	90.200	123.130
Myanmar	20	100	130	140	170	310
New Zealand	96.880	181.290	228.470	355.930	496.570	466.450
Nepal	50	120	160	200	160	450
Pakistan	200	430	460	480	490	1.130
Philippines	2.710	4.070	8.970	12.220	10.390	12.170
Singapore	20.410	48.620	146.580	184.680	145.340	144.650
South Korea	770	4.700	129.060	92.660	173.860	135.590
Sri Lanka	640	1.140	1.520	2.300	2.810	4.380
Taiwan	6.160	18.490	123.360	94.890	82.800	59.100
Thailand	2.160	10.530	56.750	38.600	30.170	29.030
Viet Nam	0	160	480	1.740	2.950	7.510

Source: Australian Bureau of Statistics, 2014

Throughout this period, New Zealand and Japan have remained the largest source markets, with Japan initially generating most tourists, only to be surpassed by New Zealand in 2007. This is mainly the result of a dramatic drop of Japanese tourist arrivals from the end of the 1990s onwards (Figure 2.3b), which partly reflects the ongoing stagnation of the Japanese economy. This is in sharp contrast with the volume of Chinese tourists, which has exploded over the last 20 years (Figure 2.3b), currently making China the third largest source of Asia-Pacific tourists. South Korea also saw a big surge, although its numbers seem more affected by the crises of 1997 and 2008 (Figure 2.3b). Multiple countries, such as Hong Kong, Thailand, and Taiwan (Figure 2.3b) and Indonesia and Singapore (Figure 2.3d) were initially characterized by a strong growth in the 1990s, after which this growth stabilized or even turned negative. This could give an indication of the maturity of the Australian tourism market, leading tourists from these countries to look for new and unfamiliar destinations (Prideaux, 2005). In contrast, Malaysia's tourist numbers have known a rather stable growth and have even spurred after 2008 (Figure 2.3d). The number of tourists from countries located a bit lower on the economic development ladder, such as Sri Lanka, Laos, and Cambodia remain low (Figures 2.3a and 2.3b respectively).

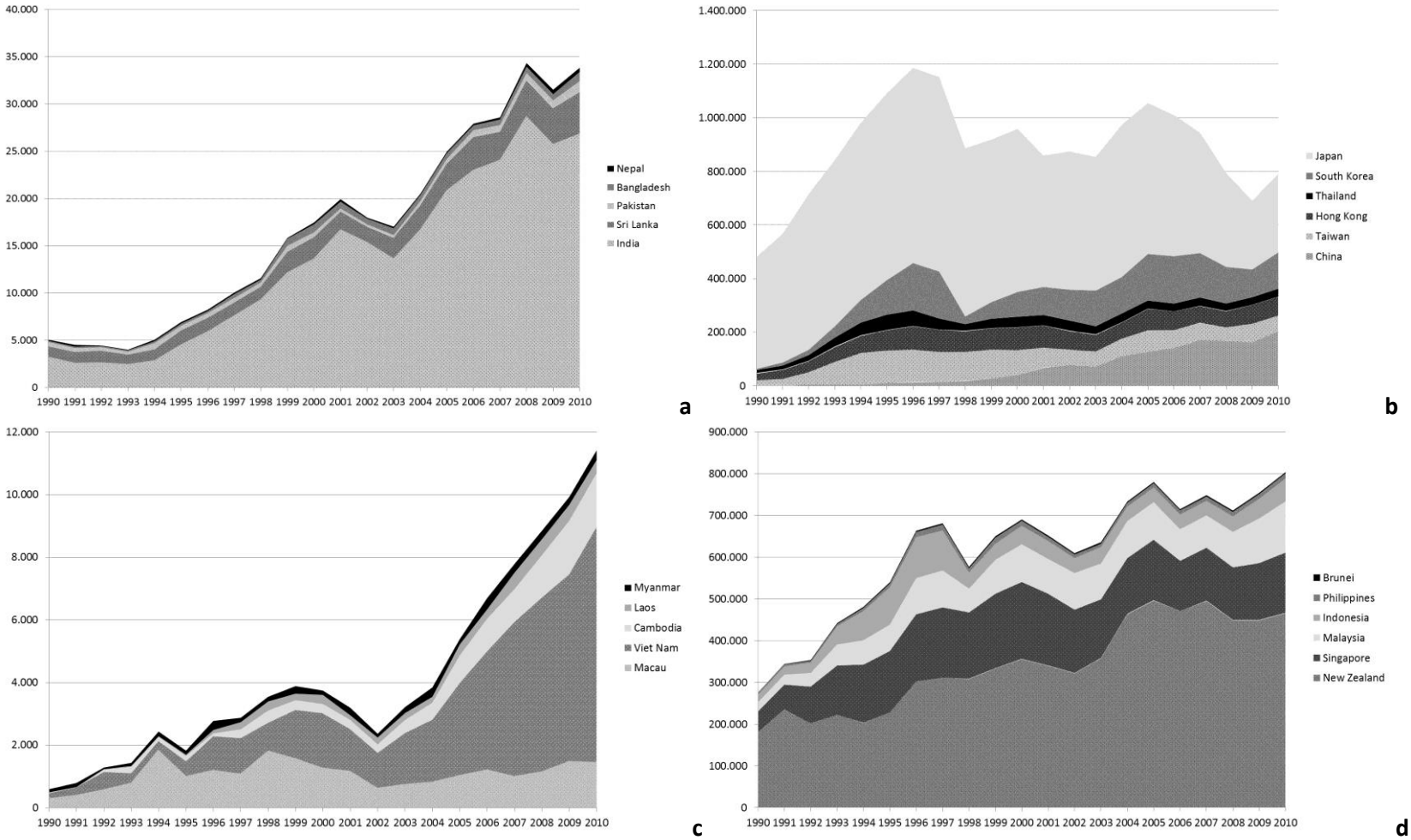

Figure 2.3a-d Relative growth of holiday arrivals in Australia from the 22 Asia-Pacific countries (1990=100%). With a) countries from South Asia, b) the more central Asia-Pacific countries with large tourist numbers, c) the more central Asia-Pacific countries with smaller tourist numbers, d) the Asia-Pacific countries located in the south east

Source: Australian Bureau of Statistics

2.3 Potential Determinants of Asia-Pacific Tourism to Australia: Income, Distance and Population

The potential factors influencing the geographies of tourism to Australia are, of course, likely to be both varied and complex (Crouch, 1994; Lim, 1999; Seetaram, 2012). However, given that virtually all international visitors to Australia arrive by plane (BTCE, 1992), we believe it is possible to model the major components of these geographies by drawing on the air travel demand literature more generally. Gillen (2010) suggests that, in addition to the obvious effect of population, inter-country demand for air travel - both business and leisure - is primarily influenced by:

(1) *macro-economic forces* - GDP growth, but also growth in mutual trade in goods and services and foreign direct investment generally lead to more demand for air travel (e.g. the stagnation of tourism from Japan in the face of rising volumes of tourists from China);

(2) *geographic proximity* - shorter distances generally lead to more demand for air travel, primarily because the costs for making the air transport connection become smaller (e.g. the larger volumes of tourists from New Zealand than from India), albeit that the relation between distance and cost is imperfect;

(3) *cultural and mental proximity* – this is a more tacit influence, and relates to a series of integration forces between countries that lead to more demand for air travel (e.g. the relative cultural and mental proximity and large cross-migration between New Zealand and Australia lead to extra air travel demand because of myriad cultural exchanges in the broadest sense, enhanced knowledge about leisure and business opportunities that are furthermore facilitated because of the shared language, visiting friends and relatives that have migrated, etc.).

Added to this complex mix is the self-reinforcing effect of a number of these factors (Van De Vijver et al., 2014): more air travel often facilitates trade and cultural proximity in its own right, subsequently leading to even more air travel in the future.

In the face of this complexity, we will try to capture the (changing) geographies of Asia-Pacific tourism to Australia by drawing on three straightforward measures: GDP/capita as a proxy for the influence of macro-economic forces, distance as proxy for the cost of traveling, and population size as control variable. Although this may seem like a very parsimonious approach, we believe this is warranted because of two reasons. First, a number of tacit processes, primarily present in the 'cultural and mental proximity' influence, are very hard to systematically operationalize and interpret. And, second, as we will see these factors collectively capture 90% of the variance shown in

Table 2.1 and Figures 2.3a-d, thus providing us with a good grasp of the major factors explaining the geographies of tourism to Australia. The remainder of this section provides more details on each of these variables.

We use a country's GDP per capita as a proxy for disposable income, because income itself is a subjective variable and is not precisely measurable (Lim, 2006). GDP per capita is one of the most cited factors in both the travel and tourism demand literature (Crouch, 1995; Crouch et al., 1992; InterVISTAS, 2007; Lim, 1999, 2006; Prideaux, 2005). Oum et al. (2009), for example, estimate a model for international air travel demand in which they include GDP growth, in addition to fuel prices and dummy variables to reflect events such as SARS, 9/11 and Asian financial crises. Hooper (1993) and Mitchell (1993) find GDP to be an important indicator for estimating air travel demand, while Tretheway and Oum (1992) consider very few goods or services to be as responsive to income as air travel. More specifically for tourism, based on a review of 100 published studies featuring international tourism demand models, Lim (1997) shows that income is the single most used variable in the tourism demand literature. Evidence for the Australian market suggests that inbound leisure travel is highly sensitive to income (BTCE, 1995). For example, BTCE (1988) and Poole (1988) successfully included GDP in their model estimating non-business travel demand towards Australia. Meanwhile, Seetaram (2010) finds GDP to be the most important determinant for outbound tourism from Australia. Taken together, it seems fair to assume that disposable income as proxied through GDP/capita will also be one of the key factors underlying growth from our selected Asia-Pacific countries, especially given their sizable economic progress from the 1980s onwards. Indeed, as Chin et al. (1999) point out, the number of Asian air travelers has substantially increased in the face of the emergence of a sizeable middle-income class with the resources to travel. That said, we are aware that in many Asian countries the income distribution is very uneven, so that an increase in GDP/capita does not linearly lead to larger disposable income and thus show different effects on the demand for air travel than those revealed for, say, Europe (BTCE, 1995). We will take this into account when discussing the results.

Distance is a second often cited factor underlying the demand for tourism (Anastasopoulus, 1991). Distance is used here as a proxy for travel cost and is negatively related to the demand: longer flights are more expensive (Eilat and Einav, 2004; Lim, 1997; Tretheway and Oum, 1992). In turn, these travel costs are also the product of a number of other factors, and we will discuss two of these.

First, the cost of a flight is in complex ways influenced by the extent of (de)regulation policies, which determine the extent and shape of airline competition and air fares on a route (Dobruszkes, 2009). The route between Kuala Lumpur and Singapore, for example, was until recently heavily regulated

due to the complicated and troubled relations between Malaysia and Singapore. This regulation comprised a bilateral agreement limiting the number of flights, enhanced by a monopolistic air shuttle agreement between competitors Malaysian Airline System and Singapore Airlines, setting the average fares in the mid-2000s to around 400US$ for a 45-minute flight. In 2007, these restrictions were lifted, resulting in a more-than-doubling of the number of flights (performed by full service carriers and LCCs such as Air Asia), and, above all, air fares below 100$ (Ng, 2009). Overall, air transport liberalization tends to bring -among other things- free market entry (more competition), and the removal of fare, capacity and frequency restrictions on routes between countries that have signed more liberal (and in certain cases open skies) agreements. In addition to more competition on routes, liberalization has also led to the opening up of new niche markets in some cases (Dobruszkes, 2006). These are routes that are served by only one airline, and that can be cheap or -on the contrary- quite expensive, even if they are being served by an LCC.

During the period 1990-2010, air transport liberalization between Australia and the other Asia-Pacific countries has been well underway. In 2002 for instance, an open skies agreement between Australia and New Zealand went into effect, creating a single aviation market. The bilateral agreements with the other countries also became less restricted, although the degree of liberalization still varies. The agreement with Singapore from 2003, for example, has no capacity restrictions, and includes restricted beyond-rights. In contrast, the air service agreement between China and Australia of 2004 permitted free market entry, and the right to fly to any points in the two countries, but still imposed capacity restrictions (CAPA, 2011). From 2005 onwards, the capacity and destinations between India and Australia were extended, just as bilateral agreements with Hong Kong, South-Korea, Malaysia and Viet Nam were further liberalized in the period under study. This has resulted in increasing competition and the entrance of low cost carriers on certain routes (for example Australian Jetstar on a couple of Australia-New Zealand routes), aiding in the expansion of air travel and lower air fares on routes between Australia and Asia-Pacific countries (Forsyth, 1998; Maillebiau and Hansen, 1995; Oum et al., 2009; Schipper et al., 2002). However, in certain cases also increases of air fares are detected after liberalization, as described in Goetz and Vowles (2009). Despite this, we expect that the importance of the variable 'distance' will decrease if liberalization proceeds.

Second, air fares also depend on fuel prices assuming changes in fuel prices are passed on to the consumer in the form of higher air fares. These fuel prices have been highly volatile, especially from the oil crises in the 1970s onwards (Becken, 2011). The general trend, however, has been an increase, as is illustrated in Figure 2.4, which gives the jet fuel prices in the US between 1990 and 2014. For instance, the cost of aviation fuel between July 2004 and July 2008 rose by 244% to a peak price (Morrison et al., 2010). This has had a large impact on air fares because fuel costs make up an

increasingly large portion of an airline's operating costs, currently constituting about 30% for long haul flights (Ringbeck et al., 2009). Small and Sweetman (2009) and Schiff and Becken (2011), have shown that the increased fares due to increasing fuel surcharges has affected -albeit to a limited extent- the number of international visitors to New-Zealand. Specifically for Australia, CAPA (2011) acknowledges that increasing fuel prices could impede future growth of inbound international tourism. In this case and in contrast with liberalization, increasing oil prices will increase the weight of the variable 'distance'. We must note that air fares do not linearly increase with distance. Each flight has inherent fixed costs (e.g aircraft use, ground handling, staff), that make up a larger part of the total air fare for shorter trips. In contrast, the fuel costs as a percentage of the airline operating cost are higher for long- haul flights.

Figure 2.4 U.S. Gulf Coast Kerosene-Type Jet Fuel Spot Price (US $ per Gallon) 1990-2014

Source: U.S. Energy Information Administration (September 2014)

Note: the spot price is the price for a one-time open market transaction for near-term delivery of a specific quantity of product at a specific location where the commodity is purchased at current market rates.

And finally, Population is used as a control variable in the research on travel demand (BTCE, 1995; InterVISTAS, 2007; Song and Turner, 2006). Abed, Ba-Fail, and Jasiuddin (2001) found in their model for international travel demand to Saudi Arabia that population size was one of the most important determinants. We expect an elasticity of 1: if a population in a country grows by 1%, the additional tourists to Australia increase by the same amount.

2.4 Data and Methodology

2.4.1 Data

In our analysis, we use these three variables to model the number of Asia-Pacific holiday arrivals in Australia at 5 different moments during the 1990-2010 timespan.

- The **GDP per capita** at purchasing power parity (PPP) is expressed in current international dollar, but has not been controlled for exchange rates. The data are derived from the International Monetary Fund, and supplemented with data from the World Bank for Macau. GDP per capita expresses the value of all final goods and services produced within a country in a given year, divided by the average (or mid-year) population for the same year. We used the PPP adjusted measure, as it takes into account the relative cost of living and the inflation rates of the countries, masking the sometimes quite large differences in living standards between the countries.
- The **population** data were derived from the Asian Development Bank, indicating the mid-year population.
- For the **distance**, we used the *distwces* measure from the CEPII-database (French Research Center in International Economics). This is a calculation based upon the distance between the largest cities (in population numbers) of those two countries. The inter-city distances are then weighted by the share of each city in the overall country's population (Mayer and Zignago, 2011).

  The general formula for this calculation of distance is:

  $$d_{ij} = \left(\sum_{k \in i}\left({pop_k}/{pop_i}\right)\sum_{l \in j}\left({pop_l}/{pop_j}\right)d_{kl}^{\theta}\right)^{1/\theta} \qquad (2.1)$$

  where pop_k designates the population of agglomeration k belonging to country i. The parameter θ measures the sensitivity of flows to bilateral distance d_{kl}. The *distwces* calculation sets θ equal to -1, which corresponds to the usual coefficient estimated from gravity models of bilateral (trade) flows. For Macau, this measure was not available, and therefore, we took the geometric distance between Macau and Sydney.
- For the **holiday arrivals**, we used a customized database from the Australian Bureau of Statistics, containing overseas arrival data from 22 Asia-Pacific countries (Table 2.1). The data are derived from the Australian passenger cards that mention holiday arrival as its primary purpose.

2.4.2 Methodology

Since the 1970s, a number of studies have attempted to empirically model the pattern of international tourist flows. The majority has been of either the econometric or gravity model type. In gravity models, push and pull factors between the origin and destination regions (such as population) and restraining factors (such as distance) are used. Econometric models usually use factors influencing the nature of the demand curve, such as income and price. Crouch et al. (1992) state that both modelling approaches are limited by the availability of adequate data, and they find regression analysis to be the most suitable means of estimating model parameters, not least because it has been successfully applied in much of the literature (BTCE, 1988; Crouch et al., 1992; Seetaram, 2012). We estimate tourism demand using multiple linear regressions with GDP per capita, population and distance as independent variables. We do this for five different moments in time (1990, 1995, 2000, 2005 and 2010) in order to evaluate the changing role and effect of the three different explanatory variables throughout the two decades. To estimate coefficient elasticities, both dependent and independent variables are put in their loglinear form. According to Witt and Witt (1995), several studies show that a loglinear model also yields superior empirical results to linear regression. Our regressions can therefore be specified as:

$$Ln(Tourism) = \beta_1 * Ln\left(GDP_{cap_{origin}}\right) + \beta_2 * Ln\left(Pop_{origin}\right) + \beta_3 * Ln(distance) + constant \quad (2.2)$$

Because we work with a small sample of 22 observations for each year, and because the assumptions of linear regression were not always fulfilled (non-normal distribution of residuals, and signs of heteroskedasticity) for every year, we applied the method of bootstrapping to check the robustness of our results (Efron, 1979). We used random resampling to estimate the reliability of the regression coefficients (Hesterberg et al., 2003). In this resampling method, 1000 bootstrap samples are selected with resampling directly from the observations, after which the statistics for each bootstrap sample are calculated. We focus on the coefficient of determination (to assess the overall fit of our model), the unstandardized beta coefficients (to assess the shifting absolute importance or elasticities of GDP per capita and distance), and the standardized beta coefficients (to assess the changing relative importance of GDP per capita, distance and population compared to each other).

2.5 Results and Discussion

Tables 2.2 to 2.6 present the results of the original and bootstrapped multiple regressions for 1990, 1995, 2000, 2005 and 2010. The bias, which is the difference between the averaged bootstrapped regression coefficients and the observed regression coefficient, is very small and the bootstrapped standard errors differ only slightly from the observed standard errors. Also the bias-corrected 95% confidence interval for each regression indicates that the GDP per capita, population and distance variables are robustly significant for each year. Hence, they contribute effectively to the estimation of the Asia-Pacific tourism towards Australia.

Table 2.2 Results from the original and bootstrapped regression analysis 1990 (# samples = 1000)

Variables	**Obs. coeff**	**Bias**	**Obs. beta**	**Obs. s.e.**	**Bootstrap s.e.**	**95%CI (bias-corrected)**	
GDP_{cap_origin}*	1.829	0.009	0.968	0.179	0.188	1.428	2.181
Pop_{origin}*	1.062	-0.017	0.787	0.126	0.127	0.790	1.275
Distance*	-3.320	0.108	-0.337	0.849	0.775	-4.811	-1.620
C	4.504	-0.726	-	8.010	7.028	-11.141	18.312
$R^2 = 0.896$							

*p<0.01

Table 2.3 Results from the original and bootstrapped regression analysis 1995 (# samples = 1000)

Variables	**Obs. coeff**	**Bias**	**Obs. beta**	**Obs. s.e.**	**Bootstrap s.e.**	**95%CI (bias-corrected)**	
GDP_{cap_origin}*	1.939	0.019	0.992	0.156	0.138	1.673	2.211
Pop_{origin}*	1.017	-0.009	0.726	0.111	0.140	0.677	1.256
Distance*	-3.214	0.104	-0.317	0.750	0.804	-5.165	-1.847
C	3.809	0.956	-	7.047	7.377	-7.237	21.285
$R^2 = 0.923$							

*p<0.01

Table 2.4 Results from the original and bootstrapped regression analysis 2000 (# samples = 1000)

Variables	Obs. coeff	Bias	Obs. beta	Obs. s.e.	Bootstrap s.e.	95%CI (bias-corrected)	
GDP_{cap_origin}*	1.779	0.009	0.975	0.126	0.103	1.529	1.944
Pop_{origin}*	0.959	-0.008	0.759	0.087	0.111	0.725	1.164
Distance*	-3.208	-0.093	-0.352	0.587	0.765	-5.273	-2.019
C	5.983	0.905	-	5.532	6.863	-3.485	24.385
$R^2 = 0.941$							

*p<0.01

Table 2.5 Results from the original and bootstrapped regression analysis 2005 (# samples = 1000)

Variables	Obs. coeff	Bias	Obs. beta	Obs. s.e.	Bootstrap s.e.	95%CI (bias-corrected)	
GDP_{cap_origin}*	1.801	0.007	0.959	0.141	0.138	1.534	2.081
Pop_{origin}*	1.024	-0.020	0.808	0.096	0.126	0.757	1.249
Distance*	-3.468	0.009	-0.382	0.629	0.797	-5.511	-1.938
C	6.464	0.227	-	5.967	7.071	-7.326	23.092
$R^2 = 0.932$							

*p<0.01

Table 2.6 Results from the original and bootstrapped regression analysis 2010 (# samples = 1000)

Variables	Obs. coeff	Bias	Obs. Beta coeff	Obs. s.e.	Bootstrap s.e.	95%CI (bias-corrected)	
GDP_{cap_origin}*	1.576	0.013	0.909	0.133	0.135	1.327	1.840
Pop_{origin}*	0.967	-0.012	0.848	0.089	0.111	0.716	1.161
Distance*	-3.636	0.045	-0.449	0.578	0.690	-5.615	-2.344
C	10.614	-0.280	-	5.453	5.725	0.221	26.681
$R^2 = 0.927$							

*p<0.01

Several conclusions can be drawn from these regressions. First, the determination coefficients are very high for all years. This implies that our model, although very straightforward in terms of its constituent parameters, is satisfactory: the independent variables jointly explain around 90% of the

variation in tourism. Hence, regression models estimate the Asia-Pacific tourism demand adequately, curbing the need for more complex travel demand models (Crouch et al., 1992).

Second, the value and evolution of the elasticities of GDP per capita and distance reveal a number of interesting patterns. The income elasticity, expressed through the unstandardized coefficient of GDP_{cap}, approximates 2, especially in the 1990s. This corresponds with the findings of Tretheway and Oum (1992), who suggested that the income elasticity of demand for international air services was of the order of 2 based on evidence from domestic and international studies. This indicates that tourism demand is highly income elastic and can -in economic terms- be defined as a luxury product (Song and Turner 2006; Witt and Witt 1995). In 1990, a rise of 1% in GDP per capita resulted in a 1.83% rise in Asia-Pacific holiday arrivals in Australia. However, in 2010, elasticity declined to 1.53, implying that Asia-Pacific holiday demand has become less income elastic. Hence, as the average income increases, the demand for additional holiday travel has been dampened down approaching 2010 (IATA, 2008).
There are a number of different possible explanations for this trend. As mentioned earlier, the uneven distribution of income in developing and newly industrialized countries may temper the translation of income growth directly to additional tourism demand. Thus, although the average GDP per capita has been growing quickly, and the growth in number of outbound Asia-Pacific tourists is impressive, these developments are generally confined to a small portion of each country's population. This occurrence is enhanced by the fact that income inequality in Asia-Pacific countries is on the rise (Ali, 2007). Another possible explanation involves a maturity of the Asia-Pacific holiday market to Australia, where growth in holiday travel is being increasingly driven by price reductions instead of income changes (Graham, 2006). Still, the coefficient remains larger than 1, implying that countries with higher average GDP per capita values produce higher levels of tourists, confirming the findings of among others Alperovich and Machnes (1994), Ishutkina and Hansman (2009: 61), and Mutti and Murray (1977). More recently Bowen (2014) reveals a clear worldwide pattern of greater airline capacity per capita in more developed countries.

Distance has the largest, but negative, elasticity, remaining larger than 3. This large negativity can be expected, as our research concerns international tourism travel. First, long-distance flights are usually more expensive than short-distance flights, and tourists are more price-sensitive than business travelers (Brons et al., 2002). Second, international air travel in the region is still principally regulated through bilateral air service agreements, discouraging the process of free-market forces. As mentioned earlier, air transport liberalization between Australia and the other Asia-Pacific countries progressed between 1990 and 2010, which has driven down travel costs, but a large degree of unevenness between the various bilateral air service agreements remains. Tourism Australia

(2013) has acknowledged the fundamental role of increasing capacity on existing routes and the opening up of new routes to Australia to stimulate international tourism demand in its Tourism 2020 Corporate Plan 2013-2016, which sets out the key strategies for obtaining the Australian tourism industry's longer-term goals. They stress the importance of negotiating more liberal air service agreements.

Despite the increased liberalization, however, the distance elasticity has actually increased towards 2010. This could be the result of regional sensitivity to increasing fuel prices. As discussed earlier these are taking up an increasingly large share of airlines' operating costs (Ringbeck et al., 2009). Coincidentally, according to CAPA (2011), Asia-Pacific carriers were the worst affected in this regard as their share of fuel prices rose to from 15% in 2001 to 37% in 2008. For North America and Europe, these numbers were respectively 13% and 12% in 2001, and 34% and 25% in 2008. This can be explained by the fact that the stage length in many Asia-Pacific airlines' networks is longer on average than those of North American and European operators, illustrated by the fact that 40% of the long haul versions of the Boeing 777-300ER are now operated by Asia-Pacific airlines (CAPA, 2013). Often, this rise in fuel prices has been passed on to passengers as fuel surcharges; if that continues these extra costs can possibly impede growth in the demand for tourism to Australia.

Hence, fuel prices and liberalization are two factors that simultaneously acted on the travel costs during the studied period, and the balance seems to have tilted towards a stronger influence of fuel prices, which counteracted the downward pressure of (limited) liberalization on travel costs. This trend can change in the future, though, given the high volatility of oil prices and the ongoing liberalization in the region.

Population has an elasticity of 1, which confirms our expectation and lends credibility to our model.

Third, the beta coefficients of the different variables give us insight into their respective individual influence on holiday demand. Income (GDP per capita) is the most important determinant of Asia-Pacific tourism to Australia. This is in line with the findings of Lim (1997), who reveals income to be the most significant variable in a review of 100 published studies on empirical international tourism demand models. Specifically for tourism to Australia, Seetaram (2012) considers income in GDP per capita (in PPP) as the most important determinant of short term visit and also Crouch et al. (1992) observe that income is a highly statistically significant variable in their tourism demand model. Population has a large beta-coefficient too, indicating that larger countries produce more possible holiday travelers (BTCE, 1995). The smaller beta coefficient of distance reflects Ishutkina and Hansman's (2009) findings that the influence of the distance is rather small compared to the other explanatory variables. However, the individual influence of distance rises towards 2010, while that of

income decreases, parallel with the elasticities. This could indicate that holiday travel to Australia becomes less income-dependent with increasing incomes (Forsyth, 2006), but more price sensitive.

2.6 Conclusions and Outlook

The objective of this paper was twofold. First, we have briefly sketched the evolution and changing geographical patterns in Asia-Pacific tourism to Australia. We can conclude that Japan and New Zealand have remained the largest sources of tourists, but that their share has respectively decreased and stagnated towards 2010. In contrast, tourist numbers from China have exploded, making the country the third largest source of tourists in the region and the future key market for Australian inbound tourism. The growth patterns of the other countries in our study vary, but a general increasing trend is present.

Second, we estimated the importance of some of the most commonly cited factors –income, distance and population- that have driven this changing demand for Asia-Pacific tourism to Australia. Our results indicate that Asia-Pacific holiday demand has a positive, and decreasing income-elasticity, and a strong, but increasing negative distance-elasticity. We consider this distance variable as a proxy for travel costs, which are in turn being determined by the level of air transport liberalization and fuel prices. The relative importance of income is much larger compared to distance, but its importance has decreased over the two decades, in favor of the distance-variable.
The combination of these results, allows us to draw a number of tentative conclusions related to the Australian tourism market maturity and the challenges this poses, the importance of air services liberalization, and the dangers of increasing fuel prices for future tourism growth.

Despite the fact that growth in the amount of Asia-Pacific tourists to Australia is to be expected in the immediate future (partly due to a continuous increase in Asia-Pacific countries' income), the decrease in income elasticity shows that the Australian tourism market from these countries is maturing. At a certain point, saturation of the market will be attained, and the Australian Government, in collaboration with the tourism industry, will have to react to counter this situation. Australia's experience with the Japanese market is an important example here; this market expanded rapidly to a high level, but it declined rapidly again. The Japanese tourist numbers are continuing to decrease -albeit also because of the stagnation of the Japanese economy. Hence for the key-market of China it is important to recognize that the perceived organic growth (associated with the rise of income in that country) will not be ever-lasting. Tourism Australia recognizes that although economic growth has been impressive in its Asian source markets (Korea, Hong Kong, Singapore, China, India,

Indonesia, Malaysia and Viet Nam), an expected slower economic growth due to the current global situation (together with the maturing of the market), can worsen the outlook for tourism growth, particularly from China. The organization is trying to anticipate this in the Corporate Report 2013-2016 of its *Tourism 2020 Strategy* and has plans for campaigns that are focused on marketing Australia as a tourist destination across all Asian source countries, including cooperative marketing campaigns with airlines and industry.

However, marketing strategies only are not enough, as we have shown that possible limits to growth are also obvious from the increase of the distance elasticity. Increasing fuel prices will pose a potential threat to future tourism growth. According to Airbus' (2010) Global Market Forecast 2010-2029 oil prices are expected to keep rising and reach the 2008 peak levels again by 2016, which will further drive air fares up. As increasing air transport liberalization may limit some of the damage caused by these costs, it is important that far-reaching liberalization is established between Australia and the Asia-Pacific countries. For instance, the bilateral air service agreement between Australia and China comprises free market entry and the possibility of flying to any destination, but currently still limits capacity. Although the capacity was increased by more than 50% under a memorandum of understanding (MoU) agreed in 2011, this entire capacity was already reached by February 2013 (CAPA, 2013). Hence, an open skies agreement, without capacity restrictions, may be essential to maintain future tourism demand growth. These benefits could also flow from liberalization efforts in the Asia-Pacific region as a whole. For example, ASEAN foresees a single aviation market by 2015, which will boost intra-ASEAN travel. Australia currently has several bilateral agreements with the constituting countries, but moving to an (open skies) agreement with ASEAN as a whole would equally benefit the tourism flows between Australian and ASEAN. One direct effect would be the introduction of more LCCs on Australia-Asia-Pacific routes which could have a strong effect on air fares.

In conclusion, we can say that it is difficult to predict the final amount of tourism growth that air transport liberalization engenders, because the oil price –which is volatile and determines fuel price- has such a powerful effect upon fares. However, forecasting was not the scope of this article, although our model enabled us to deliver some possible future outcomes based on the changing elasticities and relative importance of income and distance (as a proxy for travel costs).

Our research and methodology obviously have some limitations too, particularly associated with the limited number of observations and the lack of available data. First, the former restricts the number of explanatory variables. It would have been interesting to incorporate additional variables to indicate the level of liberalization between Asia-Pacific countries and Australia, or a dummy variable

that indicates restrictive or liberal aviation policies, or the evolution in these policies between the countries. Additionally, an explanatory variable indicating previous levels of migration from the Asia-Pacific countries to Australia could have explained part of the tourist volumes towards the country, as the choice of a holiday destination is also often influenced by ethnic and migration factors (Lim, 1997). Adding such variables would give more power to the modeling of the demand for air travel, in addition to income and distance. We also experimented with a variable for the size of the middle income class and a dummy variable for the presence of Tourism Australia Agencies but they were not significant in our model. That said, the combined explanatory power of our variables is already high (> 90%). Second, income is represented by GDP per capita. Although this measure is often used in travel demand literature, it is not a factual representation of personal income. In the same way, transport costs are represented by distance, but future research could develop a more accurate measure for transport costs taking into account the real cost of fares, but also other things such as the value of time (an overview of the possibilities is given in Burghouwt and Redondi, 2013). This would enable us to approach the real travel costs more accurately than by solely the distance-proxy.

Another future step in our research could be to collect data on tourism demand and its drivers for city-pairs between Australia and Asia-Pacific countries. This would enable us to enlarge the dataset and include more possible drivers for tourism growth. It would also allow us to estimate the importance of particular events, such as the capacity expansion or the entrance of a competing carrier on a certain route.

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CHAPTER 3

Filling some black holes: Modeling the connection between urbanization, air passenger traffic, and global service intensity

Van De Vijver, E., Derudder, B., Bassens D., and Witlox, F., 2014. Filling some black holes: Modeling the connection between urbanization, infrastructure, and global service intensity. *The Professional Geographer,* 66 (1), 82-90.

Abstract

This empirical article combines insights from previous research on the level of knowledge-intensive service in metropolitan areas with the aim to develop an understanding of the spatial structure of the global service economy. We use a stepwise regression model with GaWC's measure of globalized service provisioning as the dependent variable and a range of variables focusing on population, infrastructure, urban primacy, and national regulation as independent variables. The discussion of the results focuses on model parameters as well as the meaning of outliers, and is used to explore some avenues for future research.

3.1 Introduction

In an article in this journal, Short (2004) develops an alternative way of looking at globalized urbanization: rather than merely discussing the points where the geographical unevenness of contemporary globalization is being (re)produced, he analyzes which large cities seem to be largely absent from these processes. To this end, he draws upon the well-known world city data of the Globalization and World Cities research network (GaWC), which uses the presence of globalized advanced producer services (APS) firms as an indicator of 'world city-formation'. Short (2004) uses this GaWC indicator as a yardstick for measuring the impact of population size on the presence of globalized APS firms. His major conclusion is that although urban population size has an impact on a city's involvement in the (re)production of uneven globalization, this relation is generally weak. There are thus major outliers at both sides of the spectrum, ranging from cities that are 'hyper-connected' in the office networks of globalized APS firms even when considering their size (e.g. London and New York), to 'black holes' that are hardly connected in the office networks of globalized APS firms despite their sheer size (e.g. Dhaka and Khartoum).

Although the prime purpose of Short's (2004) article is to develop a better understanding of cities that are 'off the map' of research on world cities (Robinson 2002), his analysis can also be positioned in the context of the rich literature that aims to explain the level of service intensity of cities. Taylor et al. (2007), for instance, use a similar methodological approach to assess the impact of airline infrastructure on cities' involvement in the office networks of APS firms at the global scale. The latter study, in turn, continues a long line of more comprehensive research at the national scale (especially in the United States). Debbage (1999), for instance, has shown that population size, service intensity, and airline infrastructure are major covariates in the U.S. urban system. At the same time, however, given the specificity of the U.S. market for services and air passenger transport, it can be expected that the actual strength of the relations between these indicators may vary in different parts of the world (see Taylor et al. 2007).

Against this backdrop, the main purpose of this article is to develop a more comprehensive study of the driving forces behind cities' involvement in the globalized office networks of APS firms[19]. To this end, we will use an updated GaWC measurement of world city-formation as the dependent variable in a stepwise regression model that involves the differential impact of infrastructure, population, urban primacy, and national regulation on this measure. Furthermore, modeling these relations

supports the broader aim of this article to fine-tune the existing APS-heuristic in world cities research (Derudder et al. 2010), and disclose the spatial structure of the global service economy. However, due to the continued lack of comprehensive urban datasets at the global scale (Short et al. 1996), analyzing the relationships between indicators such as population size, service intensity, and airline infrastructure remains much easier at the national scale because of superior data. Hence, it is necessary to acknowledge from the outset that our effort is an exploratory one.

The remainder of this article is organized as follows. The next section introduces the theoretical background of our empirical analysis. We first discuss the relation between world city-formation and the presence of globalized APS, and then introduce our indicator for measuring cities' involvement in globalized APS networks. Next, we draw on a literature review to explain which processes can be assumed to drive the presence of APS firms, and discuss the formative interpretation and operationalization of these drivers in a global context. In the following section, we present our methodological framework. The third section then outlines our results, after which this article is concluded with a discussion of the implications for research on globalized urbanization in general and world city-formation in particular.

3.2 Processes underlying world city network formation

Our analysis draws on arguments derived from sometimes very different literatures. This can initially be divided in two parts: (i) the analytical linkages between world city-formation and globalized APS provision on the one hand, and (ii) the covariates of the intensity of APS provision in specific cities on the other hand. The latter literature in turn comprises very different insights at very different scales, but here we tie these together to develop a comprehensive framework of possible drivers of the presence of APS firms at the global scale.

3.2.1 World city network-formation and advanced producer services

GaWC's research on world city network (WCN) formation through the lens of APS firms' location strategies is based upon an extension of Saskia Sassen's (1991) well-known concept of 'the global city'. In her seminal book, Sassen essentially argued that there are a select number of cities that are strongly associated with contemporary globalization through their development of APS by firms offering customized financial, professional, and creative expertise to corporate clients. The urban

[19] In this sense, this paper also complements the study by Bel and Fageda (2008), in which the authors examine the presence of large international firms' headquarters in European urban areas in the context of their airline

disposition of APS rests on the straightforward observation that, to keep ahead in their business, such firms require access to a skilled labor pool, information-rich and prestigious environs, and superior office, transport and telecommunications infrastructures, all of which are primarily found in major cities across the settled world. As the corporate clients of APS firms increasingly begun to globalize from the 1970s onwards, so also did the firms servicing them in APS such as commercial law, wealth management, corporate tax advice and advertising. The result has been that major cities became simultaneously markets for these services through corporate presences, and production centers of these services through innovative knowledge clusters. It is through the expertise of APS firms in transnational servicing of their clients that cities became seen as the organizing nodes of economic globalization.

GaWC accepts Sassen's identification of APS firms at the cutting edge of the world economy through enabling transnational commerce and production, but has extended the argument beyond Sassen's focus on just a small number of select cities (Taylor, 2004; Taylor et al., 2013). Typically, leading APS firms operate through office networks across a large number of cities, ranging from a few cities in the case of law firms to thousands of cities in the case of the big accountancy firms. Thus GaWC has moved away from an emphasis on a few nodes as 'global cities' to focus on the network relations of many more cities in the servicing of global capital. This is specified as the world city network, and in this article we will therefore – in parallel with Short (2004) – use a recent operationalization of this concept as an indicator of a city's involvement in globalized APS networks.

This indicator, the global service intensity (GSI) of cities, is calculated based on data on the office networks of APS firms, collected by GaWC (Taylor et al., 2013). These data are readily available on firms' websites where they promote their 'global' status as a means of both impressing clients in a competitive services market and recruiting graduates in a competitive jobs market. This information was converted by simple coding to a so-called service value (ranging from 0 to 5), which depends on the size/relevance of the offices, to enable cross-firm comparisons. This resulted in a firm/city service values matrix that provides the basic raw material for GaWC's world city network analysis.

The data used in this article were collected in 2010, and provide information on the location strategies of 175 APS firms in 525 cities across the settled world. The firm selection is composed of 75 financial services firms and 25 each of accountancy, advertising, law and management consultancy firms. Firms were chosen using trade information ranking firms by size based upon the latest information available (e.g. on turnover) before the data collection (i.e. for 2009). A city's global service intensity is then computed by applying an interaction model as detailed in Taylor (2001). To

connectivity.

the best of our knowledge, this is the most comprehensive indicator of the involvement of cities in the office networks of APS firms available at the global scale.

3.2.2 Possible drivers of the presence of globalized APS firms

Infrastructure

Perhaps the single most researched variable in relation with the service intensity of metropolitan regions is that of infrastructure (cf. Taaffe, 1962; Bird, 1973; Warf, 1989). Continuing this geographical tradition, Keeling (1995) lists a number reasons why, for instance, air transport is a key variable in explaining world city network-formation. The most pertinent ones are: (i) airline networks and their associated infrastructure are the most visible manifestation of world city-formation (Smith and Timberlake 2001); (ii) the continued demand for face-to-face relationships in spite of the parallel development of (tele)communications (e.g. Denstadli 2004; Bel and Fageda 2008); (iii) the observation that air transport is the preferred mode of inter-city movement for the transnational capitalist class, migrants, tourists (e.g. Bowen 2002); and (iv) the fact that airline links are often important components of a city's aspirations to world city status (e.g. the flagship role of Emirates in the rise of Dubai).

The net result of these conceptual linkages is that, although far from being carbon copies, the relative and absolute importance of a globalized APS sector in metropolitan regions is known to be related to their airline connectivity. In addition to a number of general discussions of the role of airline connectivity in world city-formation (e.g. Grubesic and Matisziw, 2012; Matsumoto, 2004; O'Connor, 2003), the only analysis that explicitly links cities' airline passenger numbers to their involvement in global service provisioning is that of Taylor et al. (2007). In this article, the authors find that the number of airline passengers associated with cities explains up to 53 percent of the observed variance in GaWC's measure of world city network connectivity.

More empirical support for such strong relation comes from analyses of the relations between airline connectivity and knowledge-intensive business services at the national level, especially in the United States. Irwin and Kasarda (1991) found for a set of 104 U.S. metropolitan areas that changes in airline networks affect the employment growth in business services, while roughly a decade later Brueckner (2003) and Debbage and Delk (2001) obtained similar results. Furthermore, a recent contribution to this literature by Neal (2010) adds a new element by addressing the causality in the link between air transport and the importance of APS: his longitudinal analysis shows that, at least in the U.S. urban system, changes in airline connectivity tend to explain changes in the importance of advanced

services in the labor market rather than the other way round, which lends further credibility to using the level of airline connectivity for explaining the presence of major APS firms[20].

Although there are quite some data sources detailing the participation of cities in air passenger networks, not all sources are equally pertinent. One major example would be that most airline statistics do not contain origin-destination data, but rather give information on the way in which airlines organize their networks. Using such data would, for instance, overvalue the importance of cities comprising 'airports' acting as switching points for passengers. To circumvent this problem, we use data derived from the Sabre Airport Data Intelligence (ADI) database. ADI is a so-called 'Global Distribution System', which contains worldwide booking information on passenger flights. The database contains information on passenger flows between airports through airport codes. In contrast to most other statistics, this data source contains information on actual origins and destinations as well as information on the connections of low-cost carriers.

National regulation

In their analysis, Taylor et al. (2007) do not concentrate on the results of the 'general' relation between air passenger travel and APS firm connectivity because U.S. cities seem to have a pattern that is consistently different from that of non-U.S. cities. The authors ascribe this to sheer size of the deregulated U.S. air passenger market as well as the relatively underdeveloped presence of 'globalized' APS firms due to a strong 'national' APS market. The net effect is that U.S. cities have generally far less 'global' APS involvement than can be expected based on their air passenger connectivity. As a consequence, in practice Taylor et al. (2007) assess the relation between the size of the air passenger market and world city network connectivity for U.S. and non-U.S. cities separately. The relevance of this choice is shown by the results, as the explained variance rises from 53 percent to 73 percent (U.S. cities) and 61 percent (non-U.S. cities) respectively.

Taylor et al. (2007) restrict the use of 'national specificity' in their model to the United States because of an assumed 'American exceptionalism' in this context. However, not only in the United States the relationship between infrastructure networks and the presence of globalized APS firms is driven by national peculiarities (for a more general appreciation of the role of states in world city network-formation, see Hill and Kim, 2000; Olds and Yeung, 2004). In China, for example, the state-processed economy is clearly crucial for understanding cities' involvement in the office networks of

[20] Air transport infrastructure is obviously not the only relevant infrastructure network. However, in addition to Keeling's (1995) observations regarding the actual and perceived primacy of air transport in the infrastructural component of world cities, there is also research that has shown the network topologies of other infrastructure

globalized APS. For instance, in spite of the country's WTO ascension in 2001, doing business continues to be tightly regulated. The most obvious example, of course, is that of banking in that most of China's own financial institutions continue to be state owned and governed, while 75 percent of state bank loans continue to go to State Owned Enterprises (SOEs). China's entry into the WTO has obviously created opportunities for foreign banks as well. However, there continue to be strict rules regulating foreign financial institutions' possibilities, especially when it comes to doing business in the local currency (Pauly, 2011).

The key point for the purpose of this article is that, although a high-end service sector is undeniably developing in most Chinese cities, the involvement of firms typically featuring in GaWC's empirical framework is restricted by the regulatory context imposed by the Chinese state. Thus in addition to a specific pattern for U.S. cities, one can also suspect a differential pattern for Chinese cities, and perhaps also for cities in other states.

In our analysis, we therefore extend the framework of Taylor et al. (2007), not by 'splitting' the analysis in a set of sub-analyses, but by adding dummy variables. Cities located in countries with at least four cities in the final dataset (see below) were brought together in set of national dummy variables (e.g. China and the United States), after which the remaining cities were brought together in regional dummy variables (e.g. Latin America and Sub-Sahara Africa).

Population

As mentioned in the introduction, Short (2004) has shown that metropolitan size is less-than-perfectly correlated with world city network-formation as measured through globalized service intensity. However, although not a major indicator, there is a size effect in that large cities have the tendency to be slightly more connected in the office networks of globalized APS firms. It therefore seems warranted to adopt this indicator in our regression analysis, if only as a control variable in our analysis for the effect of infrastructure: air passenger infrastructure is of course also positively related to population size.

The population data used in our analysis are collected by Brinkhoff (2011), whose website lists up-to-date census data of urban agglomerations with more than one million inhabitants.

National primacy

A final indicator in our model lies on the intersection of population and national regulation indicators. Referring back to the Chinese example, it can be observed that the regulatory context not

networks (that of the Internet's backbone in particular) to be very similar to those of airline networks (Devriendt et al., 2010; Tranos, 2011).

only influences the involvement of globalized APS, it also imposes a specific kind of location-dependence. The restrictions for foreign banking in China, for instance, also have an important geographical dimension: restrictions on doing Renminbi-denominated business – the supposed golden grail for many foreign banks – have been phased out unevenly, with Shanghai amongst the first sites where this type of regulation was loosened. Unsurprisingly, foreign financial services firms have flocked to this city as it is the place where they can develop their China-centered businesses in the best circumstances in regulatory terms. Furthermore, in the face of this spatio-temporal unevenness in phasing out financial services restrictions, Shanghai has acquired a comparative advantage that is being reproduced as foreign banking involvement in China rises (see Lai, 2012). This specific argument chimes well with Sassen's (2001) more general contention that we are increasingly witnessing a relative concentration of transnational command and control activities of APS firms in a select number of major cities.

In addition to variables for a city's state and metropolitan size per se, we will therefore use an urban primacy dummy variable for a country's major city in a state to test whether (over and above size) major cities also house disproportionate levels of globalized APS.

3.3 Methodology

3.3.1 Data transformations

The initial data were – where necessary – transformed in three different ways to arrive at a consistent framework. A first problem related to the territorial definition of the cities in our analysis. Our population data define cities primarily in a morphological sense (i.e. urban agglomerations), while airline data entail a functional city-regional approach (i.e. the London airports serve the entire Southeast England), and GaWC data in practice often refer to economic activity contained within specific grids of business activity (e.g. most of the GaWC firms in London are located in 'the City'). To circumvent this problem, we transformed our data by adopting a territorial working definition for our 'cities' that is as coherent as possible and transforming our data to fit this operationalization.

In practice, this implies a focus on metropolitan regions that are reminiscent of American CMSAs (Consolidated Metropolitan Statistical Area). As there is no agreed upon global operationalization of this approach, we have tried to devise a list that follows the CMSA logic as closely as possible. For instance, the Dutch cities are combined into a single 'Randstad' measure. However, we concede that this approach is far from clear-cut. For instance, it is hard to make a clear-cut partition of the urban spheres of influence in, say, China's Pearl River Delta (with Hong Kong, Guangzhou, and Shenzhen as

major nodes), as airports, urban centrality and morphology in this region exhibit a highly complex and overlapping interplay. In the event, we have chosen to retain Hong Kong as a separate metropolitan region, and combine the remainder of the Pearl River Delta as a single region because of the 'one state, two systems' logic. We used existing, official designations of CSMA-like metropolitan regions when available. This territorial working definition implied – where necessary - combining urban populations, retaining the highest service value of a metropolitan region's constituent nodes, and aggregating origin/destination volumes of the airports.

The second problem relates to the uneven coverage of our datasets. We therefore decided to exclusively focus on metropolitan regions that scored at least 10 percent of the highest value on each of the (transformed) measures for population (Yangtze River Delta centered on Shanghai), airport connectivity (London Metropolitan Area), and global service intensity (London Metropolitan Area). This resulted in a total of 112 metropolitan regions. And third and finally, as each of the distributions of our continuous datasets is heavily skewed, we logged the data so that the distributions become normally distributed and can be used as an input to regression analysis.

3.3.2 Forward stepwise regression analysis

We analyze our variables with a stepwise multiple linear regression, in which the above cited drivers of world city formation and global service intensity are the independent and dependent variables respectively. A stepwise multiple linear regression is a systematic method for adding variables from a multi-linear model based on their statistical significance in the regression. An initial model is stepwise expanded by variables that have the smallest *p*-value, but in every step the variables that are no longer significant are removed. This iteration terminates when no single step further improves the model. Only the significant variables (here at the 0.05 significance level) thus remain.

For our purposes, two sets of relevant information are drawn from the model, i.e. (i) the regression model parameters proper, such as the degree of explained variance (R^2) and the relative importance of each of the variables (standardized β-coefficients); but also (ii) the deviations from the model predictions (standardized residuals), which can be used for exploring processes not captured within the model.

3.4 Results

The model derived from our data is:

$$Ln_{GSI} = 2.003 + 0.473\ Ln_{passengers} + 0.063\ Ln_{population} + 0.231\ First\ City + 0.332\ Latin\ America - 0.520\ Japan - 0.296\ United\ States - 0.521\ China + 0.327\ Sub - Sahara\ Africa \quad (3.1)$$

Table 3.1 Results from the stepwise regression model

	Unstandardized Coefficients			**Standardized Coefficients**		
	B	***Std. Error***		***β***	***t***	***p-value***
(Constant)	2.003	0.604		-	3.316	0.001
Ln(passengers)	0.473	0.034		0.920	13.889	0.000
Ln(population)	0.063	0.031		0.106	2.035	0.044
First City	0.231	0.054		0.238	4.288	0.000
Latin America	0.332	0.099		0.179	3.357	0.001
Japan	-0.520	0.128		-0.201	-4.075	0.000
United States	-0.296	0.070		-0.249	-4.209	0.000
China	-0.521	0.129		-0.202	-4.045	0.000
Sub-Sahara Africa	0.327	0.133		0.141	2.460	0.016

The first major result of our analysis is that, in line with our hypotheses, the combined effect of airline connectivity, population size, and national specificities provides strong predictors of metropolitan regions' involvement in the office networks of globalized APS firms: 74.5 percent of a metropolitan region's variation in global service intensity can be explained, which is considerably more than in previous research in which only passenger data and/or population size were used as explanatory variables (Short, 2004; Taylor et al., 2007). In general terms, this confirms that the complex web of interrelations between knowledge-intensive services, infrastructure and population previously observed in metropolitan areas at the national scale (especially in the United States) is also apparent at the global level.

To disentangle the relative role of each of the independent variables, Table 3.1 lists the β-coefficients[21]. The table shows that although each of the independent variables is retained within the stepwise regression model (and therefore contributes to explaining differences in global service intensity), there are major differences in terms of their explanatory power. In line with Short's (2004) conclusions, population is a rather modest conjecturer of the presence of globalized APS firms, especially in comparison with air passenger connectivity, which is by far the most important variable in our model. Although the complex interrelations between these variables are reproduced at the global level, there seems to be a diminishing importance of population size, which can be attributed to global differences in economic development.

Furthermore, this global pattern is also complicated by national/regional tendencies. Three national dummies have negative β-coefficients (the United States, China, and Japan), which implies that metropolitan regions in these countries have smaller levels of global service intensity than expected in the 'global' pattern sketched above. For the United States this is explained by the combined effect of a major 'national' market for APS firms and a well-developed airline market (Taylor and Lang, 2005), while for China and also Japan the main reason seems to lie in the (continued) tight regulation of the economy. This appreciation is in turn confirmed by the relatively sizable effect of the 'first city' dummy variable, which shows that – over and above the importance of size – being a country's most important metropolitan region leads to high levels of global service intensity. The likes of Greater Tokyo Area and Yangtze River Delta with Shanghai (but also, say, Karachi Metropolitan Area and Greater Sao Paulo) attract offices in the networks of globalized APS firms more so than could be expected only on their population sizes and passenger numbers alone, which corroborates Sassen's (2001) reading of concentration of global service intensity in a limited set of metropolises.

Latin American and the (few) Sub-Saharan African metropolitan regions in our analysis have higher levels of global service intensity than can be expected based on the global pattern. Metropolitan regions such as Greater Buenos Aires, Greater Sao Paulo, Tschwane Metropolitan Area (i.e. Johannesburg and Pretoria) typically function as the sole attractors of virtually *all* of the globalized APS firms, acting as service gateways for entire regions. This turns the major metropolitan regions in these regions into important sites of global service intensity relative to the other criteria in the model.

[21] β-coefficients are the model estimates resulting from an analysis carried out on variables that have been standardized so that their variances are 1. As a consequence, β-coefficients refer to how many standard deviations a dependent variable will change, per standard deviation increase in the independent variable.

The second major set of results from our analysis stems from the observation that about 25 percent of the variance in metropolitan global service intensity levels is not being accounted for. This can, of course, in part be related to the transformations needed to make our datasets comparable, as well as lingering data deficiencies at the global level (Short et al., 1996; Taylor, 1997). However, above all this suggests that some of the processes behind global service intensity geographies are outside of the model. To aid in exploring these processes, we use Table 3.2, listing the major deviations from the model (i.e. all metropolitan regions with a standardized residual above 1 or below -1). Large positive (negative) values signify that a metropolitan region has a rather high (low) level of global service intensity when considering the combined size of enplaned passengers, size, and – if relevant – national/regional status. Four observations can be made.

First, the large negative residuals for Las Vegas and Greater Orlando (but also, to a lesser degree, Bangkok Metropolitan Area, Berlin-Brandenburg Metropolitan Area, and Rome Metropolitan Area) are very probably due to tourism (in the broadest sense). Tourism is an ancillary function of globalizing metropolitan regions, and in some cases even comes to dominate the functional tissue of these city-regions (as is clearly the case for Las Vegas). Global service intensity is obviously related to a narrower conceptualization of globalized urbanization (Grant and Nijman, 2002; Robinson, 2002), and it is therefore no surprise that metropolitan regions in which the tourism function equals or even dominates that of global service intensity related business activities attract far less globalized APS firms than predicted by the number of airline passengers and population sizes.

Second, there is a diverse category of metropolitan regions that have large positive or negative residuals because of national peculiarities that cannot be reduced to (and are therefore not measured by) a mere 'national primacy effect'. This includes, for instance, Rome Metropolitan Area's negative residual because of the well-documented domination of Milan Metropolitan Area. In spite of its smaller size, the latter metropolitan region serves as the de facto leading metropolitan area in Italy for global business, which results in the choice for Milan Metropolitan Area over Rome Metropolitan Area for a lot of global APS firms that might otherwise open an office in Rome Metropolitan Area. A similar observation can be made for Berlin-Brandenburg Metropolitan Area, where Germany's 'flat' urban hierarchy as well as Frankfurt-Main Region's position as a leading international business center result in a metropolitan region with less global service intensity than might be expected. The Pearl River Delta probably also falls within this category, with nearby Hong Kong assuming some of the region's potential.

Table 3.2 Metropolitan regions with large positive and negative residuals

Metropolitan region	Residual	Metropolitan region	Residual
Greater Beijing Region	2.009	Las Vegas	-3.258
Singapore Extended Metropolitan Region	1.422	Dhaka	-2.928
Delaware Valley (Philadelphia)	1.394	Greater Orlando	-2.525
Tshwane Metropolitan Area (Johannesburg, Pretoria)	1.385	Naples	-1.977
Jakarta Metropolitan Area	1.353	Pearl River Delta (Macao, Guangzhou, Shenzhen …)	-1.928
Grand Montréal	1.247	Fukuoka	-1.717
South Florida Metropolitan Area (Miami)	1.211	Bangkok Metropolitan Area	-1.676
Chicago-Naperville-Michigan City CSA	1.195	Guadalajara	-1.561
Flemish Diamond (Brussels, Antwerp)	1.158	Rome Metropolitan Area	-1.503
Hong Kong	1.043	Chengdu	-1.464
Metropolregion Hamburg	1.015	Seoul National Capital Area	-1.368
Dubai-Sjarjah Metropolitan Region	1.009	Phoenix-Tucson	-1.258
Pune	1.002	Berlin-Brandenburg Metropolitan Area	-1.251
		Salt Lake City Metropolitan Area	-1.051

These peculiarities can also give way to positive residuals. Greater Beijing Region's high positive residual, for instance, can be related to China's emerging world city system centered on three major metropolitan regions (see Derudder, et al. 2010; Lai, 2012; Yulong and Hamnett, 2002). Thus in addition to Hong Kong's continued role as a quasi-offshore financial center for China and Pacific Asia, as well as Yangtze River Delta's role as a strategic metropolitan region for connecting China to the global economy through finance and trade since the late 1980s, Greater Beijing boasts a large residual global service intensity because it accommodates the institutions responsible for managing and determining the economic and political life in the country (Lai, 2012). Furthermore, because the Yangtze River Delta centered on Shanghai is China's largest metropolitan region, this political primacy is not accounted for in the model. Somewhat less spectacular, but equally notable is Grand Montréal's high residual, possibly because of language-driven idiosyncrasies in the location strategies of globalized APS firms (e.g. the presence of French financial services firm BNP Paribas in Grand Montréal, but not in Greater Vancouver Regional District).

Third, Short's identification (2004) of black holes re-emerges in the negative residuals, with a metropolitan region such as Dhaka having far less global service intensity than expected. However, this designation of 'black holes' can be extended beyond its implicit Third World connotation: Naples in Italy, Fukuoka in Japan, and Guadalajara in Mexico can also be dubbed black holes in that, even after taking into account the general effect of national primacy on globalized APS presence, Milan Metropolitan Area, Greater Tokyo, and Mexico City Metropolitan Area still exercise a major shadow effect: these metropolitan regions are so dominant in their global service intensity that other metropolitan regions in their countries attract very little such firms, despite being large and having sizable airports.

Fourth and finally, the model's focus on 'national domination' through an indicator of 'national primacy' does not pay sufficient attention to the presence of what can be dubbed 'regional primacy', especially in terms of metropolitan regions functioning as major business gateways for wider regions. Thus Singapore Extended Metropolitan Region, Hong Kong, Tshwane Metropolitan Area, South Florida Metropolitan Area (Miami), and Dubai-Sjarjah Metropolitan Region have large positive global service intensity residuals as these metropolitan regions perform major functions in Pacific Asia, Sub-Sahara Africa, Central America, and the Middle East respectively. Thus the contrast between Greater Orlando and South Florida Metropolitan Area, where the latter metropolitan region has by far a superior level of global service intensity because of its 'extra-mural' economic function, especially when compared to its size and number of enplaned passengers.

3.5 Conclusions

In this article, we have tried to extend previous, predominantly *national* research on the complex impact of (airline) infrastructure and population on the level of knowledge-intensive services in metropolitan regions to the *global* scale. An important conclusion of this analysis is that this impact is sizable, albeit that – given major geographical differences in economic development – air passenger connectivity seems to be a much better predictor than mere population size. Furthermore, these interrelations are geographically specific in that they often depend on national/regional particulars.

When cast in the context of the literature on 'world cities', a relevant feature of this article is that neither London Metropolitan Area nor New York-Newark-Bridgeport CSA, the pinnacles of the world city network (Taylor 2004), have come up in our discussion (i.e. both metropolitan regions have small residuals). Put differently: our analysis suggests that, given their population, infrastructure, and the fact that these are the major metropolitan regions in the United States/United Kingdom, their level of global service intensity is not exceptional at all! In contrast, it is a metropolitan region such as Delaware Valley, centered on Philadelphia, which has a high level of global service intensity when considering some of its other characteristics. In this case, the positive deviation points to Delaware Valley's liberal "onshore offshore" status, which makes it an attractive site for regulatory arbitrage for global financial institutions (Houlder et al., 2011). Equally so, much of the service connections of Singapore Extended Metropolitan Region, Hong Kong, and Dubai-Sjarjah Metropolitan Region can be linked to their role as international financial/offshore centers. This observation clearly opens up the possibility of rethinking some of our assumptions on 'world city formation'. One possible way is to trace the discussion back to Sassen's global city thesis, in which she greatly stresses the *internal* dynamics of the global financial complex (i.e. global financial institutions and auxiliary services such as accounting, auditing, and law), whose geographies are increasingly spatially detached from service sectors that feed into global production networks. As such, the analysis here performed also seems fit to detect processes of world city formation that are more closely linked to spatialities of regulatory arbitrage and broader dynamics of global financial markets than to the provision of a seamless service to the productive sector per se.

Our analysis has thus shed some new empirical light on the above-mentioned literatures, but at the same time it needs to be emphasized that this is merely a first and exploratory step. Arguably the weakest point of this article, and therefore also an obvious avenue for future research, is that in spite of the use of some of the best data on globalized urbanization and our subsequent transformations to arrive at coherent datasets, there is still much room for improvement. Some of these issues can be

clarified by considering the positive residual of Pune, a major metropolitan region in West India. Its high residual is essentially explained by its modest airline connectivity, which is in turn an artifact of the relative proximity of Mumbai Metropolitan Area. Mumbai Metropolitan Area's international airport likely acts as main gateway for Pune passengers. As a consequence, in spite of our data transformations, there is clearly a degree of overlap and fuzziness when defining metropolitan regions, especially at the global scale: adding Pune to Mumbai's metropolitan region would have been justifiable, just as retaining both metropolitan regions as separate entities is. In general terms, this clearly reveals some of the continued practical problems when researching globalized urbanization in spite of the progress made since Short et al. (1996) and Taylor (1997).

In addition to refining and developing new datasets, a further avenue for future research lies in the interpretation of the residuals. There seems to be a fair degree of overlap that is hard to disentangle. For instance, Rome Metropolitan Area's negative residual is probably due to both tourism flows and the peculiar role of what is theoretically the 'second city' in Italy (Milan Metropolitan Area), but the model obviously does not allow distinguishing between both. Future research could provide 'interpretation keys' by including extra variables in the model, albeit that the well-known data problems re-emerge here.

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CHAPTER 4

Exploring causality in trade and air passenger travel relationships: The case of Asia-Pacific, 1980-2010

Van De Vijver, E., Derudder, B., Witlox, F., 2014. Exploring causality in trade and air passenger travel relationships: The case of Asia-Pacific, 1980-2010. *Journal of Transport Geography,* 34, 142-150.

Abstract

This paper explores the potential of heterogeneous Granger analysis in transport geography research by applying this method to a specific case of the often complex and potentially reciprocal linkages between the deployment of transport infrastructures and spatial economic development: the linkages between rising intra-regional volumes of trade and air passenger traffic in Asia-Pacific. Although conceptual and empirical linkages between both indicators can be assumed based on previous research, relatively little is known about the actual causality. Using heterogeneous Time Series Cross Section Granger causality analysis for the period 1980-2010, we explore the presence of four 'causality scenarios' amongst different country-pairs: (i) there is no co-evolution, implying that both patterns develop independently (e.g. Japan-Australia); (ii) there is 'real' co-evolution in that both patterns influence each other through feedback loops (e.g. South Korea-Philippines); (iii) air passenger traffic is facilitated by trade (e.g., South Korea-Philippines); or (iv) trade is facilitated by air passenger traffic (e.g. Australia-Malaysia). Some tentative interpretations of this heterogeneity are offered.

4.1 Introduction

One of the core research areas in transport geography concerns the conceptual and empirical linkages between the deployment of transport infrastructures and services, and spatial economic development (e.g. Banister and Berechman, 2001). As Meijers et al. (2012) point out, these linkages have been debated ever since the first roads, railways and canals were built (e.g. Chandra and Thompson, 2000; Jefferson, 1928; Mitchell, 1964; Mohring and Harwitz, 1962; Dodgson, 1974), and this research field has remained vibrant in the face of the deployment of more recent infrastructures and services such as high-speed railway and airline networks (e.g. Bowen, 2000; Kasarda and Green, 2005; Levinson, 2012). It seems fair to state that the dominant focus in this literature has been on the analysis of the *generative economic effects of infrastructure developments*, e.g. estimating employment growth after the creation of a railway link as in Hensher et al. (2012).

Overall, this literature clearly demonstrates that the impact of the deployment of transport infrastructures and the introduction of new transport services on spatial economic development is complex to say the least. This is because generative effects depend on numerous contextual and intervening factors (e.g. Brueckner, 2003; Button, 1998; Ishutkina and Hansman, 2009), but also more implicitly because some distributive effects may remain hidden (e.g. Meijers et al., 2012). An additional problem is that in analyses of the effects of transport infrastructures and services, spatial economic development – however conceived – is an endogenous variable, i.e. it is an influence upon the distribution and operation of transport infrastructures and services in its own right. This effect can especially be seen in cases where transport investments can be realized relatively quickly and efficiently, such as the creation of an extra air passenger connection between cities. Here the new connection can be both cause and outcome of spatial economic developments. Or, as O'Connor and Scott (1992: 251) noticed in an analysis of the evolution of airline services between metropolitan areas in the Asia-Pacific region between 1970 and 1990: the relationships between economic development and airline connectivity are '*circular and cumulative'* (see also Doganis, 2010; Shin and Timberlake, 2000). The implication, then, is that it can be assumed that the linkages between spatial economic development and the deployment of transport infrastructure and services work in two directions, reflecting a two-way relation that takes the form of co-evolution through feedback loops (see Ishutkina and Hansman, 2009).

Although regression-type analyses of the generative effects of transport infrastructures and services on economic developments are able to tackle this endogeneity problem, the more fundamental question of the dominant causality is not addressed in such analyses as the focus remains on how

transport influences the economy. The purpose of this paper is to develop and test a possible empirical verification of the premise of co-evolution through feedback loops. In particular, we aim to show that recent advances in Granger causality analysis are particularly suited to analyse the linkages between the deployment of transport infrastructures and services on the one hand, and spatial economic development on the other hand. Originally presented in 1969, Granger causality analysis has developed into a broader suite of techniques that now for example allow analysing data that have both temporal *and* heterogeneous spatial components. The inclusion of spatial heterogeneity in the framework allows assessing regional variation of cause/effect relations in a single framework, and is therefore of special interest to geographers and regional scientists. Using the general observation of O'Connor and Scott (1992) as our starting point, in this paper we apply this altered Granger framework to assess the causality in the evolving geographies of air passenger transport and trade connections. Our empirical focus is on the developments in Asia-Pacific between 1980 and 2010, a period in which the region experienced rapid growth in both trade and air transport connections, fuelled by rapid but uneven economic liberalization and deregulation.

Previous research on the trade/air passenger transport-nexus suggests that different forms of interrelations may indeed be expected. The impact of air travel on trade can be explained based on the de facto importance of face-to-face contact in trade negotiations as discussed by Leamer and Storper (2001). These arguments are part of a much wider literature showing how declining communication costs and growing communication opportunities impact international trade and operations (see Fink et al., 2002; Orozco-Pereira and Derudder, 2010). In the case of air travel, it can be argued that as trade has boomed and become more complex as it began to incorporate the movement of components along global production networks, the co-ordination tasks grew, and strengthened the need for face-to-face contact (Storper and Venables, 2004). Thus better and more air services can be expected to help overcoming the difficulties of coordinating and running increasingly complex production networks, which is consistent with Poole's (2013: 24) observation that business air travel '*helps to overcome informational asymmetries in international trade, generating international sales in the form of new export relationships*'. Similarly, in their article on the business travel patterns of professionals in the Irish ICT-cluster, Wickham and Vecchi (2008) state that air travel enables firms to build up trust relations with distant customers and suppliers. The effect of travel on trade may vary, however, as the effect '*is stronger for differentiated products and for higher-skilled travelers, reflecting the information-intensive nature of differentiated products and that higher-skilled travelers are better able to transfer information about trading opportunities*' (Poole, 2013: 24).

Meanwhile, growing volumes of trade and the associated rise in deal-making, follow-up, etc. may in turn lead to heightened demand for air travel (see Ishutkina and Hansman, 2009). Cristea (2011), for instance, finds robust evidence that the demand for air travel is directly related to the export of U.S. states: an increase in the volume of exports has been shown to raise the local demand for business air travel. Simultaneously, she shows that that close communication between trade partners, via face-to-face-interactions, is essential for successful trade transactions, because these meetings have the potential to both improve the transaction and add value to the exported products. Furthermore, Frankel (1997: 45) stresses the importance of the reciprocal relationship between travel and exports in the high-tech capital goods sector: '*to begin sales in a foreign country may involve many trips by engineers, marketing people, higher ranking executives to clinch a deal*', but at the same time it may involve the movement of "technical support staff to help install the equipment or to service it when it malfunctions", implying export can also precede additional travel. Again, this proves that the strength of the relationship may depend on the nature of the products involved, with for instance high-end services being particularly travel-intensive (Bel and Fageda, 2008; Van De Vijver et al., 2013). In addition, it is clear that the impact of trade on travel is complicated by the fact that, especially compared to air freight connections, trade-related air travel is but one of the many motivations for air travel, alongside tourism, visiting friends and relatives, and non-trade related business travel (Kulendran and Wilson, 2000).

This brief literature review suggests that the relationship between trade and air services may be complex and varied. These potentially wide-ranging relationships between trade and air travel services can be summarized in four possible 'causality scenarios': (i) trade and air passenger geographies develop independently, i.e. both geographies chiefly develop according to different rationales and processes (e.g. air travel being only of secondary importance for trade and/or primarily being driven by other motivations); (ii) there is 'real' co-evolution in that both patterns influence each other through feedback loops; (iii) air passenger traffic is facilitated by trade, but does not facilitate trade; and (iv) trade is facilitated by air passenger traffic, but does not facilitate air passenger traffic. Using a Granger framework, these four scenarios will be statistically tested for the Asia-Pacific region as a whole as well as for individual country-pairs within the region. Our chief purpose is hereby to methodologically address and indicate the heterogeneous relationships that can occur between trade and air passenger travel, i.e. no comprehensive analysis of the development of the air transport and trade geographies in this the region is intended.

The remainder of this paper is organized as follows. The next section describes the previous use of Granger causality analysis in air transport-related studies, and uses this discussion to advance the

case for using a version that allows for (spatial) heterogeneity. The third section describes our empirical framework: we review why Asia-Pacific is a good test case, discuss our data, and the preparatory steps towards Granger causality testing. The detailed procedure, the results of the analysis, and some interpretations are discussed in the fourth section, after which the paper is concluded with an overview of the main implications and potential avenues for further research.

4.2 Spatially heterogeneous Granger causality analysis

Granger causality tests are the most widely used methods for empirically examining causal relationships between variables. 'Causality' is, of course, an elusive concept, and Granger analysis basically adds to our empirical understanding by providing a statistical indication of the *precedence* of change in one variable to change in another variable. Put differently: Granger testing is a statistical technique that can help with the uncovering of causality through a systematic appraisal of the chronological order in which change unfolds. In the remainder of this paper, we therefore use 'cause'/'causality' as a narrowed-down shorthand for situations where taking into account past values of X leads to better predictions of Y than merely taking into account past values of Y. The observation that past changes in X help forecasting the evolution of Y is therefore taken as a statistical sign that change in X 'causes' change in Y, which can be expressed as:

$$y_t = a + \sum_{k=1}^{p} \gamma_k \, y_{t-k} + \sum_{k=1}^{p} \beta_k \, x_{t-k} + u_t \qquad (4.1)$$

where: a represents fixed effects; γ_k and β_k are autoregressive and regression coefficients, respectively; y_{t-k} and x_{t-k} are lagged values of the dependent and independent variables, respectively; *k* is the number of preceding time units taken into account; u_t is an error term and p is the number of time lags.

The null hypothesis in Granger testing is that X does not cause Y. If one or more lagged values of X are significant, then the null hypothesis can be rejected, implying that Granger causality runs from X to Y. Note that in research that wishes to establish the direction of causality, X and Y can be reversed in the next step, thus leading to the four possibilities of (1) X 'causing' Y (but not the other way round), (2) Y 'causing' X (but not the other way round), (3) no causality, or (4) causality running in both directions. This traditional approach to Granger analysis has been most commonly applied to time series data, where the causal relationship between two characteristics of a single unit is monitored over a certain time period (Hood III et al., 2008).

To date, traditional Granger analysis has been applied to link air transport flows with specific economic developments on a number of occasions, most commonly at the metropolitan scale. Button et al. (1999) and Button and Lall (1999), for example, use this method in their analysis of the influence of hub airports on high technology employment in the United States. More recently, Neal (2012) uses a method inspired by Granger analysis to tease out the reciprocal influence of passenger air travel and the level of 'creative employment' in American urban areas. Meanwhile, at the national scale, Granger analysis has predominantly been used to explore the causality in the evolution of tourism, often facilitated by air transport, and trade (e.g. Kadir and Jusoff, 2010; Shan and Wilson, 2001).

Kulendran and Wilson (2000) study the co-evolution of trade and air passenger transport for four country-pairs, i.e. for the connections between Australia and four of its largest travel and trading partners (the United States, the United Kingdom, Japan and New Zealand) based on this traditional Granger approach. The authors thereby present a separate Granger analysis for each of the country-pairs. Collectively, these four analyses suggest variation in the trade/travel causality: results include a reciprocal relationship for the Australia-US link, a unilateral relationship where changes in travel precede changes in trade for the Japan-Australia link, and the opposite unilateral relationship with changes in trade preceding changes in travel for the UK-Australia link. Another, more recent, study at the national scale investigates the link between domestic air passenger traffic and GDP in Brazil (Fernandes and Pacheco, 2013).

The Kulendran and Wilson (2000) study can be used as starting point to explain the rationale for a revised Granger framework. It can, for instance, be noted that their use of traditional time series limits the remit of the analysis to pairwise comparisons between each of the separate analyses. An extension of the number of countries/country-pairs would quickly lead to rising numbers of Granger analyses to be carried out. A Granger framework for time series cross-sections (TSCS), incorporating the possibility of heterogeneous causality has been specifically developed to address this limitation[22].

In contrast to traditional Granger causality analysis, TSCS analysis allows monitoring multiple cross-sections in a single analytical framework, making it well suited for analysing larger numbers of cross-sections. Meanwhile, the heterogeneous causality extension of TSCS-testing allows for the possibility of dissimilar causation across different cross-sections (see Hood III et al., 2008; Hurlin and Venet, 2001), so that – in addition to the overall causality –the diversity across cross-sections can be assessed.

[22] In addition, in a study on the relationship between GDP, exports and FDI among eight countries in Pacific Asia, Hsiao and Hsiao (2006) prove that TSCS data causality analysis yields better results than time series causality analysis.

The method entails the following extension of the traditional Granger model:

$$y_{i,t} = a_i + \sum_{k=1}^{p} \gamma_k y_{i,t-k} + \sum_{k=1}^{p} \beta_{i,k} x_{i,t-k} + u_{i,\,t} \qquad (4.2)$$

where a_i represents fixed effects; γ_k and $\beta_{i,k}$ are autoregressive and regression coefficients, respectively; $y_{i,t-k}$ and $x_{i,t-k}$ are lagged values of the dependent and independent variables, respectively; *k* is the number of preceding time units taken into account; i represents the cross-sections ; $u_{i,\,t}$ are error terms; and p the number of time lags.

The assumption underlying this extension is that the autoregressive coefficient is constant for all cross-sections, while the regression coefficient is constant for all time lags but can vary across the cross-sections. This addresses the problem of causal heterogeneity at the level of cross-sections because it allows for dissimilar causal relationships to occur among – in this case – trade and air travel flows for each of the country-pairs under scrutiny. Technical details regarding the necessary steps to be taken when carrying out such an analysis will be provided in the results section.

This revised Granger framework has recently been picked in analyses of infrastructure networks. Button and Yuan (2012), for instance, recently used TSCS analysis (albeit without the heterogeneous extension) to decipher the causality in the relation between changes in airfreight transportation and economic development amongst 32 metropolitan areas in the United States. Based on their analysis, the authors conclude that, across the US metropolitan system, changes in airfreight volumes cause changes in personal income and in per capita income in metropolitan areas. Meanwhile, the relationship between airfreight volumes and metropolitan employment was found to be bi-directional.

The only 'geographical' example of the heterogeneous TSCS approach we are aware of is the research by Tranos (2012) in an analysis of the causality in the relation between the deployment of critical Internet infrastructures and metropolitan economic development in Europe. All four causality scenarios emerged across cross-sections, with an overarching geographical pattern of a (complex) North-South division with Internet infrastructure deployment preceding economic development in Northern European cities (and the other way round in Southern European cities).

4.3 Empirical framework

The rationale for our particular empirical focus on trade/air transport linkages in the Asia-Pacific region is that this region seems to offer an appropriate test case for this methodology for at least two reasons. First, Asia-Pacific is an obvious case study for assessing the co-evolution in both patterns given the fast-paced developments in both trade and air transport, in part facilitated by a host of deregulation and liberalization trends. Since the 1980s, the region has witnessed strong overall economic growth figures, occasionally interrupted by short – but sometimes sharp – declines. Evidently, the region's wholesale economic growth has gone hand in hand with various forms and levels of deepening spatial integration. This integration is, for instance, clearly visible in growing volumes of transnational trade and investment (Athukorala, 2010; Hiratsuka and Kimura, 2008), but also in rising levels of connectivity in infrastructure networks as evidenced by the dramatic expansion of air traffic and Internet backbone networks (Fuellhart and O'Connor, 2013; Malecki and Wei, 2009). The 'flying geese paradigm', whereby Japanese companies started outsourcing labour-intensive production to the wider region from the 1960s onwards would be a case in point: the emergence of this particular regional division of labour centred in parts of Asia-Pacific involved a relatively rapid rise of complex regional investment and trade relations, which are to varying degrees matched by new air passenger connections.

And second, in spite of the region's quasi-continuous economic growth and the concomitant trends of liberalization of trade in general and the air transport industry in particular, these processes have developed uneven in space and time to say the least. Because of the relative absence of efficient and homogeneous de jure integration in trade and air transportation, bilateral agreements among country-pairs have been norm rather than exception over the past few decades. The formation of the AFTA (ASEAN Free Trade Agreement) in 1992 was a first step towards a de jure integration in the Pacific Asian region, but due to a lack of political will from its member states and the greater importance of economic relationships of each individual economy with states outside the ASEAN region, a true integration has not yet been attained (Fouquin, 2008; Yamazawa, 1992). Especially during the 1990s the AFTA was quite fragile (Kimura, 2008), although progress has been made in the late 1990s and the beginning of the 21st century. The realization of a complete free trade area is scheduled for 2015. In the same way, attempts at liberalization of the air transport industry in the region are still often localized and haphazard, for example between neighbouring countries, thus limiting their impact (Doganis, 2010; Swan, 2002). The temporal and spatial diversity of trade and air transport deregulation in the Asia-Pacific thus provides us with a good test case for Granger analysis that allows for spatial heterogeneity, as the causality may be different for individual countries and

country-pairs. For instance, a policy conducive to the creation of air travel as in the case of Singapore's longstanding 'open skies' policies (Bowen, 2000) may result in a different causality pattern than in the case of Japan, which has traditionally adopted a more protectionist stance in the air transport industry (Findlay and Forsyth, 1992). Similarly, the Singapore-Malaysia link, which has long been under-serviced because of (geo)political tensions between both countries (Ng, 2009) may be characterized by a different causality pattern than the Singapore-New Zealand link, which has been bolstered by early bilateral air service agreements between both countries.

In our empirical analysis, we focus on 9 countries in the Asia-Pacific region: Australia, New Zealand, China, South Korea, Malaysia, Indonesia, Thailand, Philippines and Singapore. The latter five countries are the founding members of the Association of Southeast Asian Nations (ASEAN), and have – in comparison with other ASEAN members – over time adopted clear and increasingly liberal policies towards trade and the airline industry. For instance, over time these countries have moved beyond tedious and ad hoc bilateral airline service agreements (Forsyth et al., 2006; O'Connor and Scott, 1992), while all sorts of explicit and implicit trade barriers have diminished sharply (Hiratsuka, 2006).

The other four countries in our analysis are Japan, South Korea, Australia and New Zealand, which constitute the other key economic players in the Asia-Pacific region. Japan and – albeit somewhat later on – South Korea have undeniably played a key role in the region's economic integration, in large part because of their 'flying geese'-like history of outsourcing of industrial activities to other countries in the region, thus creating large regional trade flows. New Zealand and Australia, in turn, have always been (pro)actively involved in regional trade agreements, in part out of fear of becoming economically isolated from the wider region (Lee and Park, 2005).

Given that our selection consists of 9 countries, our analytical framework does in principle comprise $n(n-1)/2 = 36$ country-pairs as cross-sections. However, as we do not have sufficient data for 3 of the cross-sections (Thailand-New Zealand, Indonesia-New Zealand and Philippines-New Zealand), these were not included in the analysis. For each of the 33 remaining country-pairs, we calculated the yearly evolution in the number of scheduled seats between their airports as well as the development of total trade between 1980 and 2010.

The trade data were collected through the United Nations Commodity trade (Comtrade) statistics database (http://comtrade.un.org). This database contains detailed import and export statistics, reported by the statistical authorities of about 200 countries worldwide. We aggregated the value of exports and imports of both finished goods and parts and components for each of the country-pairs to estimate the total volume of trade.

Air passenger data were derived from the Official Airline Guides (OAG) database, which contains the number of scheduled seats on direct flights between airports. Information on the connections of low-cost carriers, a sector that continues to rapidly expand in Asia-Pacific, is included. In order to obtain passenger flows between the different countries from our analysis, we aggregated the available seats from/to all of the airports in a given country (e.g. aggregating Osaka-Singapore and Tokyo-Singapore seats). Using OAG-data entails some disadvantages, which might impact the results of our analysis. First, there is no distinction between business and leisure travel. However, this does not necessarily lead to incorrect results, as Poole (2013) reveals that both business travel and leisure travel have strong positive associations with exports from the United States. Second, OAG-data include scheduled flights rather than actual routes flown by passengers. This can bias the results for countries containing international or regional switching points for traffic (see Derudder et al., 2007). Singapore is the clearest case in point: many of the scheduled seats between Singapore and some of the other countries in our dataset (notably Australia and New Zealand) are in fact used by passengers traveling to or from Europe. As a consequence, changes in scheduled seats in these cases are only partly influenced by/influencing changes in trade between Singapore and Australia/New Zealand, as they are also a result of changing demand and supply levels outside the Asia-Pacific region. In addition to the possible presence of intervening variables that our outside the model, both data caveats imply that our results should be treated as general indications of the causality and how it can be assessed rather than as a definitive analysis

Figure 4.1 plots the relative increase in trade and scheduled seats in the Asia-Pacific region (i.e. between the 9 countries). In the period 1980-2010, the intra-regional number of scheduled seats and trade volumes grew fivefold and tenfold, respectively. Overall, both variables increased at a similar pace until the beginning of the 1990s, after which trade started growing faster, especially from the 21st century onwards. At the same, fluctuations are more apparent in trade than in seats.

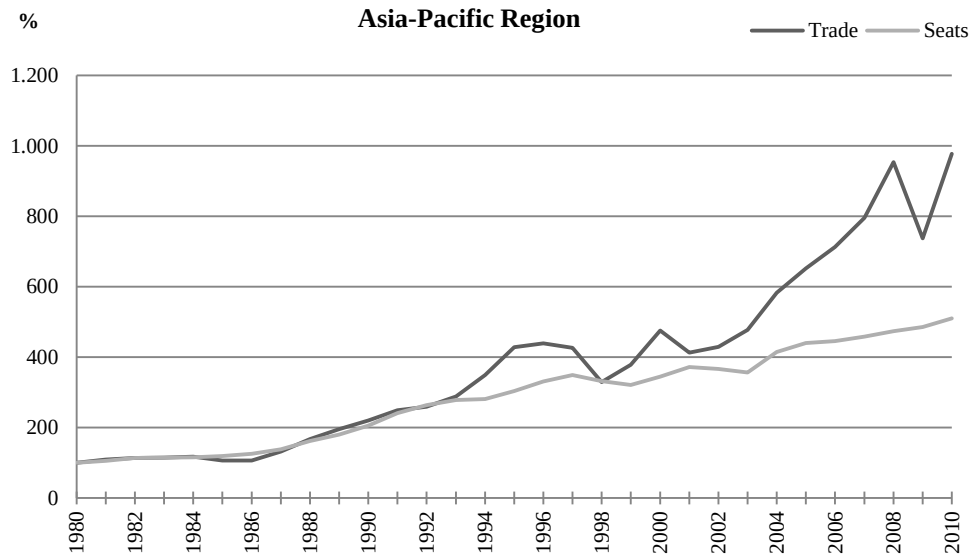

Figure 4.1 Relative growth of total trade and scheduled seats in the Asia-Pacific region

To better illustrate the topic addressed in this paper, Figures 4.2 and 4.3 plot the evolution of scheduled seats and trade volumes between Australia and Malaysia (Figure 4.2) and South Korea and the Philippines (Figure 4.3). In Figure 4.2, we see a relative surge in trade between 1993 and 1997, which is followed by a similar surge in scheduled seats some years later (1998-2002). Similarly, there was a very steep increase in trade in 2006, after which there was a similar sharp surge in seats in 2008-2009. For this specific country-pair, then, this would point to a pattern where change in trade often precedes, and therefore 'causes' change in seats. In Figure 4.3, one can observe the opposite effect: a 1996-1998 slump in seats seems to precedes a leveling out of trade, just as the subsequent rise of seats (from 2000 onwards) takes a while to be translated into extra trade. For this specific country-pair, then, this would point to a pattern where change in seats precedes, and therefore 'causes' change in trade. In both cases, the presence of a temporal lag suggests a possible causal influence, and Granger causality analysis allows us to systematically evaluate this influence.

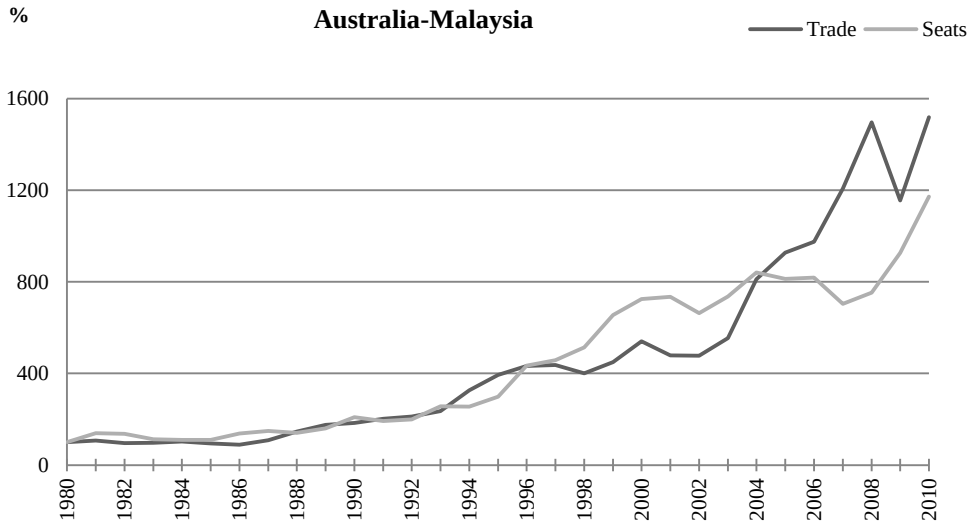

Figure 4.2 Relative growth of total trade and scheduled seats between Australia and Malaysia

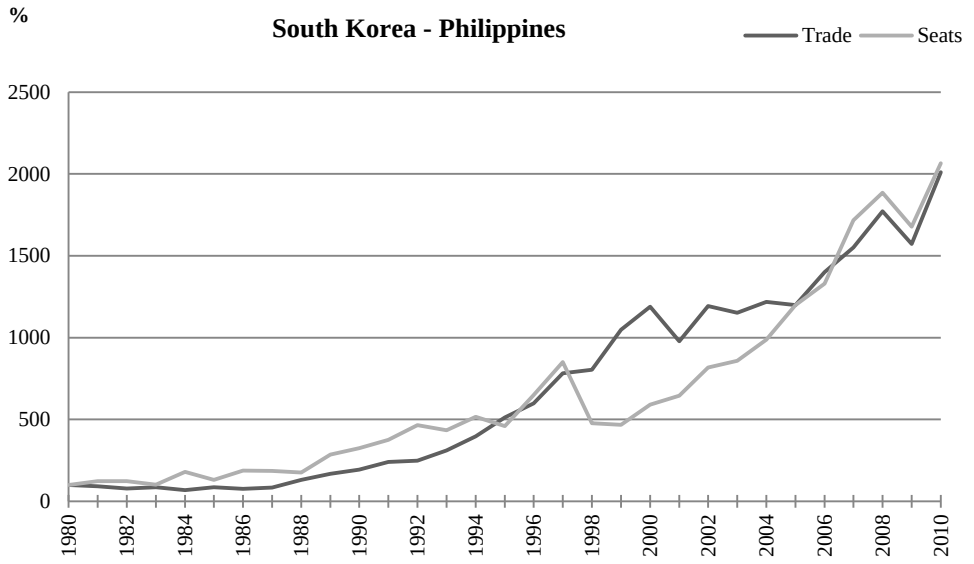

Figure 4.3 Relative growth of total trade and scheduled seats between South Korea and Philippines

Before we proceed with the Granger analysis, two preliminary steps need to be taken. First, Granger analysis requires time series that are stationary, implying that they have a constant mean and variance (Lütkepohl and Krätzig, 2004). Data series that are non-stationary contain a so-called 'unit root', a trend that causes a spurious regression and generates unreliable results. Additionally, the time series need to have the same order of integration. Two different unit root tests, specifically designed for TSCS-data, were implemented: the Levin, Lin and Chu test (Levin et al., 2002), and the Im, Pesaran and Shin procedure (Im et al., 2003). Both tests suggest that the original data for total

trade and number of seats are indeed non-stationary. This is due to the often-sharp changes in the volume of trade and the number of scheduled seats between the different countries throughout the 1980-2010 period (see Figure 4.1). The standard way of dealing with this problem is using first differences to make the time series stationary, representing yearly *growth* in total trade and yearly *increase* in scheduled number of seats between two Pacific Asian countries in the period 1981-2010.

Second, an appropriate time lag needs to be chosen from the yearly data. This time lag is specified as the time difference with the maximum level of 'causality'. This can be calculated through the Schwarz-information criterion, which indicates that a time lag of 4 years in both directions yields the best results. This corresponds with the findings of Poole (2013) that face-to-face meetings not simply occur 'alongside' trade in temporal terms. For instance, in her research she finds that '*businesspeople may fly to destinations to set up trade months or years before trade takes place'* (Poole, 2013: 15)

4.4 Results and discussion

Using the EViews-software and these transformed data, we carried out a heterogeneous TSCS Granger analysis on the 33 country-pairs. Based on equation (2), the use of first-order differences, and a 4-year time lag, the four possible causality scenarios are captured by linking the results of the following two equations:

$$\Delta seats_{i,t} = a_i + \gamma_{i,t-1}\Delta seats_{i,t-1} + \gamma_{i,t-2}\Delta seats_{i,t-2} + \gamma_{i,t-3}\Delta seats_{i,t-3} + \gamma_{i,t-4}\Delta seats_{i,t-4} + \beta_{i,t-1}FE_i\Delta trade_{i,t-1} + \beta_{i,t-2}FE_i\Delta trade_{i,t-2} + \beta_{i,t-3}FE_i\Delta trade_{i,t-3} + \beta_{i,t-4}FE_i\Delta trade_{i,t-4} + u_{i,t-1} + u_{i,t-2} + u_{i,t-3} + u_{i,t-4} \quad (4.3a)$$

$$\Delta trade_{i,t} = a_i + \gamma_{i,t-1}\Delta trade_{i,t-1} + \gamma_{i,t-2}\Delta trade_{i,t-2} + \gamma_{i,t-3}\Delta trade_{i,t-3} + \gamma_{i,t-4}\Delta trade_{i,t-4} + \beta_{i,t-1}FE_i\Delta seats_{i,t-1} + \beta_{i,t-2}FE_i\Delta seats_{i,t-2} + \beta_{i,t-3}FE_i\Delta seats_{i,t-3} + \beta_{i,t-4}FE_i\Delta seats_{i,t-4} + u_{i,t-1} + u_{i,t-2} + u_{i,t-3} + u_{i,t-4} \quad (4.3b)$$

where FE_i is an array of dummy variables (fixed effects) for each cross-section.

Heterogeneous TSCS Granger analysis proceeds in three steps: homogeneous non-causality testing, followed by heterogeneous causality testing, and - if heterogeneity is present - the causality testing of individual cross-sections.

The first step tests the 'homogeneous non-causality' across Asia-Pacific: the very presence of causality is tested across an aggregation of all cross-sections. This implies formulating a null hypothesis for both equations, stating that there is no causal relationship between the evolution in trade (seats) and the evolution in seats (trade) across Asia-Pacific.

H_{1a}: For all country-pairs, Δtrade does not Granger cause Δseats
H_{1b}: For all country-pairs, Δseats does not Granger cause Δtrade

The rejection of the null hypothesis indicates a statistically significant impact of previous change in X on change in Y (i.e. X Granger causes Y), and is tested through an F-statistic, here specified as

$$F = \frac{(RSS_2 - RSS_1)/(Np)}{RSS_1/[NT - N(1+p) - p]} \qquad (4.4)$$

where *N* = the number of country-pairs; *p* = the number of time lags; and *T* = number of time periods.

An interpretation of the test relies on cross-checking this value with an F-distribution with *Np* and *NT-N(1+p)-p* degrees of freedom for the numerator and the denominator respectively. As commonly the case with F-statistics, the test compares the sum of squared residuals of a restricted model (= RSS_2, i.e. without taking change in X into account by assuming that the regression coefficients $\beta_{i,t-k}$=0) with the sum of squared residuals of the unrestricted model (RSS_1, i.e. taking change in X into account) presented in equations (3a) and (3b).

Our analysis shows that both null hypotheses can be rejected at the 1% significance level (p=0.00), implying that there is bi-directional causality present in the dataset: for the Asia-Pacific region as a whole, there is evidence that growth in total trade precedes growth in number of seats *and* vice versa, providing statistical evidence for O'Connor and Scott's (1992) observation of "circular and cumulative" linkages at the level of trade and air passenger travel. However, this causality at the level of the entire dataset does not imply that there is a bidirectional relationship for all country-pairs, and this is where the heterogeneity extension comes into play. This is established in a second step, in which the (lack of) homogeneity of the causality among the different country-pairs is tested.

In the second step, the null hypothesis states that this causality can be found in *each* of the 33 country-pairs. An F-test is run twice again, but in this case there is a new version of the restricted model (RSS_3) that does not set the regression coefficients to zero, but equal to each other ($\beta_{i,t-1} = \beta_{i,t-k}$) for all cross-sections.

H_{2a}: For all country-pairs, Δtrade causes Δseats
H_{2b}: For all country-pairs, Δseats causes Δtrade

The test results suggest causal heterogeneity in both directions, respectively at the 1% (p=0.00) and 10% (p=0.07) significance level. This implies that, although Asia-Pacific shows signs of a bi-directional relationship between total trade and air passenger travel, this is not applicable to each country-pair. Additional tests are needed to discover for which country-pairs a Granger causal relationship exists, and in which direction(s) this relationship runs.

This implies testing each of the 33 country-pairs separately, which is done in the third and final step.

H_{3a} : For country-pair i, Δtrade does not cause Δseats
H_{3b} : For country-pair i, Δseats does not cause Δtrade

In this case F-tests are run with separate versions of the restricted model (RSS_2) so that values of $\beta_{i,t-1}$ can differ across cross-sections. Hence, we test the nullity of each regression coefficient separately (i.e. $\beta_{i,t-1} = 0$ for every *i*). Tables 4.1a and 4.1b give the p-values of the F-tests for all the country-pairs. For those country-pairs where the p-value is smaller than 0.10, we assume a significant causal relationship is present. Table 4.2 summarizes the results by classifying all country-pairs according to one of the four causality scenarios. Overall, the results indicate that total trade and air travel between Pacific Asian countries do influence each other, albeit in different ways and to varying extents. A total of 19 out of 33 country-pairs show statistically significant signs of causality, of which two (Philippines-Singapore and South Korea-Malaysia) exhibit bi-directional influence[23].

Table 4.1a P-values from the F-test for the separate cross-sections ($\beta_{i,t-k} \neq 0$); AU = Australia, ID = Indonesia, JP = Japan, KR = South Korea, MY = Malaysia, NZ = New Zealand, PH = Philippines, SG = Singapore, TH = Thailand

	AU	**ID**	**JP**	**KR**	**MY**	**NZ**	**PH**	**SG**	**TH**
AU	-	0.25	0.54	0.15	**0.01**	0.88	0.84	0.24	0.68
ID		-	0.22	0.77	**0.00**	-	0.99	**0.09**	0.38
JP			-	0.43	0.93	0.86	0.31	**0.01**	0.67
KR				-	**0.02**	0.72	0.84	**0.05**	0.64
MY					-	**0.00**	**0.05**	**0.05**	**0.07**
NZ						-	NA	0.14	NA
PH							-	**0.01**	0.12
SG								-	0.27
TH									-

Null hypothesis: For country-pair i, Δtrade does not cause Δseats

[23] It should be noted that the relative lack of statistically significant relations compared to the very clear bi-directional causality at the level of the region may in part be the result of having smaller samples (and therefore degrees of freedom for assessing the F-statistic).

Table 4.1b P-values from the F-test for the separate cross-sections ($\beta_{i,t-k} \neq 0$); AU = Australia, ID = Indonesia, JP = Japan, KR = South Korea, MY = Malaysia, NZ = New Zealand, PH = Philippines, SG = Singapore, TH = Thailand

	AU	**ID**	**JP**	**KR**	**MY**	**NZ**	**PH**	**SG**	**TH**
AU	-								
ID	**0.00**	-							
JP	0.99	**0.05**	-						
KR	0.41	**0.10**	0.73	-					
MY	0.30	0.55	0.61	**0.06**	-				
NZ	0.41	NA	0.18	0.78	0.92	-			
PH	**0.01**	0.92	0.21	**0.01**	0.60	NA	-		
SG	0.78	0.48	0.85	0.89	0.49	0.13	**0.03**	-	
TH	**0.00**	0.16	0.15	0.60	0.41	NA	**0.05**	**0.04**	-

Null Hypothesis: For country-pair i, ∆seats does not cause ∆trade

Table 4.2 The 33 country-pairs with their causal relationships

No causal relationship	**Trade -> air travel**	**Air travel -> trade**	**Bi-directional relationship**
Australia – Japan	Australia – Malaysia	Australia – Indonesia	Korea – Malaysia
Australia – Korea	Indonesia – Malaysia	Australia – Philippines	Philippines – Singapore
Australia – New Zealand	Indonesia – Singapore	Australia – Thailand	
Indonesia – Philippines	Japan – Singapore	Indonesia – Japan	
Indonesia – Thailand	Korea – Singapore	Indonesia – Korea	
Japan – Korea	Malaysia – New Zealand	Korea – Philippines	
Japan – Malaysia	Malaysia – Philippines	Philippines – Thailand	
Japan – New Zealand	Malaysia – Singapore	Singapore – Thailand	
Japan – Philippines	Malaysia – Thailand		
Japan – Thailand			
Korea – New Zealand			
Korea – Thailand			
New Zealand – Singapore			

Although a detailed discussion of the various causality patterns is beyond the scope of this paper given its methodological purpose, we briefly discuss two major patterns emerging from our results in order to provide a better understanding of the kinds of interpretative opportunities this kind of analysis can deliver.

The first pattern is the apparent lack of causality for linkages between more economically developed countries versus the more abundant presence of causality for linkages between economically developed and economically less developed countries. Australia and South Korea, for instance, have a series of statistically significant causality linkages (mostly running from seats to trade) with some of the less-developed economies in our sample (Malaysia, the Philippines, Indonesia, and in the

Australian case also Thailand). This is in sharp contrast with the observation that there is not a single instance of causality in the evolution of seats and trade between Australia, New Zealand, Japan, and South Korea. There are a number of possible explanations for this bifurcation. First, outsourcing of production leading to fast-paced change in trade has been primarily driven by differences in labour costs (see Athukorala, 2010; Ozeki, 2008). First-order changes in trade have therefore been most outspoken for linkages between relatively developed countries on the one hand and relatively less-developed countries on the other hand. Our analysis suggests that, against this backdrop, the creation of new air passenger connections between, say, Australia and Thailand, has facilitated access to and knowledge about markets that translated into the growth of trade in the subsequent years.

Second, as indicated in the introduction, any relation between change in trade and change in air passenger connections will be complicated by the fact that the motivation for air travel is multifaceted. Although there will be much trade-related travel between Australia and New Zealand, it seems unlikely that this is the key explanation to the strong air transport connections between cities in Australia and New Zealand. For instance, it is estimated that today more than 650.000 New Zealanders (or about 15% of the New Zealand population) currently live in Australia, making it the second-largest group of foreign-born migrants after the United Kingdom. Moreover, these numbers have quasi-continuously grown over the past decades. This integration has been facilitated by policies such as the 1973 Trans-Tasman Travel Arrangement, which has allowed Australian and New Zealand citizens to enter each other's country to visit, live and work, without the need to apply for authority to enter the other country before travelling. Given the relative vicinity of both countries and the rising importance of cross-migration (albeit especially from New Zealand to Australia) in the face of rising levels of disposable income, the main reason for air travel between both countries alongside tourism is visiting family and friends. Given this, it should not be a surprise that there is no statistical causality in the trade/seat linkages. The main message here is that although a multifaceted and complex linkage between motivations for air travel and trade is probably present for all country-pairs, the linkage is much more outspoken for some connections, and our spatially heterogeneous TSCS framework is able to capture this by differentiating between different cases as in Tranos (2012).

The second pattern is the causality patterns for Malaysia and Singapore, mostly running from trade to seats. Singapore obviously occupies a central role in the region's trade networks. In addition to its small size, the importance of trade stems from its persistent role as a regional 'entrepôt' economy (Siddiqui, 2010). For instance, Singapore continues to function as Japanese firms' component supply base and service center for the ASEAN region (Watanabe, 2004). In addition, since the 1980s,

Singapore has become a regional (financial) service centre as well as a command-and-control centre housing regional headquarters of many multinational enterprises with subsidiaries in neighbouring Asian countries where the more labour intensive parts of the production process are located (Athukorala and Hill, 2010). Table 4.2 suggests that the enormous trade flows to and from Singapore have been translated into air passenger connections. This could be related to Singapore's early adoption of very liberal approaches towards international air travel connections (Bowen and Leinbach, 1996), which has allowed the quick translation of demand into supply. A similar interpretation can be made for the Malaysian case. Although not as marked as in Singapore, it was one of the region's forerunners in liberalizing its trade policies (Athukorala, 2010), while over the last decade it has also become an important supplier of parts to other countries (Kimura, 2008). From 1993 onwards, the country started with an aggressive deregulation of its international air travel connections. Overall, this provides the basic lens through which we can frame the trade-to-seats causality for Singapore and Malaysia: massive trade flows that created additional demand for air travel, which could be provided because of the adoption of liberal, open skies-type of policies (as well as infrastructure provision to enable this). Strikingly, despite the many significant relations of Singapore, causal links with Australia and New Zealand are absent. As already highlighted, this may be in part due to the use of OAG-data, which include scheduled flights rather than actual routes flown by passengers. This can bias the results for Singapore in particular given its continued role as major hub in, amongst others, the 'Kangaroo Routes' connection Australia and New Zealand with Europe. As a consequence, facilitated by Singapore's 6th freedom rights, many of the scheduled seats between Singapore and especially Australia and New Zealand are in fact used by passengers traveling to or from Europe, which implies that changes in scheduled seats in these cases are less influenced by/influencing changes in trade between Singapore and Australia/New Zealand.

4.5 Conclusions

The main purpose of this paper was methodological: we have introduced and applied a technique that allows assessing the complex and often heterogeneous causality between the deployment of transport infrastructures and services, and spatial economic developments. The case of changes in the provision of air passenger connections and trade relations in Asia-Pacific provided us with a good test case, given that these relations are complex, change has been fast-paced, and linkages could be assumed to be heterogeneous, in part due to the lack of encompassing, de jure liberalization of trade and air transport. Kulendran and Wilson (2000) already hinted at the often contrasting causal

relationships between trade and air passenger transport, and our framework allows assessing such questions for a much larger number of cases in a single analysis.

Our results show that:

- there is no significant causality for links between the region's most developed economies (e.g. Australia-New Zealand);
- there is often significant causality running from air passenger connections to trade for relations between more developed and less developed economies (e.g. Australia-Thailand);
- and there is often significant causality running from trade to air passenger connections for countries that have adopted very liberal approaches towards the air transport industry (e.g. Singapore).

We believe these results are credible enough to suggest that this framework may be relevant for future transport geography research. This would imply applying the 3-step method to different operationalizations of the geographies of transport infrastructures and services, and spatial economic development.

In the narrower realm of analysing change in air passenger connectivity, one obvious area for improvement would be to employ origin-destination data. This would give less distorted results, especially when considering hub airports, such as Singapore. Another area for future research would be to include other variables that potentially explain air travel. Grancay (2009) describes the very complex, and as emphasized here often reciprocal, links between air transport liberalization, the creation of new links and services, and the many factors influencing and influenced by these and this could be used for competing assessments. Furthermore, data on changing reasons for air travel (e.g. as measured through entry cards in countries such as Australia, where air travel is the de facto mode of entry) for different countries can for instance be used to gauge to what extent shifting reasons for visiting have impacted air travel (and vice versa), both in general and for specific countries.

As for the empirical focus of this paper: a comprehensive appraisal of trade/air passenger relations in Asia-Pacific will probably need to break this period down in time intervals that conform to key policy shifts as regards trade and air transport liberalization (e.g. the different timing for Malaysia and Singapore is not really taken into account by focusing on the 1980—2010 period as a whole). Indeed, it can be said that this encompassing empirical framework should be refined to capture the fragmented nature of liberalization tendencies. This may include methodological changes such as differential time lags, but also efforts to more systematically interpret results against policy changes.

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CHAPTER 5

Air passenger transport and regional development: Cause and effect in Europe

Van De Vijver, E., Derudder, B., and Witlox, F., 2014. Air passenger transport and regional development: cause and effect in Europe. *Working paper, for submission in European and Urban Regional Studies*.

Abstract

This article scrutinizes the mutual and complex causal relationship between air passenger transport and regional development, expressed through employment, in European NUTS2-regions with heterogeneous Granger causality analysis for the 2002-2011 time span. The proposed methodology allows us to (i) investigate if air transport in the European regions causally influences employment, (ii) investigate if employment in those regions also leads to higher transport levels, and (iii) discern regional variations in this causal relationship. We use employment because it is a relatively robust and measurable indicator of a region's economic success, and treat employment in the services sector and employment in the manufacturing sector separately to discern basic sectoral variances. Results show that both directions of causality occur among European urban regions, albeit very geographically fragmented, and that these relationships are stronger for employment in the services sector, which confirms that the services industry is more sensitive to air passenger transport. However, the absence of causal links in several regions indicates that air passenger transport is a necessary part of, but not sufficient condition for generating regional development.

5.1 Introduction

This article aims to investigate the causal linkages between air passenger transport and regional development -expressed in employment- in Europe. Much research on this topic has been carried out for the United States of America (US) (Brueckner, 2003; Button and Lall, 1999; Button et al., 1999; Debbage and Delk, 2001; Irwin and Kasarda, 1991; Ivy et al., 1995), but research elsewhere has been lacking. According to Dobruszkes et al. (2011), the main reason for this is the difficulty of finding homogeneous data in a multinational context. Moreover, in the US, most of the airports serve a distinct city with limited ground transport options, while, for instance, European airports are surrounded by multiple cities, creating overlapping catchment areas. In a European context, this literature has been limited to Mukkala and Tervo's (2013) analysis of the causal link between air traffic and economic growth -represented by GDP and employment growth- in 86 regions and Percoco's (2010) study on the impact of air passenger transport on the local employment in Italian provinces. The literature often concludes that air passenger transport has a larger influence on economic development than the other way around, although it is obvious that the socio-economic function of a region (e.g. employment and GDP) can equally influence the demand for air passenger transport services (Debbage and Blackburn, 2006; Dobruszkes et al., 2011; Zuidberg and Veldhuis, 2012).

Despite the limited research on Europe, The European Commission suggests that air passenger transport is '*a strategically important sector that makes a vital contribution to the EU's overall economy and employment*' (European Commission, 2014). Against this backdrop, efforts have been made to liberalize the internal air transport market in the European Union in order to unleash the alleged economic benefits associated with the associated rise in levels of air passenger transport.
During a time span of ten years and via a three-stage process, the European Union (EU) went from a heavily regulated to a liberalized market, culminating in an opening up of European domestic markets to free competition from all EU-licensed carriers (i.e. cabotage) in 1997 (Dobruszkes, 2006; ELFAA, 2004; Scharpenseel, 2001). During this timeframe, European countries also signed increasingly liberal air service agreements with countries outside the European Union, with the Netherlands-USA Open Skies Agreement in 1992 as a pioneering event. These open skies agreements eliminate government involvement in airline decision-making about routes, capacity, and pricing, which contrasts heavily with previous restrictive air service agreements (Bowen, 2010). Since 2005, the EU -as a single aviation market- has tried to extend its uniform aviation policy beyond its borders by negotiating comprehensive agreements to integrate the EU aviation market with those of its key international partners. For example, the EU-US Air Transport Agreement, of which the first phase

went into effect in 2008, allows any airline of the EU and the United States to fly between any pair of points in the EU and the US. This progressing liberalization process has resulted in increased competition (more airlines, serving more routes), the emergence of low cost carriers (LCC), and lower air fares in the EU. It did not only significantly boost the intra-European air travel, but also the international air travel to and from European airports (Dobruszkes, 2006; Scharpenseel, 2001).

The link between air passenger transport and economic development is felt strongly in regional airports, which are the major destinations of the minimal cost seeking low cost carriers (LCC), because of their lower airport fees, higher availability of airport slots, and absence of traffic congestion (Dobruszkes, 2006; Pavlin et al., 2006). In many cases, growth in passenger volumes facilitated economic growth and employment growth and stimulated tourism in the surrounding regions (e.g Donzelli, 2010 for Southern Italy), effects that can be labeled as the 'catalytic effects' of air transport (Cooper and Smith, 2005). Also the major European airports prospered from the liberalization wave, in that they witnessed larger passenger volumes, thus influencing their surrounding urban and economic landscapes as well (ACI, 2004). Hakfoort et al. (2001), for instance, label the Dutch Amsterdam Schiphol Airport as a 'growth pole' in the regional economy. Multiple case-studies have examined the catalytic impacts of European airports on the regional economy (for instance Heuer and Klophaus (2007) for Frankfurt-Hahn Airport, and Abraham et al. (2007) for Lübeck Aiport). These case-studies generally put forward that European airports are vital for the international competitiveness of their wider surrounding region by providing improved accessibility, attracting inward investment, and facilitating trade and tourism (Abraham et al., 2007; Perovic, 2013; Van De Vijver et al., 2014b), and can as such be seen as regional economic motors (ACI, 2004). However, air passenger transport is endogenous to economic development, as economic development influences air passenger transport in its own right.

In this light, we propose to examine the complex causal relationship between air transportation and employment in European NUTS2-regions with heterogeneous Granger causality analysis, similar to the work of Tranos (2012) on the Internet infrastucture and economic regional development in European city regions. The proposed methodology allows us to (i) investigate if air transport in European NUTS2-regions has a causal influence on employment, (ii) investigate if employment in those regions also leads to higher transport levels, and (iii) discern regional variations in this causal relationship. We use employment because it is a relatively robust and measurable indicator of a region's economic success (Button and Taylor, 2000), and we treat employment in the services sector and employment in the manufacturing sector separately in our analysis to discern basic sectoral variance.

The remainder of the paper is organized as follows. First, we review the literature on the link between air passenger transport and economic development in more detail, and discuss how the EU uses air passenger transport as a tool for stimulating regional development. Next, we describe our units of analysis, present the data collection, and briefly explain the procedure of the heterogeneous Granger causality-methodology. In the following sections, the results of the Granger causality analysis are shown and discussed. The paper concludes with a summary of the results and an overview of avenues for future research.

5.2 Some notes on air passenger transport and economic development

5.2.1 Literature review: The link between air passenger transport and economic development

It is generally assumed that air transport is an enabling factor for wider economic development in a region. Button and Yuan (2013: 337), however, state that '*the evidence for this has largely been anecdotal',* while Burmeister and Colletis-Wahl (1997: 232) warn for the misperceived '*automatic nature'* of '*infrastructure effects'* which could lead to '*a dangerous vision of infrastructure investment as a universal tool for development strategies'*. Vickerman et al. (1999: 1) add that '*the precise role of transport infrastructure in the process of regional development, even the direction of causality, is still open to much debate'*. Nevertheless, some efforts have been made to shed further light on this complex relationship, mainly within a US context. Table 5.1 gives an overview of the main analyses within the literature investigating the reciprocal link between air passenger transport and employment as an indicator for economic development.

A close reading of Table 5.1 confirms the overall understanding that air passenger transport and employment in urban regions are positively linked, but additionally highlights three trends: the dominant focus on US metropolitan areas (MAs), the larger influence of air passenger transport on employment, and the emphasis on employment in the services sectors.

Referring to the second trend, a majority of the authors obtain this result by relying on regression-types analyses, where (changes in) air passenger traffic volumes are used to explain (changes in) employment in urban regions. The rationale behind these analyses is the observation that better air transport services imply better accessibility, which encourages companies to locate in a region, and stimulate existing businesses to expand (Cooper and Smith, 2005; Zak and Getzner, 2014).

Table 5.1 Literature on the relationship between air passenger transport and employment

Literature	Region	Results
Goetz, 1992	US MAs, 1950-1997	Positive relation between passengers per capita and both previous and subsequent levels of employment
Debbage, 1999 Debbage and Delk, 2001	US MAs, 1973-1995 and 1973-1996	Positive correlation between air services volume and administrative and auxiliary employment
Liu et al., 2006	US MAs, 1999	% workforce in professional, services and technical sector (PST) and management is a predictor for being a major air traffic market
Alkaabi and Debbage, 2007	US MAs, 1999	Linear relationship between number of passenger enplanements, and employment and number of companies in the PST- and high-technology sector
Button and Taylor, 2000	US MAs, 1996	Link between the quantity and quality of air services to the EU and 'new employment' (electronics, IT, telecom, management and services…)
Brueckner, 2003	US MAs, 1996	Increase in passenger enplanements leads to increase in employment in services sector, not in the manufacturing sector
Green, 2007	US MAs, 1990-2000	Boardings per capita and origin passengers per capita increase employment growth
Percoco, 2010	Italian provinces, 2002	Significant influence of air passenger transport on employment in the services sector
Blonigen and Cristea, 2013	US MAs, 1969 - 1991	Annual growth in passenger traffic leads to increase in annual growth in employment (especially in wholesale and retail-sector)
Irwin and Kasarda, 1991	US MAs, 1950-1980	Changes in the structure of the US airline network are a cause rather than a consequence of employment in manufacturing and producer services growth
Ivy et al., 1995	US MAs, 1978-1988	Changes in air service connectivity of US metropolitan areas influence employment levels in administrative and auxiliary sectors (more than the other direction)
Neal, 2012	US MAs, 2001-2008	Number of passengers 'causes' employment in creative sector and vice versa
Button and Lall, 1999 Button et al., 1999	US MAs, 1994	Increases in traffic at hub airports have a positive effect on high-tech employment. Granger causality in two case study areas indicate causality from air traffic to employment
Mukkala and Tervo, 2013	European urban regions, 1991-2010	Homogenous Granger causality from employment growth to number of passengers. Granger causality from air traffic to employment growth in peripheral regions, but not in core regions

This improved accessibility and connectivity contributes to the economic performance of the wider economy by enhancing its overall level of productivity through increased access to other markets, freer movement of investment capital and workers between regions (Perovic, 2013). Only a number of studies rely on the concept of causality by using regression analyses with lagged variables or

Granger causality analyses (e.g. Button et al., 1999; Irwin and Kasarda, 1991; Mukkala and Tervo, 2013; Neal, 2012). These analyses perceive causality as a chronological precedence of air transport to employment, and some of these studies indicate that employment can also precede air transport services (Mukkala and Tervo, 2013; Neal, 2012).

Referring to the third trend, the focus on employment in the services sector stems from the assumption that the services industry is more sensitive to air passenger transport than other sectors in the economy, because they rely heavily on direct face-to-face contact (Debbage, 1999; Percoco, 2010). Even with recent technological innovations minimizing the need for interpersonal contact, this direct contact with colleagues, suppliers, customers, and other key employees remains important (e.g. Bel and Fageda 2008; Denstadli 2004; Faulconbridge et al., 2009; Van De Vijver et al, 2014a). This point came explicitly to the fore in Brueckner (2003), who distinguished between employment in the manufacturing and services sector, and found only evidence for a link between air transport and employment in the services sector. Particularly the professional, services and technical (PST), management and high technology sectors seem related to air passenger services (Alkaabi and Debbage, 2007; Button et al., 1999; Liu et al., 2006). Also the creative sector, wholesale and retail, and administrative and auxiliary employment have been subject to research (Blonigen and Cristea, 2013; Ivy et al., 1991; Neal, 2012).

In this article, we extend previous research by focusing on European urban areas and using the methodology of Granger causality to discern causality in the relationship between air transport and employment. Additionally, we recognize that employment in the services sector may be particularly influenced by air traffic, by comparing causality patterns with total employment and employment in the manufacturing sector.

5.2.2 Air transportation as a tool for regional economic development in the European Union

The EU is, of course, in many different aspects heterogeneous, which is *inter alia* expressed in large regional economic disparities between, but also within countries. One of the prime concerns of regional economic policies is to lower these inequalities, with the particular aim of socio-economic convergence, which involves an equalization of basic incomes promoted by higher GDP growth, competitiveness and employment (Graham, 1998). Improving accessibility –particularly to remote and less developed regions- is viewed as one possible avenue for facilitating this convergence. In a report for the European Parliament, Dubois et al. (2007) acknowledge that access to large markets,

extensive and diversified labour markets and advanced services is becoming increasingly important for economic development, but they question the power of improved accessibility for stimulating this development, due to '*the lack of scientific evidence on the correlation between transport endowment and the level of economic development*' (Dubois et al., 2007: vi).

The assumption of better accessibility improving regional development was used as a starting point for the European Commission to set up the Trans-European Transport Networks (TEN-T) in 1996, a programme to support the construction and upgrade of transport infrastructure across –often peripheral- European regions to reduce the abovementioned large regional socio-economic disparities and to enhance European competitiveness, job creation and cohesion (Spiekermann and Wegener, 2006). This is part of the wider system of Trans-European Networks (TENs), including a telecommunications network (eTEN) and a proposed energy network (TEN-E or Ten-Energy). TEN-T envisages coordinated improvements to primary roads, railways, inland waterways, airports, seaports, inland ports and traffic management systems, providing integrated and intermodal long-distance, high-speed routes. Two rounds of funding schemes (2000-2006 and 2007-2013) have already been accomplished, in which also some airports (such as Faro airport, Portugal in 2009) have received funding (http://inea.ec.europa.eu/en/ten-t/ten-t.htm).

In the framework of its Regional Policy, the EU has also established development plans, where part of the focus is on improving accessibility through air traffic, for example in Greece[24], Lithuania[25] and Poland[26]. Reflecting the statement of Dubois et al. (2007), we explore to what degree these sorts of programmes and incentives significantly contribute to economic development in European regions by focusing on employment, which is of course only one, but an important dimension of development.

[24] Operational Programme 'Improvement of Accessibility' (2007-2013)
http://ec.europa.eu/regional_policy/country/prordn/details_new.cfm?gv_PAY=GR&gv_reg=ALL&gv_PGM=1075&LAN=7&gv_per=2&gv_defL=7

[25] Operational Programme 'Economic Growth' (2007-2013)
http://ec.europa.eu/regional_policy/country/prordn/details_new.cfm?gv_PAY=LT&gv_reg=ALL&gv_PGM=1169&LAN=7&gv_per=2&gv_defL=7

[26] Operational Programme 'Infrastructure and Environment' (2007-2013)
http://ec.europa.eu/regional_policy/country/prordn/details_new.cfm?gv_PAY=PL&gv_reg=ALL&gv_PGM=1212&LAN=7&gv_per=2&gv_defL=7

5.3 Delineation of the study areas, data collection and methodology

5.3.1 Delineation of the study areas

We collected data at the level of European NUTS2-regions, and only considered those regions for which all the necessary data were available. As is well known, NUTS (Nomenclature of territorial units for statistics) is developed by the statistical agency of the European Union 'Eurostat' to provide a single uniform breakdown of territorial units for the production of regional statistics (European Commission, 2011). Although it has no legal value per se, it is a powerful tool for comparing European countries and regions. The classification comprises three levels, ranging from countries (level 1) to metropolitan regions (level 3). NUTS level 2-regions are defined as the basic regions for the application of EU regional policies concerning job creation, competitiveness, economic growth, improved quality of life and sustainable development (European Commission, 2011). Their absolute sizes (in terms of population) differ: they constitute provinces, regions or counties, depending on the country to which they belong to. In this study, we assume NUTS2-regions to be the prime catchment areas of airports. Defining catchment areas of airports and linking this to functional catchment areas of airports is, of course, very difficult. The size and shape of catchment areas differ (Lieshout, 2012; Maertens, 2012), and are influenced by various parameters such as the availability of direct connections, the frequency of flights, but also the accessibility of the airport on land side (Dobruszkes et al., 2011). The overlap between catchment areas and NUTS2-regions is complex, and may include the following possibilities:

i. Some catchment areas are larger than the proposed NUTS2-regions. For example, the actual catchment area of Vienna International Airport in Austria also covers parts of Western Slovakia and Hungary, and Southern Czech Republic (Sellner and Nagl, 2010).
ii. NUTS2-regions without an airport are not included in our analysis, although they might be influenced by airports located in adjacent NUTS2-regions. For example, all NUTS2-regions in Belgium are in the sphere of influence of Brussels International Airport, but most of them are not included in our analysis because they do not have an airport in their territory.
iii. Overlap may also occur, as nearly two-thirds of European citizens are within two hours' drive of at least two airports (Thelle et al., 2012). For instance, for residents in the southern parts of The Netherlands, Amsterdam Schiphol Airport and Brussels International Airport are two viable options.

Taken together, it is clear that NUTS2-regions should above all be seen as best-available proxies for the actual catchment areas of airports, and this may have repercussions for the results of our

analysis. Nevertheless, they remain the most convenient divisions, being important units for European statistical data collection. We selected 112 NUTS2-regions located in 18 different countries, and for each of them we collected the employment-statistics and the number of passengers for the period 2002-2011. The data are freely available on the Eurostat website (http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home/).

5.3.2 Data collection

The employment-statistics were retrieved from the Eurostat-database on Labour Statistics. The information in this database is based on the EU Labour Force Survey (EU-LFS), a quarterly household sample survey conducted in all Member States of the EU and in the European Free Trade Association (EFTA) and Candidate countries.

The database follows the NACE-classification, which is a statistical classification of economic activities in the European Community (European Commission, 2008), and represents the employment in the different economic sectors across the European NUTS-regions. Until 2008, the NACE Rev. 1 version was used, after which there was a shift to an improved and more detailed Rev.2 version. Although small differences in the classification system exist between these two versions of NACE, this poses no major problems, as the changes are similar for all the 112 regions and are rather small. We collected information on the:

i. Total employment (all persons aged 15 and over)
ii. Employment in manufacturing (NACE section C for statistics from 2008 onwards, respectively D for statistics until 2008)
iii. Employment in services (NACE sections G-Q[27]). These sections comprise much of the subsectors mentioned in Table 5.1, such as wholesale and retail trade, information and communication, professional, scientific and technical activities, administrative and auxiliary activities, but also tourism-related services (accommodation and food service activities)

The passenger data were extracted from the database '*Air transport of passengers by NUTS 2 regions*'. These data express the total passengers embarked and disembarked in each region and

[27] These sections comprise: Wholesale and retail trade; Transportation and storage; Accommodation and food service activities; Information and communication; Financial and insurance activities; Real estate activities; Professional, scientific and technical activities; Administrative and support service activities; Public administration and defence, compulsory social security; Education; Human health and social work activities

have been calculated by aggregating data collected at the airport level on the regional level, excluding double counting within each region.

5.3.3 Granger causality

Granger causality tests are widely used methods for empirically examining causal relationships between variables. Causality in this sense refers to a chronological precedence of one variable to another. A variable X (e.g. air passenger transport) is said to 'Granger cause' a variable Y (e.g employment), if taking into account past values of X enables better predictions of Y than based exclusively on past values of Y (see (5.1)). The variable X does not literally 'cause' Y, but rather helps to forecast it which is then taken to be a sign of explanatory power (Van De Vijver et al., 2014b).

In this article, we use the variant of heterogeneous time series cross-section (TSCS) Granger causality testing. This method allows for scrutinizing the 112 NUTS2-regions simultaneously over a given time period (2002-2011), permitting dissimilar causation among the different regions (Hurlin and Venet, 2001), a feature that has often been neglected in other research (e.g. Button and Yuan, 2013).

The heterogeneous TSCS-Granger model can be expressed as:

$$y_{i,t} = a_i + \sum_{k=1}^{p} \gamma_k y_{i,t-k} + \sum_{k=1}^{p} \beta_{i,k} x_{i,t-k} + u_{i,\,t} \qquad (5.1)$$

In which a_i are the fixed effects, γ_k and $\beta_{i,k}$ represent the autoregressive and regression coefficients respectively, $y_{i,t-k}$ and $x_{i,t-k}$ the lagged values of the dependent and independent variables respectively, $u_{i,\,t}$ the error term, and p the number of time lags. The latter refers to the time difference which offers the maximum level of 'causality' (Lütkepohl and Krätzig, 2004).

The assumption underlying this extension is that the autoregressive coefficient is constant for all cross-sections, while the regression coefficient is constant for all time periods but can vary across the cross-sections, which enables the causal heterogeneity (Van De Vijver et al., 2014b).

The heterogeneous TSCS-causality testing procedure consists of three consecutive steps, which have been extensively described in Hurlin and Venet (2001), Hood III et al. (2008), Tranos (2012) and Van De Vijver et al. (2014b). The procedure is tested separately for the three relationships (i) passenger volume versus total employment, (ii) passenger volume versus employment in the services sector, and (iii) passenger volume versus employment in the manufacturing sector. The three procedures are performed in two directions, once running from passenger volume to the employment indicator and

once running from the employment indicator to the passenger volume. In this way, we simultaneously measure the two-way influence between employment and air transport.

In a first step, the homogeneous non-causality test, the null hypothesis of absence of causality from X (e.g. passenger volume) to Y (e.g. total employment) across all regions is put against the alternative hypothesis of presence of causality for at least one region, and verified with an F-test. If the null hypothesis is rejected, a heterogeneous causality test is performed in a second step. Here, the null hypothesis assumes that the perceived causality is similar for all regions, against an alternative hypothesis of similar causality for only some of the regions. In case of rejection of this null hypothesis, individual causality tests for all the regions are executed in a third and optional step.

This methodology is equally used in Mukkala and Tervo (2013), who examine the causal relationship between air transport and economic development (translated in GDP and employment) in 86 regions across Europe. They were able to discern regional variability in this relationship (see Table 5.1): causality from employment growth to passenger volume is homogeneous, but causality from passenger volume to employment growth is heterogeneous and mainly occurs in peripheral regions. The current paper adds to this study, in that it takes into account total employment, but also distinguishes between employment in the manufacturing and services sector.

5.4 Results and discussion

We first checked whether the data series did not exhibit a time trend, which is needed in order for the Granger tests to produce reliable results[28]. Additionally, we chose a time lag of one year, due to the short time period under study (2002-2011)[29].

We first analyze the causal relationships between the passenger volumes and total employment, and then between passenger volumes and employment in the manufacturing and services sector to test whether Breuckner's (2003) statement of air transport only influencing employment in the services sector and not the manufacturing sector holds true in our study.

[28] The logarithm of the initial data did not contain any trend.
[29] Alternatively, we also performed the Granger tests with a 2-year time lag, but no causality in step 1 could be detected.

5.4.1 Air passenger transport versus total employment

The results of the homogeneous non-causality test (step 1) and the heterogeneous causality test (step 2) are shown in Table 5.2 and indicate that for only a subset of the 112 NUTS2-regions, causality relationships between total employment and the passenger volume can be detected.

Table 5.2 Results of the homogeneous non-causality (F1) and the heterogeneous causality test (F2)

Direction	**F1-test**	**F2-test**
Passengers -> total employment	1.302**	1.223*
Total employment -> passengers	2.390***	2.382***

*** p<0.01, **p<0.05, *p<0.10

The individual causality tests[30] reveal that causality is present for about half of the regions (Figure 5.1). For the majority (43) of the regions, causality runs from the passenger volume in year t to total employment in year t+1. This confirms Irwin and Kasarda's (1991: 533) finding that '*changes in air transportation have altered the competitive advantages of metropolitan areas, and not the reverse'*. However, this statement can be challenged as well, as ten regions show this '*reverse*' effect, and four show bidirectional causality. This illustrates the ability of our analysis to reveal the regional nuances that lie in the relationship between air transport and employment.

These regional nuances do not show a clear pattern (Figure 5.1), but some clusters with causality from air transport to employment can be perceived. One cluster comprises the central, well developed German and Austrian regions, which are part of the 'European polygon' (cfr. Dobruszkes et al., 2011). There is also a Spanish cluster, where Aragon and Cantabria show bidirectional causality. At the same time, causality is missing in other well-connected areas such as the French and Dutch capital regions, while it is present in peripheral regions –both in terms of geographical location and GDP- such as Malta, Estonia and Vest (Romania).

This shows that accessibility is necessary, but not sufficient, for regional growth (Nijkamp, 1995). The absence of a link in well-developed and accessible regions could point to the fact that additional gains in accessibility may only bring marginal gains in employment (Spiekermann and Wegener, 2006). Another explanation lies in the definition of our catchment areas, the areas in the sphere of influence of particular airports: we designated NUTS2-regions as a proxy, but these do not always coincide with the actual size. In Île de France, for instance, causality is lacking, which may be ascribed to the fact that the catchment area of the Parisian airports actually cover a large part of France, instead of only the NUTS2-region.

[30] The results of the separate Granger tests of the third step are available from the authors upon request

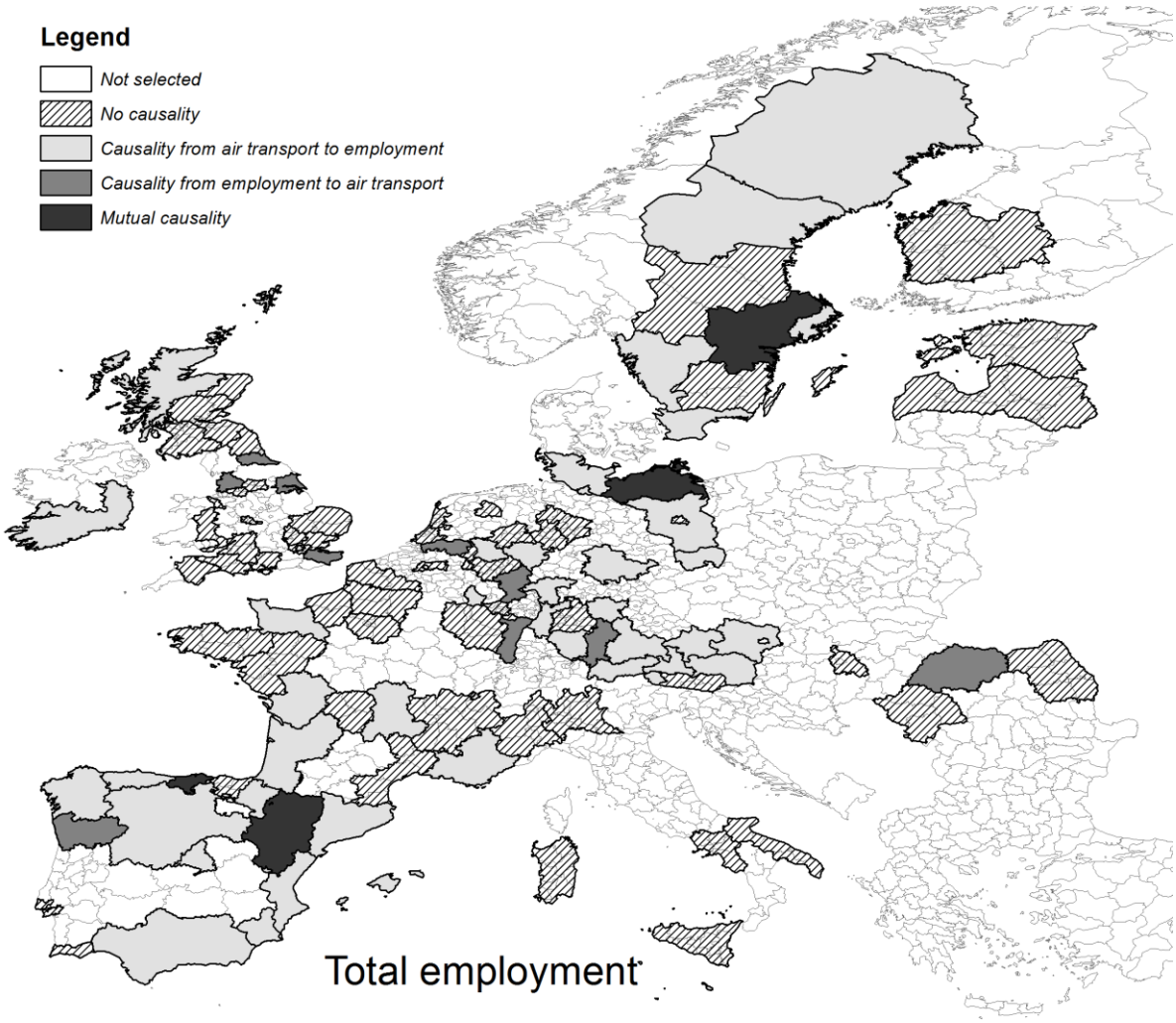

Figure 5.1 The different causality relationships between passenger volume and total employment among the 112 NUTS2 European-regions

This can equally explain the lack of any relationship in other regions with 'national' airports -that are labeled as the gateway airport for a country and possesses the majority of international connections- such as Schiphol Airport in Zuid-Holland, whose catchment area actually spans the whole of the Netherlands and parts of Belgium. The large size of these catchment areas is enhanced by the availability of the dense ground transport, such as high-speed railways (Dobruszkes et al., 2011).

5.4.2 Air passenger transport versus employment in manufacturing and services sectors

The results of the homogeneous non-causality tests and the heterogeneous causality tests for both services and manufacturing in Table 5.3 show that bidirectional causality between air passenger transport and employment is present for the services sector, but that causality only runs from air transport to employment in the manufacturing sector.

Table 5.3 Results of the homogeneous non-causality (F1) and the heterogeneous causality test (F2)

Direction	F1-test	F2-test
Passengers -> services	2.078***	1.895***
services -> passengers	1.775***	1.726***
Passengers -> manufacturing	1.203*	1.194*
manufacturing -> passengers	0.960	/

*** p<0.01, **p<0.05, *p<0.10

In other words, the link between air passenger transport and employment in the services sector seems indeed stronger and more abundant: separate analyses for the 112 regions show signs of causality for more than 60% of the cross-sections (68 NUTS2-regions, Figure 5.2). The observed trend runs mainly from the number of passengers to employment (52 cross-sections), while causality in the opposite direction holds for only six regions and bidirectional causality occurs for ten regions. In contradiction with Brueckner (2003), Granger causality for the manufacturing sector occurs for a subset of 39 NUTS2-regions (figure 5.3), mainly in regions with high levels of manufacturing employment, such as Piemonte and Lombardia in Northern Italy (Eurostat, 2013). Other clusters are Scotland and Northern France.

For the link between air passenger transport and employment in the services sector, there is a clear geographical divide. Except for the presence of causality running from air passenger transport to employment in the central European polygon, the abundance of such links frequently holds for the NUTS2-regions in Spain and Southern France. Tourism – which is comprised in our services indicator- possibly plays an important role here. A major part of passengers arriving in South-European regions are tourists, stimulating employment in the tourism industry. This is obviously related with the emergence of low cost carriers (LCCs) after intra-European air transport liberalization (Rey et al., 2011). A large part of their networks are clearly designed to carry travelers to the tourist destinations of Mediterranean Europe[31], such as the Spanish 'costas' (Dobruszkes, 2006; Dobruszkes, 2013).

[31] Currently, LCCs increasingly target the business segment (Dobruszkes, 2006).

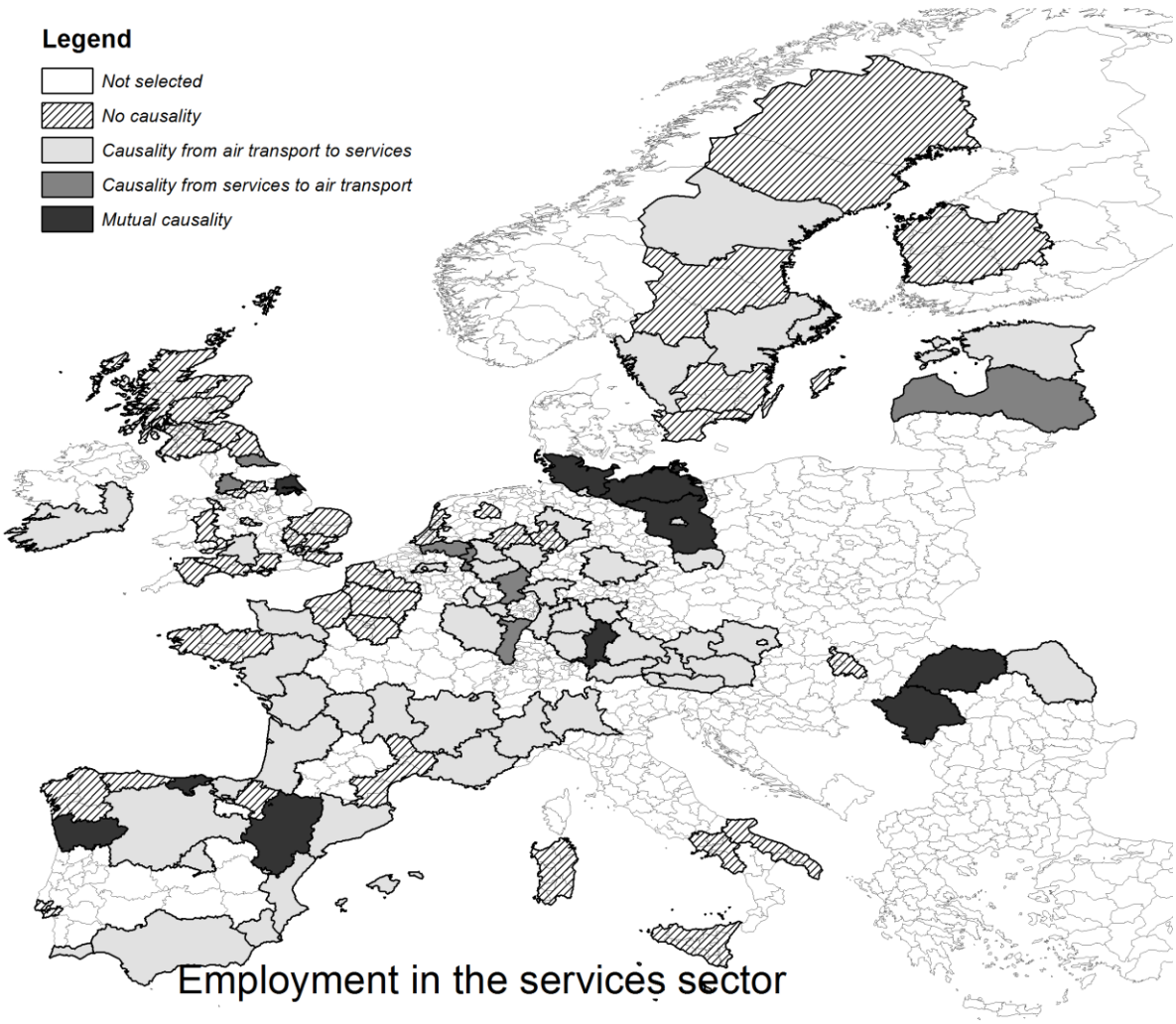

Figure 5.2 The different causality relationships between passenger volume and services employment among the 112 European NUTS2-regions

Additionally, LCCs commonly launch new routes on destinations that were previously unavailable or unpopular due to high fares, and the arrival of LCCs in such a region gives a strong initial impulse to tourism. In Barcelona, for instance, there was a considerable increase in passenger arrivals after the entrance of LCCs (Ryanair, Easyjet) into the market in 1996, which was accompanied by a strong increase in hotel room supply (Jones Lang Lasalle Hotels, 2006).

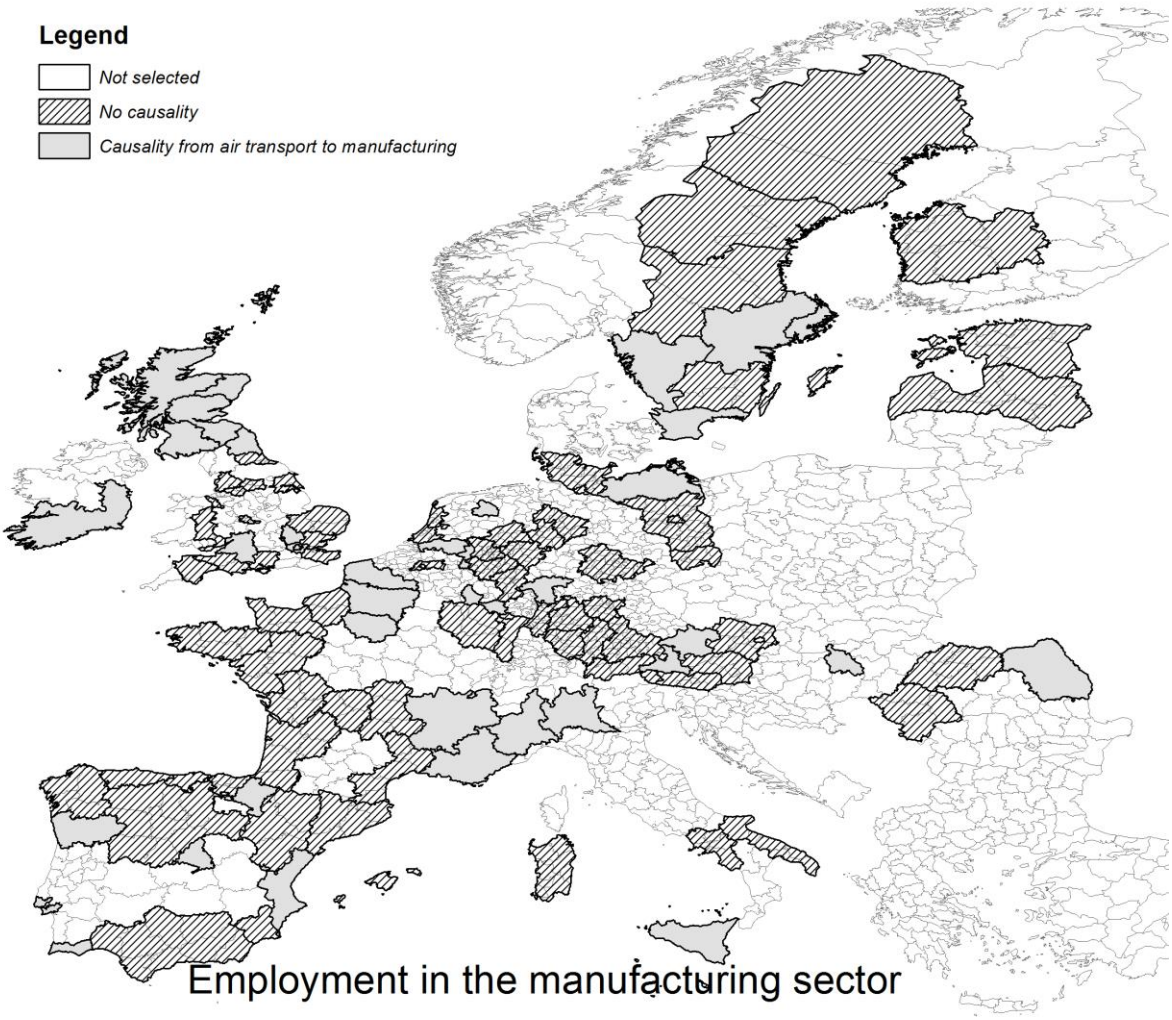

Figure 5.3 The different causality relationships between passenger volume and manufacturing employment among the 112 NUTS2-regions

The differences in results for total employment, and employment in the services and manufacturing sector call for caution when interpreting and comparing the results of research that investigates the link between air passenger transport and total employment only (Goetz, 1992; Green, 2007; Mukkala and Tervo, 2013). Although this literature offers interesting insight, it says little about how these links are translated for the different sectors of the economy. Employment in the manufacturing and services sector seems to respond differently to air passenger transport, and certainly do not show the same need for generating traffic. This, in addition to the lack of a geographical homogeneity in causality, implies that policy-makers should be cautious when interpreting results with the purpose of formulating policies for the investment in air traffic infrastructure and services for regional (re)development: not all sectors of the economy will be affected in a similar way, just as not all regions are equally affected.

Referring to the European investment programmes, such as TEN-T mentioned in 5.2.2., the presence of causal links in several peripheral sectors suggest the possible effectiveness of these development and investment programmes. Increased accessibility and connectivity (often through LCCs: ANNA, 2012) in regions that are characterized by relatively lower labour and facilities costs, can encourage companies to invest in those regions and existing business to expand their market (ELFAA, 2004). This can in turn stimulate the economic growth potential these regions still possess (Graham, 1998; Spiekermann and Wegener, 2006). However, our results indicate that the causal relationship is not omnipresent in those peripheral regions, and the EU (and national governments alike) should be cautious to set up infrastructure investment programmes with the goal of regional development.

At the same time, it must be noted that air accessibility constitutes only one small part of the total accessibility of European regions (Allroggen and Malina, 2014). Other transport modes, mainly road and rail transport (Spiekermann and Wegener, 2006), are also important, as are the internet infrastructures (e.g. Tranos, 2012; Tranos et al., 2013), and these are not taken into account in our study. Hence, we agree with Graham (1998), who states that we should view air transport as an enabling factor in regional development, overlapping with other transport infrastructures and networks to support European regional development. In this sense, the causality that we prove does not imply that air transport unconditionally leads to regional development, or that higher employment in regions unequivocally lead to additional generation of air travel. Other factors intervene in the relationship, such as the mentioned presence of other infrastructure, but just as well the population in these regions, or the level of GDP.

5.5 Conclusion

This paper has tried to disentangle some of the net causes and effects between air passenger transport and economic development, expressed through passenger volume and employment, in European NUTS2-regions. To this end, we used heterogeneous Granger causality analyses, which allows for statistically assessing causal relationships. In short, our results suggest that (i) the causality patterns between air transport and employment are geographically very heterogeneous and are sometimes absent, (ii) the influence of air transport on employment is more marked than the influence of employment on air transport, although this direction can also be detected for several regions, and (iii) causality from air transport to employment is stronger for the services sector, but also occurs in the manufacturing sector.

These findings suggest that policy-makers should be careful when advocating infrastructure investment (e.g. by expanding air transport services at airports) as a way of stimulating economic development in a region, as these investments are not always translated into comparable increases in employment. Although there are no clear patterns, it seems that air passenger transport can stimulate growth in employment in some of the peripheral countries, which makes that investment programmes such as those implemented by the EU could bring some benefits. However, focusing solely on air transport investments to stimulate regional development is not without risks, especially when it comes to LCCs, because this type of airline is extremely footloose: they "may come today" and "leave tomorrow" (Zuidberg and Veldhuis, 2012). Olipra (2012), for instance, gives examples from Poland, where LCC-passengers make up more than 90% of total passengers in some airports (e.g. Katowice, Lodz and Bydgoszcz). Cessation of services from Ryanair or Wizzair on those airports could severely affect the surrounding regions. Equally, in regions that are strongly dependent on tourism, this can cause a quick downfall in economic growth and employment levels that are dependent upon tourism.

Our analysis obviously has some limitations. The main limitation of the Granger causality test lies in its bivariate nature, while air passenger transport and economic development are interrelated though a complex web of associations with intervening factors. Future analyses could take these additional factors into account by expanding the analysis to a multivariate framework.

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Annex

Table 5.4 The 112 selected European NUTS2-regions

Country	NUTS2-region	Country	NUTS2-region
Austria	Kärnten	France	Picardie
Austria	Niederösterreich	France	Poitou-Charentes
Austria	Oberösterreich	France	Provence-Alpes-Côte d'Azur
Austria	Salzburg	France	Rhône-Alpes
Austria	Steiermark	Hungary	Közép-Magyarország
Austria	Tirol	ireland	Southern and Eastern
Belgium	Prov. Vlaams-Brabant	Italy	Campania
Germany	Arnsberg	Italy	Lombardia
Germany	Berlin	Italy	Piemonte
Germany	Brandenburg	Italy	Puglia
Germany	Darmstadt	Italy	Sardegna
Germany	Detmold	Italy	Sicilia
Germany	Dresden	Luxemburg	Luxembourg
Germany	Düsseldorf	Latvia	Latvija
Germany	Hamburg	Malta	Malta
Germany	Hannover	The Netherlands	Drenthe
Germany	Karlsruhe	The Netherlands	Limburg (NL)
Germany	Koblenz	The Netherlands	Noord-Brabant
Germany	Köln	The Netherlands	Noord-Holland
Germany	Mecklenburg-Vorpommern	The Netherlands	Zuid-Holland
Germany	Mittelfranken	Portugal	Algarve
Germany	Münster	Portugal	Lisboa
Germany	Oberbayern	Portugal	Norte
Germany	Saarland	Romania	Nord-Est
Germany	Schleswig-Holstein	Romania	Nord-Vest
Germany	Schwaben	Romania	Vest
Germany	Stuttgart	Sweden	Mellersta Norrland
Germany	Thüringen	Sweden	Norra Mellansverige
Germany	Tübingen	Sweden	Östra Mellansverige
Estonia	Eesti	Sweden	Övre Norrland
Spain	Andalucía	Sweden	Småland med öarna
Spain	Aragón	Sweden	Stockholm
Spain	Cantabria	Sweden	Sydsverige
Spain	Castilla y León	Sweden	Västsverige
Spain	Cataluña	The United Kingdom	Bedfordshire and Hertfordshire
Spain	Comunidad de Madrid	The United Kingdom	Devon
Spain	Comunidad Foral de Navarra	The United Kingdom	Dorset and Somerset
Spain	Comunidad Valenciana	The United Kingdom	East Anglia
Spain	Galicia	The United Kingdom	East Wales
Spain	Illes Balears	The United Kingdom	East Yorkshire and Northern Lincolnshire
Spain	País Vasco	The United Kingdom	Eastern Scotland
Spain	Principado de Asturias	The United Kingdom	Essex

Spain	Región de Murcia	The United Kingdom	Gloucestershire, Wiltshire and Bristol/Bath area
Finland	Länsi-Suomi	The United Kingdom	Greater Manchester
France	Alsace	The United Kingdom	Hampshire and Isle of Wight
France	Aquitaine	The United Kingdom	Highlands and Islands
France	Auvergne	The United Kingdom	Inner London
France	Basse-Normandie	The United Kingdom	Kent
France	Bretagne	The United Kingdom	Lancashire
France	Haute-Normandie	The United Kingdom	North Eastern Scotland
France	Île de France	The United Kingdom	Northumberland and Tyne and Wear
France	Languedoc-Roussillon	The United Kingdom	Outer London
France	Limousin	The United Kingdom	South Western Scotland
France	Lorraine	The United Kingdom	Tees Valley and Durham
France	Nord - Pas-de-Calais	The United Kingdom	West Midlands
France	Pays de la Loire	The United Kingdom	West Yorkshire

Table 5.5 Results from the individual Granger causality tests between air transport and total employment for the 112 NUTS2-regions. No = no causality, Bid = bidirectional causality, e -> p= causality from employment to passenger volume, p -> e = causality from passenger volume to employment.
* p<0.10, **p<0.05, ***p<0.01

Country	Region	e -> p	p -> e	Causality	Country	Region	e -> p	p -> e	Causality
PO	Algarve	0,059	0,178	No	IT	Lombardia	0,022	0,808	No
FR	Alsace	1,229*	0,659	e -> p	FR	Lorraine	0,179	0,062	No
ES	Andalucía	0,032	6,132***	p -> e	LU	Luxembourg	0,159	3,835***	p -> e
FR	Aquitaine	0,101	2,526***	p -> e	MA	Malta	0,251	3,404***	p -> e
ES	Aragón	2,725***	1,275**	Bid	DE	Mecklenburg-Vorpommern	4,766***	7,078***	Bid
DE	Arnsberg	0,255	1,808***	p -> e	SV	Mellersta Norrland	0,385	3,214***	p -> e
FR	Auvergne	0,813	1,244*	p -> e	DE	Mittelfranken	0,002	4,472***	p -> e
FR	Basse-Normandie	0,439	2,074***	p -> e	DE	Münster	0,052	0,002	No
UK	Bedfordshire and Hertfordshire	0,020	0,002	No	AU	Niederösterreich	0,376	2,610***	p -> e
DE	Berlin	0,481	3,601***	p -> e	NL	Noord-Brabant	1,298**	0,257	e -> p
DE	Brandenburg	0,979	4,204***	p -> e	NL	Noord-Holland	0,000	0,881	No
FR	Bretagne	0,010	0,988	No	FR	Nord - Pas-de-Calais	0,014	0,006	No
IT	Campania	0,008	0,765	No	RO	Nord-Est	0,339	0,086	No
ES	Cantabria	3,872***	2,953***	Bid	RO	Nord-Vest	4,704***	0,001	e -> p
ES	Castilla y León	0,058	3,599***	p -> e	SV	Norra Mellansverige	1,142	0,307	No
ES	Cataluña	0,154	2,400***	p -> e	PO	Norte	1,485***	0,455	e -> p
ES	Comunidad de Madrid	0,311	3,516***	p -> e	UK	North Eastern Scotland	0,020	0,978	No
ES	Comunidad Foral de Navarra	0,074	1,816***	p -> e	UK	Northumberland and Tyne and Wear	0,039	0,522	No
ES	Comunidad Valenciana	0,076	3,384***	p -> e	DE	Oberbayern	0,220	2,627***	p -> e
DE	Darmstadt	0,005	1,626***	p -> e	AU	Oberösterreich	0,006	1,356**	p -> e
DE	Detmold	0,022	0,137	No	SV	Östra Mellansverige	2,550***	5,396***	Bid
UK	Devon	0,012	0,354	No	UK	Outer London	0,004	0,145	No
UK	Dorset and Somerset	0,008	0,006	No	SV	Övre Norrland	0,011	1,323**	p -> e
NL	Drenthe	0,128	0,199	No	ES	País Vasco	0,012	1,145	No
DE	Dresden	0,051	1,531***	p -> e	FR	Pays de la Loire	0,741	0,717	No
DE	Düsseldorf	0,218	1,341**	p -> e	FR	Picardie	0,011	0,021	No

UK	East Anglia	0,292	0,233	No	IT	Piemonte	0,075	0,260	No
UK	East Wales	0,657	0,021	No	FR	Poitou-Charentes	0,523	1,303**	p -> e
UK	East Yorkshire and Northern Lincolnshire	1,447***	0,559	e -> p	ES	Principado de Asturias	0,308	3,626***	p -> e
UK	Eastern Scotland	0,032	0,335	No	BE	Prov. Vlaams-Brabant	0,059	1,087	No
EE	Eesti	0,001	1,153	No	FR	Provence-Alpes-Côte d'Azur	0,112	2,237***	p -> e
UK	Essex	0,047	0,124	No	IT	Puglia	0,074	0,029	No
ES	Galicia	0,221	1,757***	p -> e	ES	Región de Murcia	0,954	5,576***	p -> e
UK	Gloucestershire, Wiltshire and	0,081	0,920	No	FR	Rhône-Alpes	0,353	0,916	No
UK	Greater Manchester	0,001	0,059	No	DE	Saarland	0,003	0,078	No
DE	Hamburg	0,238	5,039***	p -> e	AU	Salzburg	0,011	1,282**	p -> e
UK	Hampshire and Isle of Wight	0,021	0,192	No	IT	Sardegna	0,306	0,930	No
DE	Hannover	0,000	0,672	No	DE	Schleswig-Holstein	0,362	1,802***	p -> e
FR	Haute-Normandie	0,260	0,003	No	DE	Schwaben	1,609***	0,823	e -> p
UK	Highlands and Islands	0,000	1,578***	p -> e	IT	Sicilia	0,079	0,025	No
FR	Île de France	0,021	1,08	No	SV	Småland med öarna	0,088	0,001	No
ES	Illes Balears	0,008	3,950***	p -> e	UK	South Western Scotland	0,461	0,044	No
UK	Inner London	0,454	4,278***	p -> e	IE	Southern and Eastern	0,161	3,733***	p -> e
DE	Karlsruhe	0,999	1,295**	p -> e	AU	Steiermark	0,047	2,666***	p -> e
AU	Kärnten	0,409	0,958	No	SV	Stockholm	0,105	7,196***	p -> e
UK	Kent	2,353***	0,737	e -> p	DE	Stuttgart	0,001	0,677	No
DE	Koblenz	1,710***	0,090	e -> p	SV	Sydsverige	0,192	8,153***	p -> e
DE	Köln	0,012	0,930	No	UK	Tees Valley and Durham	5,243***	0,162	e -> p
HU	Közép-Magyarország	0,298	0,248	No	DE	Thüringen	0,999	1,523***	p -> e
UK	Lancashire	1,498***	0,058	e -> p	AU	Tirol	0,638	4,089***	p -> e
FR	Languedoc-Roussillon	0,016	0,848	No	DE	Tübingen	0,020	1,963***	p -> e
FI	Länsi-Suomi	0,014	0,632	No	SV	Västsverige	0,177	1,231*	p -> e
LV	Latvija	0,529	0,906	No	RO	Vest	0,310	0,381	No
NL	Limburg	0,388	0,025	No	UK	West Midlands	0,028	0,018	No
FR	Limousin	0,241	0,269	No	UK	West Yorkshire	0,003	0,910	No
PO	Lisboa	0,085	0,082	No	NL	Zuid-Holland	0,236	0,233	No

Table 5.6 Results from the individual Granger causality tests between air transport and employment in services for the 112 NUTS2-regions. No = no causality, Bid = bidirectional causality, e -> s= causality from employment to passenger volume, s -> e = causality from passenger volume to employment.
* p<0.10, **p<0.05, ***p<0.01

Country	Region	s -> p	p-> s	Causality	Country	Region	s -> p	p-> s	Causality
PO	Algarve	0,194	1,515***	p - > s	IT	Lombardia	0,027	3,678***	p - > s
FR	Alsace	1,628***	0,678	s -> p	FR	Lorraine	0,161	1,796***	p - > s
ES	Andalucía	0,017	12,015***	p - > s	LU	Luxembourg	0,119	5,982***	p - > s
FR	Aquitaine	0,156	3,501***	p - > s	MA	Malta	0,257	7,802***	p - > s
ES	Aragón	3,929***	6,948***	Bid	DE	Mecklenburg-Vorpommern	4,146***	1,909***	Bid
DE	Arnsberg	0,411	2,458***	p - > s	SV	Mellersta Norrland	0,348	2,187***	p - > s
FR	Auvergne	1,009	4,766***	p - > s	DE	Mittelfranken	0,002	9,939***	p - > s
FR	Basse-Normandie	0,404	4,119***	p - > s	DE	Münster	0,056	0,354	No
UK	Bedfordshire and Hertfordshire	0,002	0,011	No	AU	Niederösterreich	0,475	5,143***	p - > s
DE	Berlin	0,499	5,290***	p - > s	NL	Noord-Brabant	1,501***	0,249	s -> p
DE	Brandenburg	1,829***	5,191***	Bid	NL	Noord-Holland	0,087	0,001	No
FR	Bretagne	0,001	2,028***	p - > s	FR	Nord - Pas-de-Calais	0,414	0,492	No
IT	Campania	0,001	0,124	No	RO	Nord-Est	0,420	8,226***	p - > s
ES	Cantabria	4,388***	11,812***	Bid	RO	Nord-Vest	9,955***	6,256***	Bid
ES	Castilla y León	0,024	6,611***	p - > s	SV	Norra Mellansverige	0,996	0,016	No
ES	Cataluña	0,263	8,854***	p - > s	PO	Norte	2,072***	2,493***	Bid
ES	Comunidad de Madrid	0,281	9,514***	p - > s	UK	North Eastern Scotland	0,010	0,008	No
ES	Comunidad Foral de Navarra	0,194	0,994	No	UK	Northumberland and Tyne and Wear	0,009	0,622	No
ES	Comunidad Valenciana	0,107	10,567***	p - > s	DE	Oberbayern	0,323	6,682***	p - > s
DE	Darmstadt	0,014	4,459***	p - > s	AU	Oberösterreich	0,017	2,003***	p - > s
DE	Detmold	0,337	0,487	No	SV	Östra Mellansverige	1,086	2,396***	p - > s
UK	Devon	0,287	0,017	No	UK	Outer London	0,005	0,178	No
UK	Dorset and Somerset	0,477	0,002	No	SV	Övre Norrland	0,012	0,708	No
NL	Drenthe	0,216	0,055	No	ES	País Vasco	0,024	4,983***	p - > s
DE	Dresden	0,008	3,610***	p - > s	FR	Pays de la Loire	0,710	1,504***	p - > s
DE	Düsseldorf	0,436	2,701***	p - > s	FR	Picardie	0,687	0,662	No

UK	East Anglia	0,196	0,024	No	IT	Piemonte	0,117	2,097***	p - > s
UK	East Wales	0,698	0,056	No	FR	Poitou-Charentes	0,313	2,519***	p - > s
UK	East Yorkshire and Northern	1,591***	2,373***	Bid	ES	Principado de Asturias	0,281	1,079	No
UK	Eastern Scotland	0,047	0,804	No	BE	Prov. Vlaams-Brabant	0,054	2,046***	p - > s
EE	Eesti	0,019	1,439***	p - > s	FR	Provence-Alpes-Côte d'Azur	0,125	1,740***	p - > s
UK	Essex	0,079	0,550	No	IT	Puglia	1,068	0,207	No
ES	Galicia	0,340	1,002	No	ES	Región de Murcia	0,070	1,324**	p - > s
UK	Gloucestershire, Wiltshire and	0,119	1,763***	p - > s	FR	Rhône-Alpes	0,380	2,102***	p - > s
UK	Greater Manchester	0,003	0,114	No	DE	Saarland	0,001	0,159	No
DE	Hamburg	0,264	6,525***	p - > s	AU	Salzburg	0,004	0,959	No
UK	Hampshire and Isle of Wight	0,011	0,672	No	IT	Sardegna	0,489	4,101***	p - > s
DE	Hannover	0,008	1,707***	p - > s	DE	Schleswig-Holstein	1,520***	2,537***	Bid
FR	Haute-Normandie	0,150	0,101	No	DE	Schwaben	9,092***	1,639***	Bid
UK	Highlands and Islands	0,002	1,132	No	IT	Sicilia	0,220	0,197	No
FR	Île de France	0,032	1,133	No	SV	Småland med öarna	0,086	0,025	No
ES	Illes Balears	0,025	4,359***	p - > s	UK	South Western Scotland	0,372	0,605	No
UK	Inner London	0,359	4,982***	p - > s	IE	Southern and Eastern	0,012	6,630***	p - > s
DE	Karlsruhe	0,746	3,667***	p - > s	AU	Steiermark	0,042	5,293***	p - > s
AU	Kärnten	0,324	1,559***	p - > s	SV	Stockholm	0,107	4,226***	p - > s
UK	Kent	1,037	0,787	No	DE	Stuttgart	0,001	2,546***	p - > s
DE	Koblenz	4,306***	0,261	s -> p	SV	Sydsverige	0,182	1,065	No
DE	Köln	0,004	1,837***	p - > s	UK	Tees Valley and Durham	6,352***	0,844	s -> p
HU	Közép-Magyarország	0,326	1,145	No	DE	Thüringen	1,050	2,987***	p - > s
UK	Lancashire	1,358**	0,026	s -> p	AU	Tirol	0,562	3,398***	p - > s
FR	Languedoc-Roussillon	0,009	0,769	No	DE	Tübingen	0,027	3,045***	p - > s
FI	Länsi-Suomi	0,059	0,785	No	SV	Västsverige	0,201	6,745***	p - > s
LV	Latvija	6,005***	0,843	s -> p	RO	Vest	4,741***	1,754***	Bid
NL	Limburg	1,269**	0,506	s -> p	UK	West Midlands	0,004	0,525	No
FR	Limousin	0,110	4,079***	p - > s	UK	West Yorkshire	0,028	1,074	No
PO	Lisboa	0,281	0,400	No	NL	Zuid-Holland	0,206	0,019	No

Table 5.7 Results from the individual Granger causality tests between air transport and employment in manufacturing for the 112 NUTS2-regions. No = no causality, Bid = bidirectional causality, e -> m = causality from employment to passenger volume, m -> e = causality from passenger volume to employment. * p<0.10, **p<0.05, ***p<0.01

Country	Region	F-value	Causality	Country	Region	F-value	Causality
PO	Algarve	1,505***	p -> m	IT	Lombardia	4,553***	p -> m
FR	Alsace	0,143	No	FR	Lorraine	0,360	No
ES	Andalucía	0,045	No	LU	Luxembourg	4,952***	p -> m
FR	Aquitaine	0,062	No	MA	Malta	0,003	No
ES	Aragón	1,173	No	DE	Mecklenburg-Vorpommern	3,155***	p -> m
DE	Arnsberg	0,006	No	SV	Mellersta Norrland	0,160	No
FR	Auvergne	0,925	No	DE	Mittelfranken	0,099	No
FR	Basse-Normandie	0,224	No	DE	Münster	0,019	No
UK	Bedfordshire and Hertfordshire	1,276**	p -> m	AU	Niederösterreich	0,561	No
DE	Berlin	0,228	No	NL	Noord-Brabant	1,742***	p -> m
DE	Brandenburg	0,170	No	NL	Noord-Holland	0,002	No
FR	Bretagne	0,174	No	FR	Nord - Pas-de-Calais	3,496***	p -> m
IT	Campania	0,655	No	RO	Nord-Est	3,474***	p -> m
ES	Cantabria	0,297	No	RO	Nord-Vest	0,354	No
ES	Castilla y León	0,022	No	SV	Norra Mellansverige	1,069	No
ES	Cataluña	1,041	No	PO	Norte	2,523***	p -> m
ES	Comunidad de Madrid	1,846***	p -> m	UK	North Eastern Scotland	2,852***	p -> m
ES	Comunidad Foral de Navarra	1,416***	p -> m	UK	Northumberland and Tyne and Wear	2,846***	p -> m
ES	Comunidad Valenciana	3,051***	p -> m	DE	Oberbayern	1,190	No
DE	Darmstadt	3,544***	p -> m	AU	Oberösterreich	1,809***	p -> m
DE	Detmold	0,260	No	SV	Östra Mellansverige	1,403***	p -> m
UK	Devon	1,062	No	UK	Outer London	3,026***	p -> m
UK	Dorset and Somerset	0,007	No	SV	Övre Norrland	0,004	No
NL	Drenthe	4,860***	p -> m	ES	País Vasco	1,073	No
DE	Dresden	0,101	No	FR	Pays de la Loire	0,030	No
DE	Düsseldorf	0,715	No	FR	Picardie	2,197***	p -> m

UK	East Anglia	0,382	No	IT	Piemonte	3,461***	p -> m
UK	East Wales	0,089	No	FR	Poitou-Charentes	0,271	No
UK	East Yorkshire and Northern Lincolnshire	0,650	No	ES	Principado de Asturias	0,970	No
UK	Eastern Scotland	3,559***	p -> m	BE	Prov. Vlaams-Brabant	0,213	No
EE	Eesti	0,302	No	FR	Provence-Alpes-Côte d'Azur	2,299***	p -> m
UK	Essex	0,712	No	IT	Puglia	0,538	No
ES	Galicia	0,586	No	ES	Región de Murcia	0,798	No
UK	Gloucestershire, Wiltshire and Bristol/Bath area	2,145***	p -> m	FR	Rhône-Alpes	1,269**	p -> m
UK	Greater Manchester	1,026	No	DE	Saarland	1,465***	p -> m
DE	Hamburg	0,003	No	AU	Salzburg	4,143***	p -> m
UK	Hampshire and Isle of Wight	0,795	No	IT	Sardegna	0,061	No
DE	Hannover	0,552	No	DE	Schleswig-Holstein	0,341	No
FR	Haute-Normandie	0,373	No	DE	Schwaben	0,025	No
UK	Highlands and Islands	3,775***	p -> m	IT	Sicilia	3,625***	p -> m
FR	Île de France	4,503***	p -> m	SV	Småland med öarna	0,233	No
ES	Illes Balears	1,036	No	UK	South Western Scotland	2,843***	p -> m
UK	Inner London	1,368**	p -> m	IE	Southern and Eastern	4,797***	p -> m
DE	Karlsruhe	0,431	No	AU	Steiermark	0,043	No
AU	Kärnten	0,073	No	SV	Stockholm	4,038***	p -> m
UK	Kent	0,031	No	DE	Stuttgart	0,846	No
DE	Koblenz	0,120	No	SV	Sydsverige	2,796***	p -> m
DE	Köln	0,464	No	UK	Tees Valley and Durham	0,931	No
HU	Közép-Magyarország	2,246***	p -> m	DE	Thüringen	0,564	No
UK	Lancashire	0,367	No	AU	Tirol	0,034	No
FR	Languedoc-Roussillon	0,001	No	DE	Tübingen	0,220	No
FI	Länsi-Suomi	0,038	No	SV	Västsverige	2,107***	p -> m
LV	Latvija	0,820	No	RO	Vest	0,519	No
NL	Limburg	2,421***	p -> m	UK	West Midlands	1,081	No
FR	Limousin	0,461	No	UK	West Yorkshire	0,936	No
PO	Lisboa	1,595***	p -> m	NL	Zuid-Holland	1,014	No

CHAPTER 6

General discussion and conclusions

6.1 Introduction

The overall aim of this dissertation was to contribute to ongoing research on the reciprocal and complex relationships between air passenger transport and economic development. We have sought to contribute to a more profound understanding of these links at both the aggregate and the regional level. In the introduction, four general research objectives were put forward. These objectives were to (i) discern some of the determinants of, and their respective importance for, air passenger transport, (ii) study in what ways and to what extent air passenger transport influences economic development, (iii) reveal some of the signs of causality between economic development and air passenger transport, and (iv) determine some of the intervening factors in this relationship. These objectives were translated into a series of specific research questions that were answered throughout the four chapters. Each of these chapters had a different combination of methodology, geographical scale and scope, and can as such be situated along a scalar axis and a methodological axis (Fig 6.1).

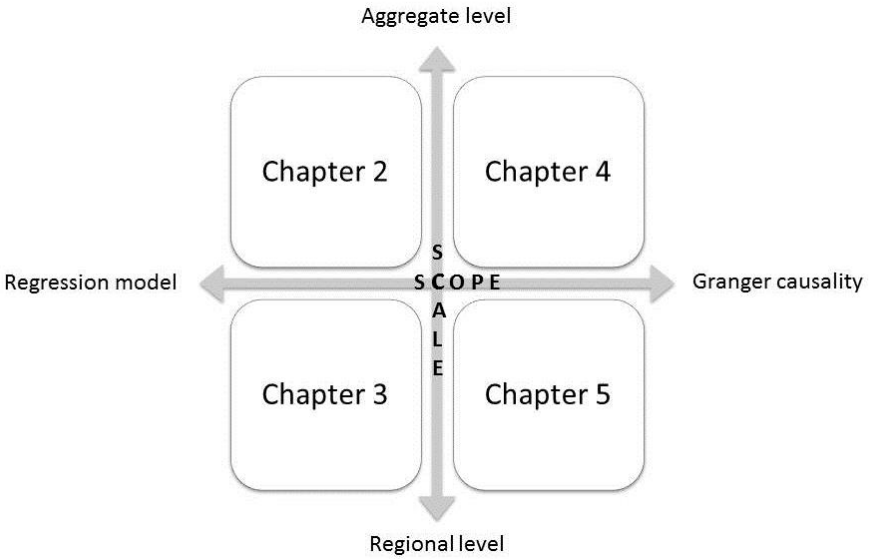

Figure 6.1 Conceptual model of the outline of this dissertation

In the remainder of this final chapter, I first briefly recap the main results of each chapter to provide a short but succinct answer to the research questions. In paragraph 6.3, the three first research objectives are explored in detail on both the aggregate and regional level. A separate section is devoted to the role of air passenger transport as an enabler for regional economic development: it spells out air passenger transport as an INUS-condition, an *'insufficient* but *non-redundant* part of an *unnecessary* but *sufficient'* condition (Mackie, 1980). I felt that this topic needed some elaboration, because a large part of the literature -and also Chapter 5- consider a stronger causal link from air transport to economic development than vice versa (cf. Brueckner, 2003; Button and Lall, 1999; Irwin and Kasarda, 1991; Ivy et al., 1995, Neal, 2012), which may raise the impression that this relationship is straightforward. In paragraph 6.4., I move on to the fourth research objective and investigate the regulatory background against which the relationship between air passenger transport and economic development should be understood. This chapter concludes with some critical reflections on the use of the data and methodology, and provides some avenues for further research.

6.2 Short summary of the main results

Chapter Two of this dissertation investigated some of the main determinants -income, distance, and population- underlying the Asia-Pacific demand for tourism to Australia using multiple regression analysis in a longitudinal framework. The strong affinity between the demand for tourism and general air travel to Australia -over 99% of international visitors arrive by air- allows to perceive these factors as determinants for air travel as a whole. In this chapter, the link between the income level of a country and its ability to generate air passenger travel was confirmed. However, this ability is also influenced by (i) the extent of air transport liberalization, which has a positive effect on the demand for air passenger travel, and (ii) rising fuel prices, which restrain the demand. The delicate balance between these two factors seems to determine the further Asia-Pacific travel and tourism growth to Australia, as it is not certain that rising incomes will guarantee continued growth.

Chapter Three looked at the relationship from the opposite angle and from a regional perspective, and does this by exploring the catalytic economic effects[32] of air passenger transport: it shows how the relative and absolute importance of a particular kind of services, advanced producer services, in metropolitan regions is related to the volume of air services (Taylor, Derudder and Witlox, 2007). An important conclusion of this analysis was that regions that have more and better connections are

[32] Air passenger transport has, as stated in the introduction, also direct, indirect and induced regional impacts. These sorts of effects originate from the air transport industry itself (the presence of an airport), while catalytic

generally marked by a presence of more of these knowledge-intensive services. This interrelation is however geographically specific in that it often depends on national and regional particulars.

The fourth Chapter moved away from research that investigates mere associations between air passenger transport and economic development and introduced the concept of heterogeneous Granger causality analysis to investigate the causal link between air passenger transport services and goods trade between Asia-Pacific countries. The results were varied: air passenger transport does not necessarily lead to trade, just as trade does not necessarily lead to air passenger travel. The presence of a causal relationship seems dependent on a number of intervening factors, such as the economic development level of the countries, and the extent of air transport (de)regulation.

Chapter Five further explored the causal relationship between air passenger transport and economic development by focusing on the relationship between air passenger transport and employment in European urban regions. Again, this relationship was characterized by a strong heterogeneity across the different regions, indicating that air transport is an enabling factor for economic development, but not a sufficient condition. In turn, employment levels are only a determinant for generating travel in a minority of the regions. Similar to Chapter Three, air passenger transport seems to be significantly impacting the services industry in particular, while the economic development level and air transport liberalization again appear as intervening factors.

6.3 The mutual link between air passenger transport and economic development explored at various scales

In this section, the mutual links between air passenger transport and economic development are explored in more detail, and this based on the insights gained throughout the four chapters. In the first section, three main drivers for air passenger transport at the aggregate level are elaborated: income, goods trade and air transport costs. Income and goods trade are, in turn, also influenced by air passenger transport. The second section focuses on the regional expression of the air passenger transport and economic development relationship. Regional economic development is a multidimensional concept, but was expressed in this dissertation through the presence of services and employment in urban regions. In a third section, the role of air transport as an enabler for regional development is highlighted.

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effects represent the wider socio-economic benefits effects of air transport (and are related to the fact that a region benefits from air transport services).

6.3.1 The aggregate level

Based on Gillen (2010), I suggested four main forces that influence the general demand for air passenger transport in the introduction. Except for the obvious effect of population, these are (i) macro-economic forces, such as GDP growth, growth of trade in goods and services, and foreign direct investment (Graham, 2006; Rimmer, 2000); (ii) transport costs, which are influenced by a broad range of factors such as distance, fuel prices, degree of air transport liberalization (BTCE, 1995; Oum et al., 2009); and (iii) a range of miscellaneous forces, such as cultural and mental proximity, which is a more tacit influence and relates to integration forces between countries or regions that lead to additional demand for air travel. Examples are language similarities, a common colonial history or immigration (Lim, 1997; Reyes, 2013). These factors are not easy to quantify and were only tentatively discussed in this dissertation. Concerning the macro-economic factors, Chapters 2 and 4 show that growth in GDP and trade and investments lead to more air passenger transport (Brons et al., 2002; Cristea, 2011; Ishutkina and Hansman, 2009). Concerning the transport costs, Chapter 2 shows that these are negatively correlated with air passenger transport (Eilat and Einav, 2004; Lim, 1997; Tretheway and Oum, 1992).

Air passenger transport is not only influenced by macro-economic factors such as GDP and trade, but it also acts upon GDP, investment and trade. This general understanding often leads governments to promote air transport, mainly tourism travel, as a generic panacea to boost the economy of their country. The US, for example, launched the National Travel and Tourism Strategy[33] [34] in 2012, in which free flow of trade in travel services is a key point. Another example is the *Tourism 2020* Strategy in Australia[35], of which a considerable part focuses on the improvement of air transport, and which is discussed in Chapter 4.

In the next paragraphs, I will elaborate on the three main forces of income, goods trade and air transport costs.

Income

Income is perceived as one of the most important factors for the generation of air transport (Tretheway and Oum, 1992). The Asia-Pacific viewpoint of Chapter 2 proved to be a good case-study area, because it illustrated how high growth rates in personal incomes in the developed and newly

[33] http://travel.trade.gov/pdf/national-travel-and-tourism-strategy.pdf
[34] http://www.cbp.gov/sites/default/files/documents/Travel%2Band%2BTourism%2BProgress%2BReport.pdf
[35] http://www.tourism.australia.com/documents/Tourism_2020_overview.pdf

industrialized countries of the Asia-Pacific region during the 1990s coincided with a heightened Asia-Pacific tourism demand towards Australia (Lim, 1997). The Chapter confirms income's importance in comparison with population and transport costs, and recognizes the high income elasticity of air travel (Brons et al., 2002; Mutti and Murai, 1977; Smyth and Pierce, 2008). I obtained an income elasticity that decreased from 1.83 in 1990 to 1.53 in 2010, a value that approximates the typical value of 2, which is put forward by Tretheway and Oum (1992) after evaluating multiple domestic and international studies.

At least two points of discussion emerge here: its absolute value on the one hand and its decrease with time on the other hand. First, the absolute value of approximately 2 indicates that the growth in air passenger transport is highly elastic. Research of the BTCE[36] (1995) revealed that the income-elasticity for travel from the Asia-Pacific region towards Australia is indeed high, but that it differs considerably among countries, with some showing far higher elasticities than others (e.g. a low elasticity of New Zealand against a very high elasticity of Malaysia). This difference can be attributed to differences in development levels (in terms of GDP) and to market maturity (Graham, 2000; Graham, 2006). Generally, countries with higher GDP levels show lower elasticities, in contrast with countries with lower GDP that have higher elasticities. The high elasticity of Malaysia, for instance, was a consequence of its rise in GDP and accompanied high growth in outbound tourism towards Australia at the time of the BTCE-study (1995). However, in Chapter 2 it was found that the high income elasticity in countries with lower GDP may also be dampening because in those countries, income distributions are very uneven and the highest incomes occur only for a small part of population. As a result, an increase in average disposable income may not lead to an increase in travel demand to the same extent that would a similar increase in disposable income in countries with higher GDP (BTCE, 1995). Second, the decrease in income elasticity in Chapter 2 pointed to the maturing of the Australian tourism markets: after a certain point, rising incomes will become less fast translated into additional air travel demand (Graham, 2006; IATA, 2008). This trend also appears in other markets, such as the domestic market in the UK (Graham, 2006).

An imminent maturity of the international air travel market is however unlikely, even in North America or Europe, due to–among other factors- increased economic integration, and evolutions in air transport liberalization and technology[37], which are the major drivers for air passenger transport discerned in the introductory chapter. Especially in the long haul market there is little evidence of

[36] Australian Bureau of Transport and Communication Economics

[37] Although maturity in some niche markets can be expected: Graham (2006) claims that the British leisure market is mature, and that declining growth rates are expected for the future.

market maturity (Smyth and Christodoulou, 2011). In this context, I would like to refer to the statement on p72 in Chapter 3, that '*GaWC accepts Sassen's identification of APS firms at the cutting edge of the world economy through enabling transnational commerce and production, but has extended the argument beyond Sassen's focus on just a small number of select cities […] GaWC has moved away from an emphasis on a few nodes as 'global cities' to focus on the network relations of many more cities in the servicing of global capital […] specified as the world city network*'. Increased economic integration leads to more cities being 'caught' in this expanding global network of cities, cities that are connected through deepening flows of *people*, goods, investment and information (Keeling, 2007). At the same time, it seems that increasingly more secondary cities are being incorporated in the global air passenger network as well (see O'Connor, 2003), making these cities increasingly more physically connected. This chimes well with O'Connor's (2003)[38] observation that '*the character of the global geography of airports is shaped by the forces associated with global city development'.* This connection can be illustrated by looking at China and Chinese cities. As argued in Chapter 2, the largest growth of Asia-Pacific tourists to Australia is expected to come from China, including from secondary Chinese cities (Tourism Australia, 2011). This example of increasing integration of Chinese cities in the air transport market runs parallel with an increased integration of those cities in the world city network[39] (Derudder et al., 2013). Hence, it could be that the expansion of the air passenger transport market due to increasing economic integration and expansion of the world economy, counteracts the maturing of other already established markets, enabling further growth.

In the same way, air transport liberalization and technological improvements fuel this trend. First, increasing liberalization between countries has contributed to a shift away from the international routes between 'national airports' as was evident in the former restrictve bilateral agreements, to routes between multiple points in countries (including secondary cities) as allowed in less restrictive and open skies agreements. This is reinforced by the formation of international alliances and the development of hub-and-spoke networks that span the globe and stimulate possible connections between an increasing number of cities (Dennis, 2005). Increased liberalization will likely further deepen this trend. Second, while improvements in technology were, and remain, focused on increasing non-stop distances and higher-passenger-volume jets, more emphasis has also been put on the development of mid-size fuel efficient wide-body long haul aircraft, such as the Boeing 787 Dreamliner, which can serve distant cities with thinner routes between them (Doganis, 2010). In this

[38] In his research, he illustrated that during the 1990s, there was a shift in share from total air passengers away from the dominant global cities to secondary global cities.
[39] Although the three cities of Shanghai, Beijing and Hong Kong remain the leading cities by far.

way, also those cities that are non-major hubs are linked through direct connections. These types of jets can equally serve the spokes in hub-and-spoke networks.

Trade

Trade in goods and services is another macro-economic force that stimulates, and is stimulated by, air passenger travel (ATAG, 2014). Focus in Chapter 4 of this dissertation is on goods trade flows. Both trade and air passenger flows have grown over the last couple of decades, and according to Kulendran and Wilson (2000), countries that have adopted more open trade policies and increased their international trade flows, have also experienced higher international passenger flows (and vice versa). Chapter 4 confirmed this link, but additionally showed –on the basis of Granger causality analysis- that international goods trade is a *stimulator* for international air passenger transport in the Asia-Pacific region, in the sense that previous growth in trade flows between pairs of countries can explain subsequent growth in passenger volumes between those countries. In the same way, results showed air passenger transport stimulates goods trade. This mutual causality is however not the norm, as the analyses suggested that intra-regional (and as a corollary inter-regional) differences exist in this mutual relationship. This follows from the fact that bilateral trade and travel flows occur against a backdrop of influential multilateral forces and an institutional context, such as geographical distance, common history and culture, the degree of trade openness (Adey et al., 2007; Frankel et al., 1998; Khan and Lin, 2002; Kulendran and Wilson, 2000; Rauch, 2001; Yanikkaya, 2003), but also the degree of air transport deregulation, and the difference in development levels (in terms of GDP), which were indicated in Chapter 4. One key trend is that more liberal policies, both regarding trade and transport, foster the possibility of a causal link in the goods trade - air passenger transport relationship, although this trend is not self-evident. A case in point would be the trade and travel relations between Australia and New Zealand. In 1983, the Australia-New Zealand Closer Economic Relations Free Trade Agreement (ANZCERTA) was concluded, which created a liberal business and economic regime for goods and services[40]. It is perceived as one of the most open economic trade relationships between any two countries in the world (InterVISTAS, 2007). Similarly, in 1996[41], the two countries signed the Single Aviation Market (SAM) agreement, which opened up ownership and control regulations in the air transport services industry, and introduced cabotage rights (Kissling, 1998). Both agreements facilitated strong bilateral growth in trade and air travel flows respectively. However, in Chapter 2, and in the research of Kulendran and Wilson (2000) no significant causality

[40] It also set a collaborative umbrella to deal with customs, transport, regulatory, product standards and business law issues.

[41] Followed by an open skies agreement in 2002, which permitted beyond rights (http://www.icao.int/sustainability/CaseStudies/StatesReplies/Trans-Tasman_EN.pdf).

relations between trade and travel were found for this country-pair. Kulendran and Wilson (2000) attribute this to the strong economic integration through ANZCERTA, while Chapter 4 stresses another political factor, the Trans-Tasman Travel Arrangement which allows Australians and New Zealanders to travel freely between, and live and work freely within, each country[42]. This increases the proportion of leisure travel (e.g. tourism, visiting friends and relatives), and limits the proportion of air travel for trade reasons. This can obscure the link between travel flows and trade flows. Nevertheless, Kulendran and Wilson (2000), indicate that also holiday travel influences trade and the reverse. It seems that in the case of Australia-New Zealand, the liberal policies that have intensely integrated both trade and air travel markets, are one of the reasons for the absence of a significant causal link: travel and trade flows are so ubiquitous that increases in e.g. trade flows only bring marginal increases in air passenger travel flows and *vice versa*.

It can be concluded that multifaceted and complex linkages between motivations for air transport and trade between countries are present, and that although a general link between trade flows and air passenger transport is assumed on a global level, it is difficult to predict its particular regional of national articulations.

Transport costs

Third, transport costs have a negative relationship with air passenger travel demand. These costs are influenced by multiple factors, of which Chapter 2 examined two[43]: the degree of air transport liberalization, and fuel price. First, transport costs are in complex ways influenced by air transport liberalization. Overall, liberalization leads to growth in air travel when it is associated with lower air fares, but these advantages are often confined to the core markets and routes, where competition[44] is highest (Goetz and Sutton, 1997). In other markets, and on other routes, airline monopolies exist and fares remain high (Dobruzskes, 2009). In the US, for instance, dominance of major airports by one or two carriers, in many cases the result of hub formation, appears to result in higher fares (Borenstein, 1989; Good et al., 1993). Zhang et al. (2013), for instance, empirically showed that on routes between an airline's two primary hubs the air fare is increased on average by almost 50%. And in Europe, competition remains limited to a couple of routes and mainly benefits passengers in the large cities and in popular tourist destinations (Dobruzskes, 2009). However, air transport

[42] Due to the regulatory context: the open skies policy, but also the Trans-Tasman Travel Arrangement (1973), which allows for the free movement of citizens of one nation to the other (http://www.mfat.govt.nz/Foreign-Relations/Australia/0-trans-tasman-travel-arrangement.php).

[43] The transport costs were proxied by the distance between origin and destination markets.

[44] The intensity of this competition is relative: at best, there is a situation of oligopoly (e.g. the New York – London route is currently served by three airlines: British Airways, Delta-Virgin and United Airlines (Carrington, 2014).

liberalization is still in progress, and the actions and reactions of airlines are in a constant flux: mergers, acquisitions, alliances, route structures… are changing continuously and will keep impacting upon the transport costs in different ways.

Second, fuel prices are highly volatile and have been on the rise, and are taking up an increasingly large share of airlines' operating costs (Ringbeck et al., 2009). To maintain yields, airlines increasingly pass these costs on to the passengers as fuel surcharges, augmenting air fares (Brueckner and Zhang, 2010). In the US, for instance, rising fuel prices and the economic downturn, have increased overall domestic air fares between 2007 and 2012, albeit with varying intensities: from a couple of percentage points to 20% in some airports, while others saw decreases (Wittman and Swelbar, 2013). This coincided with a considerable reduction in scheduled domestic flights in that same period. Chapter 2 equally showed that rising fuel prices impact transport costs in Asia-Pacific, which negatively affects air travel demand. Hence, while air transport liberalization can stimulate the demand for air travel to varying degrees, rising fuel prices can have a negative effect on future air transport. This is anticipated by airlines by investing in aircraft that (i) have higher load factors, such as the A380 Superjumbo, with the intention of lowering direct operating costs per seat, or (ii) are more fuel efficient[45], such as Boeing's 787 Dreamliner, which uses 20 percent less fuel than similar size aircrafts (Bowen, 2010). Both strategies lead to lower fuel usage per passenger kilometre, and may temper the airfare increase due to fuel expenses as a share of operating cost (Brueckner and Zhang, 2010).

From this overview, it seems likely that the traditional key drivers of demand, such as economic growth (trade, income) and transport costs will continue to play an important role in the demand for air passenger transport (Gillen, 2010). However, this research confirms the signs of a possible divide between countries with lower and higher GDP. In countries with lower GDP, economic growth will remain key driver for stimulating transport growth (Zuidberg and Veldhuis, 2012), although this increase is threatened by rising fuel costs. In countries with higher GDP, however, travellers seem less sensitive to income growth, but the transport costs are likely to have a greater impact in encouraging additional trips (Graham, 2006).

The exact relationships of the mentioned drivers and travel demand vary in time and space, just as the generative effects -the overall impact on economic activity- of air transport are unevenly distributed across space (Rietveld 1994). These disparities come to the fore especially when

[45] Through better engine technology as well as use of lighter materials (Brueckner and Zhang, 2010).

scrutinizing the mutual relationship between air transport and economic development at regional scales.

6.3.2 The regional level

Chapters 3 and 5 focus on the regional expressions of the relationship by scrutinizing the link between air passenger transport and the presence of services and employment in urban regions, respectively. Chapter 3 found that the regional link between air passenger transport and the presence of advanced producer services (APS) is geographically specific, and dependent on the regulatory context. The intensity of the link differs across the different parts of the world, as the world regions –and their constituting countries- are characterized by different aviation policies (from the highly liberalized US and European market, to the still more tightly regulated Asian market), and economic policies (the strongly regulated Japanese and Chinese economies versus the more open economy of Singapore). Additionally, air passenger transport is undertaken for different reasons: business, tourism, education, visiting relatives. These are not all equally relevant for the location and growth of APS, but tourism travel is in turn important for the presence of other services (such as hotels), 'translating' the catalytic impact of air transport services and contributing to the regional economy in an alternative way (as is the case in Las Vegas, or the Spanish costas) (Cortés-Jiménez, 2008). This indicates that air passenger transport can be linked with the intensity of services in a region, be it advanced producer, tourism or other services, and as a corollary with regional development. However, this measurement of the impact of air passenger transport on development can be obscured because of the endogeneity-issue (Vickerman, 1995), which implies that air transport can influence the presence of services, but that –at the same time- these services can influence the demand for air travel.

Chapter 5 explores this endogeneity-issue by investigating if air passenger transport has a causal influence on regional development (as measured in total employment, and employment in manufacturing and services sector) and if regional development also has an influence on air passenger transport. Through Granger causality analysis, it was confirmed that there is mutual causality in Europe, but that this causality is not present across all the regions. In fact, three general trends can be perceived. First, changes in air transport seem to precede changes in employment more often than the other way around, which implies that air passenger transport is more of an instigator of employment, rather than employment a driver of air transport. Second, the relationship between air passenger transport and employment is stronger for the services sector than for the manufacturing sector. Third, the influence of air passenger transport on employment does not

exhibit a clear geographical pattern, but is felt more in some European core-regions (such as the 'European polygon', cfr. Dobruzskes, 2009), the touristic regions, and the peripheral European regions (both geographically as in terms of GDP). The detection of a causal link in these peripheral regions implies that investments in air transport services can be vital as a policy instrument to stimulate lagging regions (Vickerman et al., 1999). This was confirmed in Mukkala and Tervo (2013), who equally detected causality from passenger transport to economic development across multiple European peripheral regions. However, it is not a *conditio sine qua non*, as Chapter 5 equally shows regions where this causal relationship is absent. In the same way, in regions that already have strong air transport services, accessibility tends to become ubiquitous and additional air transport may bring only marginal benefits for regional development (Banister and Berechman, 2001; Vickerman et al., 1999), although there are also some of those regions were the causal link exists.

These findings put the general assumptions that *'both regional economic development and connectivity […] by air have a mutual spin-off relationship with each other: Economic development […] stimulates air service demand. While increasing connectivity, resulting from increasing air service demand, makes a region more attractive for (internationally orientated) businesses, leading to regional economic growth and, in turn, to additional air service demand'* (Zuidberg and Veldhuis, 2012: 40) into perspective. It seems that air passenger transport and economic development are intertwined through a complex web of relationships, and it is not always easy to determine to what degree these two influence each other. This was shown for Europe in Chapter 5, but the Chapter also partly deals with this issue, because the causality analysis technique allows investigating the relationships separately for different regions, something which other methodologies do not always allow (cfr. Irwin and kasarda, 1991).

The discussion of the mutual relationship between air passenger transport and economic development on both the aggregate and regional level shows that this relationship is not straightforward. There is a clear link between both, but the question of endogeneity is more difficult to answer. Debbage and Delk (2001: 167) point to it as the *'thorny ''chicken or egg'' issue'*. I would like to recast this into a question of 'chicken AND egg', in that both air transport and development can lead to one another. However, this is only true if a rooster is involved: a chicken can lay an egg, but for the egg to become a chick, one needs a rooster. This means that the possibility for economic development to be stimulated by air passenger transport can only be fulfilled if the right circumstances are in place (e.g. the regulatory context). The same is true for the causality running from economic development to air passenger transport. This 'rooster', the regulatory context, is discussed in 6.3.3 and 6.4.

6.3.3 Air passenger transport as an INUS-condition

The debate about whether transportation guarantees or conditions economic development continues in the literature (Banister and Berechman, 2001; Debbage and Delk 2001; Nijkamp, 1986), and this question can be applied to the specific case of air passenger transport as well. It can be said that air passenger transport is important for regional development because it creates the facilitating conditions for economic development: it provides accessibility so that companies can serve more markets (Bowen, 2000), it offers locational advantages for companies (Irwin and Kasarda, 1991), and it facilitates face-to-face contacts (Tornqvist, 1970, 1973). It also attracts more tourists who can spend money in the region.

From this perspective, air passenger transport *can* (subject to certain conditions, as mentioned on p5 of the introduction) contribute to the longer term development process in a region (Button and Taylor, 2000). This dissertation has shown some of the circumstances under which this could be realized. It became clear that air passenger transport has to be perceived as an INUS-condition (Mackie, 1980). This implies that air passenger transport is an *'insufficient* but *non-redundant* part of an *unnecessary* but *sufficient'* condition (Verweij and Gerrits, 2013).

To explain this, I would like to refer to the work of Banister and Berechman (2001), who point out that three conditions have to be simultaneously fulfilled for transport investment to lead to economic development: (i) investment conditions (such as the moment, scale, and location of investment), (ii) the economic conditions (referring to the labour market, the local economic conditions), (iii) political and institutional conditions (referring to the broader policy environment, such as the supporting legal, institutional and organizational policies and processes). This can similarly be extrapolated to air transport: take for instance (i) air passenger transport through new routes introduced by an airline at a particular airport, (ii) regional economic conditions (e.g. large labour pool), and (iii) the regulatory context (e.g. attractive investment climate). According to the *rationale* of Banister and Berechman (2001), air passenger transport can only lead to economic development (e.g. in the shape of investment of service companies by locating in the region), if all three conditions are fulfilled. In this setting, air transport (i.e. (i)) can be perceived as an INUS-condition (Mackie, 1980). Here, air transport is not sufficient to produce economic development, because the other two conditions (economic and regulatory context) are required. Nor is air transport separately a necessary condition, because rail or road transport along with the economic conditions and regulatory context can produce economic development as well. Hence, air transport is an INUS-condition, in that it is an insufficient (i.e. it can not produce economic development by

itself), but non-redundant (i.e. it is a necessary condition in combination with the economic condition and regulatory context) part of an unnecessary (road or rail transport in combination with the economic condition and regulatory context can also produce economic development) but sufficient (i.e. air transport, economic condition and regulatory context can lead to economic development) condition for economic development (Verweij and Gerrits, 2013).

This concept is quite abstract, but it can be put in more concrete terms: it is rather obvious that despite higher accessibility (due to more air transport), a company is less inclined to invest in a region if there is no available labour pool in that region (cf. (ii)), and if open tax, tariff and trade rules or open immigration policies are not in place (cf. (iii)). As a result, economic development through increased air accessibility will be unlikely. This can be illustrated with an example from Chapter 3: the presence of APS-services in Chinese metropolitan regions was less than expected based on air passenger volumes, because of the tight regulation of the Chinese economy.

However, I believe this should not be confused with transport infrastructure as a whole, which is by most authors perceived a necessary, although not sufficient condition for regional economic development (Nijkamp, 1986). Air passenger transport has to be viewed in a broader frame of the other transport modes such as highways and rail transport, especially in regions where these modes serve as real substitutions (e.g. in Europe, Allroggen and Malina, 2014; Dobruzskes, 2009). Hence, to perceive the total contribution of transport as an enabler for economic development of a region, it is important to look at this aggregation of transport modes, but this was not the objective of this dissertation.

In conclusion, figure 6.2 shows how and to what extent air passenger transport can lead to economic development. Air transport investments (e.g. new passenger services) will only lead to additional economic development under the right conditions -the economic conditions and regulatory context- which are fulfilled in the two top cells only. It can be assumed that in regions with high levels of accessibility (e.g. large passenger volumes) and economic development (e.g. high GDP-levels), additional air transport can only bring limited additional economic development, which contrasts with regions with lower accessibility and lower GDP-levels that still have more potential for development. It must be emphasized that this figure should not be viewed as a rule, it is rather a framework in which we can perceive the relationship. It merely tries to explain why in some regions air transport will lead to economic development and in others, this causal link is absent. The reality is of course more complex.

		Economic, institutional and political conditions	
		Weak	**Strong**
Accessibility	**Low**	The effect of additional air passenger services could be limited, due to absence of economic and regulatory conditions	The effect of additional air passenger services will probably be large here
	High	The effect of additional air passenger services could be limited, because high accessibility, and absence of economic and regulatory conditions	Positive effect of additional air passenger services, but possible saturation

Figure 6.2 Air transport and regional development. Based on Nijkamp (1986) and Banister and Berechman (2001)

6.4 The regulatory context

In this section, the role of the regulatory context is extended[46], as its influence on the link between air passenger transport and economic development was acknowledged in each chapter. Two aspects of this regulation came to the fore: air transport liberalization and the more general economic regulation, which have to be viewed simultaneously.

6.4.1 Air transport liberalization

A first aspect of regulation is air transport liberalization: first, Chapter 2 indicates that it theoretically heightens the demand for air travel, because it leads to lower airfares (Grancay, 2009). This effect is however very geographically dispersed and varies in intensity, which was already extensively discussed in Chapter 2 and section 6.3.1.

Second, Chapter 4 shows that country-pairs that both have more liberal aviation policies show stronger causal relationships between air passenger transport and goods trade (e.g. country-pairs containing Singapore), than country-pairs with more restrictive agreements (e.g. country-pairs containing Japan). Additionally, there are parallels with more liberal and more restrictive national economic policies as well: Singapore has more liberal trading policies than Japan. However, also in this case, liberal policies do not unconditionally lead to strong causality in the air passenger transport-economic development link (e.g. New-Zealand and Australia, discussed in 6.3.1).

[46] Beyond the regional level, discussed in section 6.3.3.

In addition to the influence of air transport liberalization on airfares, its more regional spatial articulations -in the shape of markets served by low cost carriers (LCC) and the formation of hub-and-spoke networks- have also had differential impacts on economic development.

First, Chapter 5 suggests that air transport liberalization can potentially play an important role in regional development, by discussing the arrivals of LCCs in European cities.. Two regions were focussed upon: the touristic Mediterranean urban regions, and the more peripheral regions of the newest member states of Eastern Europe. In the first case, LCCs bring many Northern European (e.g. UK, Belgium) tourists to the south at generally lower prices than the Full Service Carriers (FSCs). This has stimulated the tourism sector, and as a corollary a particular kind of regional development, in these regions. In the case of the newest member states, LCCs (such as the Hungarian carrier Wizzair) have opened up new markets, which still have a large potential for additional economic development. These insights from Chapter 5 are backed up by more empirical evidence of the influence of air transport liberalization on European regional development. Gillen and Hinsch (2001), for instance, developed a model to measure the impact of the implementation of an open skies agreement between Germany and ten non-EU destinations linked to the Hamburg region and found that this would increase the number of passengers, which in turn would stimulate employment and investment growth, and employment in the Hamburg tourism sector. For the US, Button et al. (2014) proved that after the introduction of the EU–US Open Skies Agreement in 2008, there was an increase in Trans-Atlantic passengers US's to east-coast hubs, with a consistent pattern of the regions gaining the largest number of passengers also experiencing the greatest increase in regional employment.

Second, this hub-formation was a non-anticipated, though typical outcome of air transport liberalization. Research in the US has shown that after the Deregulation Act of 1978, the population of the urban regions surrounding these hub-airports have benefited more from air transport liberalization than passengers living in urban regions surrounding non-hub airports due to –among else- more frequent and direct flights, more destinations, and better chance at international flights (Button et al., 1999). The authors empirically showed that metropolitan areas of a hub-airport attract more high-technology employment, and *ipso facto* income, than cities surrounding comparable non-hubs, irrespective of the volume of airline traffic passing through.

However, air transport liberalization does not always lead to economic development in a region, and government intervention is sometimes needed: due to air transport liberalization some remote urban regions were threatened to be cut off from airline networks. Liberalization gave the airlines

the freedom to improve their efficiency through adopting efficient network strategies and more effective operating practices (Button and Taylor, 2000). Services to these remote regions are of course not efficient because of thin routes, and were at risk to be no longer served. Hence, government intervention was and is needed to sustain those routes. In the EU, for instance, member states can impose Public Service Obligation routes (PSO) to ensure an adequate service with fixed capacity and fair pricing if it is considered vital for the economic development of a region (Graham, 1998).

6.4.2 General economic regulation

Apart from the obvious influence of air transport liberalization, the relationship between air passenger transport and economic development is also shaped by the way countries regulate their economies. In addition, also supranational institutions such as the IMF and the WTO, and regional economic organizations such as the EU, ASEAN or the NAFTA and other major governance institutions are important. Chapter 4, for instance, did not only emphasize the importance of liberal air transport policies, but also open trade regimes to facilate the translation of passenger flows into goods flows and the reverse. Dicken (2011: 171) illustrates this by stating that '*an increased facility to transcend geographical distance made possible by transportation and communication technologies is of little use if there are political barriers to such movement*'. Poole (2013) adds that '*over the last half-century, tariffs and non-tariff barriers to international trade have fallen considerably around the world as countries join regional and multilateral trading agreements; yet substantial barriers still exist'*. This plethora of regulations and barriers have made the articulations of the air transport-economic development relationship varied and dispersed.

This is expressed within countries and their urban regions, which is already discussed in 6.3.3 in the shape of the 'institutional and political conditions', and illustrated with the state-managed economy of China in Chapter 3. Also Graham (1998) indicates that the contribution of air transport to regional economic development in the EU can only be understood within the wider context of the EU's cohesion policy.

In fact, firms are still tied to and grounded in their specific locations: even transnational companies with their global production networks, which are geographically dispersed across national boundaries, are deeply influenced by the concrete socio-political, institutional and cultural contexts within which they are embedded, often expressed through the national state (Dicken, 2011). It was argued in 6.3.3 that companies are inclined to invest in those regions where there are less costs, which can for example depend on the monetary and fiscal policies countries or regions apply. A

concrete example is the tax level, which is a key topic for businesses evaluating the attractiveness of a location. A lower tax burden attracts new companies to a location and provides an incentive for existing companies to stay (ESPON, 2013). However, more tangible, and extremely relevant for the relationship between air transport and economic development are the *physical infrastructures* that national economies provide -roads, railways, airports- through public investments (Dicken, 2011). In Chapter 5, it was suggested that additional air passenger traffic -mainly through LCCs- to European peripheral regions could stimulate employment in those regions. However, this is of course impossible without the provision of adequate airport infrastructure, which is often done through public aid (EC, 2014)[47].

Hence, increased interconnectedness, through flows of people, trade and FDI are still influenced by the regulatory context, despite a movement towards liberalization. This context should be taken into account when assessing the interaction between air passenger transport and the different aspects of economic development.

6.5 Critical reflections on the data and methods, and avenues for further research

6.5.1 Data

In this dissertation, air passenger transport and economic development were the two main variables that needed to be quantified. This always brings a level of uncertainty, as these variables are often represented by 'proxies', which measure their appearance in a specific way. This is particularly the case for economic development.

Here, economic development at the aggregate level was represented by goods trade and income. This latter is in turn measured through GDP per capita, which is an often used proxy for income (Lim, 2006). Regional development was measured through employment, and the presence of the advanced producer services sector. In fact, measures for regional development are often limited to employment, and production and income indicators, although it is essentially a *multidimensional* concept (Baster, 1972; Nijkamp, 1986). Also in this dissertation, most Chapters only measure one aspect of 'economic development', bearing the risk of giving a one-sided view of the variable.

[47] Within the EU single market, public aid measures may not give rise to undue distortions of competition (http://europa.eu/rapid/press-release_MEMO-14-498_en.htm) Since 2014, there are new guidelines for State aid to the aviation industry (http://ec.europa.eu/competition/publications/cpb/2014/002_en.pdf).

However, throughout the entire dissertation this has been compensated by measuring economic development with different indicators and on different levels. Ideally, I could have brought the different indicators for economic development on each studied level together to form a single development measure, but the lack of data availability prevented me from doing so. Measuring economic development at the regional level proved to be particularly challenging, as there is little worldwide comparable data available on, for example, GDP or employment in regions. In Chapter 5, this problem was circumvented by using Eurostat-data. Unfortunately, these kinds of uniform data are not really available in other world parts (except for the US of course), which limits the possibility of studying regional development across a wider geographical scale (e.g. across Asia-Pacific).

Also air passenger transport was measured in different ways. On the aggregate level, it is represented by the volumes of tourists arriving in a country (Chapter 2), and the aggregated number of scheduled seats to a country (Chapter 4). The latter are based on the Official Airline Guides (OAG)-database, which contains information on the number of scheduled seats on direct flights (including passengers on LCC-flights) between airports, and does not make a distinction between leisure and business travel. The disadvantages[48] of the use of this OAG-database were thoroughly discussed in Chapter 4. On the regional level, the incoming volumes of passengers based on the Sabre Airport Data Intelligence (ADI) database is used (Chapter 3). This data source contains information on actual origins and destinations with intermediary stops (contrary to OAG) and comprises information on LCC-flights as well. One major disadvantage is that, although information is given on cabin class and air fares, no reliable distinction between business and leisure travel can be made. The latter could have enriched the findings in Chapter 4. Another disadvantage concerns the limited historical time span: the database only goes back to 2002. Chapter 5 uses data that express the total passenger volumes embarked and disembarked at the airport level, but these were aggregated to the NUTS2-level prior to our analysis.

I believe that there are two main limitations of the passenger data used in the various analyses in this dissertation. The first limitation is that the data are restricted to passenger volumes. Although these are useful to measure the importance of air passenger transport in regions and countries, I acknowledge that in certain chapters other measures might have been more relevant. Chapter 3 in particular, in which I measured airline connectivity in the different metropolitan regions by using origin-destination passenger numbers, would have benefited from a simple measure of connectivity, such as the number of direct connections to and from an airport. Other more complex connectivity

[48] The two most reported disadvantages are the recording of direct flights instead of origin-destination flights, and use of scheduled seats instead of actual passengers. For other disadvantages, readers are referred to the work of Derudder and Witlox (2005) and Devriendt et al. (2006).

measures combine information on the number of destinations served, the frequency of service, the number of seats per flight, and the size of the destination airport (see Pearce, 2007). Veldhuis (1997) uses connectivity matrices that combine quantitative and qualitative factors. In summary, measuring connectivity (in terms of connections) instead of passenger volume would have better reflected the accessibility of a region to national and international markets (Burghouwt and Redondi, 2013; Perovic, 2013), which was of prime importance in this Chapter.

The second limitation is the fact that in three of the four chapters no distinction is made between business and leisure travel. In Chapter 4, for example, where the causal relationships between air passenger transport and goods trade were investigated, this was a possible source of inaccuracy for detecting causal relations. The example of the Australia-New Zealand was already discussed in section 6.3.1: a large part of the total volume of air passengers between these countries travels because of non-business reasons (e.g. encouraged by the terms of the Trans-Tasman Agreement of 1973). Because the research did not focus on business travel separately, the chance of detection of a causal relation -if present- is smaller. However, this does not necessarily pose a problem, as Poole (2013), reveals that both business and leisure travel have strong positive associations with exports from the United States. Also in Chapter 5, it would have been interesting to discern business from leisure travel in order to make a distinction between the influence of air passenger transport on employment in manufacturing and services, and the influence of these different sectors on air passenger transport. For example, a geographical link was found between air transport and employment in the services sector (which also contained employment in the tourism sector) in the Mediterranean touristic regions, but I guess even more -or stronger- links would have been found if leisure travel would have been studied separately.

6.5.2 Methodology

Two sorts of analyses were used here: multiple regression analysis and heterogeneous Granger causality analysis. The first mainly indicates significant associations, while the second disentangles the causality in the relationship between economic development and air passenger transport. This causality is based on the concept of the precedence of phenomena: air transport 'causes' employment if it significantly precedes employment and vice versa. The logic behind this is that a 'cause' can chronologically not follow the 'effect'. In this context, it should be perceived as indicative rather than confirmatory (Mukkala and Tervo, 2013). This causality concept gives more insight into the mutual link between air passenger transport and economic development than simple contemporaneous association (Geweke, 1984), wich was already discussed in detail in Chapter 4. Although it is a useful tool, its bivariate nature could pose a limitation. This may produce misleading

results when other relevant variables influencing the bilateral relationship between economic development and air transport are omitted (Lütkepohl, 1982; Mukkala and Tervo, 2013). In particular, if the obtained result would be that two variables 'cause' each other, it could be that it is rather the omitted variable that drives both and there is no actual causality between transport and development. However, the literature indicates that there is a strong link between air passenger transport and economic development, and Chapters 4 and 5 detected strong correlations between the used economic development variable and air passenger transport variable. Because this is seen as one of the assumptions for the bivariate Granger analysis to be reliable, the possible disadvantage of bivariate analysis is put into perspective. Nevertheless, adding additional variables to the analysis would have enriched the analyses in the sense that more possible nuances could have emerged among the results. For example, adding other transport variables (e.g. rail and road) in Chapter 5 would have shown the broader picture of, and the particular contribution of air transport to, the influence of transport as a whole on economic development. Alternatively, adding a variable such as GDP or GDP per capita in Chapter 4 would have allowed for controlling for the economic conditions in each country, and would have given more power to acknowledge the economic development levels of Asia-Pacific countries as an explaining factor for the differences in trade and air passenger transport relationships among them. However, I am convinced that the end results of the analyses would not have changed dramatically.

I think the main value of the performed analyses from a societal point of view stems from the ability of heterogeneous TSCS-Granger analysis to distinguish spatial differences in the relationship between air passenger transport and economic development at the different levels and to reveal certain patterns (e.g. in Chapter 5) in the relationship. This allows formulating some of the main additional factors that influence the relationship between air passenger transport and economic development (such as the regulatory and economic context). Above all, the methodology empirically shows that air transport is not always a driver for economic development, which is often misperceived by national and regional governments.

6.5.3 Avenues for further research

A first avenue for further research is methodological and can be tied to the abovementioned bivariate character of Granger causality. The use of vector autoregressive (VAR) modelling (Sargent, 1979; Sims, 1980) can perhaps tackle this issue, as it extends the bivariate nature of the Granger model to a multivariate framework, allowing to integrate additional variables (such as a measure of global integration, or air transport liberalization) that might impose on the relationship, and in this

way limiting the mentioned possible spurious correlations (Stern, 1993). It would also allow to acknowledge the importance of those contextual factors with more statistical certainty.

Other avenues for further research are associated with the data-limitations. First, the analyses were performed with yearly data, which can mask part of the variance in the relationship between air passenger transport and economic development. For instance, by using Granger causality with yearly data, causes and effects that occur in the same year are not recorded. The focus on yearly data in this dissertation was mainly due to the limited availability of international comparable data, but a search for quarterly data (e.g. on a smaller scale) could provide a possible answer to this limitation. Second, future analyses could make use of air passenger transport data that distinguish between business and leisure travel. In this way, the potential differential cause on and effect of economic development can be captured, which was already mentioned in 6.4.2. Third, instead of relying solely on passenger volumes, future research should also consider using a measure of connectivity to represent the accessibility of a region, especially when relating to accessibility and attractiveness of regions for companies that rely heavily on national and international contacts. Fourth, more attention could be given to the delineation of the cathment areas of airports (Lieshout, 2012). In Chapters 3 and 5, different catchment areas were used: metropolitan statistical regions and NUTS2-regions respectively. More accurate and airport-specific catchment areas could better estimate the catalytic effects of air passenger transport. However, it would be very difficult to collect the economic development-indicators for these diverse catchment areas, as those indicators are usually only collected on the level of statistical areas (e.g. Metropolitan Statistical Areas in the US, and NUTS-regions in Europe).

Still other possibilities are asociated with some of the specific processes that underly the relationship between air passenger transport and economic development, and that could not be treated separately in the large-scale quantitative research that constitutes this dissertation. A case in point would be the seemingly stronger link between the services industry and air passenger transport, which is indicated throughout literature (e.g. Brueckner, 2003; Liu et al., 2006), and emphasized in Chapters 3 and 5. In order to reveal the articulations of this link, more qualitative -but also quantitative- research can be performed in order to investigate why air passenger transport is particularly important for the services sector (Faulconbridge et al., 2009; Jones, 2007), or when the specific need for face-to-face contact through air travel arises (e.g. Denstadli et al., 2013; Lu and Peeta, 2009; Storper and Venables, 2004). Alternatively, more qualitative research could be performed on the detection of the 'appropriate' time lag between cause and effect in the Granger studies in Chapters 4 and 5. The time lags in these Chapters were based on a combination of

statistical criteria and 'best practice'. Case studies, where the particular reaction patterns of economic development (represented by e.g. additional trade or employment in a region) on changes in air pasenger transport (represented by e.g. new links to an airport) and *vice versa* are monitored, could provide insight in these relationships in order to determine the appropriate time lag more in a more consistent and accurate way.

Although the relationship between air passenger transport and economic development is often touched upon in scientific and -even more- in the popular press, this dissertation has shown that still much research can be performed on the geographical dimensions and expressions of this relationship, and on the way these can be measured. This work has equally shown that commenting on the general relationship is difficult, because it is intertwined by other influencing factors, such as the regulatory context, but also fuel prices, and technological changes.

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DUTCH SUMMARY

Doelstelling

Dit doctoraatsonderzoek levert een bijdrage aan het lopende onderzoek dat de complexe en wederkerige relaties tussen de passagiersluchtvaart en economische ontwikkeling bestudeert. Met de huidige globalisatieprocessen en liberalisatie van zowel luchtvaarttransport als de wereldeconomie als achtergrond, worden voornoemde relaties benaderd vanuit verschillende ruimtelijke invalshoeken en met verscheidene kwantitieve technieken. Het hoofddoel is dus niet enkel om de algemene interactie tussen luchtvaarttransport en economische ontwikkeling beter te begrijpen, maar vooral om meer inzicht te krijgen in de regionale articulaties van deze interactie. De gebruikte methodologieën variëren van standaard regressie-analyse om de algemene interactie na te gaan tot de meer geavanceerde econometrische Granger causaliteitsanalyse, die aangewend wordt om de wederzijdse causaliteit tussen luchtvaarttransport en economische ontwikkeling te onderzoeken. In het onderzoek worden vier algemene onderzoeksdoelen naar voor geschoven: (1) het onderscheiden van de meest belangrijke determinanten, en hun respectievelijke belang, voor passagiersluchtvaart, (2) bestuderen hoe, en in welke mate, passagiersluchtvaart economische ontwikkeling bevordert, (3) de causaliteit tussen passagiersluchtvaart en economische ontwikkeling onderzoeken, en (4) enkele tussenliggende factoren in deze wederzijdse relatie bepalen en bestuderen. Deze vier onderzoeksdoelen worden in elk hoofdstuk vertaald naar een reeks meer specifieke onderzoeksvragen.

De algemene context

De passagiersluchtvaart heeft vanaf de tweede helft van de 20ste eeuw een enorme expansie gekend. Vier processen hebben daartoe bijgedragen: economische ontwikkeling zelf, economische integratie, de liberalisatie van de luchtvaartsector en technologische innovaties binnen deze sector.

Economische ontwikkeling kan gedefinieerd worden als het proces dat de groei en de herstructurering van een economie beïnvloedt en zo het economische welzijn van een gemeenschap bepaalt (IEDC, s.d.). Economische ontwikkeling hangt nauw samen met economische groei, maar verschilt ervan doordat het de structuur van een economie kan veranderen op lange termijn. Economische ontwikkeling kan gemeten worden aan de hand van BNP (Bruto Nationaal Product) per capita, en een groei in BNP per capita leidt theoretische gezien tot meer vraag naar

luchvaarttransport. Meer passagiersluchtvaart beïnvloedt op haar beurt dan weer economische ontwikkeling en economische groei, hetgeen centraal staat in deze dissertatie. Veel auteurs, zoals Cidell (2006) beweren echter dat economische ingratie, meer nog dan economische groei, een invloed heeft (gehad) op de passagiersluchtvaart. Deze economische integratie en verwevenheid van nationale, regionale en lokale economieën gaan samen met een steeds groeiende en intenser wordende stroom van goederen, diensten, technologieën, mensen en kapitaal over grenzen heen (Dicken, 2011). Vooral de groei in multinationale ondernemingen (MNO) en bijhorende groei in handel en buitenlandse directe investeringen hebben geleid tot meer luchtvaarttransport, maar worden er tevens door vergemakkelijkt. Dit kon enkel gebeuren door veranderingen in de regulering van de economie: handels-en investeringsbarrières werden verlaagd, net zoals de liberalisatie van de luchtvaartsector werd doorgevoerd. Deze liberalisatie begon in 1978 in de Verenigde Staten van Amerika en verspreidde zich daarna geleidelijk over de andere werelddelen (Budd en Goetz, 2014). Algemene resultaten van deze liberalisatie waren het ontstaan van competitie op nationale en internationale routes, het ontstaan van internationale allianties, het dalen van ticketprijzen en de groeiende vraag naar luchtvaarttransport, alhoewel grote onderlinge verschillen bestaan op routes (Button, 2009). De graad van liberalisatie verschilt ook sterk wereldwijd, en is het meest geavanceerd binnen de Verenigde Staten van Amerika en de Europese Unie. In andere werelddelen en ook op internationaal vlak is liberalisatie nog steeds beperkt. De gevolgen van deze liberalisatie variëren bijgevolg ruimtelijk sterk, waardoor ook de interactie tussen passagiersluchtvaart en economische ontwikkeling zich op verschillende manieren manifesteert in en tussen de verschillende regio's (Debbage, 2014). Als laatste is er de technologische ontwikkelingen, die het mogelijk hebben gemaakt om steeds meer mensen te vervoeren over grotere afstanden en tegen lagere prijzen en zo bijgedragen hebben aan de toenemende integratie en connecties tussen landen en regio's (Bowen, 2010).

Deze vier processen vormen het kader waarin we de link tussen passagiersluchtvaart en economische ontwikkeling moeten zien: de globale economie wordt gekenmerkt door integratie en schaalvergroting, terwijl liberalisatie van de luchtvaartsector en technologische innovaties de realisatie ervan toelaten.

Deze link wordt in deze disseratie op twee verschillende schaalniveaus onderzocht: het geaggregeerde en het regionale niveau. Op het geaggregeerde niveau zijn er naast populatie drie andere krachten die de vraag naar passagiersluchtvaart sturen: (i) macro-economische krachten zoals BNP, handel, inkomen en werkgelegenheid (Gillen, 2010; Graham, 2006; Rimmer, 2000; Tretheway en Oum, 1992), (ii) transportkosten die bepaald worden door onder andere afstand, brandstofprijzen

en liberalisatie (Dobruszkes, 2009; Ringbeck et al., 2009), (iii) en een reeks additionele factoren zoals cultuur en migratie (Lim, 1997). De passagiersluchtvaart beïnvloedt ook de globale en nationale economieën en maakt de verspreiding van goederen, mensen en kennis over landsgrenzen heen mogelijk, wat het economische welzijn van individuen, en het BNP en de productiviteit in landen verhoogt. Ook op het regionale niveau is er een sterke link tussen de passagiersluchtvaart en regionale ontwikkeling en oefent luchtvaarttransport directe (onmiddelijke effecten, vaak op de luchthavens zelf), indirecte (in de productieketen), geïnduceerde (secundaire effecten) en catalytische impacten uit. Vooral deze laatste soort impact wordt benadrukt in dit onderzoek en kan gedefinieerd worden als de invloed van de beschikbaarheid van luchtvaartdiensten op de wijdere omgeving van luchthavens, zoals de invloed op het BNP van of werkgelegenheid en toerisme in een regio (Nijkamp, 1986). Passagiersluchtvaart moet dus gezien worden als een stimulator, en geen garantie, voor economische ontwikkeling. Deze effecten hebben op hun beurt dan weer een grote invloed op de vraag naar luchtvaarttransport in de regio's: regio's met een hoger BNP worden bijvoorbeeld vaker gerelateerd met een hogere transportvraag (Dobruszkes, 2011).

Uit onderzoek van de literatuur op zowel het geaggregeerde als het regionale niveau komen enkele hiaten in het huidige onderzoek naar de link tussen passagiersluchtvaart en economische ontwikkeling aan het licht. Ten eerste is er veel onderzoek naar deze associatie, maar wordt weinig bewijskracht geleverd voor een *causaliteitsrelatie* tussen deze twee variabelen. Ten tweede beperkt veel van de literatuur zich voornamelijk tot Noord-Amerika en in mindere mate ook tot Europa (e.g. Brueckner, 2003; Debbage, 1999; Irwin en Kasarda, 1991), en worden andere werelddelen 'vergeten'. Deze leemtes in het onderzoek worden in het tweede tot en met het vijfde hoofdstuk van dit doctoraatsproefschrift aangekaart.

Overzicht van het onderzoek en voornaamste bevindingen

De dissertatie bestaat in totaal uit zes hoofdstukken, waarbij de vier voornoemde hoofdstukken geconceptualiseerd zijn als artikels in wetenschappelijke tijdschriften. Elk van deze vier hoofdstukken beantwoorden enkele specifieke onderzoeksvragen, die voorvloeien uit de vier onderzoeksobjectieven die daarnet werden aangehaald. Het eerste hoofdstuk vormt de inleiding, terwijl het zesde hoofdstuk in dit boek zich baseert op de resultaten uit de vier hoofdstukken om antwoord te bieden op de geformuleerde onderzoeksobjectieven. Verder is er in dit laatste hoofdstuk ook een kritische reflectie over de gebruikte data en methoden en worden enkele trajecten voor verder onderzoek aangeduid.

In het tweede hoofdstuk worden de dimensies van enkele van de belangrijkste indicatoren voor de vraag naar toerisme vanuit Aziatisch-Pacifische landen naar Australië onderzocht en gekwantificeerd. Dit gebeurt aan de hand van vijf meervoudige regressie-analyses voor de periode 1990-2010, zodat veranderingen in het absolute en relatieve belang van deze indicatoren gevolgd kunnen worden. De vraag naar toerisme is onlosmakelijk verbonden met de meer algemene vraag naar luchtvaarttransport (Duval, 2013; Graham, 2010). Dit is zeker het geval voor Australië, aangezien 99% van de internationale bezoekers per vliegtuig aankomen. In dit hoofdstuk worden het inkomen, dat weergegeven wordt door BNP per capita, als een indicator voor economische ontwikkeling beschouwd en wordt volgende onderzoeksvraag gesteld: *Is het BNP per capita een determinant voor de Aziatisch-Pacifische vraag naar toerisme naar Australië?* Ook afstand, een indicator voor de kosten van luchtvaarttransport, en populatiegrootte, een controle variabele, worden in beschouwing genomen. Luchtvaartkosten worden op hun beurt bepaald door de graad van liberalisatie van de passagiersluchtvaart en door de brandstofprijzen. Zo kunnen de volgende onderzoeksvragen gesteld worden: *Welke invloed hebben liberalisatie van de passagiersluchtvaart en olieprijzen op de vraag naar passagiersluchtvaart? Wat is hun invloed op de link tussen passagiersluchtvaart en economische ontwikkeling?* Dit hoofdstuk heeft als voornaamste conclusies dat het inkomensniveau van een land wel degelijk bepalend is voor de vraag naar passagiersluchtvaart. Deze vraag wordt echter ook positief bepaald door de toenemende graad van liberalisatie in de luchtvaartsector en negatief beïnvloed door stijgende brandstofprijzen. Het delicate evenwicht tussen deze twee laatste factoren zijn bepalend voor de verdere groei van Aziatisch-Pacifische reispatronen en toerisme naar Australië, omdat het niet zo zeker is dat verdere groei in inkomens de additionele vraag naar luchtvaart zal blijven sturen.

In het derde hoofdstuk wordt de relatie bekeken vanuit regionaal niveau en wordt de catalytische invloed van de passagiersluchtvaart onderzocht op de aanwezigheid van een bepaald soort diensten (geavanceerde productiediensten) (Taylor et al., 2007). Daarbij wordt opnieuw gebruik gemaakt van een meervoudige regressieanalyse die de invloed van passagiersvolumes, populatie, stedelijke dominantie en nationale regulatie op de aanwezigheid van deze diensten modelleert. De onderzoeksvraag *'in welke mate beïnvloedt passagiersluchtvaart de aanwezigheid van geavanceerde productiediensten in urbane regio's?* staat hier centraal. Een belangrijk resultaat is dat regio's die beter geconnecteerd zijn over het algemeen gekenmerkt worden door meer van deze kennisintensieve diensten. Deze relatie is echter ruimtelijk gedifferentieerd en hangt af van nationale en regionale omstandigheden.

Het vierde hoofdstuk focust op de causale relatie tussen internationale passagiersluchtvaart en handel van goederen tussen Aziatisch-Pacifische landen onderling. Belangrijke onderzoeksvragen zijn: *Leidt passagiersluchtvaarttransport tot meer handel tussen landen? Leidt meer handel eerder tot meer transport? Of is deze causale relatie toch wederzijds?* De methode van heterogene TSCS (Time Series Cross Section) Granger causaliteit wordt aangewend, zodat de variaties in de transport-handel relatie beschreven kunnen worden. Daaruit volgt een vierde onderzoeksvraag: *Is Granger causaliteitsanalyse een geschikte methode om de causaliteit tussen luchtvaarttransport en handel te onderzoeken?* De resultaten bewijzen het nut van Granger analyse en tonen een gevarieerd patroon: luchtvaarttransport en handel leiden niet noodzakelijk naar elkaar: hun wederzijdse relatie is afhankelijk van een aantal tussenliggende factoren zoals het economische ontwikkelingsniveau van de landen, en de mate van liberalisatie in de luchtvaartsector.

In het vijfde hoofdstuk wordt heterogene TSCS Granger analyse gebruikt om de causale relatie tussen passagiersluchtvaartdiensten en werkgelegenheid in Europese NUTS2-regio's tussen 2001 en 2011 te bestuderen. Volgende onderzoeksvragen komen aan bod: *Leidt passagiersluchtvaart tot meer werkgelegenheid in Europese regio's? Ligt die werkgelegenheid ook aan de basis van meer luchtvaartverkeer? Verschilt deze link naargelang werkgelegenheid in de industriële sector en dienstensector?* Opnieuw zijn de resultaten divers over de verschillende regio's, waardoor de rol van passagiersluchtvaart als stimulator (in plaats van garantie) voor economische ontwikkeling wordt bevestigd. Vooral de relatie tussen de luchtvaartsector en werkgelegenheid in de dienstensector blijkt sterk (Brueckner, 2003). De relatie met de industriële sector is minder sterk, maar niettemin toch aanwezig. Ook hier zijn het ontwikkelingsniveau van de regio's en de graad van luchtvaartliberalisatie bepalende factoren voor de onderlinge relatie tussen transport en ontwikkeling.

Als samenvattend resultaat kan aangehaald worden dat de relatie tussen passagiersluchtvaart en economische ontwikkeling heel heterogeen is en beïnvloed wordt door tal van factoren. Op basis van de resultaten wordt in deze dissertatie passagiersluchtvaart dan ook gezien als een 'INUS-conditie' (Mackie, 1980). Dit houdt in dat passagiersluchtvaart een 'onvoldoende maar niet-redundant deel is van een onnodige maar voldoende' conditie (Verweij en Gerrits, 2013: *'an insufficient but non-redundent part of an unnecessary but sufficient' condition*). Dit betekent dat passagiersluchtvaart alleen onvoldoende is om economische ontwikkeling te induceren, omdat er aan andere voorwaarden voldaan moet zijn, zoals de regulerende context en een voldoende groot economische draagvlak. Op zijn beurt is passagiersluchtvaart dan weer niet noodzakelijk omdat ook landtransport samen met de regulerende en economische context economische ontwikkeling kunnen veroorzaken;

alhoewel luchtvaarttransport uiteraard wel economische ontwikkeling teweegbrengt in combinatie met de juiste regulerende en economische context. Die regulerende context verwijst ondermeer naar de liberalisering van de luchtvaartsector en de openheid van nationale economische regimes. De economische context duidt ondermeer het BNP aan, of de graad van tewerkstelling.

Beperkingen van het onderzoek en mogelijkheden tot verder onderzoek

In dit grootschalig onderzoek was het uiteraard nodig om de verschillende articulaties van passagiersluchtvaart en vooral economische ontwikkeling kwantitatief voor te stellen. Hierbij moeten twee kanttekeningen gemaakt worden. Ten eerste wordt passagiersluchtvaart in deze dissertatie voorgesteld door passagiersvolumes, waarbij de data afkomstig zijn van verschillende databanken die grotendeels een beperking hebben: er wordt, met uitzondering van hoofdstuk 2, geen onderscheid gemaakt tussen vrijetijdsreizen en zakenreizen. Daarbij komt dat passagiersvolume niet altijd de beste maat is om connectiviteit naar en toegankelijkheid van regio's weer te geven. Vooral in hoofdstuk 3, waren andere connectiviteitsmaten allerhande (zoals in Pearce (2007), Burghouwt en Redondi, 2013) beter geweest. Een tweede beperking is de kwantificering van economische ontwikkeling, dat eigenlijk een multidimensioneel concept is, maar in de verschillende hoofdstukken vaak maar door één variabele voorgesteld wordt. Doordat deze variabele echter verschilt van hoofdstuk tot hoofdstuk, wordt deze beperking gedeeltelijk geneutraliseerd. Ook de geburikte methodes in dit onderzoek hebben uiteraard voor-en nadelen, waarbij de voornaamste kritiek op Granger causaliteit zijn bivariate natuur is, waardoor andere factoren die de relatie tussen passagiersluchtvaart en economische ontwikkeling bepalen, niet rechtstreeks in de analyse worden opgenomen. Toekomstig onderzoek zou vector autoregressive (VAR)-analyse (Sargent, 1979) kunnen aanwenden om een multivariaat kader te kunnen modelleren en zo andere factoren ook in acht nemen. Tevens zouden de bevindingen in het onderzoek (bijvoorbeeld de sterkere link tussen luchtvaarttransport en de dienstensector) verder conceptueel uitgewerkt kunnen worden.

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