An economic monitor for air cargo at Schiphol

Developing a method to estimate employment and added value on a yearly basis, with an indication for 2010 and 2015

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Abstract:

Schiphol is an important logistical gateway to the Netherlands which increases the connectivity of the Netherlands. The economic contribution of Schiphol as a whole has recently been estimated in terms of employment and added value. However, the effect of the air cargo sector is unknown. A yearly study on the added value and employment of air cargo provides insights on the developments in this sector. This research therefore focuses on developing a methodology to estimate the economic contribution of air cargo on a yearly basis. Personal research together with methods of three relevant studies have been combined to a new basic methodology which is viable for this estimation.

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1   Introduction

1.1

The trade of goods is increasingly global by lower shipping prices and better connections. Global trade has experienced significant growth since the 1950s and has tripled as share of output. Within the global trade, air cargo is estimated to be accountable for 35% of trade in value, even though it moves below 1% in volume (Shepherd, Shingal and Raj, 2016). In the Netherlands, the most important freight connection is Amsterdam Schiphol Airport, the oldest and main international airport in the country. It has an important hub function for air cargo and within Europe it is one of the busiest airports in terms of tonnage of freight. In 2016, 1.662 million tons of airfreight were moved through Schiphol and thereby it is the third largest airport in Europe (Royal Schiphol Group, 2016). Schiphol creates value for society and the economy by connecting the Netherlands (Royal Schiphol Group, 2016) and therefore holds an important place in the Dutch economy.

With the recent development of Schiphol reaching its maximum capacity of 500.000 aircraft movements per year in 2017, the future growth is uncertain. The Dutch government is expected to follow the Aldersakoord, which set the maximum of 500.000 aircraft movements until 2020. As a consequence, Schiphol is not able to grow and meet demand in the near future. The impact of this development is not evenly distributed between airfreight and passengers, in November and December 2017 there has been a decline of 12% in full freighter flights due to the slot restrictions (Stekelenburg, 2017). Twice a year, slots (the right to land or take of at a certain time) are reallocated by Slot Coordination Committee Netherlands (SCCN). An airline is allowed to keep a slot when it is used at least 80% of the time (EU ruling), otherwise the slot will be reallocated by SCCN. The cargo airlines are more likely to lose a slot because of seasonality and delays caused by late delivery of cargo by its customers. Accordingly, the cargo airlines have lost relatively more slots and did not receive as many new slots with the reallocation, which explains the decline in full freighter flights. This development exemplifies the relevance of a yearly monitor with a focus on airfreight; with a yearly estimation of value added, the impact of such an event to the Dutch economy can be observed through time.

Airfreight considers a significant part of the total aviation activities at Schiphol and delivers an important contribution to the development of the regional and Dutch economy (Royal Schiphol Group, 2017). However, the total size of this contribution to the economy is unknown in terms of economic impact. The tonnage of freight and flight movements are the only yearly statistics available that provide an indication of the growth and size of airfreight. These indicators are currently the most used to compare airports in terms of size. More important is the economic impact. As De Langen (2004) has stated, added value is a more relevant variable than tonnage to measure the performance of a seaport. Therefore, a yearly

monitor for the Dutch seaports, Havenmonitor, was introduced in 2002 that includes economic value added as a performance indicator. This indicator is equally relevant for airports; a ton of flowers transported by air makes a different contribution to the economy than a ton of pharmaceuticals. The economic impact of air cargo at Schiphol has been estimated for 2003 by Districon and Ecorys (2005). After this report, no further estimations have been made considering air cargo at Schiphol. Recently in 2015, Decisio estimated the total economic impact of Schiphol on behalf of the Dutch Ministry of Infrastructure and Environment. However, the distinction between passengers and airfreight is not made in this estimation. Therefore, the current contribution to the economy of air cargo at Schiphol is unknown and the differences over time cannot be observed. A solution would be a product like Havenmonitor for airfreight, a yearly monitor of the added value to the Dutch economy of airfreight would provide a valuable source of information to the government, airport and airfreight related parties. It would provide an overview of developments at the airports and in the airport regions through time. This need for a monitor occurred within Air Cargo Netherlands (the branch organization of airfreight), partly caused by the development in slot restrictions at Schiphol.

1.2   Economic impact analysis with Input-output model

A common method to estimate added value of a sector or region is the input-output model. The national accounts (input-output tables of CBS) provide an overview of the interdependencies of sectors in terms of production value. By using related employment of the sector or region of interest as input and the method of Wassily Leontief (1965) with the input-output tables, the direct and indirect added value and employment can be estimated. This method is often used for economic impact studies such as the yearly Havenmonitor (2002-2018). Therefore, this method is deemed as most relevant as basis for this study. In addition, it has previously been used for air cargo in the Netherlands in a report of Districon and Ecorys (2005). However, this analysis is dated and used a data source that is not available anymore and therefore another approach is needed. Moreover, the more recent Dutch economic impact studies of Havenmonitor and Decisio (2015) improved the adjustments for employment input data compared to the report of Districon and Ecorys (2005) for more accurate results. The previous economic impact studies can function as a guideline to set up a yearly economic monitor of air cargo.

1.3   Research Question

This leads to the following research question:

How can the economic impact of the cargo function of an airport be estimated on a yearly basis?

To answer the research question, the following sub questions are posed:

1. Which methods are used for economic impact analyses?
2. Which relevant applications of the Input-Output model exist on air cargo or similar industries?
3. Which activities are (partly) directly related to air cargo?
4. How should the employment of (partly) directly related activities be included into the estimation?
5. Which corrections should be applied for double counted employment?
6. How robust are the outcomes for inaccuracy of estimations and data?

1.4 Delimitation

The focus of this research is on the basis of the methodology to estimate the added value of air cargo activities to the Dutch economy. Therefore, due to time constraints, only activities related to air cargo at Schiphol are included, activities related to other airports than Schiphol are not included in this research. The intention is to include all air cargo activities in the Netherlands into the added value estimation of the yearly economic monitor at a later stage by extending this methodology. Furthermore, since the focus is on the basis, only activities directly related to the supply chain of air cargo are included, this means a firm has to have a vital role in the supply chain. Activities such as European Distribution Centres or the Flower Auction are therefore not included.

Since the estimation concerns added value to the Dutch economy, only activities registered in the Netherlands are included. Activities registered in other countries only (directly) contribute to their Gross domestic product (GDP).

Furthermore, the estimation only includes the direct and indirect contribution of air cargo. The catalytic or dynamic effect is not included because this effect is hard to quantify and methodologies differ significantly which lead to significant different outcomes. Decisio (2015) studied the literature on methodologies to estimate the catalytic effects and the difference between the lowest yielding and highest yielding result had a difference of factor seven. This exemplifies the inaccuracy of (some of) these methods. In addition, the induced effect is not included since the employees would otherwise likely have a similar job with similar spending. Therefore, this contribution cannot fully be attributed to air cargo activities. This is in line with Havenmonitor and Decisio (2015).

To provide a first indication of the value of air cargo at Schiphol, the methodology is used to calculate the direct and indirect added value and employment for 2010 and 2015.

1.4.1 Data restrictions

Since this concerns a master thesis project, there is limited time and a pre-selection is needed in the data selection. Therefore, not all employment data of all sectors could be selected in the LISA database. This means only relevant activities in the sectors 'Transportation on land', 'Air transport', 'Warehousing and services for transport', 'Mail and

couriers' and 'Public organizations, government and mandatory social insurances' can be included in the estimation. Therefore, it is possible that some air cargo related activities are not present in the pre-selected dataset by imperfections of the dataset (for instance a wrong sector classification). These activities that should be included and are already excluded in the pre-selection, are therefore not taken into account in the estimation.

1.5 Structure

The remaining of this paper is structured as follows:

1. The paper starts with a literature review on the I/O model and the earlier applications of this model on the air cargo sector and similar industries.
2. The methodology to estimate the direct and indirect added value and employment is explained. This includes an explanation of how and which activities are included in the estimation and which correction is performed for double counts.
3. The datasets and data selection are discussed.
4. In the results the estimation of 2010 and 2015 are presented and reviewed and a sensitivity analysis is performed to check for robustness of the estimations.
5. The research is concluded and the possibilities for future research are explained.

2   Previous Literature

In this section relevant previous literature is discussed to increase understanding of the economic impact analysis with the Input-Output model and its applications. First, economic impact analysis and the input output model with its use and limitations are explained. Secondly, the relevant previous applications of this model on air cargo or similar topics are analysed and discussed. Lastly, the previous literature is summarized.

2.1   Economic impact analysis and the I/O model

2.1.1   Economic impact analysis

An economic impact analysis is a method to estimate economic impact of an event in a specific area on the economy. It is mostly used to estimate the effect on the economy of a policy measure or another development that impacts a certain sector or region. However, this method can also be used to analyse the current contribution of a specific region or sector when there is adequately corrected for double counted employment. The outputs of the analysis can be business output, value added or jobs. For this study, value added and jobs are most relevant and comprehendible. Value added is an income effect that essentially is the same as contribution to Gross Domestic Product (GDP) and therefore basically consists of wages and business profit. This is the preferred measure for regional economic activity (Weisbrod, 1997).

The economic impact generally consists of four effects:

-Direct Economic Effects:

The changes in production, added value and employment in directly related local business activity caused by business decisions, policy changes etc.

-Indirect Economic Effects:

The changes in production, added value and employment caused by rounds of spending by the directly related companies at other companies

-Induced Economic Effects

The expenditures of wages of the employees working at the air cargo related companies

-Dynamic or Catalytic Economic Effects

Longer term effects of for example shifts of companies like EDC's that use Schiphol Airport

As explained in the delimitation, only the direct and indirect effect is in the scope of this research. These effects are mostly calculated with the Input-Output model.

2.1.2 I/O model

To measure economic impact, the most common and widely used methods use the I/O model as a basis (AKRF, 2013) (Lynch, 2000), which is derived from the I/O tables. The I/O tables are defined by OECD as follows: "Input-Output Tables describe the sale and purchase relationships between producers and consumers within an economy. They can either show flows of final and intermediate goods and services defined according to industry outputs (*industry × industry* tables) or according to product outputs (*product × product* tables)". Using the inter-industry relations in these tables, Leontief multipliers per industry can be calculated to estimate the indirect effect, a technique created by Wassiliy Leontief (1965). This multiplier uses the (simplified) linear relationship of the I/O model which can be used to estimate the indirect contribution for every euro of production in a sector caused by consumption in other sectors. These multipliers can be translated to employment and added value multipliers and are the basis of the I/O model.

Different forms of the I/O model exist, arguably the most well-known models are RIMS-II, IMPLAN and REMI. These are all models from the United States, based on I/O tables of U.S Department of Commerce, mostly used to assess the economic impact of a public or private project (AKRF, 2013). Firstly, RIMS-II stands for Regional Input-Output Modelling System and is owned by The U.S. Department of Commerce. They compute multipliers based on the I/O tables which can be bought to use for research. Secondly, IMPLAN (Impact Analysis for Planning) is very similar in method, though a modelling system instead of a set of multipliers where the multipliers can be manually applied. IMPLAN is owned by a private organization called The IMPLAN Group. Lastly, REMI (Regional Economic Models, Inc.) is a I/O model with additional econometric equations which has the main advantage that it provides a time dimension. These models however, are focussed solely on the U.S. and something similar is not available in The Netherlands. Therefore, the I/O model has to be calculated manually, without the econometric equations since the time dimension is not relevant for this research.

To estimate the total economic impact with the multipliers of the I/O model, input data is required. Generally, direct related employment is used as input to estimate the total effect. The employment data selection and transformation are a significant part of the process because delimitation is difficult and it is either acquired with a survey which is very time consuming or with a database, which has imperfect sector classifications of companies (for instance not detailed enough or errors in the classification). Therefore, a significant determinant for the specification of the model. When data selection is successful, the employment data can be used as input and translated to other measures like added value using national averages.

2.1.2.1   Limitations of I/O model

The I/O model is a simplified model of reality to estimate the contribution to or effect on the economy. All estimations of the indirect effect made with the model are based on the inter-industry linkages, which are national averages and therefore not always representative for singular cases. In addition, the model assumes the relationship between output of different sectors to be linear. As a consequence, the model has some limitations. First of all, prices are fixed because of the fixed input and output coefficients, which means economies of scale is not possible either. This unrealistic since firms have different methods of production and the ratio would likely change with economies of scale. In addition, substitution is not possible because of this fixed and linear relationship. Lastly, it also makes the assumption that for every extra demand there will be extra supply available. This means that supply is assumed to be fully elastic without any additional costs for the demand side (Havenmonitor, 2006). Therefore, the estimations are a simplified version of reality and the results should be interpreted with care.

2.2   I/O model Air Cargo Applications and other similar topics

In the literature, economic analyses of airports are often performed using the I/O model. Especially in North America many economic impact studies are performed on airports in the United States and Canada. Airport Counsil International – North America collected more than hundred different I/O studies between 2003 and 2016, mostly issued by local government. These studies are either performed with the RIMS-II method or the IMPLAN method and often use survey employment data as input. Since these studies were performed on behalf of the government with commercial models, their methodologies are not discussed extensively, the focus is on the results. More extensive research on their exact methodologies did not yield more results. In Europe, the economic impact studies on airports are rather limited, these mostly concern studies about German, English and Dutch airports. The contribution of the air transport sector is significant. Oxford Economics (2011) estimated the economic impact of the air transport sector in the UK to be 49.6 billion pounds (2010), including the direct, indirect, induced and catalytic effect. In addition, InterVISTAS (2015) performed an economic impact study on the whole air transport sector in Europe and estimated the contribution to GDP to be 247.8 billion euros (2013), including the direct, indirect and induced effect. However, none of these studies make the distinction between the economic impact of air cargo and passengers and none of these studies focus on the Netherlands specifically. The focus on the Netherlands is relevant since, as explained in 2.1.2, the model has to be calculated manually and input data is a significant determinant of the specification of the economic impact model. Types of datasets and data availability differs around the world. Therefore, three other economic impact studies are identified as most relevant:

1. The report of Districon and Ecorys (2005) on the economic impact of air cargo; concerns the same topic with the focus on Schiphol
2. the report of Decisio (2015) on the economic impact of Schiphol; concerns Schiphol and has access to the same data sources
3. the yearly study called Havenmonitor on the economic impact of the Dutch port sector; is essentially an example of the aim of this study to set up a yearly economic monitor. In addition, it considers many similar activities due to the cargo focus and has access to the same data sources.

These studies are discussed in more detail.

2.2.1 Air Cargo Schiphol

The report of Districon and Ecorys (2005) is the most recent economic impact study on air cargo in the Netherlands. The study was commissioned by the Ministry of Transport and Water Management (currently the Ministry of Infrastructure and Environment). The report describes the nature and size of air cargo, estimates the employment and added value for 2003 and estimates the economic effects of two policy scenarios. In the report the air cargo sector is divided into three groups. The first group, directly bound economic activities considers the activities in the supply chain of air cargo. The second group are the indirectly bound economic activities, which are the suppliers of the companies active in the supply chain and the dynamic effects like EDC's. The last group are the functionally bound activities such as research and education related to air cargo. For every group the employment and added value is determined using mainly employment figures of Regioplan (2003) with some additional estimations as input. Regioplan (2003) provided data of air transport related employment at Schiphol based on surveys without a full distinction between air cargo and passenger related employment. Therefore, this study used estimations for the air cargo related employment. For road transport employment related to air cargo, a different estimation is used. Since most road transport companies are not located in the Schiphol area, these are identified based on tons of cargo transported and the national average of road transport employment per ton of cargo (CBS, 2003). They recognised the need for an upward correction of employment per ton kilometre because of the lower load factors in airport trucking. The contribution in terms of added value and employment is further calculated with input output tables and Leontief multipliers. This resulted in a direct employment of 13600 jobs with an added value of 0.8 billion euros and an indirect employment of 12400 jobs with an added value of 0.7 billion euros.

Overall a solid economic impact study that can be used as guideline for this study. However, this study used Regioplan (2003) data as input which is not available anymore. Therefore, other data sources are needed which complicate the process and which requires other data selection methods. In addition, there are points of criticism. First of all, the estimations of air cargo related employment can be considered too general; the air cargo related employment of 'Airplane bound employment' is estimated with an accounting

measure called 'Work Load Unit' where one passenger equals 100kg of air cargo, which is mainly based on weight. For 'Other air transport related employment', the air cargo related employment is estimated to be 25 percent without any further explanation. Secondly, the study uses one single multiplier to estimate indirect added value and employment, this multiplier is the average of the multipliers of the sector 'Air transport' and the sector 'Transport of goods'. Since the aggregated data is retrieved from Regioplan, the amount of employment per sector qualification is not known. Therefore, the multiplier does not full correspond to the identified employment. In addition, the study does not control for double counted employment that is caused by the use of multipliers. As mentioned, this is necessary in an I/O study when estimating the current situation. Lastly, the road transport related employment is identified based on tons of cargo. Hereby, implicitly the possibly incorrect assumption is made that air cargo trucking has the same average distance per ton as the national average.

2.2.2 Schiphol

The research of Decisio (2015) is the most relevant study of Schiphol in general, since this is the most recent economic impact analysis. The report was commissioned by the Dutch Ministry of Infrastructure and Environment. It demonstrates the economic importance of Schiphol by analysing the direct and indirect economic relations of Schiphol with data from 2013. Hereby, focussing on the economic contribution of air transport activities at Schiphol and related economic activities elsewhere to the Dutch economy. The results provide a recent indication of direct and indirect related employment and added value. Around 65 thousand working people are directly related to air transport activities at Schiphol with an added value of 5,1 billion euros and indirectly 49 thousand working people with an added value of an additional 3,1 billion euros. The estimations are composed by using employment from firm level employment and sector registrations of municipalities as input. The contribution is further calculated with input output tables and Leontief multipliers. The results are corrected for double counted added value and employment by removing the 'first order effect' (explained in 3.3.3). In addition, the importance of the catalytic contribution is stretched as well by discussing previous literature. However, no estimation is made in terms of value or employment since this contribution is hard to quantify; Schiphol is one of the many factors that influences firm's locations and therefore isolating this factor is difficult. Even single companies probably would not be able to quantify the importance of Schiphol, let alone to indicate this for all businesses. This is exemplified by the multipliers for this dynamic effect from the literature, these differ significantly (ranging from 0,5 to 7) (Decisio, 2015).

2.2.3   Dutch Port Sector

The Havenmonitor (2002-2016) is a yearly economic impact study of the Dutch port sector, issued by the Ministry of Infrastructure and Environment and executed by UPT (Urban, Port and Transport) department of Erasmus University. This study provided a yearly estimation of the main port areas in the Netherlands in terms of direct and indirect added value and employment, businesses establishments, business dynamics and private investments. Hereby, focussing on the economic contribution of the Dutch port sector and its development. Activities are included in the estimation based on three dimensions: sectoral delimitation, functional delimitation and geographical delimitation. Therefore, only port related activities within the defined port area are included. As input for the direct effect within the defined port area, the LISA database is used, which consists of business establishments with related employment, location and sector code. Mainly based on location and sector code, business establishments are included. In addition, like Districon and Ecorys (2005) a distinction is made between location bound and non-location bound activities. The non-location bound activities consider not just road transport, but also inland shipping and rail transport. However, the Havenmonitor method to estimate employment is more advanced than Districon and Ecorys (2005). Their method includes the average distance of tons of cargo and therefore arguably yield more reliable results. The contribution in terms of added value and employment is further calculated with input output tables and Leontief multipliers. This resulted in a direct employment of 180 thousand jobs with an added value of 26.4 billion euros and an indirect employment of 177,5 thousand jobs with an added value of 14.8 billion euros for the Dutch port sector in 2016. Their results are corrected for double counted employment and added value per sector. However, this correction only depends on the size of the indirect effect in its own sector; the aggregated Leontief multiplier (the multiplier that estimates the total indirect effect of a specific sector) is divided by the multiplier that estimates the indirect effect within its own sector as correction. Therefore, the correction of the indirect effect is not case specific and a more general measure.

2.3   Summary

For economic impact studies the Input-Output model is a commonly used method to measure total economic impact. The Input-Output model is a method that uses national accounts to calculate multipliers based on inter-industry linkages. These multipliers are used to estimate the additional indirect impact. Here, the input data selection and transformation are a significant part of the process. The employment data selection and transformation together with national averages of added value per employee is used to measure the direct effect, which in turn, is used as input for the I/O model to measure the indirect effect. In the literature, these effects are the most accepted to include in the total economic impact related to a specific event or sector. The analysis does have its limitations due to its simplified assumptions of the real world, which means the results should be

interpreted with care and when a current situation is analysed, a correction for double counts is needed.

This methodology has often been used for economic impact studies of international airports. However, the distinction between air cargo and passengers is not made. In addition, input data selection and transformation are a significant part of the process for the further specification of the Input-Output model. Delimitation of the research in terms of location and activities that should be included is difficult, especially when employment data is acquired with a database which has imperfect sector classifications of companies that are not detailed enough and contain errors. Therefore, the local studies with similar data sources and the focus on air transport or cargo are the most relevant. This concerns the Air cargo study of Districon and Ecorys (2005), Schiphol study of Decisio (2015) and the Havenmonitor study of the Dutch port sector (2002-2016).

The report of Districon and Ecorys (2005) can function as guideline on activities in the air cargo supply chain that should be included. However, this research uses a data source that is not available anymore. Therefore, their data selection method cannot be used. In addition, there are some points of criticism on their method that can be improved. Both Decisio (2015) and Havenmonitor (2002-2016) offer insights for data selection since they use similar datasets as in this research. Moreover, their methods offer improvements for the points of criticism of the report of Districon and Ecorys (2005). The three reports offer a solid base of knowledge to estimate the added value and employment of air cargo at Schiphol.

3 Methodology

In this research the direct and indirect added value and employment is estimated using employment data, national averages and the I/O model. First an overview of this method is explained. Secondly, the calculation of the direct added value and the selection criteria of direct employment is discussed. This is divided in location bound and non-location bound activities. Hereafter, the method to calculate the multipliers to estimate indirect employments and added value with an appropriate correction is explained.

3.1 Overview method

A simplified overview of the used method is presented in figure 1, which is derived from the Havenmonitor (2002-20016). The model makes a division into location bound activities and non-location bound activities, both Havenmonitor (2002-2016) and Districon and Ecorys (2005) use this division. The location bound activities can be identified based on location, where the non-location bound activities cannot, which in this case is road transport. The location bound added value is the result of the multiplication of air cargo related employment and sector specific added value per employee. The non-location bound

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added value is based on transport performance related employment and the multiplication with added value per employee. The sum of both yields the total direct employment and added value. The multiplication of this result with the multipliers provides an estimation of the indirect contribution.
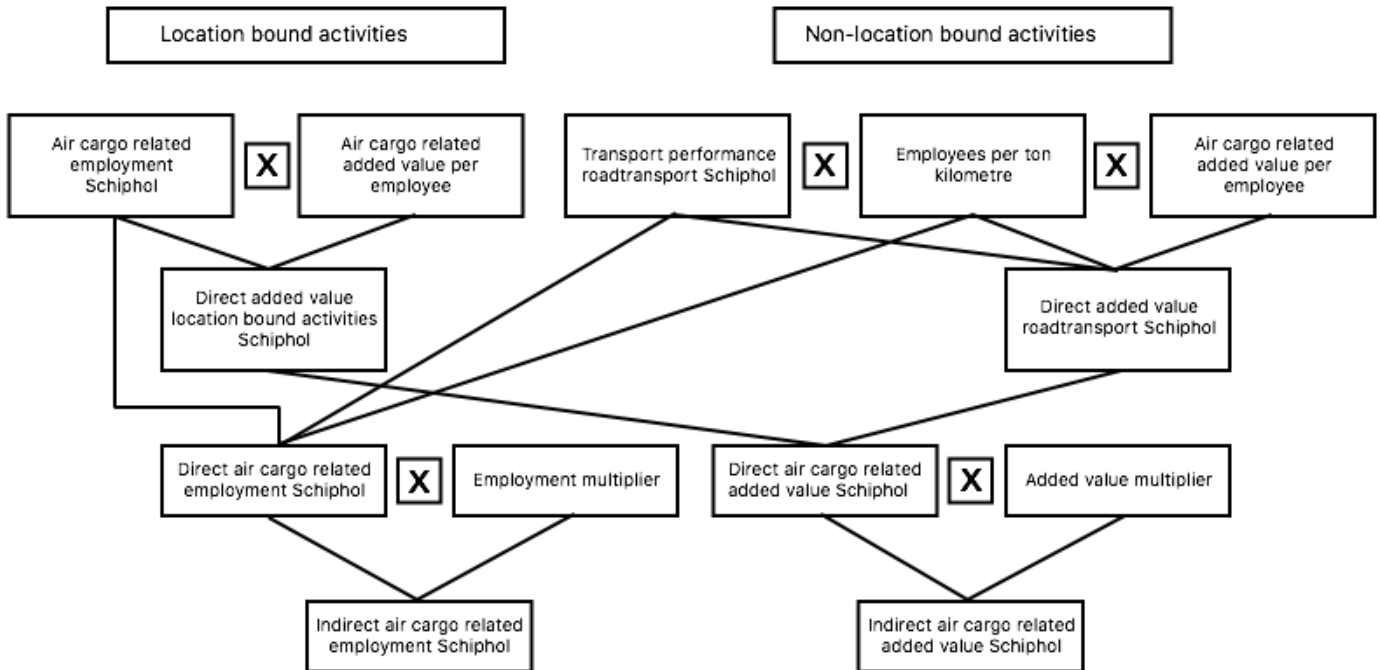
Figure 1. Simplified overview of methodology (Based on Havenmonitor, 2006)

3.2   Direct

The selection of direct air cargo related employment is divided in location bound activities and non-location bound activities, the sum of both calculations is the direct added value (VA).

$$Direct\ VA = Location\ bound\ VA + Non-location\ bound\ VA$$

The location bound added value is based on employment data of business locations related to air cargo at Schiphol. The employment is divided in sectors and per sector the employment is multiplied with the sector specific added value per employee. The sector specific added value per employee is the result of the national added value per sector divided by national employment (Emp) of this sector.

$$Location\ bound\ VA = \sum Air\ cargo\ Emp\ per\ sector * \frac{National\ VA\ sector}{National\ Emp\ sector}$$

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The non-location bound value added is based on the transport performance of road transport related to air cargo at Schiphol. Transport performance (TP) is measured in ton kilometre and this is multiplied with employment per ton kilometre. Employment per ton kilometre is based on national statistics of road transport (RT), where national employment is divided by the national transport performance (this is corrected for load factor, which is explained in 3.1.2.3. The employment is multiplied with the road transport specific added value per employee. The road transport specific added value per employee is the result of the national added value of road transport divided by national employment (Emp) of this sector.

$$Non-location\ bound\ VA = \left(TP * \frac{National\ Emp\ RT}{National\ TP\ RT} * \Delta Loadfactor \right) * \frac{National\ VA\ RT}{National\ Emp\ RT}$$

3.2.1 Selection Criteria Direct Employment

In this section the selection criteria for employment of activities related to the air cargo supply chain are described. Only the employment of parties vital to the supply chain are included, these are identified and described according to the description of Van Damme, Radstaak and Santbulte (2014) and Districon and Ecorys (2005). As explained, these activities are divided into location bound activities and non-location bound activities for further identification of employment. This division is used in Districon and Ecorys (2005) and Havenmonitor as well. First, all air cargo related activities are discussed. Hereafter, the division of the location bound activities and non-location bound activities is discussed separately. The location bound activities are discussed first, this includes an explanation of the selection of employment not fully related to air cargo. Lastly, the inclusion of the non-location bound activities is explained.

3.2.1.1 Air cargo supply chain

To estimate the economic value added by air cargo, it is important to know which activities are to be included in the estimation. Therefore, a description of air cargo and the air cargo value chain activities that are include are described in this section. Air cargo is defined any property that is or is to be transported by plane, this includes air freight, airmail and air express (Allaz, 2005). Transport by air is generally the fastest and most expensive method of transport, which means that goods transported by air are either valuable and/or time sensitive (Shepherd et al., 2016). Pharmaceuticals, perishables, expensive electronics, gold and mail are examples of goods that generally are transported by air. The supply chain of air cargo consists of different parties and activities with a different relation. The activities involved in transport of air cargo can be divided into seven different groups: air cargo service providers, mail companies, road transport, warehousing, ground handlers, airlines and facilitation, inspection and security organizations. Below the seven parties are described.

Air cargo service providers

Air cargo service providers exist in different forms; freight forwarders, express couriers, integrators and mail companies (PostNL). They all provide service for part or the whole air cargo supply chain to shippers. For export, they take care of pick-up at the shipper and drop off at ground handler (with optionally a stop at the freight forwarder in between where loads are combined), documentation for customs and the booking at the airline; for the import the freight forwarder is responsible for custom clearance and transport to the end destination. There are different kinds of air cargo service providers in terms of services offered and organization of the supply chain. In terms of service, some are able to provide the whole supply chain of both export and import where other do not have an office at the importing country to provide this service here. In terms of supply chain organization, freight forwarders generally do not have the hardware for the logistics. However, integrators like FedEx and UPS provide the full supply chain with their own hardware. This activity concerns many organizations that generally offer additional services not related to air cargo (such as ocean freight). However, there is only a single national mail company, which is PostNL.

Road transport

Road transport around Schiphol Airport consists of two parts; firstly, the transport to and from the airport, secondly the air transport replaced by road transport.

Transport to and from the airport

This considers the transport from the shipper to the freight forwarder and then to the ground handler or directly from the shipper to the ground handler and the reverse to the consignee on behalf of the freight forwarder.

Air transport replaced by road transport

This form of transport is commissioned by the airline, it considers continental transport to bigger airports where the cargo is shipped to an intercontinental destination. An airline commissions this kind of transport when it is not possible to transport the cargo to the intercontinental destination at once. This could be caused by limited space at the flights to this destination or not flying on this destination from this airport.

Warehousing

A very limited amount of small companies exist that are specialized in warehousing around Schiphol, most warehousing activity is performed inhouse by road transport and other companies active in the air cargo supply chain. Air cargo is fast moving cargo, therefore not necessary to store goods for longer periods. The bigger road transport firms have their own warehouses where cargo is stored and waiting to be send on behalf of the freight forwarder. Hereby, cargo of more customers can be combined in one truck for more efficiency. This activity is therefore mainly included by employment of road transport.

Ground handlers

Ground handlers are responsible for loading and unloading process of aircrafts on behalf of the airlines. This includes both luggage and cargo from passenger and full freighter aircrafts. Most ground handlers provide full service, they (distribute) receive and control cargo, (un)load pallets and containers and (un)load the aircraft. Sometimes ground handlers only provide the process (after)until the (un)loading of the aircraft and another party (for example KLM themselves) provides the ramp handling. In addition, ground handlers often provide service as general sales agents on behalf of the airlines that do not have a cargo division at Schiphol. Since some ground handlers offer both services to passengers as cargo, only the cargo division is included.

Airlines

The airlines ship the freight to the final destination, with often a hub airport in between for intercontinental destinations for more efficiency. There are three sorts of airlines that ship cargo: passenger airlines, combi airlines and cargo airlines.

Passenger airlines

As the name suggests, the main focus is passenger traffic. However, remaining belly capacity is used for cargo to increase profitability.

Combi airlines

Combi airlines have both passenger aircrafts with belly capacity as full freighters and/or combi aircrafts.

Cargo airlines

The third type are cargo airlines, fully specialized in air cargo. These airlines only operate full freighter aircrafts.

Generally, airlines the least active in cargo use general sales agents that organize cargo for them at Schiphol and airlines more active in cargo have their own cargo division at Schiphol. Only airlines that ship cargo to and from Schiphol are included.

Facilitation and government organizations

Airport and airport traffic control

The airport facilitates runways to the airlines and warehouses to the ground handlers, vital for the supply chain of air cargo. This concerns one organization, both responsible for air cargo as passengers.

Airport traffic control provides the organisation of traffic to all planes landing and taking of for both passenger planes as full freighters. This concerns one organization, both responsible for air cargo as passengers.

Customs and security

Customs at Schiphol are responsible for control of imported and exported goods of both passengers as shippers. Customs is a government body and has its own cargo division at Schiphol. The airport and warehouses at the airport are secured by the Marechaussee, therefore in service for both passengers as cargo. The Marechaussee is also a government body. These both concern single organizations that are responsible for both passengers and cargo.

3.2.1.2   Location bound activities

The location bound activities concern all activities described above except road transport. These activities are identified as air cargo related based on the sort of activity and their location and their employment is used as input for the formula of Location bound VA in 3.2. The different location groups are explained in this section.

Schiphol Airport is the main international airport of the Netherlands, situated in the municipality of Haarlemmermeer. The airport is important for different production and value chains that use air transport. Therefore, most companies active in the air cargo supply chain locate in proximity of Schiphol airport. In addition, for the users of air cargo services like European Distribution Centres (EDC's), it is an important determinant to locate around Schiphol. The municipalities around Haarlemmermeer are active in air cargo as well, with Aalsmeer for example in the flower market (Schiphol, 2015).

The locations have five divisions based on closeness and relation to Schiphol. The member list and knowledge of ACN serves as a main guideline for this division. The locations of the members are analysed first for a draft division. This version is discussed with Ben Radstaak (Managing Director, ACN) for a final version, which is explained below.

Group 1: Schiphol area

The Schiphol area is supervised and (partly) owned by Schiphol Real-estate. Almost everything within this area is related to Schiphol Airport. Around thousand companies (with at least one employee) are registered in this area (Sectorfonds Luchtvaart, 2016).

Group 2: Haarlemmermeer (excluding Schiphol)

Haarlemmermeer is the municipality that surrounds Schiphol and most activity is related to Schiphol Airport due to the closeness. This area is significantly cheaper for companies to rent a location than Schiphol area.

Group 3: Airfreight related municipalities around Haarlemmermeer

This group includes the municipalities Amstelveen, Aalsmeer, Hillegom, Teylingen and Lisse. These are all bordering municipalities to Haarlemmermeer and have been identified as related to airfreight using the member list and knowledge of ACN.

Group 4: Other municipalities around Haarlemmermeer

This group includes the municipalities Amsterdam, Kaag en Braassem, Heemstede, Haarlem, Haarlemmerliede c.a. These are the other bordering municipalities to Haarlemmermeer that are not identified as specifically related to airfreight.

Group 5: The rest of the Netherlands

The rest of the Netherlands is treated as one group and less likely to be related to airfreight at Schiphol due to distance.

According to the location division and the business activities the framework shown in figure 2 is developed.

Activity	Regions				
	1	2	3	4	5
Integrators/freight forwarders/express couriers	+	+	+	-	-
Mail company (PostNL)	+	-	-	-	-
Warehousing	+	-	-	-	-
Ground handlers (cargo division or fully cargo)	+	-	-	-	-
Belly and combi airlines (without cargo division)	Partly included by name				
Belly and combi airlines (cargo division)	Fully included by name				
Cargo airlines	Fully included by name				
Facilitation and government organizations	Partly included by name				

Figure 2: Framework inclusion location bound activities (own composition with knowledge and data of ACN, 2018)

The integrators, freight forwarders and express couriers are fully included or fully excluded based on their location. It is assumed that the companies more specialised in air cargo locate closer to Schiphol in the cargo related regions and the companies less dependent on air cargo locate in a different location. By fully taking into account the employment in regions 1 till 3 and not taking into account the employment in regions 4 and 5, the strictly air cargo related is assumed to be balanced out. For the mail company PostNL only the Schiphol location is included, it is assumed that this location is the specialised department for air cargo and the other PostNL locations focus on different activities. Furthermore, the warehousing activity is mainly included by the inclusion of road transport companies. For the ground handlers, only the air cargo division is included, which are all located at Schiphol. In addition, the airlines are (partly) included by name based on a known list of (belly/combi/cargo) carriers of Sectorfonds Luchtvaart (2016). Likewise, the facilitation and government organizations are partly included by name.

Activities partly related to air cargo

As discussed in 3.2.1.1, some of the organizations are not fully related to air cargo and should only be taken into account for the part related to air cargo. This concerns belly and combi airlines, Schiphol, airport traffic control, Marechaussee and customs. In the research of Districon and Ecorys (2005) two estimates are used for 'airplane bound activities' and 'other employment at Schiphol'. For the 'airplane bound activities' such as airlines, ground handlers and technical staff an accounting measure is used. This accounting measure is called Work Load Unit which is generally used to divide costs between passengers and cargo, here 100kg cargo equals one passenger. Because this measure is not based on employment figures, a more specified measure per activity is used in this study, this is explained below. For 'Other employment at Schiphol' a rough estimate of 25 percent is used by Districon and Ecorys (2005), this concerns airport traffic control, customs etc. This measure is not explained any further, therefore unknown why this is estimated to be 25 percent. The estimate of 25 percent might have its origin from Regioplan (2003), which was the data source of their research. However, since the origin of this estimate is unknown a more specified measure is developed which is explained below.

Belly and combi carriers without cargo division (except KLM)

A ratio between cargo employees and passenger employees is calculated using the data of belly cargo airlines with a separate cargo division. This figure is divided by two since it is assumed that the other airlines without a separate division have relatively fewer employees related to cargo and make more use of general sales agents.

KLM and Martinair cargo

KLM and its subsidiary Martinair cargo do not have a separate cargo division and are too big in terms of employment to use an estimate; therefore, KLM Cargo is contacted.

Schiphol, Airport traffic control and Marechaussee

The employment of Schiphol, airport traffic control and Marechaussee can only be attributed to cargo for a small percentage. This percentage is based on the number of full freighter flights relative to total flights at Schiphol, which is divided by the ratio between tons of full freighter cargo and total tons of cargo at Schiphol.

Customs

Customs of Schiphol are both for passengers as cargo. Customs at Schiphol is contacted for their employment data related to air cargo.

3.2.1.3   Non-location bound activities

The non-location bound activities concern the transport activities from and to the airport, the input for the formula of Non-location bound VA in 3.2 is described. These activities are not necessarily located close to Schiphol, which means identification of businesses and employees by the geographical delimitation and the business activity is less appropriate. Both Districon and Ecorys (2005) and Havenmonitor offer an alternative to identify non-location bound related employment. Districon and Ecorys (2005) use tons of freight transported to and from Schiphol and the national average of tonnage transported per road transport employee (CBS) to calculate employment. However, this method implicitly makes the assumption that the average distance of a ton of cargo from or to Schiphol is the same as the national average. Therefore, the more advanced method of Havenmonitor is chosen as basis for these transport activities. This method does take into account the transport performance. Unlike a seaport which has rail, road, inland shipping and pipelines as inland transport modes, Schiphol's only inland access (that is used for air cargo) is road transport. As a consequence, only the road transport method of the Havenmonitor is necessary. This method is altered to match road transport related to Schiphol, the result is explained in the next section.

Transport performance

The road transport employment is estimated using professional Dutch transport performance. It concerns professional transport since own transport is already attributed to the sector wherein that business is active and Dutch since this estimation concerns the national added value. The transport performance is measured as load ton kilometres, which means the transported weight by Dutch professional transporters is multiplied by the transported distance. The transport performance is divided in cross-border and inland transport, the sum yields the total transport performance.

$$Transport\ performance = (Weight * Avg\ distance) * \%Dutch\ proffesional\ transport$$

Transported weight

The transported weight is equal to the weight arriving and leaving Schiphol by plane, minus the flight-flight traffic. This weight is divided in international and national transport.

Average distance

The average distance is divided in the average for cross-border and inland transport. This is the average a ton of cargo travels from or to Schiphol.

Professional transport

This is the percentage of tons of cargo that is transported by professional transport companies.

Dutch transport

This is the percentage of tons of cargo that is transported by Dutch companies for inland and cross-border transport.

Employment related to transport performance

This concerns the average employment related to the transport performance and is calculated based on national figures and the difference in load factor. The difference in load factor is important since the national average employment per ton kilometre is based on the assumption that a truck is filled with an equal number of tons. However, as Districon and Ecorys (2005) also recognized, the load factor for air cargo is lower than the national average. This means that for the same weight of air cargo as other 'general road transport' cargo, more trucks are required, which means more employment.

$$Avg\ employment = \frac{National\ Emp\ RT}{National\ TP} * \Delta\ load\ factor$$

3.2.2 Direct added value and employment

The sum of the selected and calculated employment of the location bound and non-location bound activities is the total direct employment. The identified employment is used as input for the formulas described in 3.2.

3.3 Indirect

3.3.1 Indirect employment and added value

The indirect employment and added value is taken into account by calculating output multipliers per sector according to the method of Leontief (1965). This the backward linked indirect economic effect of the direct air cargo related companies at their suppliers (Excel Method explained in Appendix A). One could think of the added value and employment at the fuel supplier of airlines, office equipment suppliers or accountants that

compose the annual report. In addition, those companies have a second indirect effect at their suppliers.

This effect is calculated using the input output method of Leontief the national accounts. These tables describe the relation in terms of production value between Dutch suppliers and clients. In figure 3 a simplified version of these relations and their indirect effect is shown. The farming sector produced 100 euro and to do so, needed to purchase for 60 euro in farming sector and machinery sector. The other 40 euro are wages, taxes, imported goods and profit. The 100 euro of production in farming leads to an additional production of 60 euro in the sectors farming and machinery. In addition, for 60 euro to be produced, other goods and services need to be purchased that lead to more production in other sectors. Each time the indirect effect becomes smaller and by calculating this effect till infinity, a multiplier can be calculated for the production value. These multipliers are translated to added value and employment by using data of employees and added value per euro of production in each sector. With the direct effects and the multipliers, the indirect effects are calculated.
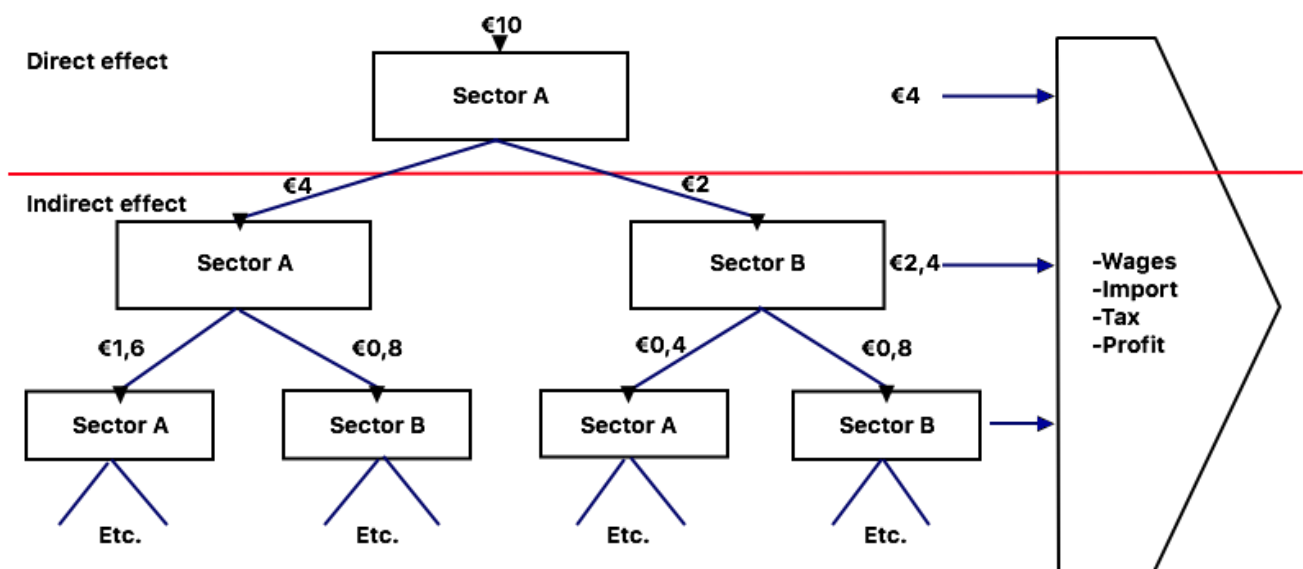
Figure 3: Visualization indirect effect (Decisio, 2015; own modification)

3.3.2 Correction for double counted employment

A large part of the indirect added value and employments is already included in the direct added value and employment which leads to double counts. The studied companies have many interlinkages that result in indirect effects at each other that are taken into account by the direct effect. The freight forwarders for example purchase room in a full freighter of Martinair, this indirect effect of the freight forwarders at Martinair is already included in the direct effect. Therefore, a correction is needed.

Both Decisio (2015) and Havenmonitor (2002-2016) offer a method for this correction. The Havenmonitor (2002-2016) corrects for this effect by altering the multiplier itself and removing the indirect effect it has on its own sector. This makes it easy to implement in a calculation, once the multiplier is altered, no further actions are needed. Decisio (2015) offers a more targeted approach that corrects the indirect effect the multiplier has on sectors that are already included in the direct effect. This makes this method more targeted for the corrections, though more difficult and time consuming. However, since the approach of Decisio (2015) is a more targeted correction, this method is used.

Decisio (2015), an economic research agency, developed a method for this correction, which is used for a similar case study of the added value of Schiphol Airport. This method is therefore deemed as fitting for this study and is used for the correction. Their solution is to visualize the first-order effects of the researched companies and to perform a correction on this so called first-order indirect effect. The first-order effect concerns the companies where air cargo related companies spend their budget. The second-order effect concerns the further effect of those companies with their budget; the companies where that budget is spent have their own suppliers and those suppliers have in term their suppliers etc. The sum of those effects is called the second-order effect. In table 1 a step by step visualization by Decisio (2015) is shown of this correction. At step 1 the total production of air cargo related companies is visualized and divided per sector. Secondly, at step 2 the initial first-order effect in this sector is determined with the input-output tables, this is the sum of the first order effects in this sector caused by the sector itself and the other sectors. Hereafter, at step 3 the first-order effect is corrected by the already included direct effect; when the first-order effect is higher than the direct effect, the difference is included. At step 4 the second-order effect is calculated with the input-output tables. The total effect is the result of step 1, 2 and 4, which is calculated in step 5. At step 6 and 7 this effect is translated to added value and employment.

Sector	Direct effect production value (mln €)	First-order effect I/O-model (mln €)	Missed first order effect: step 2-1 (mln €)	Second-order effect I/O-model (mln €)	Total effect (step 1+2+4) (mln €)	Added value (mln €)	Employed people (*1.000)
	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7
Sector 1	0,0	0,2	0,2	0,2	0,4	0,1	2,4
Sector 2	0,2	0,4	0,2	0,3	0,7	0,4	4,6
Sector 3	15,2	2,8	-	0,7	15,9	5,1	48,3
Sector 4	0,24	0,09	-	0,0	0,3	0,1	4,4
Sector 5	0,40	0,82	0,41	0,4	1,3	0,7	15,6
Sector 6	0,2	0,8	0,6	0,6	1,4	0,3	2,9
...	...	...	...	...	...	...	...
Total	16,2	5,0	1,3	2,4	19,9	6,7	78,1

Table 1: Visualization correction double counts (Decisio, 2015)

3.4 Summary

The methodology is based on the I/O model, previous research of Districon and Ecorys (2005), Decisio (2015) and Havenmonitor (2002-2016) and other research. The employment of activities that should be included is based on research of Districon and Ecorys (2005) and Van Damme, Radstaak and Santbulte (2014) with the focus on the vital parts of the air cargo supply chain. These activities are divided into location bound activities and non-location bound activities to identify related employment, similar to Havenmonitor (2002-20016) and Districon and Ecorys (2005). The location bound activities are included based on a developed framework of regions and activities. Specific estimations are made in this research for the partly related air cargo activities. The non-location bound activities (road transport) are included based on transport performance, following mainly the method of Havenmonitor (2002-2016) with a correction for load factor used in Districon and Ecorys (2005). With the identified employment of the location bound and non-location bound activities the direct added value is calculated with value added per employee based on

national averages. The indirect contribution is calculated using Leontief multipliers, which is corrected for double counts by the targeted method of Decisio (2015).

4 Data

4.1 Data selection

In this section the data sources and the selection of data according to the methodology is described. First, the data sources are described. Hereafter, the explanation of data selection is discussed, which is divided according to the structure in the methodology. First, the selection of direct employment data is explained, with a division in location bound activities and non-location bound activities. Hereafter, the data for the related added value is described. Lastly, the data used for the calculation of the multipliers is discussed.

4.1.1 Data sources

LISA employment data

The input of direct employment is retrieved from LISA (2010, 2015), "Landelijk Informatie Systeem van Arbeidsplaatsen", which is Dutch for national information system of employment. The database consists of employment figures per business establishment, with an SBI-code (classification of companies based on core business activity of CBS) and address. List of SBI codes included in the provided dataset is shown in Appendix B. LISA composes this national dataset by combining business establishment registries of all regions in the Netherlands on a yearly basis. Both permanent employment as temporary employment of more than 12 hours per week at the business establishment is included.

Sectorfonds Luchtvaart

Sectorfonds Luchtvaart (2016) is the sector foundation of air transport. They performed research on employment related to air transport and air cargo at companies located at Schiphol based on a survey. A list of the air cargo related companies is composed that is used in this research.

ACN member list

Air Cargo Netherlands is the branch organization of air cargo in the Netherlands. The member list of ACN (2018) offers all their members divided into the activities freight forwarders, airlines, road transport and services with business location.

CBS

CBS stands for "Centraal Bureau van Statistiek", which is Dutch for central bureau of statistics. CBS is a government organization that provides reliable statistics on the Dutch society, mostly on a yearly basis. These statistics are mostly national and sometimes regional statistics. Therefore, can provide a national or regional average that can be used in different estimations.

Company specific data

Customs, KLM and other airlines are contacted by phone and email for company specific data on cargo related employment because the LISA data was sometimes not sufficient to separate cargo related employment.

Expert judgement of road transport sector related to air cargo

A meeting at ACN of the air cargo related road transport sector is the main data source when the national averages of CBS were too far off the actual figures. Large road transport companies such as Bos logistics, D.J. Middelkoop and R. Nagel were present during this meeting.

4.1.2   Direct

4.1.2.1   Location bound activities

Employment data

Since data of LISA is used, the identified activities need to be translated to SBI codes, the sector codes used in LISA. The dataset is analysed whether the SBI division is as expected. In figure 4 it can be observed that the SBI division is not perfect, many companies have a different SBI code than expected in the dataset.

SBI code	Sector Name	Activities expected in sector	Activities present in sector
51.10	Air passenger traffic	Belly cargo carriers	Belly cargo carriers Cargo carriers
51.21	Air cargo traffic	Cargo carriers	Freight forwarders General sales agents
52.10	Warehousing	Warehousing	Integrators
52.23	Services for air traffic	Airport	Ground handlers General sales agents Airport Belly cargo carriers Freight forwarders

		Shipping agents	
		Airport traffic control	
52.24.2	Loading, unloading and transfer activities not related to ocean freight	Ground handlers	Freight forwarders Integrators Express couriers
52.29	Shipping agents, ship brokers, charterers, weight and measurement	Freight forwarders Shipping agents Integrators Express courier service companies General sales agents	Cargo carriers Freight forwarders Shipping agents Integrators Express courier service companies General sales agents Ground handlers
53.10	National mail with universal service obligation	Mail companies	Mail companies Integrators
84.11	General government bodies	Airport traffic control Customs	Airport traffic control Customs

Figure 4: Results analysis correctness SBI codes dataset (own composition)

Following the methodology and the results of the table 4, and the methodology a basic framework is developed to identify air cargo related employment. The basis of this framework can be observed in figure 5.

SBI code	Sector Name	Regions				
		1	2	3	4	5
51.10	Air passenger traffic	+/-	+/-	+/-	+/-	-

51.21	Air cargo traffic	+	+	+	+	-
52.10	Warehousing	-	-	-	-	-
52.23	Services for air traffic	+/-	+/-	+/-	+/-	-
52.24.2	Loading, unloading and transfer activities not related to ocean freight	+	+	+	-	-
52.29	Shipping agents, ship brokers, charterers, weight and measurement	+	+	+	-	-
53.10	National mail with universal service obligation	+/-	-	-	-	-
84.11	General government bodies	+/-	-	-	-	-

+ Air cargo related, +/- Partly air cargo related, - Not air cargo related

Figure 5: Translation methodology inclusion location bound activities to dataset (own composition)

51.10 – Air passenger traffic: sector that includes (belly) cargo airlines, these are manually identified since not all airlines ship cargo. Other companies assumed not to be cargo related.

51.21 – Air cargo traffic: based on sector code, all firms identified as cargo related.

52.10 – Warehousing: the companies present in this sector at Schiphol area were not cargo related storage companies according to ACN, therefore not identified as cargo related.

52.23 – Services for air traffic: this sector holds both services for air cargo as for passengers, these are manually identified since this is a small sector.

52.24.2 – Loading, unloading and transfer activities not related to ocean freight: based on sector code, all activities are cargo related. Therefore, based on the location identified as air cargo related or not air cargo related.

52.29 – Shipping agents, ship brokers, charterers, weight and measurement: based on sector code, all activities are cargo related. Therefore, based on the location identified as air cargo related or not air cargo related.

53.10 – National mail with universal service obligation: only the Schiphol location of Dutch mail identified as air cargo related.

84.11 – General government bodies: only customs and airport traffic control identified as air cargo related.

Extra manual check

Since the firms are not always in the expected SBI code, an extra manual check is performed.

-All firms in region 1 in the sector codes 49, 51, 53 and 84 are checked manually

-All firms in regions 1 till 4 in the sector codes 49, 51, 53 and 84 are checked manually with the "luchtvaartsectorfonds" (2016) list of air cargo companies and ACN member list (2018)

-All firms in regions 1 till 4 in the sector codes 49, 51, 53 and 84 with more than 50 employees are checked manually

Employment data companies not fully related to air cargo

Belly cargo airlines without registered cargo division

Employees related to cargo based on LISA data (2010, 2015) and Schiphol data (2015) is estimated to be around 20 percent, the result is shown in table 2.

Year	2010		2015	
	Total	Cargo	Total	Cargo
Airlines without cargo division	334	65	257	50

Table 2: Estimated employment at cargo shipping airlines without registered cargo division 2010, 2015 (own calculation with LISA, 2010, 2015)

Ground handlers

The ground handlers active in both passengers and air cargo have a separate registered division. Only this division is taken into account.

Companies in sector 52.24.2 and 52.29

Some of the companies in these sector codes are active in multiple logistics activity, for example a freight forwarder that is active in air, road and sea transport. Based on the methodology these are fully included in region 1,2 and 3.

Integrators and other supply chain companies

Most of these companies are included or excluded based on location in sector 52.24.2 and 52.29. However, some of the companies with more than 50 employees that are checked manually have more registered locations. In this case only the location closest to the airport is taken into account. The other locations are assumed to be related to other parts of the supply chain.

Schiphol, Marechaussee and Airport traffic control

Of the total employment 6.2% is estimated to be related to air cargo. This percentage is based on the number of full freighter flights relative to total flights at Schiphol, which is divided by the ratio between tons of full freighter cargo and total tons of cargo at Schiphol (Schiphol, 2015). The result is shown in table 3.

Year	2010		2015	
	Cargo	Total	Cargo	Total
Air traffic control	63	1022	64	1033
Schiphol	132	2140	134	2159
Marechaussee	104	1678	118	1906

Table 3: Estimation air cargo employment air traffic control, Schiphol and Marechaussee 2010, 2015 (own calculation with data of LISA, 2010, 2015)

Customs

Customs of Schiphol are both for passengers as cargo. Customs at Schiphol is contacted and they provided employment data related to cargo for both 2010 and 2015 (Appendix C).

Year	2010	2015
Customs cargo	736	729

Table 4: Air cargo employment at customs, 2010, 2015 (Customs, 2018)

KLM and Martinair cargo

KLM does not have a separate registered cargo division and does not provide data on cargo related employment. Since KLM has a significant amount of cargo related employment and is a home carrier. Therefore, KLM cargo is contacted for employment data of KLM Cargo and their subsidiary Martinair Cargo (Appendix D). They provided the data as full time equivalent (FTE), therefore this translated to number of jobs as shown in table 5.

Year	2010		2015	
	FTE	Employed*	FTE	Employed*
KLM Cargo	1672	1900	1702	1934
Martinair Cargo	515	585	349	397

*Own calculation with CBS statistics about employment per SBI (2010, 2015)

Table 5: Cargo employment at KLM and Martinair 2010, 2015 (KLM, 2018)

4.1.2.2 Non-location bound activities

Transport performance

As explained in the methodology, transport performance is calculated with tons of freight at Schiphol, tons of freight on flight-flight traffic at Schiphol, average distance per ton of freight, percentage of Dutch professional transport and a load factor correction.

Tons of freight moved at Schiphol are obtained from the yearly statistics of Schiphol group (2010, 2015).

Secondly, tons of flight-flight traffic are based on research of Districon (2005) that studied air bills of Cargonaut and found that 3 percent of cargo at Schiphol is flight-flight traffic. This is the most recent and

Thirdly, the average distance of a ton freight by road transport to and from Schiphol was more difficult to come up with a reliable number. Havenmonitor uses an average calculated from CBS data. There are three datasets of CBS that can be used to calculate this average, these are shown in figure 6. Since these datasets are based on samples, the national dataset has a bigger sample size than Schiphol region. Therefore, the national dataset is more reliable but offers only the average of the whole country (CBS, Panteia).

Data	Reliability	Fitness
CBS National data	++	-
CBS NUTS region data	+	+/-
CBS Schiphol region data	-	+

Figure 6: Evaluation CBS data (based on judgement Panteia, 2018 and CBS, 2018)

Since the average distance for all three datasets is between 70 and 80 km (CBS 2010, 2015), this has been qualified as too low and not representative for road transport of air cargo. Air cargo is often transported by road across the border, the 'general rule' is that half of the air cargo is international road transport according to ACN and road transport companies (Bos logistics, D.J. Middelkoop and R. Nagel). Therefore, the average distance is significantly higher. CBS offers a division between average distance of inland and cross border road transport on national level. However, the difference between the average distance of cross border transport between 2010 and 2015 is 72km. This difference would result in a very different employment level between 2010 and 2015 purely based on this distance, which means that this average does not seem to be reliable either.

Moreover, the national averages for Dutch professional transport and load factor of CBS (2010, 2015) differed significantly from the actual numbers as well (ACN, Bos logistics, D.J. Middelkoop and R. Nagel). Based on the expert judgement of these parties in the road transport sector related to air cargo, the following estimates in table 6 are made and compared to the national average of CBS.

	Sector estimates	CBS	
		2010	2015
Inland transport	50%	79%	80%
Cross border transport	50%	21%	20%
Distance Inland	>75km	73km	72km
Distance cross border	>500km	384km	312km

Dutch transport	95% of inland 50% of cross border	95%	95%
Professional transport	>99%	77%	77%
Tons per truck Inland	5 ton	15 ton	13 ton
Tons per truck cross border	Unkown	17 ton	15 ton

Table 6: Comparison estimates road transport sector and CBS averages (ACN road transport meeting, 2018 and CBS 2010, 2015)

These estimates are pure indicative and should be researched to be confirmed. However, since the CBS data differs significantly from the estimates made by the sector, the sector estimates are the best data available at this moment. Therefore, the sector estimates are used.

Employment related to transport performance

The employment per ton kilometre is retrieved from national statistics of CBS (2010, 2015). CBS provides an overview of total employment in the road transport sector and total ton kilometres in the Netherlands. The division yields average employment per ton kilometre.

4.1.3   Direct added value

The direct added value per employee is retrieved from CBS (2010, 2015). The total national employment and added value per SBI-code is provided on a yearly basis.

4.1.4   Indirect added value and employment

The multipliers are calculated with the national accounts of the Netherlands for 2010 and 2015. These are provided yearly by CBS. For the translation to employment multipliers, the national employment data per sector of CBS for 2010 and 2015 is used.

4.2   Summary

The main data sources for this study are LISA (2010, 2015), Sectorfonds Lunchvaart (2016), ACN memberlist (2018), various statistics of CBS (2010, 2015), company specific data and expert judgement of road transport companies. The dataset of LISA is analysed with the translated methodology to match the dataset characteristics to retrieve location bound air cargo related employment. Company specific data is used to estimate or determine

employment of companies that are not fully related to air cargo. The non-location bound employment is based on tons of cargo at Schiphol and expert judgement since the CBS data is not accurate enough. CBS data (2010, 2015) is used for employment and added value per sector to determine direct added value. The multipliers are based on the input-output tables of CBS (2010, 2015).

5   Results

In this section the results of 2010 and 2015 are presented and discussed first. This consists of: direct, indirect and total employment per sector; direct, indirect and total added value per sector; growth of direct, indirect and total employment per sector between 2010 and 2015; and growth of direct, indirect and total added value per sector between 2010 and 2015. Hereafter, the results of the sensitivity analysis are discussed. This includes different inputs for road transport and airlines and a different region specification.

5.1   Discussion of results

5.1.1   Results 2010

Following the methodology and the data selection, the results presented in table 7 and 8 are obtained 2010. The results are divided per SBI code to provide insights in the significance per sector (the activities included per SBI can be observed in figure 4). These results provide an indication of the size of the air cargo sector around Schiphol. With a direct employment of 12104 and a direct added value of 1179 million euros, the sector has a significant size. Noteworthy is that the direct employment is lower compared to the results of Districon and Ecorys (2005), who estimated direct employment to be 13600 in 2003. However, since the methodology is different, it is hard to compare the results. The downturn of the economy together with the more conservative estimations in this research for the partly air cargo related employment might be part of the cause for the lower employment. Furthermore, it is interesting to see that almost half of the direct employment is in the sector 'Warehousing and services for transport'. This is mainly the case because of the freight forwarders, integrators, ground handlers, airport and some of the airlines that are included in this sector.

Sector (SBI-code)	Direct	Indirect	Total
Road transport (49)	1486	660	2146
Air transport (51)	2843	3075	5918
Warehousing and services for transport (52)	6026	4751	10777
Mail and couriers (53)	714	99	813
Public boards, government services and mandatory social insurances (84)	1035	505	1539
Total	12104	9091	21194

Table 7: Results estimated employment 2010

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Sector (SBI-code)	Direct	Indirect	Total
Road transport (49)	86,52	48,02	134,54
Air transport (51)	319,14	210,44	529,58
Warehousing and services for transport (52)	664,28	322,23	986,51
Mail and couriers (53)	25,42	7,43	32,85
Public boards, government services and mandatory social insurances (84)	84,11	35,59	119,70
Total	1179,46	623,71	1803,18

Table 8: Results estimated added value (in millions of euros) 2010

5.1.2   Results 2015

Following the methodology and the data selection, the results presented in table 9 and 10 are obtained for 2015. The results are divided per SBI code to provide insights in the significance per sector. The size of the air cargo sector remains significant as expected with a direct employment of 13502 and an added value of 1549 million euros. Decisio (2015) reported a total (direct and indirect) employment related to Schiphol of 113 thousand in 2013. All though the results cannot be compared due to the different methodologies, it does provide an indication of the size of the air cargo sector compared to the total air transport sector at Schiphol. In addition, the results can be compared to the added value and employment of the Port of Rotterdam from the Havenmonitor. Here, direct employment is estimated to be 80 thousand with an added value of 11 billion euros for 2015. As expected, the Port of Rotterdam has a significantly higher employment and added value. As explained, ocean freight is much cheaper and therefore often the favoured shipping method; less than one percent of tons of cargo is transported by air. Therefore, the employment and added value related to air cargo at Schiphol are actually surprisingly high when considering Schiphol moved more than 200 times less the tonnage of cargo then the Port of Rotterdam in 2015 and the difference in employment is only one to six and one to seven for added value. The difference in ratios of employment and added value are interesting as well. Apparently, employment in the Port of Rotterdam delivers more added value per employee then employment related to air cargo at Schiphol. This means that the Port of Rotterdam holds employment from sectors with a higher national average added per employee (since the added value is calculated by multiplying employment per sector with the national average

added value per employee per sector). Part of the cause is likely the oil and gas industry that is present in the Port of Rotterdam, this sector has a very high added value per employee that contributes to this difference.

Sector (SBI-code)	Direct	Indirect	Total
Road transport (49)	1421	643	2064
Air transport (51)	2599	3297	5896
Warehousing and services for transport (52)	7983	6187	14170
Mail and couriers (53)	455	103	558
Public boards, government services and mandatory social insurances (84)	1044	441	1485
Total	13502	10671	24173

Table 9: Results estimated employment 2015

Sector (SBI-code)	Direct	Indirect	Total
Road transport (49)	100,77	53,57	154,34
Air transport (51)	315,50	283,64	599,141
Warehousing and services for transport (52)	1024,59	418,36	1442,96
Mail and couriers (53)	15,08	7,85	22,93
Public boards, government services and mandatory social insurances (84)	93,18	34,65	127,84
Total	1549,13	798,08	2347,21

Table 10: Results estimated added value (in millions of euros) 2015

5.1.3   Growth between 2010 and 2015

In tables 11 and 12 the difference in percentages between 2010 and 2015 are presented. Overall employment has grown significantly according to the results, with 12 percent for direct employment, 17 percent for indirect employment and 14 percent for total employment. Indirect employment showed the highest growth. However, it is difficult to determine whether this is caused by increased interdependencies with suppliers at the air cargo sector at Schiphol, since this effect is calculated with multipliers based on national averages.

Even more interesting are the differences per sector. First, the decline in the sector 'Mail and couriers' is noteworthy and not in line with the worldwide growth of express as result of the growth in e-commerce. After a more detailed study of the data, the main cause is found to be a decline in registered employment of 316 employees at integrator FedEx. Secondly, the decline in 'road transport' is interesting, since the non-location bound employment included in this sector has actually increased. However, this increase is overpowered by a strong decrease of freight forwarder Eagle Logistics (wrongly) in this sector. Thirdly, the decrease in 'Air transport' is mainly caused by the decrease in employment at Martinair and the decrease of employment at foreign airlines with local offices. Lastly, the strong increase of 32 percent in the 'Warehousing and services for transport' sector is interesting. This is caused by an increase of employment at freight forwarders and integrators, especially at DHL where employment increased with 129 employees. In addition, the relatively stronger increase in added value compared to employment is interesting. This might be explained by increased productivity, higher margins or the stronger economy.

Sector (SBI code)	Direct	Indirect	Total
Road transport (49)	-4%	-3%	-4%
Air transport (51)	-9%	7%	0%
Warehousing and services for transport (52)	32%	30%	31%
Mail and couriers (53)	-36%	4%	-31%
Public boards, government services and mandatory social insurances (84)	1%	-13%	-4%
Total	12%	17%	14%

Table 11: percentage growth employment between 2010 and 2015

Sector (SBI code)	Direct	Indirect	Total
Road transport (49)	16%	12%	15%
Air transport (51)	-1%	35%	13%
Warehousing and services for transport (52)	54%	30%	46%
Mail and couriers (53)	-41%	6%	-30%
Public boards, government services and mandatory social insurances (84)	11%	-3%	7%
Total	31%	28%	30%

Table 12: Percentage growth added value between 2010 and 2015

5.2 Sensitivity analysis

To check for robustness of the results of the model, a sensitivity analysis is performed. The focus is on the impact of the estimations that are made in this analysis. It is interesting to see how the results would change if the estimations are performed differently. The estimations of airlines without cargo division and road transport and the inclusion/exclusion by regions for the sectors "Loading, unloading and transfer activities not related to ocean freight" and "Shipping agents, ship brokers, charterers, weight and measurement" are included in this analysis. These estimations are the least based on facts and therefore the most arbitrary.

5.2.1 Airlines without cargo division

This considers the airlines that are known to ship air cargo from and to Schiphol, though do not have a registered cargo division in LISA. It is assumed that the airlines without a registered cargo division have a lower percentage of total employment in the Netherlands related to cargo. This assumption is based on two things; first, airlines without cargo division probably focus less on cargo and second, there is an increased likelihood these airlines use GSA's for their cargo. Therefore, the percentage of cargo related employment is estimated to be half compared to the belly airlines with a cargo division, which is 20 percent. The actual percentage of employment related to cargo should be between zero (if they all use GSA's) and as the absolute maximum of 39 percent (if they have an equal amount of employment as the airlines with cargo division related to cargo). As shown in 13, the cargo related

employment for 2010 is estimated to be 65 employees with a minimum of zero and a maximum of 130 and for 2015 estimated to be 50 employees with a minimum of zero and a maximum of 100. This results in a maximum difference in the direct employment of 65 employees for 2010 and 50 employees in 2015, which is a possible under or over estimation of total direct employment of 0.5% and 0.4% for 2010 and 2015. Therefore, the possible under or over estimation is not problematic for the end result and can be considered robust. In addition, the cargo related employment of 9 out of 15 of these airlines is known for 2018. Leo de Haas of ACN able was able to retrieve current cargo related employment at these airlines, which resulted in a total employment of 32 for the 9 out of 15 airlines without cargo division. If the same ratio of employment per airline would apply to the other 6 airlines, this would result in 53 employees related to cargo. Therefore, the estimation seems to be in the right order of magnitude for 2010 and 2015.

Year	Estimated	Min.	Max.	Max. difference
2010	65	0	130	65
2015	50	0	100	50

Table 13: Sensitivity analysis airlines without cargo division

5.2.2   Road transport

The road transport estimation considers the "expert judgement of the sector" compared to the national averages of CBS. The national CBS averages were deemed as inaccurate for air cargo related road transport by ACN and several road transport companies and they provided other estimates. The difference between related employment in road transport calculated with the sector estimates and CBS averages can be observed in 14. The results show a possible overestimation of 387 employees for 2010 and 534 employees for 2015 compared to the results with the CBS averages. This would mean a possible over estimation of 3.2 percent for 2010 and 4.0 percent for 2015 of direct employment, which is a more significant number. However, ACN even considered the higher final result with the sector estimates as possibly too low. ACN provided more than three thousand ACN cards (that are still registered) which road transport employees need for inland transport to and from Schiphol. Therefore, more than three thousand road transport employees for inland transport ship air cargo at least once in a while. Considering both estimations and the knowledge of the sector and ACN, the final result based on the sector estimates is far from perfect and definitely needs more research. However, the results are not likely to be overestimated by the maximum difference with the CBS average (might even be underestimated). Therefore, the end results of direct employment would not change significantly and the final estimation still provides a solid indication of the size of the sector.

Year	Sector estimates	CBS averages
2010	679	292
2015	863	329

Table 14: Sensitivity analysis road transport

5.2.3 The effect of the defined regions

The sectors "Loading, unloading and transfer activities not related to ocean freight" and "Shipping agents, ship brokers, charterers, weight and measurement" are included and excluded based on regions (region 1-3 includes, region 4-5 excluded). Firms with more than 50 employees in regions 1 to 4 are checked manually, which insures that companies of significant size are not mistaken included or excluded. In addition, all companies in region 1 are checked manually with the list of Sectorfonds Luchtvaart (2016). However, this still might lead to an underestimation by companies in region 4 that are excluded mistakenly. Therefore, the companies in these sectors in region 4 are analysed. Companies with more than 50 employees are already manually checked, this has been extended to companies with more than 20 employees. Most of these companies can be defined as not (fully) related to air cargo, since most of these companies did not mention air cargo on their website. This resulted in possible missed employment shown in table 15 of companies with mostly one employee. The maximum possible underestimation of direct employment for 2010 would be 4.3% and for 2015 would be 31%, which is a significant amount of employment. However, these are all small companies that probably make their earnings more related to other forms of transport. The effect that is missed is likely to be compensated by the full inclusion of freight forwarders that also perform other transport activities. Therefore, the end results of direct employment would not change significantly and the final estimation still provides a solid indication of the size of the sector.

Year	Possibly missed employment
2010	520
2015	414

Table 15: Sensitivity analysis by region included SBI

5.3   Summary

The results provide a first indication of the contribution to the Dutch economy of the air cargo sector at and around Schiphol in terms of added value and employment. The contribution can be considered significant with a total employment of 22 thousand and an added value of 1.8 billion euros for 2010 and a total employment of 24 thousand and an added value of 2.4 billion euros for 2015. It should be noted that these results are an indication because:

-Only firms in the sectors 'Transportation on land', 'Air transport', 'Warehousing and services for transport', 'Mail and couriers' and 'Public organizations, government and mandatory social insurances' could be included by data restrictions

-The indirect effects are estimated with the I/O model and therefore the limitations of this model should be considered

-Added value is estimated based on national averages of the whole sector

-Input data of LISA is not perfect and estimations are made for road transport and other companies not fully related to air cargo

However, the performed sensitivity analysis showed that the final results of direct employment can be considered relatively robust. Therefore, the results do provide a solid indication of the contribution of air cargo at Schiphol.

6 Conclusion

The main purpose of this study is to develop a methodology to estimate the contribution of air cargo at Schiphol on a yearly basis. Therefore, the following research question is posed:

How can the economic impact of the cargo function of an airport be estimated on a yearly basis?

To answer this question, a literature review is performed, which resulted in a solid base for the specification of the Input-Output model. The three most relevant studies of Districon and Ecorys (2005), Decisio (2015) and Havenmonitor (2002-2016) provided a guideline for the methodology and the data selection of this study. The methods of these studies are analysed and have been combined to a new method with additions that resulted from performed research. This has led to a basic and viable methodology to estimate the added value and employment of air cargo at Schiphol on a yearly basis.

This resulted in the I/O model with the following specification, explained hereafter. Employment data should be used as input for this model to calculate the direct and indirect contribution of air cargo to the Dutch economy. The selection of related employment is an important factor for the specification of the model. There is chosen to follow Districon and Ecorys (2005) and Havenmonitor (2002-2016) in the division of non-location bound activities and location bound activities. Location bound employment is included based on activity and location, a framework is developed with 5 regions and all (partly) air cargo related activities to include or exclude employment of businesses. The 5 regions range from the most air cargo related region 1 (Schiphol) to the least air cargo related region 5 (the rest of the Netherlands), based on an analysis of the ACN member list (2018) and expertise of ACN. The selection of activities is based on the air cargo supply chain, which is described by Van Damme, Radstaak and Santbulte (2014). Since many activities in the air cargo supply chain are not fully related to air cargo, estimations had to be made for these specific activities. Districon and Ecorys (2005) provided some insight on these estimations, however were very general. Therefore, new estimation methods are developed or company specific data selection is performed for a more targeted approach. This means that KLM and customs were contacted for employment data, employment of Schiphol airport, airport traffic control and Marechaussee was estimated based on number of cargo flights (6,2%) and employment at airlines without a registered cargo division is estimated based on the ratio of cargo employment at other airlines with a downward correction (20%). The non-location bound activities concern road transport activities related to air cargo and are included based on transport performance. The transport performance is estimated based on expert judgement, Schiphol data and CBS data. The estimates of expert judgement were needed since the national CBS averages are significantly different from the actual numbers in road transport related to air cargo according to the road transport sector. The total employment is divided

per sector and multiplied by the CBS average of added value per employee per sector which yields the total direct added value. With the national accounts of CBS and the Leontief multipliers the indirect effect is calculated. The indirect effect had to be corrected for double counts, which is performed with the method of Decisio (2015), since this was deemed as the most fitting method.

The model has been checked for robustness with three sensitivity analyses on the most arbitrary estimates; airlines without cargo division, road transport and the defines regions have been checked. This resulted in small deviations from the initial results with a maximum of 4.3 percent with the defined regions.

Therefore, the model and results are fitting for an estimation of the employment and added value of air cargo with the additional limitations of the I/O model. When the economic impact is estimated with the same methodology on a yearly basis, the results are more likely to have the same bias by the imperfections of the data and methodology. This makes the results comparable and trends observable.

6.1   Recommendations for further research

As mentioned, the focus was on the basis of the methodology, which means improvement can be made with further research. First of all, the region specification is currently based on the ACN member list and municipality codes. The regions could be more specific based on postal code to define a narrower area, which possibly could include a part of Amsterdam. A more accurate definition of the regions would lead to a more accurate result. Secondly, the estimations of the road transport sector of air cargo related road transport should be validated. The estimations could be analysed by a sample with survey, truck drivers entering and leaving Schiphol could be asked to fill in this survey. This should be performed at different times during the year (seasonality). Furthermore, the catalytic effect and inclusion of other activities should be researched. Many EDC's are located in the Netherlands because of Schiphol. However, this effect is hard to quantify with the current available data and methods. These activities could be included with a validated multiplier, or as direct effect with employment data of relevant EDC's. The relevant EDC's, related to air cargo, could be identified with surveys on the importance of Schiphol.

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Productiewaarde
BASISTABEL

	Landbouw	Industrie	Diensten	Finale vraag	Totaal
Landbouw	30	40	0	30	100
Industrie	10	200	50	140	400
Diensten	20	80	200	200	500
Andere bronnen	40	80	250	230	600
Totaal	100	400	500	600	1600

Verhoudingstabel met relaties tussen sectoren

	Landbouw	Industrie	Diensten
Landbouw	0,30	0,10	0,00
Industrie	0,10	0,50	0,10
Diensten	0,20	0,20	0,40

Effecten van impuls; veel herhalingen input output relaties…

Eerste-orde indirecte effect

	Vraagimpuls
Landbouw	100,00
Industrie	0,00
Diensten	0,00

	Landbouw	Industrie	Diensten	Indirect effect (som)
Landbouw	30,00	-	-	30,00
Industrie	10,00	-	-	10,00
Diensten	20,00	-	-	20,00
				60,00

Tweede-orde indirecte effect

	Vraagimpuls
Landbouw	30,00
Industrie	10,00
Diensten	20,00

	Landbouw	Industrie	Diensten	Indirect effect (som)
Landbouw	9,00	1,00		10,00
Industrie	3,00	5,00	2,00	10,00
Diensten	6,00	2,00	8,00	16,00
				36,00

Etc.

	Vraagimpuls
Landbouw	10,00
Industrie	10,00
Diensten	16,00

	Landbouw	Industrie	Diensten	Indirect effect (som)
Landbouw	3,00	1,00	-	4,00
Industrie	1,00	5,00	1,60	7,60
Diensten	2,00	2,00	6,40	10,40
				22,00

	Vraagimpuls
Landbouw	4,00
Industrie	7,60
Diensten	10,40

	Landbouw	Industrie	Diensten	Indirect effect (som)
Landbouw	1,20	0,76	-	1,96
Industrie	0,40	3,80	1,04	5,24
Diensten	0,80	1,52	4,16	6,48
				13,68

	Vraagimpuls
Landbouw	1,96
Industrie	5,24
Diensten	6,48

	Landbouw	Industrie	Diensten	Indirect effect (som)
Landbouw	0,59	0,52	-	1,11
Industrie	0,20	2,62	0,65	3,46
Diensten	0,39	1,05	2,59	4,03
				8,61

	Vraagimpuls
Landbouw	1,11
Industrie	3,46
Diensten	4,03

	Landbouw	Industrie	Diensten	Indirect effect (som)
Landbouw	0,33	0,35	-	0,68
Industrie	0,11	1,73	0,40	2,25
Diensten	0,22	0,69	1,61	2,53
				5,45

	Vraagimpuls
Landbouw	0,68
Industrie	2,25
Diensten	2,53

	Landbouw	Industrie	Diensten	Indirect effect (som)
Landbouw	0,20	0,22	-	0,43
Industrie	0,07	1,12	0,25	1,44
Diensten	0,14	0,45	1,01	1,60
				3,47

	Vraagimpuls
Landbouw	0,43
Industrie	1,44
Diensten	1,60

	Landbouw	Industrie	Diensten	Indirect effect (som)
Landbouw	0,13	0,14	-	0,27
Industrie	0,04	0,72	0,16	0,92
Diensten	0,09	0,29	0,64	1,01
				2,21

Zelfde effect, maar de Leontief matrixoplossing

BASISTABEL

	Landbouw	Industrie	Diensten	Finale vraag	Totaal
Landbouw	30	40	0	30	100
Industrie	10	200	50	140	400
Diensten	20	80	200	200	500
Andere bron	40	80	250	230	600
Totaal	100	400	500	600	1600

IO-coëfficiëntenmatrix (M)

	Landbouw	Industrie	Diensten
Landbouw	0,30	0,10	0,00
Industrie	0,10	0,50	0,10
Diensten	0,20	0,20	0,40

Eenheidsmatrix (I)

	Landbouw	Industrie	Diensten
Landbouw	1	0	0
Industrie	0	1	0
Diensten	0	0	1

(I - D)

	Landbouw	Industrie	Diensten
Landbouw	0,70	-0,10	0,00
Industrie	-0,10	0,50	-0,10
Diensten	-0,20	-0,20	0,60

$(I - D)^{-1}$ (=INDIRECTE EFFECTENMATRIX!!)

	Landbouw	Industrie	Diensten
Landbouw	1,49	0,32	0,05
Industrie	0,43	2,23	0,37
Diensten	0,64	0,85	1,81
Multiplier	2,55	3,40	2,23

Vraagimpuls

	Landbouw	Industrie	Diensten
Bestedingen	100	0	0

Indirect effect

	Totaal	Direct	Indirect
Landbouw	148,9	100,0	48,9
Industrie	42,6	0,0	42,6
Diensten	63,8	0,0	63,8
Totaal	255,3	100,0	155,3

Door de productie per sector te vermenigvuldigen met de werkgelegenheid en toegevoegde waarde per mln. euro productie (per sector), kunnen ook werkgelegenheids en toegevoegde waarde multipliers worden berekend.

Functie: cellen door matrix selecteren (P34:R37) --> inversemat --> bronmatrix selecteren (P28:R30) en dan CTRL + SHIFT + ENTER

	Vraagimpuls		Landbouw	Industrie	Diensten	Indirect effect (som)
Landbouw	0,27	Landbouw	0,08	0,09	-	0,17
Industrie	0,92	Industrie	0,03	0,46	0,10	0,59
Diensten	1,01	Diensten	0,05	0,18	0,41	0,64
						1,41

	Vraagimpuls		Landbouw	Industrie	Diensten	Indirect effect (som)
Landbouw	0,17	Landbouw	0,05	0,06	-	0,11
Industrie	0,59	Industrie	0,02	0,30	0,06	0,38
Diensten	0,64	Diensten	0,03	0,12	0,26	0,41
						0,90

	Vraagimpuls		Landbouw	Industrie	Diensten	Indirect effect (som)
Landbouw	0,11	Landbouw	0,03	0,04	-	0,07
Industrie	0,38	Industrie	0,01	0,19	0,04	0,24
Diensten	0,41	Diensten	0,02	0,08	0,16	0,26
						0,57

	Vraagimpuls		Landbouw	Industrie	Diensten	Indirect effect
Landbouw	0,07	Landbouw	0,02	0,02	-	0,05
Industrie	0,24	Industrie	0,01	0,12	0,03	0,15
Diensten	0,26	Diensten	0,01	0,05	0,10	0,17
						0,37

	Vraagimpuls		Landbouw	Industrie	Diensten	Indirect effect (som)
Landbouw	0,05	Landbouw	0,01	0,02	-	0,03
Industrie	0,15	Industrie	0,00	0,08	0,02	0,10
Diensten	0,17	Diensten	0,01	0,03	0,07	0,11
						0,23

	Vraagimpuls		Landbouw	Industrie	Diensten	Indirect effect
Landbouw	0,03	Landbouw	0,01	0,01	-	0,02
Industrie	0,10	Industrie	0,00	0,05	0,01	0,06
Diensten	0,11	Diensten	0,01	0,02	0,04	0,07
						0,15

	Vraagimpuls		Landbouw	Industrie	Diensten	Indirect effect (som)
Landbouw	0,02	Landbouw	0,01	0,01	-	0,01
Industrie	0,06	Industrie	0,00	0,03	0,01	0,04
Diensten	0,07	Diensten	0,00	0,01	0,03	0,04
						0,10

	Vraagimpuls		Landbouw	Industrie	Diensten	Indirect effect (som)
Landbouw	0,01	Landbouw	0,00	0,00	-	0,01
Industrie	0,04	Industrie	0,00	0,02	0,00	0,03
Diensten	0,04	Diensten	0,00	0,01	0,02	0,03
						0,06

	Vraagimpuls		Landbouw	Industrie	Diensten	Indirect effect (som)
Landbouw	0,01	Landbouw	0,00	0,00	-	0,00
Industrie	0,03	Industrie	0,00	0,01	0,00	0,02
Diensten	0,03	Diensten	0,00	0,01	0,01	0,02
						0,04

	Vraagimpuls		Landbouw	Industrie	Diensten	Indirect effect (som)
Landbouw	0,00	Landbouw	0,00	0,00	-	0,00
Industrie	0,02	Industrie	0,00	0,01	0,00	0,01
Diensten	0,02	Diensten	0,00	0,00	0,01	0,01
						0,02

	Vraagimpuls		Landbouw	Industrie	Diensten	Indirect effect (som)
Landbouw	0,00	Landbouw	0,00	0,00	-	0,00
Industrie	0,01	Industrie	0,00	0,01	0,00	0,01
Diensten	0,01	Diensten	0,00	0,00	0,00	0,01
						0,02

	Vraagimpuls		Landbouw	Industrie	Diensten	Indirect effect (som)
Landbouw	0,00	Landbouw	0,00	0,00	-	0,00
Industrie	0,01	Industrie	0,00	0,00	0,00	0,00
Diensten	0,01	Diensten	0,00	0,00	0,00	0,00
						0,01

	Direct	Indirect	Totaal
Landbouw	100	49	149
Industrie	0	43	43
Diensten	0	64	64
Totaal	100	155	255

Source: De Pater, M. (2018). Personal email.

Appendix B – SBI codes Transport and Warehousing

H   Vervoer en opslag

49   Vervoer over land

49.1   Personenvervoer per spoor (geen tram of metro)
49.10   Personenvervoer per spoor (geen tram of metro)

49.2   Goederenvervoer per spoor
49.20   Goederenvervoer per spoor

49.3   Personenvervoer over de weg
49.31   Openbaar vervoer binnen steden
49.32   Vervoer per taxi
49.39   Vervoer per bus, tram en metro (geen stadsvervoer)
49.39.1   Ongeregeld besloten busvervoer
49.39.2   Streekvervoer per bus, tram en metro
49.39.3   Geregeld besloten busvervoer

49.4   Goederenvervoer over de weg
49.41   Goederenvervoer over de weg (geen verhuizingen)
49.42   Verhuisvervoer

49.5   Transport via pijpleidingen
49.50   Transport via pijpleidingen

51   Luchtvaart

51.1   Personenvervoer door de lucht
51.10   Personenvervoer door de lucht

51.2   Goederenvervoer door de lucht
51.21   Goederenvervoer door de lucht

52   Opslag en dienstverlening voor vervoer

52.1   Opslag
52.10   Opslag
52.10.1   Opslag in tanks
52.10.2   Opslag in koelhuizen e.d.

52.10.9	Opslag in distributiecentra en overige opslag (niet in tanks, koelhuizen e.d.)
52.2	Dienstverlening voor vervoer
52.21	Dienstverlening voor vervoer over land
52.22	Dienstverlening voor vervoer over water
52.23	Dienstverlening voor de luchtvaart
52.24	Laad-, los- en overslagactiviteiten
52.24.1	Laad-, los- en overslagactiviteiten voor zeevaart
52.24.2	Laad-, los- en overslagactiviteiten niet voor zeevaart
52.29	Expediteurs, cargadoors en bevrachters; weging en meting
52.29.1	Expediteurs, cargadoors, bevrachters en andere tussenpersonen in het goederenvervoer
52.29.2	Weging en meting
53	Post en koeriers
53.1	Nationale post met universele dienstverplichting
53.10	Nationale post met universele dienstverplichting
53.2	Post zonder universele dienstverplichting en koeriers
53.20	Post zonder universele dienstverplichting en koeriers
53.20.1	Post zonder universele dienstverplichting
53.20.2	Koeriers

Source: Kamer van Koophandel (2018). Overzicht Standaard bedrijfsindeling

Appendix C – Email Air cargo related employment data customs

Beste Ruben,

Hierbij de gevraagde cijfers.

Het aantal werknemers werkzaam bij Douane Schiphol Cargo is:
- in 2010: 736 koppen/ 696 fte
- in 2015 540 koppen/503 fte

Hier hoort wel een toelichting bij om het best wel grote verschil in koppen/fte te verklaren.

In 2014/2015 is er sprake geweest van een landelijke centralisatie van staftaken en ook van een landelijke centralisatie van de aansturing van controleopdrachten. Daarvoor zijn twee aparte kantoren ingericht, een landelijke serviceorganisatie en een landelijk tactisch centrum. Medewerkers (fte) die belast waren met deze taken zijn ondergebracht bij de twee nieuwe kantoren en de gemoeide fte's hebben wij als kantoor daarmee ingeleverd.
Schipholgerelateerd zijn er in 2015 124 koppen/ 118 fte werkzaam bij het Douane Landelijk Tactisch Centrum en 65 koppen/57 fte bij de Douane Landelijke Service Organisatie. Een optelsom maakt dat wij dan als kantoor Douane Schiphol Cargo in 2015 toch met zo'n 20 fte minder het werk hebben moeten doen.

Ik vond het wel heel leuk dat je -toevallig- naar het jaar 2015 hebt gevraagd. Hiermee kun je zien dat de wijze waarop een organisatie intern is georganiseerd ook van invloed is op de werkgelegenheid op Schiphol.

Ik hoop je hiermee voldoende te hebben geholpen.
Mocht je nog vragen hebben, kun je me natuurlijk altijd nog even mailen.

Ik wens je heel veel succes met het schrijven van je scriptie en veel plezier tijdens je stage!

Met   vriendelijke   groet,

Willeke   **Tops**
Managementassistente   directie   DSC
....
Belastingdienst/ Douane Schiphol   **Cargo**
Evert   van   de   Beekstraat   384| 1118CZ| Luchthaven   Schiphol
Postbus   3070 | 6401   DN | Heerlen
....
M: 06   1052   89   50
w.tops-kruize@belastingdienst.nl
MA van Jan Kamp, Evert de Jager en Josje van der Tonnekree

Source: Tops, W. (2018) Douane Schiphol Cargo

Appendix D – Email KLM cargo related employment data

Van: "Santbulte, Wico (SPLFA) - KLM" <Wico.Santbulte@KLMCARGO.COM>
Datum: 28 juni 2018 om 08:15:50 CEST
Aan: Ben Radstaak <Ben.Radstaak@acn.nl>
Onderwerp: Antw.:☐ Nog wat vragen☐

Hoi Ben,

Over trucking heb ik geen cijfers, maar de FTE's heb ik voor je

Groet,

Wico

KLM Cargo

2015: 1.702

2010: 1.672

Martinair Cargo

2015 (ex pilots): 169

2010 (ex pilots): 255

Martinair Cargo Cockpit crew

2015: 180 cockpit crew

2010: 260 cockpit crew

Source: Santbulte, W. (2018) KLM