The Economic Effects of Brussels Airport

Independent study by UAntwerp and UCLouvain, commissioned by Brussels Airport Company

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Antwerp, 30th November 2023

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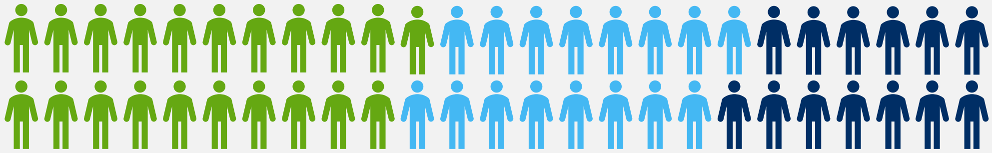
Demand side

Employees (60,563)

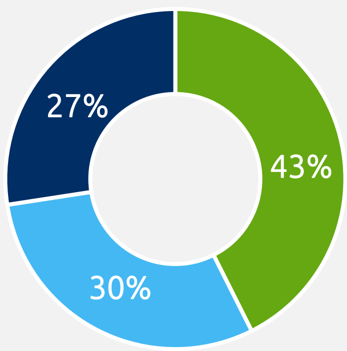


Direct	Indirect	Induced
25,796 employees	**19,152** employees	**15,615** employees
42%	32%	26%

The **3,662 employees** hosted by the **airport business district** are not directly related to airport activities and are thus not included here.

Added Value (5.408 bln.)

Induced
€1.483 bln.



Direct
€2.303 bln.

Indirect
€1.622 bln.

Direct employers (357)

Top 5 employers (employees)

1. brussels airlines
2. DHL Aviation
3. TUI
4. swissport
5.

Top 5 employers (added value)

1. brussels airport the heart of Europe
2. brussels airlines
3. skeyes
4. DHL Aviation
5.

Supply side

Catalytic effects

8.83 bln. added value	**81,637** employees	**1.85%** of Belgium GDP in 2019

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Executive summary

In this study, the economic impact of Brussels Airport is investigated in terms of employment and added value on different levels for the year 2019. This year was chosen as the last 'normal' year before the COVID-19 outbreak started.

First, the **direct effects** of the airport are investigated based on a company and annual account analysis, according to a similar yet slightly updated methodology from the National Bank of Belgium (NBB). This study takes into account only airport-related activities. Activities in the airport zone that are not directly related to airport activities in a strict sense, such as the Airport Business District, which accounts for 3,662 employees on the site, have been calculated separately, and are not included in the proper direct effects. The direct effects are generated by airline and airport operations in the airport zone and other directly airport-related activities, such as concessions to airport shops and airport hotels. For Brussels Airport, the direct effects account for 2.303 billion euros added value, 21,773 full-time equivalents or 25,796 employees who work in 357 companies. When distributing these direct effects between passengers (including joint supporting activities) and cargo, it could be observed that 27% of the full-time equivalents (5,829) and the employees (7,062) and 23% of the added value (538,753,344) are solely obtained through cargo activities.

Second, the **indirect effects** of the airport are estimated based on the methodology of the NBB, using an input-output analysis. The indirect effects are created by companies providing services to the airport and passengers or supporting cargo operations such as the provisioning of restaurants at the airport or not airport-related logistic warehousing outside the airport zone. The indirect effects comprise 1.622 billion euros added value and 17,399 full-time equivalents or 19,152 employees.

Third, the **induced effects** of the airport are estimated by extending the input-output model based on a study by Huderek-Glapska (2020). These effects include the spending of wages in the national economy by employees working at the directly and indirectly related companies. The induced level provides 1.483 billion euros added value and 13,513 full-time equivalents or 15,615 employees.

The sum of those three effects is the economic effect of Brussels Airport on the Belgian economy when analysed from the demand side of the airport. Brussels Airport's direct, indirect and induced effects are 52,685 FTEs, or 60,563 employees and 5.408 billion euros added value in total, accounting for 1.13% of the Belgian GDP in 2019.

Finally, a tentative estimation of the **catalytic effects** applying an earlier established econometric analysis of InterVISTAS for ACI Europe is performed. These effects can be described as the supply side effects or, more concretely, "the comprehensive economic advantages that arise from an airport's ability to stimulate various sectors of the economy, such as trade, investments, productivity, and tourism" (InterVISTAS, 2015). The sum of those catalytic effects is the economic effect created on the supply side. As for the catalytic effects, it is concluded that the airport creates an added value of 8.83 billion euros. When this is converted to the number of employees, this is the equivalent of 81,637 employees. This accounts for 1.85% of our Belgian GDP in 2019.

To summarise, Brussels Airport's direct, indirect and induced effects (the economic effects from the demand side) are estimated at 52,685 FTEs, or 60,563 employees and 5.408 billion euros added value in total, accounting for 1.13% of the Belgian GDP in 2019. The airport business district hosts another 3,662 employees on the airport site. The catalytic effects (the economic effects from the supply side) are estimated at 8.83 billion euros added value. When this is converted to the number of employees, this is the equivalent of 81,637 employees. This accounts for 1.85% of our Belgian GDP in 2019.

Keywords:

Economic effects | Airport activities | Employment | Added value | Brussels Airport

Acknowledgements

The authors want to thank Saskia Vennix from the National Bank of Belgium, Marie Durant and Freddy Cocquit from the National Social Security Office and Bart Hertveldt from the Federal Planning Bureau for providing information on earlier studies, employment data and the Input-Output tables, respectively.

1. Introduction

In today's times, an airport should be able to quantify and express its impacts on all possible areas. This can range from an environmental impact study to an economic impact study to provide an overview of the social and economic benefits of air transport and airport activities (Montalvo, 1998). With this economic impact study, Brussels Airport now has a comprehensive overview of direct, indirect, induced, and catalytic effects. This study complements the spectrum of relevant airport-related studies.

Economic impact studies of airports can be executed in many ways. It is, therefore, essential to keep the ultimate objective of the study in mind when deciding which method to adopt. At the request of the Federal Aviation Administration, the ACRP (2008) conducted a study on the reasons for an airport economic impact study. This revealed that the main reason for requesting an economic impact study is 'to indicate the significance of the airport towards the local community' (as indicated in Figure 1). This was endorsed by 93.1% of users and 100% by the authors of such studies.

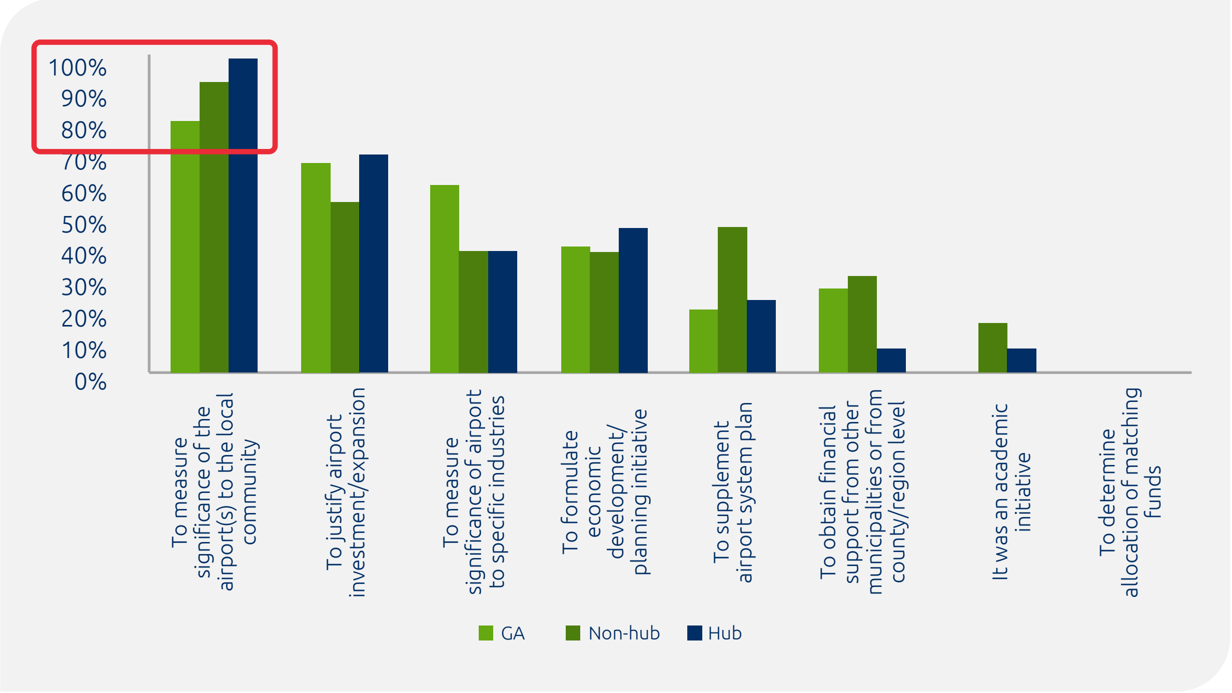

Figure 1: The reasons for conducting an economic impact study of airports (ACRP, 2008)

The objective of this report is to generate a reliable and academically sound view of the airport's economic impact. Therefore, we looked at several ways of doing this: e.g., financial key performance indicators, a (social) cost-benefit analysis, a wider economic benefit analysis or an input-output analysis. The National Bank of Belgium (NBB) provided these insights until 2015 by publishing an annual report which included estimating and assessing the economic importance of air transport and airport activities in Belgium in terms of value-added, employment and investments. We mainly used this methodology (Kupfer & Lagneaux, 2009; Vennix, 2017) as our principal guideline. Note that the induced and catalytic effects are mentioned in those NBB studies, but are not estimated. It is, therefore, of utmost interest to update the estimations of 2015 for the direct and indirect effects of Brussels Airport and to investigate the induced and catalytic effects of Brussels Airport. This gives Brussels Airport and its stakeholders a better view of the impact of its economic activities in the region and in Belgium.

2. Literature review

As stated earlier, the economic impact can be expressed in various terms such as the number of full-time equivalents, employees or the added value (expressed in billion euros) generated by the airport's existence. The total economic impact of an airport on the demand side in such terms can be divided into three categories: direct, indirect and induced effects (ACI Europe, 2015; ACRP, 2008; Baker et al., 2015; Bogdański, 2014; Button et al., 2010; Olariaga, 2021; Zuidberg & Veldhuis, 2012).

The direct employment and added value are generated by airline and airport operations in the airport zone and other directly airport-related activities, such as concessions to airport shops and airport hotels. Companies providing services to the airport, passengers or supporting cargo operations create indirect employment and added value. These services include, for example, the provisioning of restaurants at the airport or non airport-related logistic warehousing outside the airport zone. In addition, induced employment and added value are generated by employees working at the directly and indirectly related companies that spend their wages again in the national economy. An overview of the different effects that compose the total economic effects of an airport can be found in Table 1. The estimation of these effects will answer the question 'What economic effects would be lost if the total demand for air transport at Brussels Airport would disappear?'.

Apart from the demand-side effects, there is also a supply side effect, which is defined by the catalytic effects. These effects include "the comprehensive economic advantages that arise from an airport's ability to stimulate various sectors of the economy, such as trade, investments, productivity, and tourism" and answer the question 'What economic effects would be lost if the airport was not there?' (Forsyth et al., 2021; InterVISTAS, 2015).

Economic effects on the demand side			Economic effects on the supply side
Direct effects	**Indirect effects**	**Induced effects**	**Catalytic effects**
Employment and added value generated by the (construction and) operation of the airport. **Airports** 1. Management 2. Maintenance 3. Operations 4. Security 5. Rescue fire **Concessions** 1. Real estate 2. Hotels 3. Catering 4. Ground handling **Airlines** 1. Airline ticketing 2. Flight crew 3. Check-in staff 4. Maintenance crew **Air navigation service providers** 1. Air traffic controllers 2. Management **Civil aerospace** 1. Engineers 2. Designers 3. Construction	Employment and added value created by the chain of suppliers of goods and services to the direct activities, within the economy of the study area. **Off-site** 1. Fuel suppliers 2. Food and beverage 3. Construction 4. Transport providers **Manufacturing** 1. Computer components 2. Retail goods **Services** 1. Accounting firms 2. Lawyers 3. Call centers 4. IT systems	Employment and added value generated by the spending of incomes by employees that are created by the direct and indirect effects, within the economy of the study area. **For instance:** groceries and childcare where the employees spend money on.	Employment and added value that arises from an airport's ability to stimulate various sectors of the economy, such as trade, investments, productivity, and tourism. **For instance:** Tourism 1. Hotels 2. Entertainment 3. Restaurants 4. Museum 5. Tour operators Trade Productivity and investments of other businesses Connectivity

Table 1: Total economic effects from the demand and supply side perspective (own composition, based on InterVISTAS)

A complete list of the used literature can be found at the end of this report.

3. Methodology

The methodology to estimate the direct and indirect effects was adapted from the methodology used in the economic impact studies of the National Bank of Belgium (NBB). In those studies, the economic impact of the six individual airports in Belgium was estimated annually up to and including 2015 (Kupfer & Lagneaux, 2009; Vennix, 2017). The induced effects were calculated by extending the input-output model based on a study by Huderek-Glapska (2020). Finally, the estimation of the catalytic effects of Brussels Airport was based on a study by InterVISTAS for ACI Europe in which the causality between a given country's connectivity thanks to its airport(s) and a country's Gross Domestic Product was used as a foundation. In what follows, the methodology is explained for each effect; first, the methodology is explained for the direct effects, then the indirect and induced effects, and finally, the catalytic effects.

3.1. Direct effects

The direct effects were estimated based on an annual account analysis that involved four steps. First, a company list was composed based on the relevant sector codes; then, the companies from the list were linked to their annual accounts, after which the number of FTEs, employees and value-added could be derived. Finally, a sensitivity analysis was executed to determine the confidence interval.

3.1.1. Company analysis

In the first phase of this analysis, it was necessary to list the companies that directly generate employment at or provide direct added value to the airport. Figure 2 gives an overview of the types of companies that were included in this study.

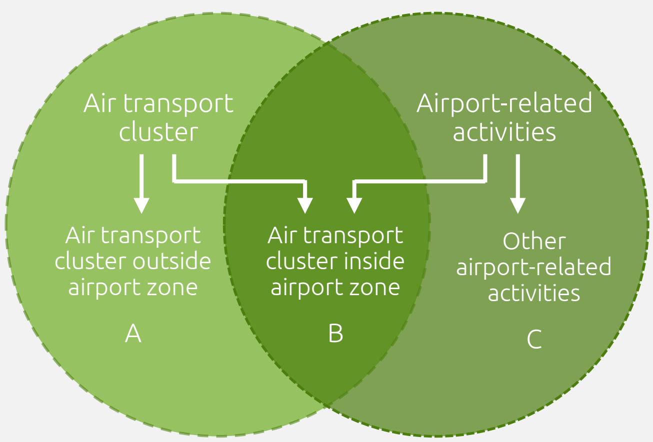

Figure 2: Direct impact of air transport cluster and airport (own composition based on Kupfer & Lagneaux, 2009)

The left side of Figure 2 shows the types of companies that would be included when estimating the economic impact of an air transport cluster. The right side demonstrates the types of companies that should be included when estimating the economic impact of an airport. More specifically, in this study, it was therefore necessary to include all companies within the air transport cluster inside the airport zone (e.g. airlines or baggage handlers) and all other airport-related activities (e.g. restaurant concessions or airport hotels). Businesses outside categories 'B' and 'C' do not belong under the category of direct effects of individual airports. Consider, for example, businesses that are not airport-related but are in the airport zone (e.g., IT consultancy companies that are not providing services for the airport), or businesses that are air transport related but are located outside the airport zone (e.g., SABCA (Société Anonyme Belge de Constructions Aéronautiques)).

To distinguish between companies inside and outside the airport zone, the airport area was delineated based on the airport boundaries and the territory of municipalities on which the airport is located (see chapter 4 'data collection').

There were also some exceptions to consider when compiling the list of relevant companies. For example, the name displayed on the airport's company list sometimes differed from the company's official name required to request the annual accounts. This was verified on an individual basis. Secondly, the airport also provides jobs for self-employed people and there are also non-profit organizations (NPOs) based at the airport. In principle, these were not included in the direct effects of the airport, unless it concerned (the training of) pilots in flight schools. Here, an average from the sector was then used to calculate the added value. A third exception when compiling the enterprise list was employees working for the government. After all, they are not declared as an enterprise and would therefore not be included in the estimations without a manual addition. A final exception was found among airlines that sometimes register employees abroad.

Important to note are two differences with the methodology used by the National Bank of Belgium and HIVA-KU Leuven. First, companies located in the airport zone but having no direct or indirect relation with airport activities were included by the NBB and partly by HIVA-KU Leuven; however, we have not included these companies in the direct effects. Nevertheless, as these companies are present in the airport zone, we have calculated their effects separately. Second, companies located outside the airport zone whose reason for existence is Brussels Airport were not included in the direct effects by the NBB and HIVA-KU Leuven; however, they were included in this study (for instance, the airport hotels located just outside the airport zone). Therefore, the results are not fully comparable.

3.1.2. Link the annual accounts and RSZ data to the companies

Once the company list was finalised, the aim was to link it to the annual accounts in question. For this study, the annual accounts were requested for 2019 as this is the year when the COVID-19 crisis did not yet affect the economic impact that airports can generate and thus, we obtained the most reliable data. In 2023 the airport activities are close to the 2019 activity level, therefore, 2019 serves as a good proxy of the current levels. Since a large amount of employment data was not available in the published annual accounts, the data was supplemented with social security establishment data, obtained from the Belgian Social Security agency RSZ (Rijkdienst voor Sociale Zekerheid)[1]. This was data in which the number of FTEs and employees per establishment of the company in question was provided, which was very relevant to the study because only the establishment at the airport needed to be considered for some companies.

3.1.3. Derive the direct number of FTEs, employees and added value

When the data collection was completed, the direct number of full-time equivalents, employees and direct added value was calculated. The number of direct full-time equivalents and employees could be derived by the sum of the data provided by the RSZ in combination with the sector averages for the exceptions explained in the first step. However, to be able to use the sector averages, the employment hours on the NACE-BEL branche level were divided by the number of hours an employee works per week. An employee working in a given NACE-BEL "branche" was assumed to work either 37.6, 38 or 40 hours a week, each with an equal probability (see chapter 5 'sensitivity analysis').

[1] Or ONSS (Office National de Sécurité Sociale) in French

The formula used in calculating the added value was the sum of numbers 62 (Remuneration, social security contributions and pensions), 630 (Depreciation and amortization of formation expenses, intangible and tangible fixed assets), 631/4 (Write-downs on inventories, contracts in progress and trade receivables additions (reversals)), 635/7 (Costs for risks and provisions), 640/8 (Other operating expenses) and 9901 (Operating profit (Operating loss)) minus 649 (Operating expenses capitalised as restructuring costs) and 740 (Operating subsidies and compensatory amounts received from government) (if it was not product-related). When no information was available on the value-added of a particular establishment, it was possible to work through extrapolation of the number of FTEs. Thus, the total added value could be divided among the different establishments according to the number of FTEs for that establishment. Because of this, it is opportune to show the result with confidence intervals (explained in chapter 5 'sensitivity analysis') as it remains an approximation of the direct economic effects.

3.2. Indirect effects

The indirect effects are the added value and employment generated upstream in the supply chain or in other words, the added value and employment created by suppliers (not only the first level of suppliers but it goes well beyond toward the infinite level) of the direct related companies. The methodology used to estimate these effects was an input-output analysis.

3.2.1. The input-output table

Wassily Leontief is the originator of the input-output model and won the Nobel Prize in economics with it in 1973 (Coppens & Degreef, 2005). The analysis is based on an input-output table in which the total domestic output of the economy is divided by n sectors (illustrated in Table 2).

	1	2	…	n	f	X
1	X_{11}	X_{12}	…	X_{1n}	f_1	X_1
2	X_{21}	X_{22}	…	X_{2n}	f_2	X_2
…	…	…	…	…	…	…
n	X_{n1}	X_{n2}	…	X_{nn}	f_n	X_n
m	m_1	m_2	…	m_n	m_f	
va	va_1	va_2	…	va_n		
X	X_1	X_2	…	X_n		

Table 2: The basics of an input-output table (based on NBB, 2009)

There are two ways to interpret this input-output table. On the one hand, there can be looked horizontally to the table where sector 1 delivers output X_{11}, X_{12}, … to sector 1, 2... or to the exogenous actors (which is the final demand (f) of households, government, investments or export).
On the other hand, there can be looked vertically to the table where sector 1 receives input X_{11}, X_{21}… from sector 1,2,… from import or creates added value itself. When looking horizontally, the total output of a certain sector i can be described as the sum of the intermediate usage and the final consumption, as stated in the below formula:

$$x_i = \sum_{j=1}^{n} x_{ij} + f_i$$

Where:

- x_i = total output of sector i
- x_{ij} = intermediate usage of sector j (from sector i)
- f_i = final demand of products from sector i

Furthermore, many variations of these input-output tables exist, and it depends on the type of study being conducted which table is most appropriate (Eurostat, 2008; European Union, 2013). Firstly, not all input-output tables reflect domestic production. Instead, there are also tables that reflect total (domestic and foreign) production. Tables reflecting total production require more assumptions, such as assuming the same production processes for domestically produced goods and foreign-produced goods. Secondly, there is also a difference between product-by-product input-output tables and industry-by-industry input-output tables. Eurostat's input-output manual (2008) indicates that the product-by-product tables are better suited for many input-output analyses as they can theoretically provide more homogeneous descriptions of the transactions since the industry-by-industry tables can refer a single element to products characteristic of other industries (Eurostat, 2008; European Union, 2013). In other words, the intermediate part of a product-by-product input-output table describes, for each product, the amounts of products that were used to produce this product, irrespective of the producing industry. An industry-by-industry table describes inter-industry relations. The intermediate part of the table represents the use of products in production for each industry. Figure 3 shows the process of preparing the different possible input-output tables according to their specific assumptions.

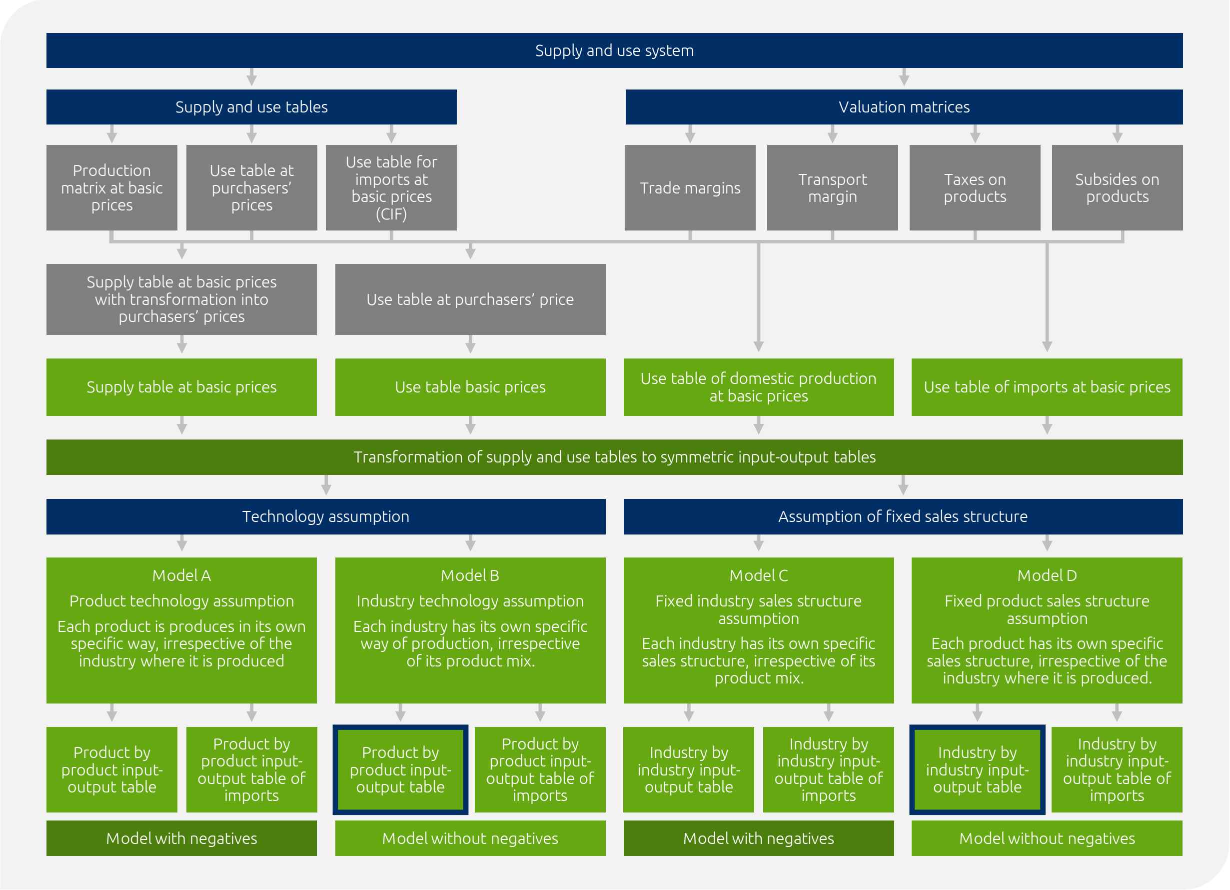

Figure 3: The different types of input-output tables and the way they are drawn up (Eurostat, 2008)

After obtaining the appropriate input-output table (the product-by-product input-output table of 2015), an extra sector 'Brussels Airport' was added apart from the 64 other sectors that were already present in the table. This was necessary because, for instance, sector 51 'air transport' is not entirely dedicated to Brussels Airport and does not include companies related to Brussels Airport that are not air transport related, such as the retail, courier companies etc. To tackle this, every sector was split into a part dedicated to Brussels Airport and a residue according to the share of full-time equivalents and added value in that sector working for Brussels Airport and the residue part.[2] The sum of all the Brussels Airport parts was then the new sector. Mathematically, this extension of the input-output table was done via the following matrix transformation:

$$X' = A^T X A$$

Where:

- X is the original input-output table ($n \times n$ matrix)
- X' is the extended input-output table ($(n+1) \times (n+1)$ matrix)
- A is the transformation matrix ($(n \times (n+1)$ matrix) and A^T its transpose matrix

[2] NBB Stat does not report FTEs on NACE-BEL branche level, which was needed in our calculation of the direct and induced employment effects. Therefore, the employment hours on NACE-BEL branche level were divided by the number of hours an employee works per week. It was assumed that an employee working in a given NACE-BEL branche works either 37.6, 38 or 40 hours a week, each with an equal probability (uniform distribution).

Suppose that the share of the Brussels Airport cluster in the employment (or added value) of sector i, is represented as p_i, then the transformation matrix A was composed as:

$$A = \begin{pmatrix} p_1 & 1-p_1 & 0 & \cdots & 0 \\ p_2 & 0 & 1-p_2 & \cdots & 0 \\ \vdots & \vdots & \vdots & \ddots & 0 \\ p_n & 0 & 0 & 0 & 1-p_n \end{pmatrix}$$

3.2.2. The technical coefficients

As a second step, the input or output coefficients should be calculated based on the inputs (i.e., a horizontal reading of the IOT) or the outputs (i.e., a vertical reading of the input-output table). The most used method – the technical coefficients method – uses the input structure of the table. In the NBB's economic impact analyses the output structure was used, applying the degrees of dependency method. However, if the same IO tables and the same data are used, both methods should give equal results (Aviato, 2020; Coppens & Degreef, 2005).

Since not all data was available to apply the degrees of dependency method, the technical coefficients were estimated in this report. These capture in one number the input structure of a sector and are defined as the intermediate use of products between two industries (for every unit of output from sector j, aij units of output from sector i are used). When looking at the earlier formula, this means:

$$x_i = \sum_{j=1}^{n} \frac{x_{ij}}{x_j} \,.\, x_j + f_i \quad \leftrightarrow \quad x_i = \sum_{j=1}^{n} a_{ij} \,.\, x_j + f_i$$

Where: $a_{ij} = \frac{x_{ij}}{x_j}$ = the technical coefficient

3.2.3. The Leontief multiplier

When the technical coefficients were defined, the Leontief multiplier could be calculated. The Leontief multiplier defines the total effect on the output of the national economy by a change of one unit in final demand for the industry concerned. The reason why it was necessary to look at a multiplier instead of the direct effect of a change in the final demand of a specific industry is the ripple effect. For instance, an increase in the final demand for the air transport industry (e.g., an increase in demand for airline tickets) would not only increase the direct output of the air transport industry (more flights). Instead, the air transport sector would require additional input from the related sectors, such as the wholesaler that offers food and beverages to the in-flight catering company. In that way, the output from these industries would also increase and in turn, these sectors would require additional input from the related sectors. More concretely, the Leontief Multiplier was calculated as follows:

$$X = AX + F$$

$$\Leftrightarrow F = X - AX$$

$$\Leftrightarrow F = (I - A)X$$

$$\Leftrightarrow X = (I - A)^{-1}.F$$

$$\Leftrightarrow X = L.F$$

Where:

- X = matrix with the output
- A = matrix with the technical coefficients
- F = matrix with the final demand
- I = identity matrix
- L = Leontief multiplier

Thereafter, a correction factor was applied (by dividing the Leontief multiplier through the technical coefficient from the sector) to become the net multiplier. This was necessary to estimate the net effect of a change in the final demand of a certain sector.

3.2.4. Indirect FTEs and added value

In the final stage, the Leontief multiplier and the total final demand of Brussels Airport was used to calculate the effect on the number of full-time equivalents, employees and added value when Brussels Airport disappears, and both the intermediate usage and final demand fall back to zero. The change in direct and indirect full-time equivalents or employees was estimated by using the formula[3] on the next page. Because only the indirect effect was calculated here, the number of direct full-time equivalents was subtracted from the result.

$$\Delta e_i^{(\infty)} = \sum_i \frac{e_i}{x_i} . (1 - a_{ij})^{-1} . \Delta f_j = \sum_i \frac{e_i}{x_i} . \ l_{ij} . \Delta x_j$$

Where:

- e_i = the number of full-time equivalents / employees in sector i
- x_i = the output in sector i
- $(1 - a_{ij})^{-1}$ or l_{ij} = the Leontief multiplier
- x_j = the output of sector j

Note that, in the formula above, as we were assessing the impact of the entire Brussels Airport sector, we multiplied with the change in the total output of Brussels Airport Δx_j (consisting of both final as intermediary demand), instead of multiplying with a change in just final demand Δ_{fj} , as often done in input-output analyses conducted for other purposes.

3.2.5. Attention points of the input-output analysis

As much as the input-output analysis is an established, well-known method for employing economic impact studies, it is also criticised by some academic experts (Forsyth et al., 2021; Huderek-Glapska, 2020; Montalvo, 1998). The main points of criticism are:

1. There might be a misinterpretation of results because there could be differences in defining the effects and the impact area. Therefore, it is crucial to consider the definitions of the described effects and the impact area as being the country in total (not only the close surroundings of the airport) in this study.
2. The results are static. This means that the time of performing the analysis should be considered when distributing the results. For instance, the conduction of the study in a peak year may overestimate the results and conversely, conducting the study in a recession may underestimate the size of the effects (Huderek-Glapska et al., 2016).
3. The absence of the airport would then require the employees etc. to be reallocated to other sectors. However, over the last five years, there has been an average unemployment rate of 12.86% in the Brussels-Capital region (Statbel, 2023). For 2019 (year of the study), Brussels had an average unemployment rate of 12.83%. As the unemployment rate has remained relatively stable over the last five years, it can be argued that this is structural unemployment, and the disappearance of the airport could indeed have an impact on the unemployment rate in Brussels.

[3] The formula was the same for calculating the value-added but then the ei was changed into VAi.

3.3. Induced effects

The induced effects of an airport can be described as the added value or employment that is generated by the expenditure of the direct and indirect employment incomes. In other words, the induced effects are a multiplier effect of the sum of the direct and indirect effects. For instance, a certain airport ground handler employee buys a new car with his income, which can then be re-spent by the car dealer at a certain percentage on a new bicycle and groceries (all issued in the same country where the airport is located).

3.3.1. Extend the input-output model

An extension of the previously explained input-output model was used to estimate these induced effects. In this extension of the input-output model, the consumption function or the money flowing in and out of the household sector was added as an additional sector in the input-output model (D'Hernoncourt et al., 2011; Huderek-Glapska, 2020; Miyazawa, 2012; Pischner and Stäglin, 1976; Schumann, 1975). This means that the input-output matrix includes an extra row' compensation of employees' and an additional column 'final consumption expenditure by households' (as highlighted in Table 3). The extra row, the compensation of employees, refers to the labor used per industry, or the income paid to households per unit output from the industries; and the extra column, the final consumption expenditure by households, refers to the different sectors from which an input is bought with the total household income.

	Agriculture, forestry and fishing	Mining	Manufactures	Utilities	Construction	Services	**Final consumption expenditure by households**
Agriculture, forestry and fishing	0.12	0.00	0.04	0.00	0.00	0.00	0.00
Mining	0.00	0.02	0.01	0.22	0.00	0.00	0.00
Manufactures	0.15	0.02	0.19	0.03	0.13	0.04	0.08
Utilities	0.04	0.00	0.01	0.24	0.00	0.01	0.03
Construction	0.01	0.01	0.00	0.01	0.23	0.02	0.00
Services	0.13	0.09	0.13	0.08	0.16	0.25	0.59
Compensation of employees	0.11	0.04	0.17	0.09	0.24	0.35	0.00

Table 3: The necessary extra row and column in the IOT to be able to estimate the induced effects (Miyazawa, 2012)

Using the total household income instead of the total household expenditure was important because a certain part of the consumption can be bought with 'unearned' income, such as a pension, gains from equities, etc. This could result in an overestimation of the Leontief multiplier and induced effects.

3.3.2. Attention points of the extended input-output model

The approach of the extended input-output model enhances the traditional input-output model by treating consumption demand as an endogenous instead of an exogenous variable. However, it should be noted that, while this approach is superior to a rule-of-thumb multiplier, it is still imperfect. Changes in the distribution of labour demand in the economy undoubtedly lead to changes in the income distribution and therefore also in consumption patterns. This sort of effects is not accounted for in the extended input-output model approach used here (Miyazawa, 1976).

3.4. Catalytic effects

Catalytic effects are described by York (2004) as "employment and income generated in the economy of the study area by the wider role of the airport in improving the productivity of businesses and in attracting economic activities such as inward investment and inbound tourism" (InterVISTAS, 2015). Catalytic effects were traditionally not included in economic impact studies because the studies solely focused on the demand effects of airport activities (ACRP, 2015; Forsyth et al., 2021). However, more recent literature states that analysing the supply side effects from an airport as a location factor is gaining importance. Catalytic effects being computed from the supply side must be compared to the direct, indirect and induced effects, as the three latest are computed from the demand side.

Catalytic effects were most often estimated using qualitative research (surveys). However, more recent studies such as the study from interVISTAS for ACI (2015) use a quantitative approach, which analyses the relationship between the GDP per capita and a connectivity index. By controlling for other factors that contribute to economic growth (education, investments, research and development spendings etc.), they try to isolate the impact of air transport, undertaking an econometric analysis estimating the impact of air connectivity on the GDP per capita.

Important to note is that the results of this kind of analysis should always be considered as an indication of magnitude and economic significance rather than a robust and precise number. The reasons are fourfold and explained at the end of this section.

3.4.1. Define catalytic effects

InterVISTAS (2015) retains a more elaborated definition for catalytic effects as being "the comprehensive economic advantages that arise from an airport's ability to stimulate various sectors of the economy, such as trade, investments, productivity, and tourism".

- For instance, airports play a pivotal role in fostering trade by providing connections to new export markets. Despite accounting for a mere 0.5% of global trade volume, air cargo contributes a significant 35% in terms of value, largely due to its high value and time-sensitive nature. Research studies, including works by Cech (2004), Cooper and Smith (2005), the UK Institute of Directors (2008), and others, affirm a positive correlation between heightened air connectivity and the growth of trade activities.
- Similarly, an international airport's geographical proximity is a decisive factor for companies when making location decisions, resulting in increased investments in the surrounding regions. Extensive research by Ishutkina and Hasnman (2009), Cooper and Smith (2005), and others substantiate the connection between enhanced air connectivity and more significant investment activities.

- Furthermore, the impact of airports extends to productivity enhancements. Access to new markets facilitated by airports drives economies of scale, which is central to improved productivity. In turn, the increased trade, investments, business activities, and tourism that airports and aviation activities facilitate contribute to economic productivity, GDP growth, and expanded employment opportunities. Studies conducted by Irwin and Kasarda (1991), Button et al. (1999), and various other researchers underline the role of improved air connectivity in driving these productivity gains.
- The influx of tourists made possible by airports also bolsters the tourism sector and related industries. As tourists arrive, they contribute to the local economy by supporting various businesses such as hotels, restaurants, entertainment venues, and more. Interestingly, even outbound tourism seems to involve spending within the home economy, highlighting how air service impact ripples through various economic activities.

3.4.2. Investigate the relationship between connectivity/GDP and the GDP growth

Quantifying the relationship between air connectivity divided by the GDP and the GDP growth requires a more sophisticated method than surveys due to the extensive distribution necessary. In response, researchers turn to generalised parameters derived from the analysis of historical data.

To delve into this relationship, econometric analysis was employed by InterVISTAS on behalf of ACI Europe. More specifically, an Ordinary Least Squares (OLS) regression analysis was used to relate economic growth to connectivity and other variables that might be expected to have an impact on economic growth. The panel data included data from 40 countries between 2000 and 2012. The final model used a log-log formulation, as follows:

$$\ln(GDP\ per\ capita) = C + \beta_1 \ln(Connectivtiy/GDP) + \beta_2 \ln(Education\ spend) + \beta_3 \ln(R\&D\ spend\ ) + \beta_4 \ln(GCF\ per\ worker) + \beta_5 * country\ dummies + \beta_6 * time\ dummies$$

The IATA connectivity index (see formula below) emerged as a crucial metric, measuring the level of access an airport, region, or country has to the global economy. The connectivity index had been divided by the GDP to control for the influence of economic size on connectivity. For instance, large, rich economies with large populations generally have higher levels of air service.

$$IATA\ connectivity\ index = \frac{[Number\ of\ destinations * weekly\ frequency * seats\ per\ flight]\ weighted\ by\ size\ destination\ airport}{Scalar\ factor\ of\ 1000}$$

Through this analysis, the authors concluded that a 10% increase in connectivity corresponds to a 0.5% increase in GDP per capita. Importantly, this connection is not unidirectional; as an economy grows, it not only supports a burgeoning air transport sector but growth in air transport simultaneously spurs economic expansion. This mutual relationship is established through Granger Causality analysis, substantiating the reciprocal causation between connectivity/GDP and GDP growth.

3.4.3. Estimate the catalytic effects of Belgium

To quantify the catalytic impact, attention was turned to gauging the additional air connectivity that European airports have supported since 1993. This reference year was chosen by InterVISTAS (2015) due to its alignment with the liberalisation of the EU aviation market (the "third package" came into place in 1993, which fully opened the EU market for all EU airlines) and the emergence of low-cost carriers (for example, EasyJet was founded in 1995).

The formula (demonstrated below) employed for this estimation, considered GDP per capita in 1993 (adjusted for 2019 prices), the connectivity-GDP relationship, the percentage change in the connectivity index between 1993 and 2019, and the population in 2019. Through this calculation, the GDP attributed to the incremental economic activity facilitated by air connectivity was deduced, which in turn supported additional employment opportunities in the economy.

$$\begin{aligned}&\textit{Catalytic impact Belgium } 2019\\&= \textit{GDP per capita } 1993 \textit{ inflated to } 2019 \textit{ prices} \,.\, 0.05 \,.\, \frac{\frac{\textit{IATA connectivity index } 2019}{\textit{GDP } 2019} - \frac{\textit{IATA connectivity index } 1993}{\textit{GDP } 1993}}{\frac{\textit{IATA connectivity index } 1993}{\textit{GDP } 1993}} \,.\, \textit{Population } 2019\end{aligned}$$

Because the data for the IATA connectivity index of 1993 were unavailable (see next chapter 'data collection'), we could not directly define the percentage change in the connectivity index between 1993 and 2019. Therefore, we used the ACI connectivity index which is based on the SEO NetScan connectivity model. This airport connectivity measure comprises all connections offered from the airport, either direct or indirect via an intermediate hub and uses OAG passenger flight schedule data on direct flights as input (ACI, 2019). As visible in Figure 4, the correlation between the two indices (the IATA connectivity index and the ACI connectivity index) is prominent. When we plotted the data for 2019 (the indices for Belgium are shown by the green dot), it became immediately apparent that the correlation was surely holding for Belgium.

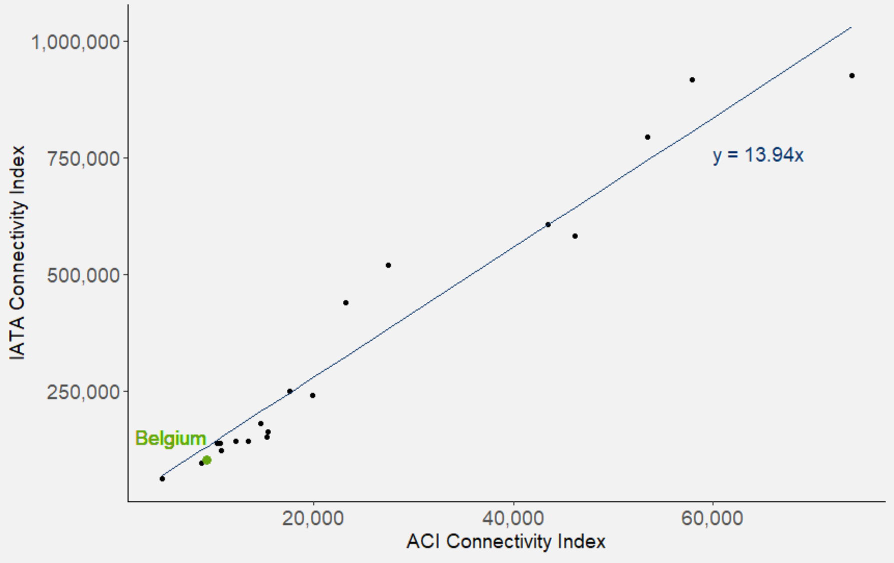

Figure 4: Correlation between the IATA and ACI connectivity index (own composition)

3.4.4. Estimate the catalytic effects of Brussels Airport

Because the study aims to investigate the supply side effects for Brussels Airport, it was necessary to break down the catalytic effects estimated for Belgium to an individual airport level. Because the ACI connectivity index was given for every individual airport, the same factors were used to divide the catalytic effects. It is essential to keep in mind that the connectivity index only considers the passenger flights.

Moreover, to define the number of employees generated by supply side effects, the catalytic impact in terms of added value can be expressed in the number of employees by dividing this catalytic impact in terms of added value by the average GDP per employee in Belgium (InterVISTAS, 2015).

3.4.5. Attention points of the analysis on the catalytic effects

First, it is important to understand the difference between catalytic impact, wider economic benefits, and wider economic impact. As indicated in Table 4, catalytic effects do not consider crowding out (e.g., price effects), general equilibrium impacts (e.g., tax effects) and outbound tourism which makes the catalytic effects substantially higher than the impacts as measured using WEIs (Forsyth & Niemeier, 2020).

	Catalytic	WEB	WEI
Crowding out	✗	✓	✓
General equilibrium effects	✗	✓	✓
Impact on output	✓	NA	✓
Impact on employment	✓	✓	✓
Connectivity	✓ - impact on output	✓ - impact on welfare	✓ - impact on output
Tourism inbound	✓	✓	✓
Tourism outbound	✗ (with exceptions)	✓	✓
Scale economies	✓ in principle	✓	✓
Welfare	✗	✓	NA

Abbreviations : WEBs, wider economic benefits: WEIs, wider economic impacts.

Table 4: Differences between catalytic effects, WEBs and WEIs (Forsyth & Niemeier, 2020)

Second, the estimation is far more complex than the one for direct, indirect, and induced impact because the national economies take a wide range of players acting together to generate economic growth into account: e.g. government, business, infrastructure providers, residents, and others. For example, if no one decided to build hotels in a country, tourism would also be substantially lower (InterVISTAS, 2015).

Third, there is the issue of causality. While air service can undoubtedly facilitate trade, it is equally valid that increased trade fosters a higher demand for air services. This interdependence is recognised by the InterVISTAS study, which confirms a two-way relationship between air connectivity and economic growth. In other words, economic expansion triggers demand for air services, which, in turn, unlocks new prospects in trade, business development, investment, and tourism. This cyclical effect continues to stimulate air service demand and economic growth. Dividing connectivity by GDP assists in accounting for the reciprocal influence of economic growth on connectivity, thereby enabling a detailed assessment of connectivity's distinct contribution to overall GDP growth (InterVISTAS, 2015).

Finally, there are some other methodological considerations:

1. The used connectivity index only takes into account passenger flights, therefore, there might be a partial underestimation of the catalytic effect.
2. The catalytic effects are estimated at the country level, not for a given airport and the breakdown of catalytic effects to individual airports was never done before. Although the authors of this report provided their best efforts to propose a data-driven breakdown method that makes sense, the resulting figures must still be considered with caution.
3. The pattern from which it could be concluded that a 10% increase in connectivity corresponds to a 0.5% increase in GDP per capita (Figure 5), is based on a trend derived from the econometric analysis.

Therefore, as stated earlier, the results of this analysis must be considered as an indication of magnitude and economic significance rather than a robust and precise number.

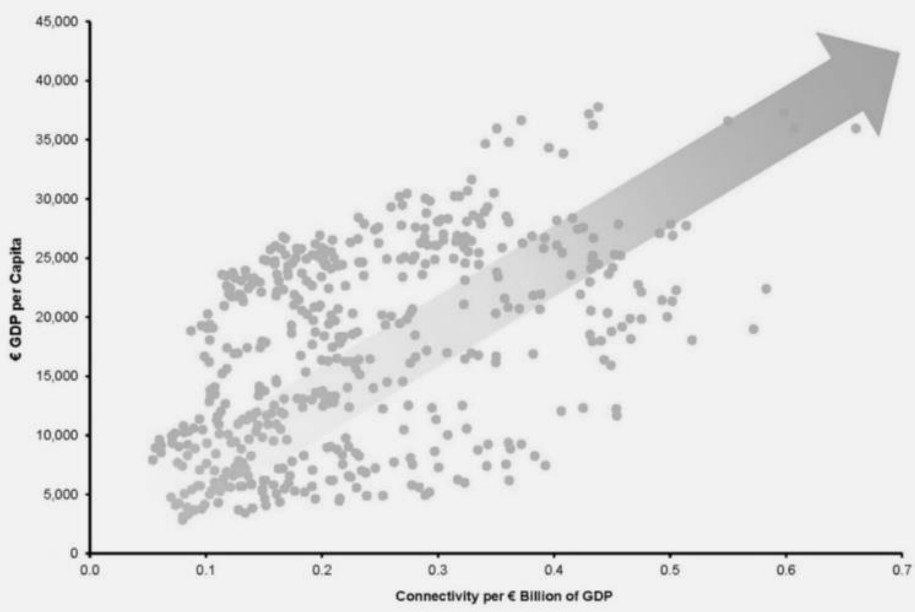

Figure 5: Correlation between the GDP per capita and connectivity per GDP (InterVISTAS, 2015)

4. Data collection

4.1. Direct effects

To estimate the direct effects, the air transport-related companies inside the airport and the airport-related companies around the airport were incorporated. Therefore, it was crucial to delineate the airport zone. For instance, this study delineated the airport zone as the territory of four different municipalities: Machelen (including Diegem boroughs), Steenokkerzeel (including Melsbroek borough), Zaventem and Kortenberg. The four different municipalities were designated to be the airport zone (Figure 6), meaning that all airport-related companies within these municipalities were included in the calculations. [4]

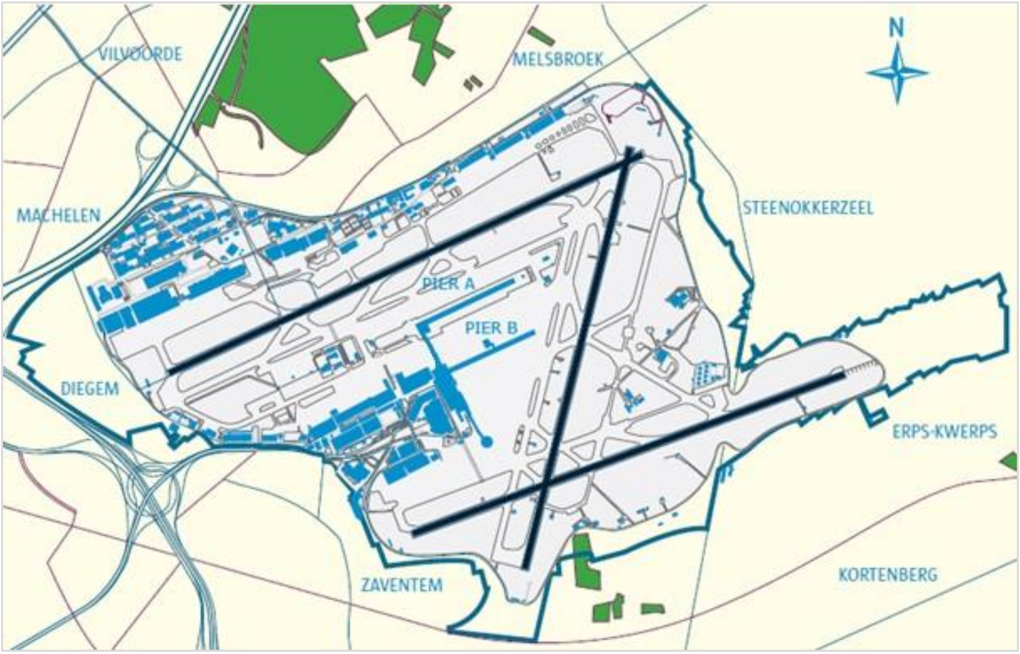

Figure 6: Municipalities in and around Brussels Airport (Brussels Airport)

When all the air transport-related companies inside the airport and the airport-related companies around the airport were listed with the help of a NACE-BEL search in the Bel-First databank, the full-time equivalents, employees and value-added could be estimated. The total number of direct full-time equivalents and employees were retrieved via RSZ data and a sector average was used for certain companies where data was unavailable.[5] The data needed to calculate the added value, according to the formula stated in the methodology part, was retrieved from the Bel-First databank.

4.2. Indirect effects

The Federal Planning Bureau was contacted to provide the most recent product-by-product input-output table (from 2015) for the indirect and induced impact data collection. The IO-table of 2015 was used because this is the most recent IO-table available. Moreover, the national figures of employment, added value and output for each sector were extracted from the NBB and Statbel.

[4] As stated before, the methodology differs here from the methodology of the National Bank of Belgium because in the NBB-study the direct effects were estimated for the companies within the literal airport boundaries.

[5] I.e. for instance airlines that are reporting FTE and employee figures abroad.

4.3. Induced effects

To estimate the induced effects, the same data sources as for the indirect effects were used in combination with the compensation of employees, and the final consumption expenditure by households was extracted from Statbel (Statbel, 2023b).

4.4. Catalytic effects

As the formula suggests, data was gathered concerning the GDP of Belgium, the population of Belgium, the exchange rates to exchange the GDP in dollars to euros, the consumer price index to inflate the prices and the IATA connectivity indexes of 1993 and 2019.

Input (for Belgium)	Sources	1993	2013	2019
GDP	Worldbank, 1993 - 2019	224,721,795,709 dollar	521,791,015,247 dollar	535,830,876,745 dollar
Population	Statbel, 2023c	10,068,319	11,099,554	11,431,406
IATA connectivity index	IATA, 2019	/	/	101,273
Average exchange rate	Eur-lex, 2013; NBB, 2019; Statistiek, 2004	1 dollar = 0.85 euro	1 dollar = 0.75 euro	1 dollar = 0.89 euro
Consumer price index	Statbel, 2023a	/	1 euro in 1993 is 1.49 euro in 2013	1 euro in 1993 is 1.62 euro in 2019
Catalytic impact	ACI Europe, 2015	/	8,948,000,000 euro GDP	/

Table 5: Data collection catalytic effects (own composition)

As mentioned in the methodology part, the IATA connectivity index for 1993 was not available. Moreover, the connectivity index of 2013 was not available, which in case it was, could be used together with the outcome of catalytic impact 2013 to calculate the IATA connectivity for 1993. The correlation between the ACI connectivity index based on the SEO NetScan connectivity model and the IATA connectivity model was used to estimate the IATA connectivity index of 2013.
With this estimation, the connectivity index of 1993 could be estimated.

5. Sensitivity analysis

In the last step before getting the results, a Monte Carlo simulation was used as a sensitivity analysis on the results. Probability distributions were linked to each assumption, from which ten thousand drawings were used to make the calculations as described above. The figures reported in this document are the mean, 2.5% quantile and 97.5% quantile of the outcome of this Monte Carlo simulation.

5.1. Assumptions direct, indirect and induced effects

The following assumptions and distributions were used in the calculations of the direct, indirect and induced effects:

1. NBB Stat does not report FTEs on NACE-BEL branche level, which is needed to calculate the direct and induced employment effects. Therefore, the employment hours at NACE-BEL branche level were divided by the number of hours an employee works per week. It was assumed that an employee working in each NACE-BEL branche works either 40, 38 or 37.6 hours a week, each with an equal probability (uniform distribution).
2. Missing values in the social security employment data were approximated with averages. These averages were either based on employment data of organizations within the airport cluster and the same NACE-BEL branche, or were based on NACE-BEL branche averages. In the first case, the Monte Carlo drawings were taken from the following formula:

$$\bar{x} + t_{n-2} * \frac{s}{\sqrt{n}}$$

   Where, $\bar{x}$ is the average used in the approximation, $t_{(n-2)}$ is a random drawing from a t-distribution with (n−2) degrees of freedom, s is the standard deviation belonging to $\bar{x}$ and n is the number of observations on which $\bar{x}$ is based.

   In the second case, as the standard deviation and number of observations for the NACE-BEL averages were unknown, the NACE-BEL average was assumed to follow a normal distribution with standard deviation equal to the approximated average divided by 19. This corresponds more or less with a 10% deviation from the mean as the lower and upper levels of the 95% confidence interval.

   When calculating the number of employees instead of FTEs, the missing values were approximated by multiplying the number of FTEs (if they are known, if not those were also approximated) by the number of employees per FTE in the NACE-BEL branche. For this approximation drawings were again taken from a normal distribution with the approximation divided by 19 as the standard deviation.
3. Missing values in added value were also approximated. If the number of FTEs working for the organisation was known, this number of FTEs was multiplied with the average added value per FTE for the NACE-BEL branch to which the organisation belonged. This average was assumed to follow a normal distribution with standard deviation equal to the mean divided by 19. If the number of FTEs working for the organisation was unknown, both the FTEs as the added value were approximated.

5.2. Assumptions catalytic effects

The following assumptions and distributions were used in the estimation of catalytic effects:

1. As the IATA connectivity index for 2013 and 2019 on airport level were unknown, these were approximated from the ACI connectivity index by use of linear regression. In the Monte Carlo simulations, drawings were taken from the distributions of the linear regression parameters.
2. To convert changes in connectivity to changes in added value, this study relied on earlier work by InterVISTAS. This conversion was again based on a linear regression, so that the Monte Carlo simulation took drawings from the distribution of the regression parameter used.

6. Results

The section below describes the results for direct, indirect, induced effects to answer the question 'What economic effects would be lost if the total demand for air transport at Brussels Airport would disappear?' and the catalytic effects to answer the question 'What economic effects would be lost if the airport was not there?'.

6.1. Direct effects

Brussels Airport is home to a cluster of **357 companies**, generating the direct effects. Those direct effects, coming from the 357 companies, are expressed in the number of full-time equivalents, employees and added value. The top 5 sectors and companies as well as a distribution between cargo and passengers are included in this chapter. The sector specifications are based on NACE-BEL codes in line with the study of the NBB.[6]

a) Number of full-time equivalents and employees

The direct effects of Brussels Airport are estimated at **21,773 FTEs** with a 95% confidence interval between [21,095; 22,545] and **2.303 billion euros added value** with a 95% confidence interval between [2.284 billion euros; 2.347 billion euros]. The subdivision of the FTEs in different sectors can be found in Table 6. When the number of full-time equivalents is expressed in the number of employees, a total of **25,796 employees** with a 95% confidence interval between [24,931; 26,997] is received.

FTEs 2019 BRU	FTEs	%
Air transport cluster	**9,183**	**42.2%**
Air transport	4,762	21.9%
Travel agencies and tour operators	237	1.1%
Airport operator	850	3.9%
Airport handling	1,734	8.0%
Building and repairing of aircraft	782	3.6%
Other air transport supporting activities	817	3.8%
Other airport-related activities	**12,590**	**57.8%**
Passenger transport over land	324	1.5%
Freight transport over land	358	1.6%
Cargo handling and storage	3,524	16.2%
Courier and post activities	1,636	7.5%
Security and industrial cleaning	1,467	6.7%
Trade	476	2.2%
Hotels, restaurants and catering	1,692	7.8%
Other services	1,239	5.7%
Other industries	26	0.1%
Public authorities	1,848	8.5%
	21,773	**100%**
Within the 95% confidence interval: [21,095; 22,545]		

Table 6: Direct effects in number of FTEs (own composition)

[6] Annex 1 provides an overview of the sectors and NACE-BEL codes as used in the report 'Economic importance of air transport and airport activities in Belgium – Report 2015': https://www.nbb.be/doc/ts/publications/wp/wp324en.pdf.

b) Added value (in euros)

The direct effects of Brussels Airport are estimated **at 2.303 billion euros added value** with a 95% confidence interval between [2.284 billion euros; 2.347 billion euros]. The subdivision of the added value in different sectors can be found in Table 7.

Added value 2019 BRU	Euros	%
Air transport cluster	**1,196,195,538**	**51.9%**
Air transport	439,940,076	19.1%
Travel agencies and tour operators	7,019,066	0.3%
Airport operator	425,533,000	18.5%
Airport handling	106,180,209	4.6%
Building and repairing of aircraft	68,047,713	3.0%
Other air transport supporting activities	149,475,475	6.5%
Other airport-related activities	**1,107,097,809**	**48.1%**
Passenger transport over land	16,205,457	0.7%
Freight transport over land	25,624,843	1.1%
Cargo handling and storage	276,865,287	12.0%
Courier and post activities	146,242,131	6.3%
Security and industrial cleaning	81,406,378	3.5%
Trade	32,149,061	1.4%
Hotels, restaurants and catering	81,920,637	3.6%
Other services	273,026,473	11.9%
Other industries	11,036,202	0.5%
Public authorities	162,621,338	7.1%
	2,303,293,347	**100%**

Within the 95% confidence interval: [2.284 bln. euros; 2.347 bln. euros]

Table 7: Direct effects in euros added value (own composition)

c) Contributing sectors and companies

Regarding the contributing sectors and accompanied activities, it becomes clear from Table 8a that NACE-BEL code 51 (air transport) is the largest contributor to the total number of direct FTEs (21.9%) and value-added (19.1%).

Top 5 sectors according to FTEs	Top 5 sectors according to VA
1. Air transport (21.9%)	1. Air transport (19.1%)
2. Cargo handling and storage (16.2%)	2. Airport operator (18.5%)
3. Public authorities (8.5%)	3. Cargo handling and storage (12%)
4. Airport passenger handling (8%)	4. Other services (11.9%)
5. Hotels, restaurants and catering (7.8%)	5. Public authorities (7.1%)

Table 8a: Summary of the sectors that generate the highest number of FTEs and VA for Brussels Airport (own composition)

The top 5 companies contributing the highest number of FTEs and added value to the total are summarised below in Table 8b. The largest company by FTEs is the home carrier, Brussels Airlines. They are followed by the courier and postal service, DHL Aviation and TUI Airlines. Regarding added value, the airport operator (Brussels Airport Company) ranks first, followed by Brussels Airlines and the air traffic controller, Skeyes.

Top 5 employers according to FTEs		Top 5 employers according to VA	
	Brussels Airlines		Brussels Airport Company
	DHL Aviation		Brussels Airlines
	TUI Airlines Belgium		Skeyes
	Swissport Belgium		DHL Aviation
	Ministry of national defence		Ministry of national defence

Table 8b: Summary of the companies that generate the highest number of FTEs and VA for Brussels Airport (own composition)

d) Distribution between passenger service (incl. joint supporting activities) and cargo

To divide the direct effects in terms of full-time equivalents, employees and added value between passengers and cargo, the different NACE-BEL codes were considered. Codes such as 55 (Accommodation; food and beverage service activities) and 53 (Courier and postal activities) were easily added to passengers and cargo, respectively. However, other codes such as those under which, for example, Skeyes, Brussels Airport Company and security companies were much more challenging to assign. As the purpose of this comparison is to reflect the importance of cargo activities, we opted to merge supporting activities and passengers at present and report the 100% cargo-related activities separately.

- When the distribution is observed regarding **full-time equivalents** and **employees**, 27% of the full-time equivalents (5,829) and the employees (7,062) are solely obtained through cargo activities. The largest number of cargo-related FTEs is created by cargo handling and storage, followed by courier and postal activities and freight transport over land and by air.

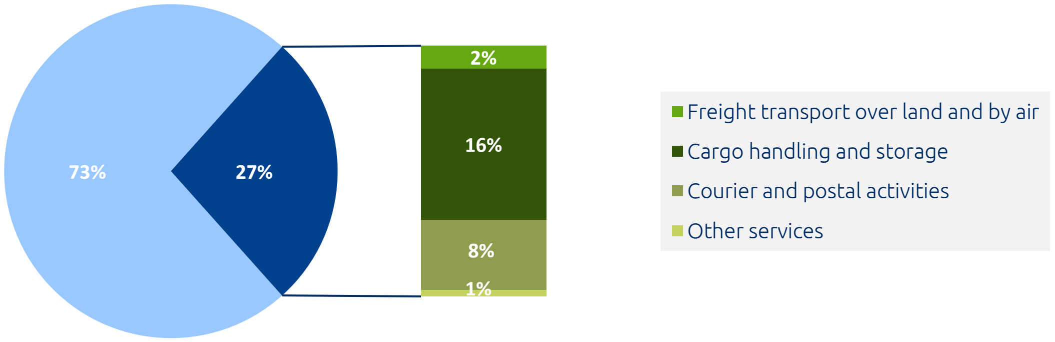

Figure 7a: Passenger (including joint supporting activities) versus cargo in terms of FTEs

- In terms of **added value**, the same observation can be made. In this case, 23% of the added value (538,753,344) is solely obtained through cargo activities. The largest amount of cargo-related added value is created by cargo handling and storage, followed by courier and other services.

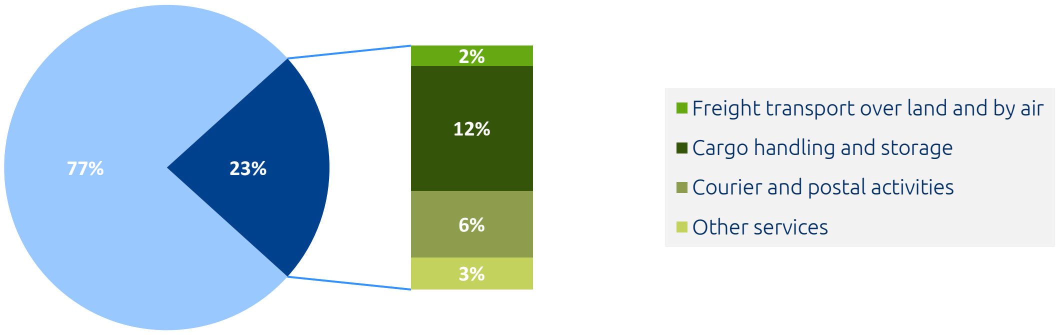

Figure 7b: Passenger (including joint supporting activities) versus cargo in terms of added value

Employment at the airport business district

The business district at the airport site is in principle not part of the direct effects of Brussels Airport as these activities are not directly related to the airport's aviation operations. By contrast, it provides a lot of employment on the Brussels Airport site. Therefore, the number of full-time equivalents '**3,568**' (converted into the number of employees: **3,662**) is reported here separately.

Company name	NACE-BEL code	NACE-BEL description	Number of FTEs
Deloitte accountancy	69201	Accountants and tax consultants	207
Deloitte bedrijfsrevisoren	69203	Corporate auditors	200
Deloitte belastingconsulenten	69201	Accountants and tax consultants	301
Deloitte consultancy & advisory	62020	Computerconsultancy-activiteiten	1,456
Deloitte global tax center	69201	Accountants and tax consultants	116
Deloitte services & investments	70100	Activities of head offices	252
ETEX	64200	Holdings	24
KPMG accountants	69202	Bookkeepers and accountants-tax consultants	22
KPMG advisory	70220	(Other) business management consultancy services	221
KPMG bedrijfsrevisoren	69203	Corporate auditors	156
KPMG central services	70100	Activities of head offices	100
KPMG taks advisers	69201	Accountants and tax consultants	109
Microsoft	62010	Design and programming of computer programmes	369
Redevco retail	68203	Rental and operation of own or leased non-residential property, excluding land	34
Total			3,568 FTEs

Table 9: Summary of the employment located at the business district of Brussels Airport (own composition)

6.2. Indirect effects

The indirect effects, or the supply side of the companies directly related to Brussels Airport, is estimated at **17,399 FTEs** with a 95% confidence interval of [16,845; 18,035] and **1.622 billion euros added value** with a 95% confidence interval of [1.606 bln. euros; 1.642 bln. euros]. When the number of full-time equivalents is expressed in the number of employees, **19,152 employees** can be reported with a 95% confidence interval of [18,965; 19,929].

When looking in more detail at the NACE-BEL sectors that are generating those indirect effects, it can be concluded that the sector 69-70 'Legal and accounting activities; activities of head offices; management consultancy activities' are creating most of the indirect effects in terms of FTEs (18.09%) followed by sector 78 'employment activities; interim offices' and sector 52 'Warehousing and support activities for transportation' is creating most indirect effects in terms of added-value (16.82%), followed by sector 69-70 'Legal and accounting activities; activities of head offices; management consultancy activities'.

NACE-BEL sectors that are generating the most indirect FTEs	
1. Legal and accounting activities; activities of head offices; management consultancy activities (69-70)	18.09%
2. Employment activities; interim offices (78)	17.18%
3. Warehousing and support activities for transportation (52)	11.42%
4. Accommodation; food and beverage service activities (55-56)	9.75%
5. Security and investigation activities; services to buildings and landscape activities; office administrative, office support and other business support (80-82)	9.44%
Other	34.12%

Table 10: Summary of the sectors that generate the highest amount of indirect FTEs for Brussels Airport (own composition)

NACE-BEL sectors that are generating most indirect added value	
1. Warehousing and support activities for transportation (52)	16.82%
2. Legal and accounting activities; activities of head offices; management consultancy activities (69-70)	14.11%
3. Employment activities; interim offices (78)	8.63%
4. Real estate activities (68)	8.57%
5. Rental and leasing activities (77)	5.30%
Other	46.57%

Table 11: Summary of the sectors that generate the highest amount of indirect added value for Brussels Airport (own composition)

6.3. Induced effects

The induced effects generated by the locally spent salaries of employees working at the direct and indirect value-creating companies is estimated at **13,513 FTEs** with a 95% confidence interval of [13,058; 14,037] and **1.483 billion euros added value** with a 95% confidence interval of [1.463 bln. euros; 1.504 bln. euros]. When the number of full-time equivalents is expressed in the number of employees, **15,614 employees** can be reported with a 95% confidence interval of [15,372; 16,267].

6.4. Catalytic effects

Finally, the estimation of the catalytic effects (or supply side effects of Brussels Airport according to the methodology described in part 3) is added. This estimation answers the question 'What economic effects would be lost if the airport was not there?'. The result brings us to a number of **8.83 billion euros added value** with a 95% confidence interval of [8.72 billion; 8.93 billion] or the equivalent of **81,637 employees**. When comparing this with the GDP of Belgium, the catalytic effects for Brussels Airport respond with 1.85% of this GDP in 2019. On a country level, the total amount of catalytic effects of the Belgian airports is estimated at 9.58 billion euros added value with a 95% confidence interval of [9.47 billion; 9.70 billion]. It should be noted again that the connectivity indices, used for the division between the different Belgian airports, only consider passenger-flights and that the connectivity indices consider indirect flights and the size of the destination airport.

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8. Annex

Definition of the clusters according to NACE-BEL codes

		NACE-BEL 2008	NACE-BEL Definition
	Air transport cluster		
1	Air transport	51100	Passenger air transport
		51210	Freight air transport
2	Travel agencies and tour operators	79110 [1]	Travel agency activities
		79120 [1]	Tour operator activities
3	Airport operator	52230 (where applicable)	Service activities incidental to air transportation
4	Airport handling	52230 (where applicable)	Service activities incidental to air transportation
5	Building and repairing of aircraft	30300 [1]	Manufacture of air and spacecraft and related machinery
		33160 [1]	Repair and maintenance of aircraft and spacecraft
6	Other air transport supporting activities	52230 (other than sectors 3 and 4)	Service activities incidental to air transportation
		71209 [1]	Technical testing and analysis
		77350	Renting and leasing of air transport equipment
		85532 [1]	Driving school activities of planes and boats
		85592 [1]	Professional training
	Other airport-related activities		
7	Passenger transport over land	49100	Passenger rail transport, interurban
		49310-49320-49390	Other passenger land transport
8	Freight transport over land	49200	Freight rail transport
		49410-49420	Freight transport by road and removal services
9	Cargo handling and storage	52100	Warehousing and storage
		52210	Service activities incidental to land transportation
		52249	Cargo handling except sea ports
		52290	Other transportation support activities
10	Courier and post activities	53100-53200	Postal and courier activities
11	Security and industrial cleaning	80100	Private security activities
		80200	Security systems services activities
		81210-81220-81290	Cleaning activities
12	Trade	45***	Wholesale and retail trade and repair of motor vehicles and motorcycles
		46***	Wholesale trade, except of motor vehicles and motorcycles
		47***	Retail trade, except of motor vehicles and motorcycles
13	Hotels, restaurants and catering	55***	Accommodation
		56***	Food and beverage service activities
14	Other services	Other 5**** to 9****	Other services
15	Other industries	Other 1**** to 43***	Other industries
16	Public services	N/A	

[1] Only activities relating to air transport