DIW ECON

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Economic impact of public contracts awarded to the aerospace industry in Germany

The macroeconomic impact of public contracts awarded to the defence sector of the aerospace industry in Germany

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Executive Summary

This study provides an assessment of the **economic impact of public contracts awarded to the development, manufacturing, and maintenance of military aircraft in Germany.** For this purpose, DIW Econ developed a model of the German defence aerospace industry and its complex supply chain. The model is based on the German input-output table and is adapted to capture the aerospace industry in detail and to estimate the economic effects on value added, employment and returns to public funds. Moreover, the model captures additional economic activity induced by consumption spending of workers, entrepreneurs and shareholders of involved companies.

Our model indicates substantial effects **per 100 million euro net contract volume**[1] **in each of the relevant segments of the defence sector of the aerospace industry** on value added, employment and returns to public funds in Germany:

Table 0-1:
Total effects (direct, indirect and induced) on value added per 100 million euro net contract volume in each of the relevant segments

Segments of the defence sector of the aerospace industry	Unit	Contract volume (net)	Gross value added
Research and development	Million euro	100.0	**128.2**
Manufacture of air and spacecraft	Million euro	100.0	**114.3**
Repair and maintenance of aircraft and spacecraft	Million euro	100.0	**106.4**

Results per 100 million euro net contract volume in the three segments are generally valid for public contracts in the defence sector of the aerospace industry in Germany.

Source: DIW Econ.

[1] Net contract value at basic prices according to the System of National Accounts, i.e. excluding value added tax.

Moreover, as shown in Table 0-2, employment effects are caused in all three segments of the defence sector of the aerospace industry.

Table 0-2:
Total effects (direct, indirect and induced) on employment per 100 million euro net contract volume in each of the relevant segments

Segments of the defence sector of the aerospace industry	Unit	Contract volume (net)	Persons employed
Research and development	Persons	100.0	**1,676**
Manufacture of air and spacecraft	Persons	100.0	**1,461**
Repair and maintenance of aircraft and spacecraft	Persons	100.0	**1,706**

Results per 100 million euro net contract volume in the three segments are generally valid for public contracts in the defence sector of the aerospace industry in Germany.

Source: DIW Econ.

Additionally, the production effectuated per 100 million euro net contract volume in the three segments generates public revenue in the form of taxes and social security contributions:

Table 0-3:
Total effects (direct, indirect and induced) on returns to public funds in terms of taxes and social security contributions per 100 million euro net contract volume in each of the relevant segments

Segments of the defence sector of the aerospace industry	Unit	Contract volume (net)	Returns to public funds (taxes and social contributions)
Research and development	Million euro	100.0	**43.4**
Manufacture of air and spacecraft	Million euro	100.0	**31.5**
Repair and maintenance of aircraft and spacecraft	Million euro	100.0	**35.8**

Results per 100 million euro net contract volume in the three segments are generally valid for public contracts in the defence sector of the aerospace industry in Germany.

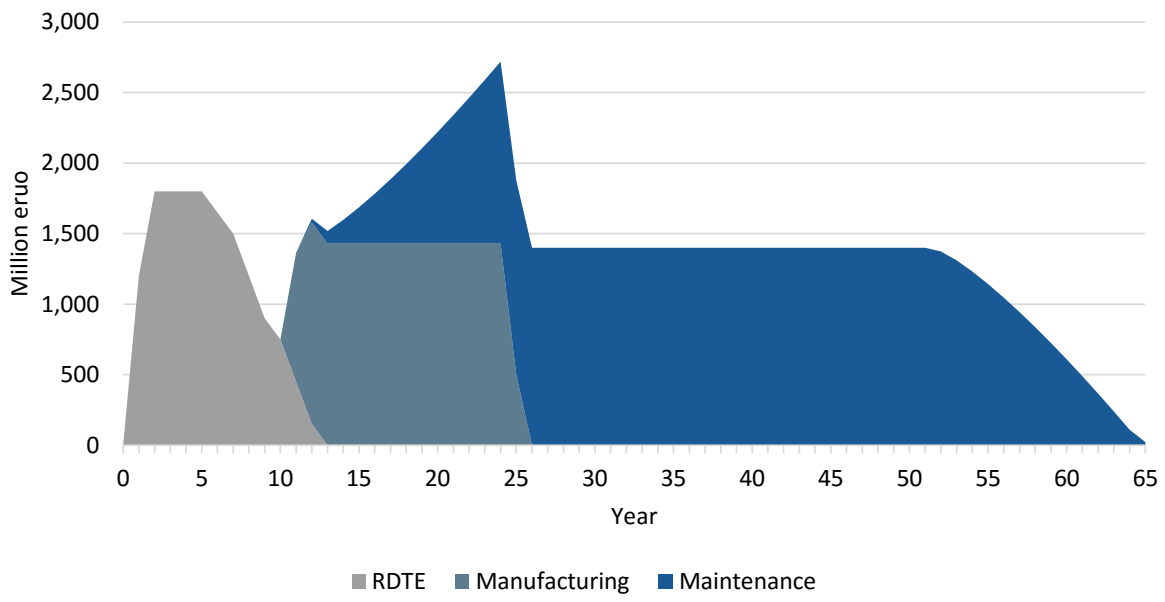
Source: DIW Econ.

Moreover, this report estimates the effects of demand for an exemplary European long-term cooperative project lasting for 65 years. The project involves economic activities related to the co-development, manufacture and maintenance of 200 aircraft for military purposes. The average total net expenditure[2] per year of this project amounts to 1,400 million euro. Total net expenditure is

[2] Expenditure at basic prices, i.e. excluding value added tax.

distributed among the three segments and their respective importance vary throughout different phases of the project as shown in Figure 0-1.

Figure 0-1:
Net expenditure by segment (Research, Manufacturing, and Maintenance) and year, stacked



Source: DIW Econ.

On average, 1.6 billion euro gross value added and 23,000 persons employed per year can be attributed to the entire project. On average it raises **about 500 million euro annual tax returns and social security contributions per year.**

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1. Introduction

The German aerospace industry is a high-tech sector and a driver of economic growth featuring high paying jobs and strong technological innovation activity. In addition to the development, production, and maintenance of commercial aircraft, the German aerospace industry also develops cutting-edge technologies and produces and operates products for the defence sector. Such research and knowledge-intensive activities have spill-over effects to the wider economy and thus positively affect overall economic output, employment and competitiveness.

This study focuses on quantifying the immediate economic effects that are caused by public demand for products of the defence sector of the aerospace industry.

- First, companies in the defence sector of the aerospace industry directly add to German gross value added and employment.
- Second, many other industries supply intermediate inputs to the defence sector of the aerospace industry, adding indirectly to German value added and employment.
- Third, these economic activities generate additional income and in turn the associated consumption spurs additional economic activity in many sectors of the economy.
- Finally, in addition to effects on economic output and employment, all companies and persons employed involved generate returns to public funds in terms of tax payments and social contributions.

With regard to public “make-or-buy decisions” in the defence sector of the aerospace industry, these effects matter. Commissioned by Airbus, this report quantifies and assesses the macroeconomic impact of a public contract awarded to the defence sector of the aerospace industry in Germany.

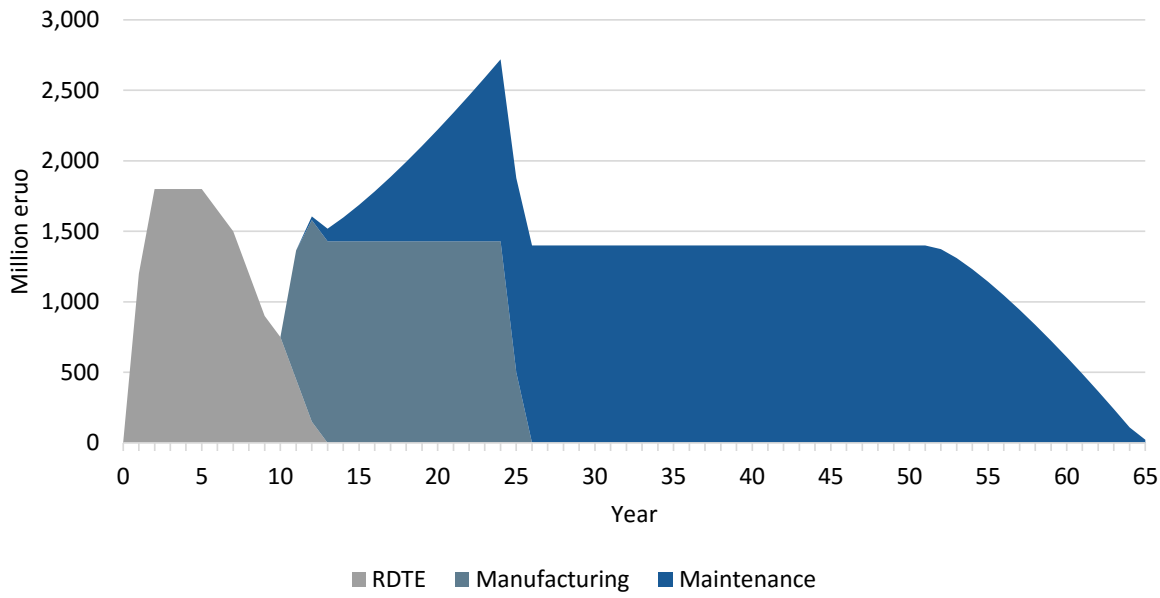
The structure of this report is as follows: Chapter two describe an exemplary project in the defence sector of the aerospace industry. Chapter three introduces economic impact analysis, explains different types of effects, and defines the core metrics used to assess the macroeconomic impact. Readers familiar with sectoral specificities and economic concepts can directly continue with the results (chapter four). Methodological details are presented in chapter five.

2. Exemplary Long-term Project

The starting point of the analysis is an exemplary, fictitious long-term project of the defence sector of the aerospace industry in Germany. While the project is a joint European partnership programme, this study focuses on the net contract volume of the German share and the effects on the German economy. In the following, we assume that the project involves the development, production and maintenance of 200 military aircraft in Germany. The underlying project timeline consists of 12 years of research, development, testing and evaluation (RDTE) and 15 years of production. The repair and maintenance of aircraft starts in the second year of production once the customer has accepted the first series aircraft and lasts for the entire life-span of the produced aircraft. The overall project duration is 65 years. Based on the experience of industry experts we make the following assumptions and show the following parameters at basic prices (net), i.e. excluding value added tax, of the project:

- Production of 200 aircraft (German share of total production)
- Manufacturing costs (net) of 100 million euro per series-built aircraft in Germany
- German share of total development costs (net): 15,000 million euro
- Operating time of 8,000 flying hours per aircraft
- Repair and maintenance costs (net) of 35,000 euro per flying hour

Figure 2-1:
Net expenditure by segment (Research, Manufacturing, and Maintenance) and year, stacked



Source: DIW Econ.

Furthermore, we assume that the defence project is carried out among European cooperation partners, in this case in close cooperation with Spain. For details on typical European cooperation programmes see section 5.6.

The project results in the following total net expenditures in Germany, where all monetary terms are real values (i.e. the price level at the time of study 2018):

- Total net expenditure for RDTE: 15,000 million euro (16 percent of total net contract volume)
- Total net expenditure for manufacturing: 20,000 million euro (22 percent of total net contract volume)
- Total net expenditure for repair and maintenance: 56,000 million euro (62 percent of total net contract volume)
- Average total net expenditure per year: 1,400 million euro

In the case of long-term projects such as the one assessed in this study, it can reasonably be assumed that the principal makes regular, e.g. annual payments, instead of paying large sums up front. Therefore, the model is based on the assumption that taxes are paid immediately at the time of the principal's payment even though parts of tax payments might occur with slight delay.

3. Analytical Approach: Economic Impact Analysis

This study analyses the economic impact of public contracts awarded to the defence sector of the aerospace industry in Germany. The main activities related to this sector take place in three segments:

- RDTE (research, development, test and evaluation),
- manufacture of air and spacecraft and related machinery, and
- repair and maintenance of aircraft and spacecraft.

In order to estimate the economic impact of such contracts, DIW Econ used a series of matrix algebra calculations and the input-output table of the German Federal Statistical Office.[3] The bespoke input-output table provides the framework for studying the interconnections between the above specified relevant segments of the defence sector of the German aerospace industry and other industries within the German economy. On this basis, DIW Econ calculated the total economic impact of a public contract awarded to the defence sector of the aerospace industry, accounting for its complex and global supply chain.

3.1 Quantifying Economic Impact: Core Metrics

This economic-statistical analysis measures the economic impact of public contracts awarded to the aerospace industry in Germany using indicators for an increased level of economic activity. Economic activity is expressed using three core metrics: gross value added (henceforth also value added), employment, and returns to public funds.

- **Gross value added** is the most important indicator for economic performance; it measures the value of goods and services produced. Throughout the report, we refer to gross value added, which contains depreciation.[4] It is defined as output less intermediate inputs. It corresponds to the incomes received by entrepreneurs, shareholders, and workers in the sector.

[3] Destatis (2017): Volkswirtschaftliche Gesamtrechnung. Input-Output-Rechnung 2013, Fachserie 18 Reihe 2.

[4] In contrast, net value added equals the value of gross value added minus depreciation (see Destatis https://www.destatis.de/DE/ZahlenFakten/GesamtwirtschaftUmwelt/VGR/Glossar/Nettowertschaetzung.html).

- **Employment** is measured according to the internationally agreed labour force concept of the International Labour Organization (ILO). It is the number of persons employed, comprising all persons in employment covering employees, self-employed, civil servants etc. regardless of the hours worked.
- Finally, this study estimates **returns to public funds** associated with the economic activity in the defence sector of the aerospace industry and all upstream stages. This study considers tax revenues from income tax, value added tax, corporate tax and trade tax[5] as well as social security contributions (compulsory employers' social contributions plus compulsory actual social contributions by employees and the self-employed). It is important to note that value added tax is only relevant regarding induced spending (see induced effects, section 3.2). In contrast, value added tax revenues generated through public consumption will not result in any direct or indirect returns to public funds since taxes are both directly paid and collected by the government.

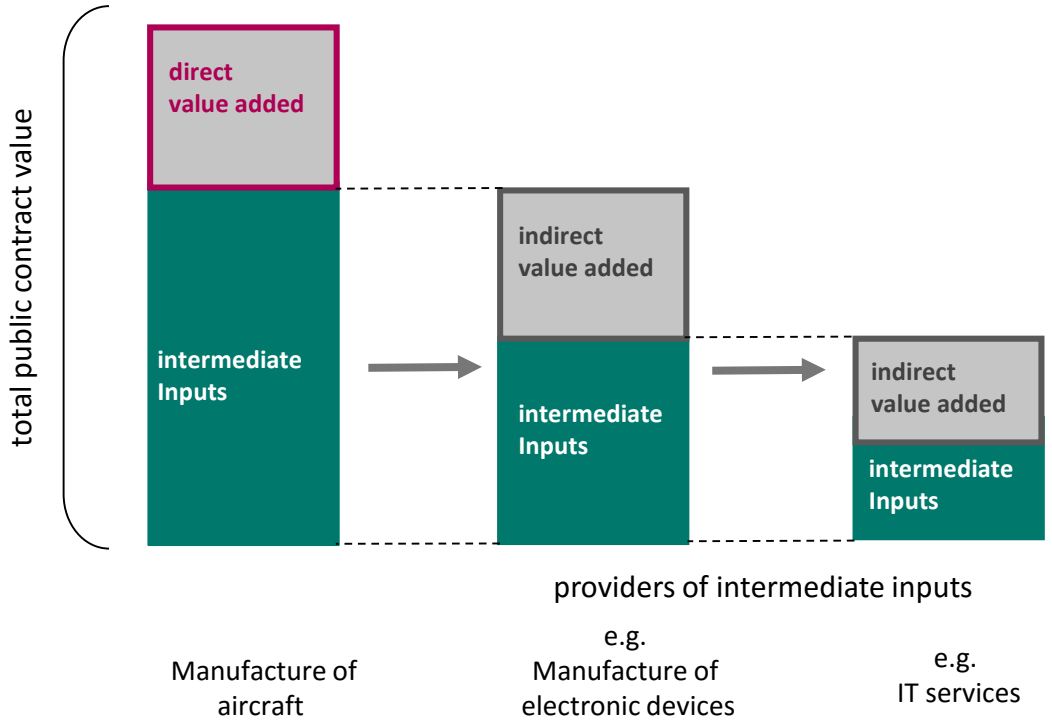
3.2 Types of Economic Effects Along the Value Chain

The total economic impact of a public contract awarded to the aerospace industry in a given area is the sum of *direct*, *indirect*, and *induced effects*.

- The first component is the **direct effect.** An award of a public contract to the defence sector of the aerospace industry is associated with production activities in the core fields, i.e. in research and development, manufacturing, repair and maintenance of air- and spacecraft. Thus, direct economic effects are generated by companies that are directly involved in the production of the final products (i.e. aircraft) as illustrated on the left-hand side of Figure 3-1.
- The second component goes beyond the direct production activities in the core fields of the aerospace industry. **Indirect effects** consider the production of intermediate goods and services by suppliers that are critical inputs for the production of the final product. Thus, indirect effects account for all stages of the supply chain of the aerospace industry. The generation of indirect effects along the value chain is exemplarily illustrated on the right-hand side of Figure 3-1.

[5] In German: *Einkommensteuer*, *Mehrwertsteuer*, *Körperschaftsteuer,* and *Gewerbesteuer*.

Figure 3-1:
Direct and indirect effects generated through a public contract awarded to the aerospace industry

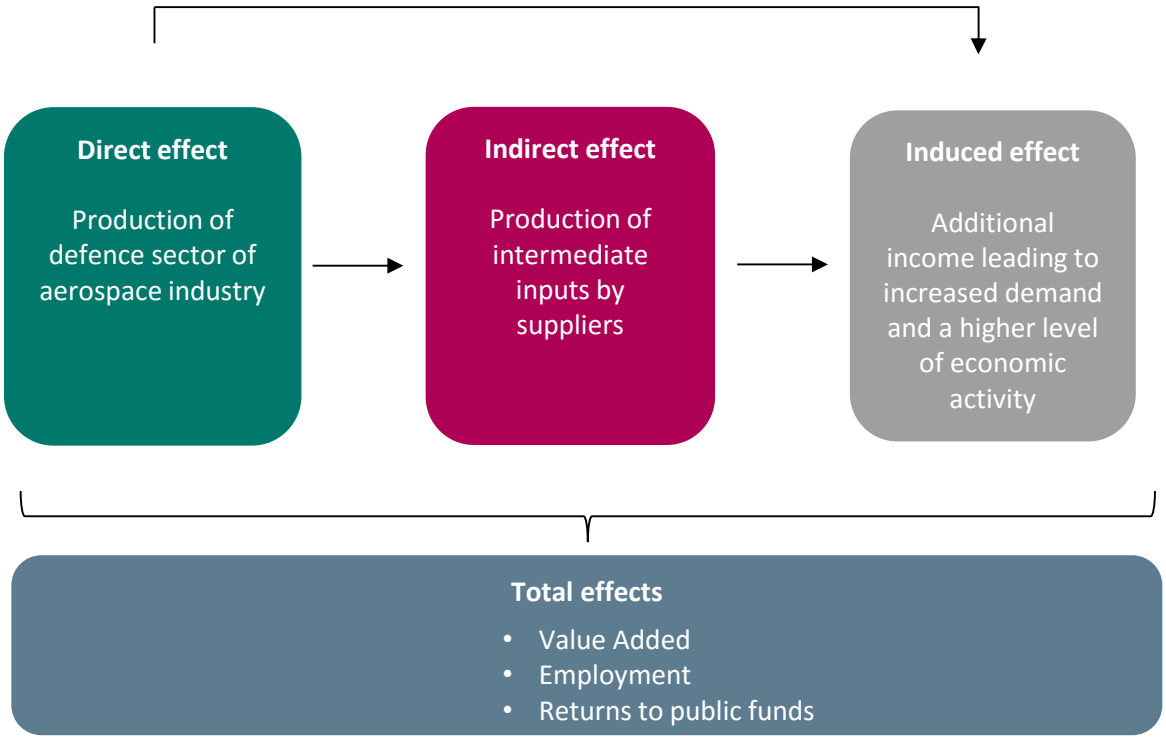


Source: DIW Econ.

- Finally, this study not only quantifies direct and indirect, but also estimates **induced effects.** Direct and indirect value added generated in production processes of the defence sector of the aerospace industry constitutes income (both profits and labour income). Workers, shareholders and entrepreneurs spend these incomes, which leads to increased demand and – in turn – a higher level of economic activity in the total economy. This higher economic activity translates into higher levels of value added, employment, tax revenues and social contributions, captured by induced effects. Due to induced effects total effects on value added can potentially exceed the contract volume (see section 5.2 for or a more detailed discussion of induced effects).

Figure 3-2 provides an overview of the total effects as sum of direct, indirect, and induced effects.

Figure 3-2:
Total effects as sum of direct, indirect and induced effects



Source: DIW Econ.

4. Economic impact: Results

4.1 Economic Impact of Exemplary Project

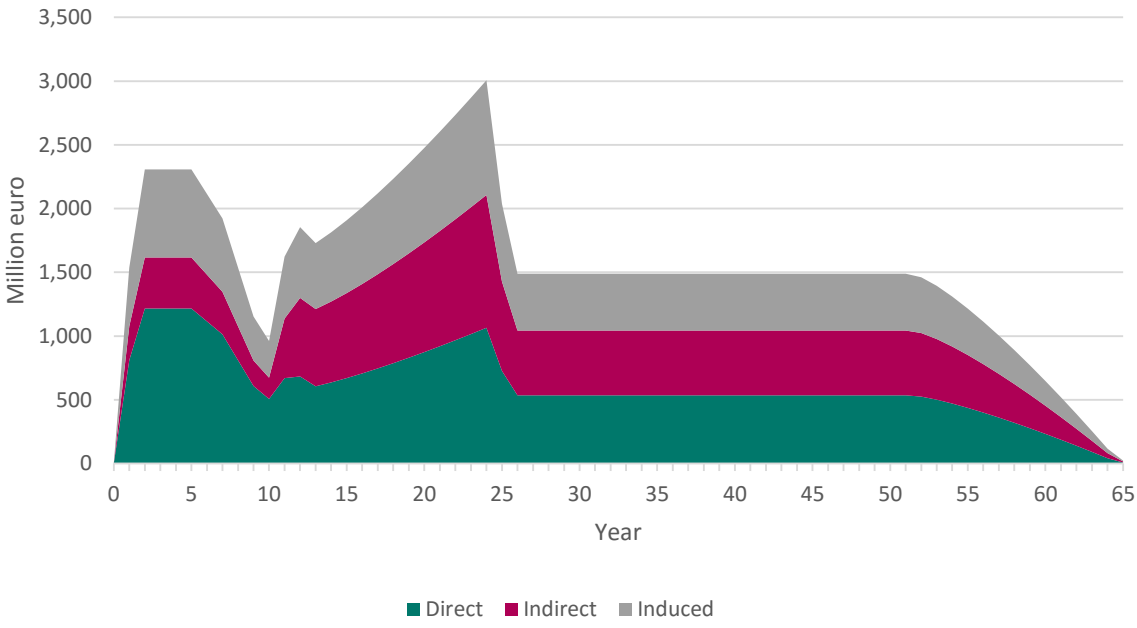
This section presents the economic effects of the exemplary public procurement project over 65 years (see section 2) on the German economy. The companies involved in the development, manufacturing, and maintenance of aircraft directly add to GDP and employment, and they pay taxes (direct effect). Companies in all three segments rely on an extensive supply chain in Germany, which delivers crucial inputs for their production. The companies in the supply chain also contribute to value added, employment and returns to public funds (indirect effect).[6] Finally, people working at the directly involved companies and the entire supply chain as well as entrepreneurs and shareholders make purchases that stimulate demand and thus further economic activity (induced effect).

[6] Note that the production of intermediate goods imported by the commissioned companies in Germany are generally not relevant for the generation of value added in Germany. Instead, value added is generated in the country where the intermediate goods are produced. The value of imported intermediate goods per production value (including imports from partner countries) in the relevant segment *other transport equipment*, which is used to approximate the import quote in *manufacture of aircraft and spacecraft*, is 20 percent, in the segment *repair and maintenance* 16 percent and in *research and development* 5 percent of the production value at basic prices (i.e. excluding value added tax).

4.1.1 Gross Value Added

Figure 4-1 shows a stacked area graph of the annual impact the exemplary 65-year project has on value added. Research and development rely to a lower extent on supply from other sectors than aircraft manufacturing or maintenance and repair. Therefore, the indirect effect is about one third of the direct effect during the first phase of the project, i.e., when the aircraft are developed. Consequently, in Figure 4-1 in the first 12 years the area representing indirect value added is substantially smaller than the area representing direct value added. This changes in the manufacturing phase, where value added by suppliers exceeds the value added contributed directly by the firms that produce the aircraft. Additionally, induced effects play an important role throughout the entire project. We estimate **the project's average total annual impact on value added** to be **1.6 billion euro** for the project's life span of **65 years.** The annual contribution to gross value added is strongest at the end of the manufacturing phase (in the 24th year), 3.0 billion euro, about 0.1 percent of Germany's annual GDP (in 2016).

Figure 4-1:
Annual impact on gross value added

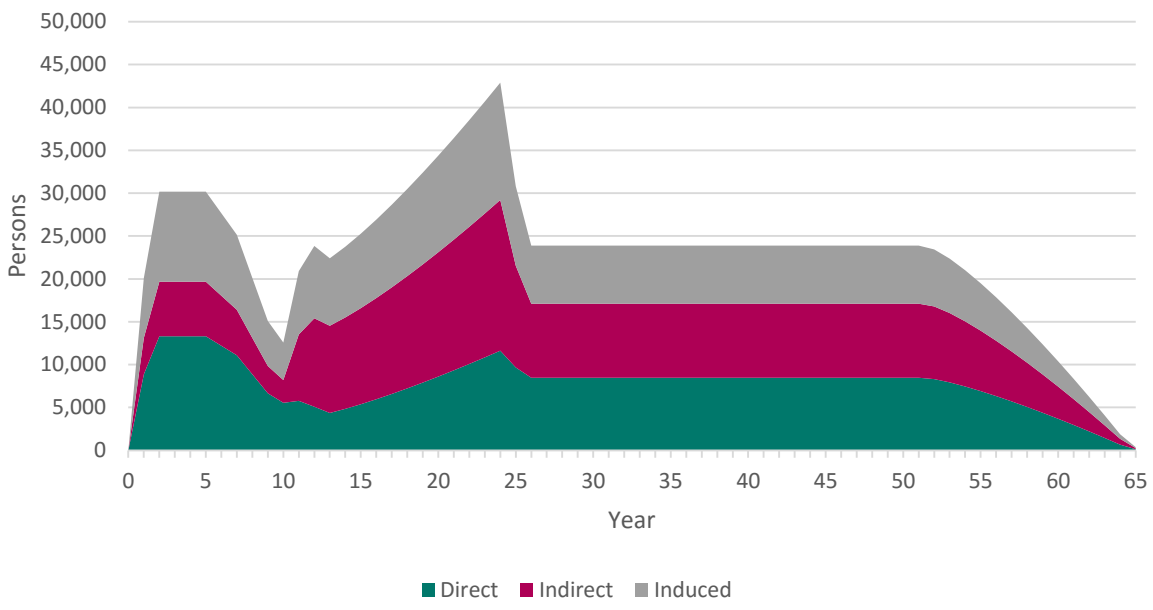


Source: DIW Econ.

4.1.2 Persons Employed

Figure 4-2 shows a stacked area graph of the annual employment effects. As is the case for value added, the role of the supply chain gains importance starting in the eleventh year of the project. On average, the project **sustains** about **23,000 jobs** throughout its duration of **65 years**. Roughly, one third of these jobs is created directly in the commissioned companies, one third at suppliers and one third is ascribed to the induced effect. The annual contribution to total employment is largest at the end of the manufacturing phase (in the 24th year) with about 43,000 jobs.

Figure 4-2:
Annual impact on persons employed



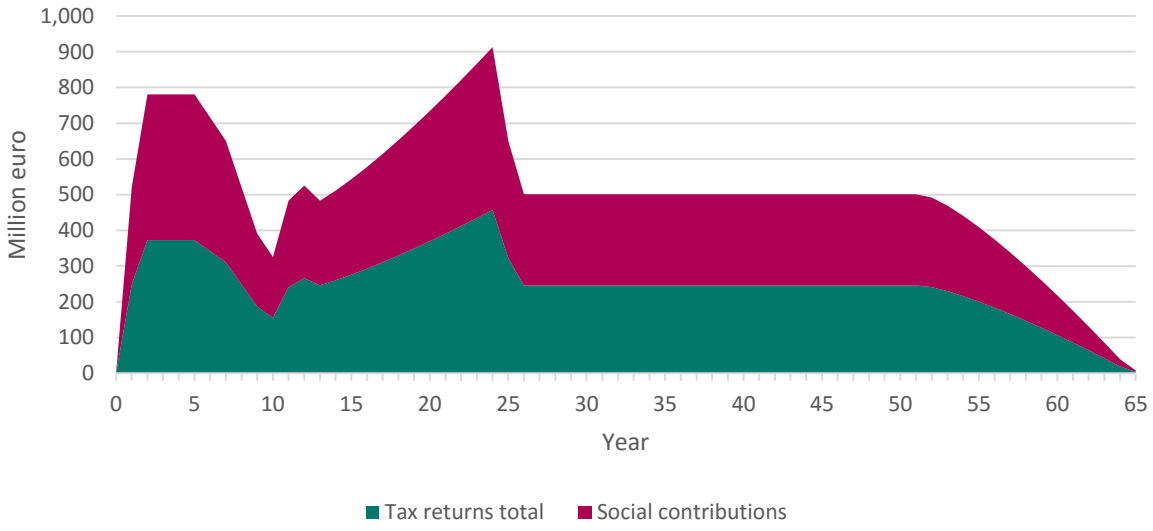
Source: DIW Econ.

4.1.3 Returns to Public Funds

The commissioning of the development, manufacturing, and maintenance and repair of 200 aircraft in Germany triggers substantial returns to public funds. All companies involved in the value chain as well as those involved in induced economic activity pay taxes. In particular, we model cooperation tax (Körperschaftsteuer), trade tax (Gewerbesteuer), value added tax that is generated through induced consumption (Mehrwertsteuer), and income tax (Einkommensteuer). The latter is paid by the additional persons employed. The jobs created also lead to substantial payments of social security contributions.

Figure 4-3 shows a stacked area graph of the returns to public funds. These include returns due to direct, indirect, and induced effects. The project raises on average **about 250 million euro additional annual tax returns** and **250 million euro additional social security contributions** per year. This amounts to an annual 500 million euro additional return to public funds.

Figure 4-3:
Total annual returns to public funds



Source: DIW Econ.

4.1.4 Average Annual Effects in Three Project Phases

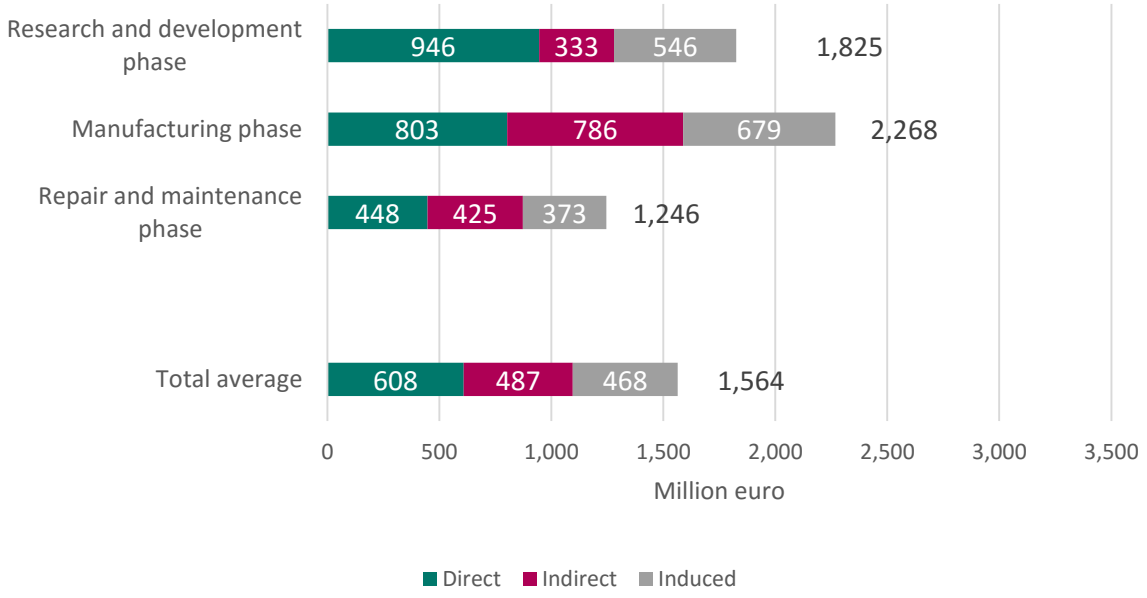
This section presents the average annual effects of the entire project. For this purpose, the overall project duration of 65 years is divided into the following three characteristic phases (according to their main activities, but also accounting for overlapping activities, see Figure 2-1):

- **Research and development phase**: years 1-10
- **Manufacturing phase:** years 11-25
- **Repair and maintenance phase:** years 26-65

As illustrated Figure 2-1, the entire manufacturing process takes place in the manufacturing phase. Research and development is phased out at the beginning of this phase and the demand for maintenance and repair increases during the manufacturing phase as soon as the first aircraft is in operation in year 12.

Figure 4-4 shows the average annual value-added effect in the three phases of the project as well as the total average. The value-added effects are broken down into direct, indirect, and induced effects. We estimate an average additional annual value added of 2.3 billion euro during the manufacturing phase. Of these, about 800 million euro are supported by the commissioned companies' demand for intermediate inputs. The value-added effects in the development and operating phase are at 1.8 and 1.2 billion euro, respectively.

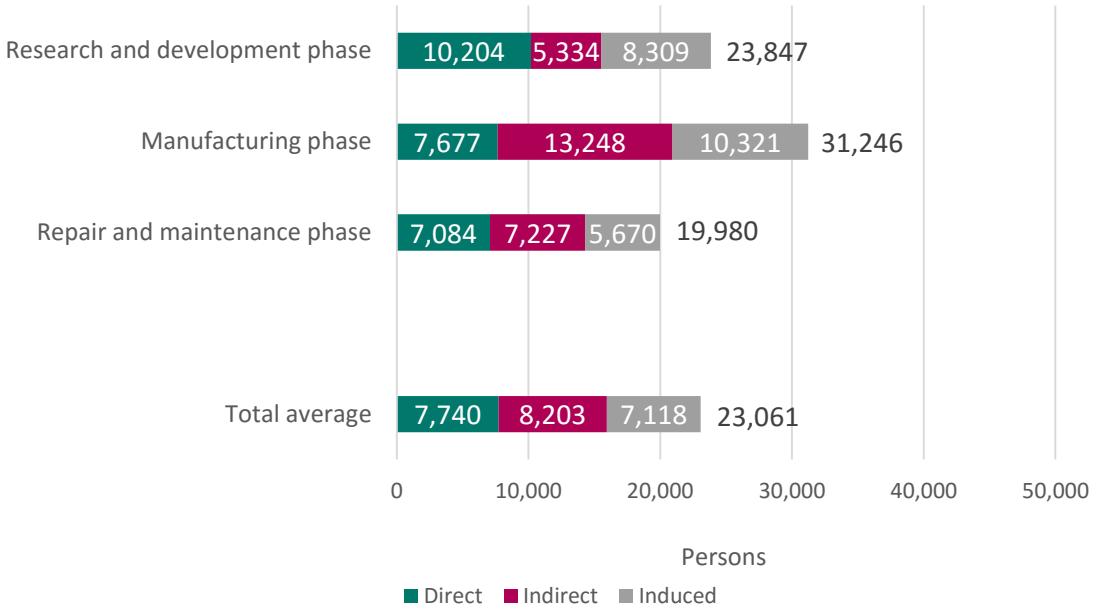
Figure 4-4:
Average annual value added



Source: DIW Econ.

Figure 4-5 shows the average annual employment effects during the three phases of the project. Again, total effects (direct, indirect and induced) are strongest during the manufacturing phase. Compared to value added, the demand for intermediate inputs from suppliers along the value chain plays an even more important role during this phase. The reason is that the sectors involved in the supply chain of the manufacturing phase are characterized by a higher labour intensity than the directly commissioned firms (aircraft-manufacturing and maintenance) that are involved in the manufacturing phase itself. Compared to the firms directly involved in the manufacturing phase, there are more persons employed in supplying industries to generate the same amount of gross value added. Moreover, in the research and development phase one can see that suppliers along the value chain are of less importance, direct effects are significantly larger than indirect effects. Accordingly, the *direct* employment effect in the research and development phase amounts to 43 percent of the *total* employment effect during this phase.

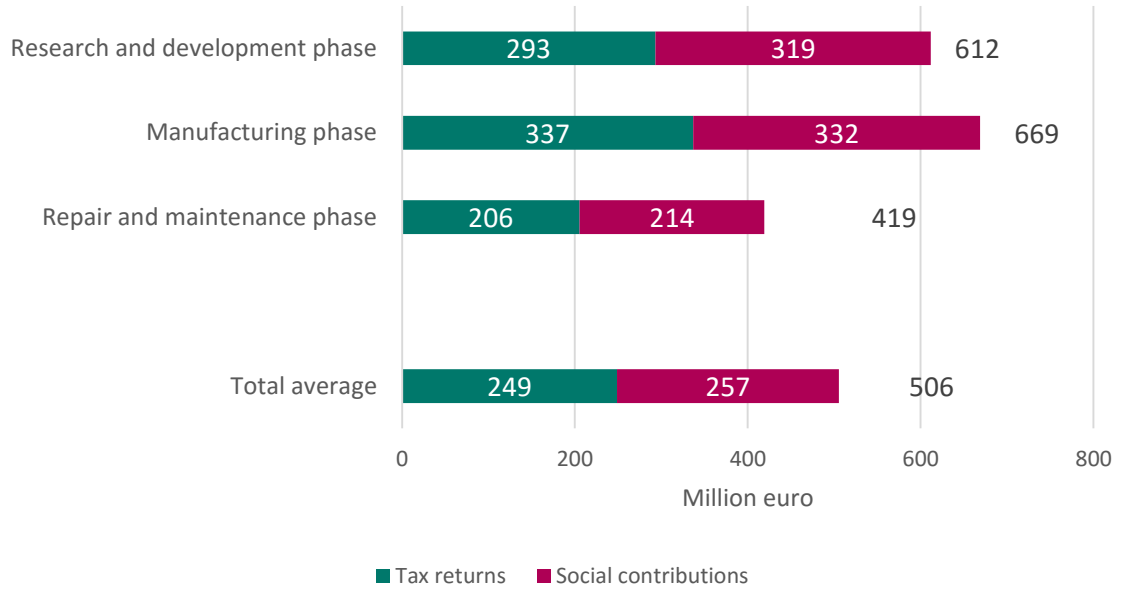
Figure 4-5:
Average annual employment effects



Source: DIW Econ.

Figure 4-6 shows average annual returns to public funds, the sum of tax revenues and social security contributions, which are generated within the scope of the exemplary project. Again, the figure is highest during the manufacturing phase.

Figure 4-6:
Average annual returns to public funds



Source: DIW Econ.

4.2 Economic Effects per 100 Million Euro Public Net Contract Value

This section presents estimates for the economic impact of public net spending (at basic prices according to the System of National accounts, i.e. excluding value added tax) of 100 million euro into each of the three segments of the defence sector of the German aerospace industry.

Within the modelling framework of the input-output model, the effects are linearly scalable as far as the contract value to be modelled is within the range of valid volumes (see section 5.4). This means that the impact of a contract volume of 200 million euro is twice the impact of a contract volume of 100 million euro.

4.2.1 Gross Value Added

In total, **a net contract value of 100 million euro leads to gross value added in Germany of 128 million euro if invested in research and development, to 114 million euro if invested in manufacture of aircraft and spacecraft, and to 106 million euro if invested in repair and maintenance** (see Table 4-1).

A net contract volume of 100 million euro in one of the three segments leads to effects on value added that are generated directly in the commissioned companies (direct effects). 68 million euro are directly generated in the field of research and development, 40 million euro in manufacture of aircraft and spacecraft and 38 million euro in the field of repair and maintenance. It can be noted that the ratio of gross value added to net contract volume is with almost 70 percent highest in research and development. This ratio is not only above average when compared to the other segments of the defence sector of the aerospace industry, but also when compared to the entire economy.

The demand for intermediate inputs lead to further effects in supplying industries (indirect effects). Per 100 million euro net contract volume in research and development, 22 million euro indirect value added is generated. 100 million euro net contract volume spent on manufacturing of aircraft and spacecraft leads to 40 million euro indirect value added and when spent on repair and maintenance to 36 million euro. Once again it can be observed that the supply chain of both segments manufacture and maintenance of aircraft and spacecraft contribute to a higher share of total value added compared to the suppliers of the research and development segment. This is reflected in the relatively high indirect effects for the former two segments.

Finally, directly and indirectly generated incomes in the segments lead to increased consumption and as a consequence to a higher level of economic activity (induced effects). The boost of economic activities translates into additional value added of 38 million euro (research and development), 34 million euro (manufacture of aircraft and spacecraft) and 32 million euro (repair and maintenance).

Table 4-1:
Gross value added in Germany per 100 million euro contract volume (net) per segment

in million euro		Research and development	Manufacture of aircraft and spacecraft	Repair and maintenance of aircraft and spacecraft
Net contract volume		**100.0**	**100.0**	**100.0**
Gross value added	Total effect	**128.2**	**114.3**	**106.4**
	direct	67.6	40.0	38.2
	indirect	22.2	40.1	36.3
	induced	38.4	34.2	31.8

Source: DIW econ.

4.2.2 Persons Employed

A public contract awarded to the defence sector of the aerospace industry creates jobs in Germany. A **net contract volume of 100 million euro leads to total employment effects of 1,700 jobs if invested in research and development, of 1,500 jobs if invested in manufacture of aircraft and spacecraft, and of around 1,700 jobs if invested in repair and maintenance** (see Table 4-2).

The net contract volume of 100 million euro in each of the three segments is associated with direct employment effects in the respective segment. The highest direct employment effect can be found in research and development. Almost 740 jobs are associated with a contract volume of 100 million euro awarded to research and development. The respective direct employment effects in manufacture of aircraft and spacecraft amount to almost 270 jobs and in repair and maintenance to 600 jobs. This outlines the relatively high productivity, measured as gross value added per person employed, in the segment manufacture of aircraft and spacecraft compared with the other two segments. Also, labour productivity is relatively high in aircraft manufacturing compared to labour productivity in the supplying industries. The indirect employment effect (670 jobs) is significantly higher than the direct employment effect (270 jobs), while direct and indirect value added effects are roughly the same in this segment.

Table 4-2:
Persons employed in Germany per 100 million euro contract volume (net) per segment

Persons employed in persons		Research and development	Manufacture of aircraft and spacecraft	Repair and maintenance of aircraft and spacecraft
Net contract volume (in mio. euro)		100.0	100.0	100.0
Persons employed	Total effect	**1,676**	**1,461**	**1,706**
	direct	739	267	605
	indirect	354	673	617
	induced	583	520	484

Source: DIW Econ.

4.2.3 Returns to Public Funds

Table 4-3 shows that **a 100 million euro net contract value invested in one of the three segments leads to an increase in returns to public funds of 43 million euro (research and development), 32 million euro (manufacture of aircraft and spacecraft) or 36 million euro (repair and maintenance), respectively**. In all segments, total returns to public funds can be attributed in roughly equal parts to tax revenues and to social security contributions.

Table 4-3:
Public revenue in Germany per 100 million euro contract volume (net) per segment

in million euro		Research and development	Manufacture of aircraft and spacecraft	Repair and maintenance of aircraft and spacecraft
Net contract volume		100.0	100.0	100.0
Taxes	Total effect	**20.7**	**16.1**	**17.5**
	direct	10.0	3.7	6.1
	indirect	2.8	5.4	4.9
	induced	7.9	7.1	6.6
Social security contributions	Total effect	**22.7**	**15.4**	**18.3**
	direct	14.4	4.6	8.5
	indirect	3.2	6.3	5.6
	induced	5.1	4.5	4.2
Taxes and social security contributions	Total effect	**43.4**	**31.5**	**35.8**
	direct	24.4	8.3	14.5
	indirect	6.0	11.7	10.5
	induced	13.0	11.6	10.8

Source: DIW Econ.

Table 4-4 shows the tax revenues further broken down by different taxes. Income tax contributes the lion's share to the sum of tax revenues while induced value added tax, trade tax and corporation tax are of less importance. In sum, income tax accounts for between 64 and 74 percent of total tax revenues in each of the three segments. It is also important to note that in contrast to the other taxes value added tax is only generated through induced effects, i.e. through increased incomes as a consequence of higher economic activity that in turn leads to increased spending and therefore value added tax.

Table 4-4:
Tax revenues in Germany per 100 million euro contract volume (net) per segment

Taxes in million euro		Research and development	Manufacture of aircraft and spacecraft	Repair and maintenance of aircraft and spacecraft
Net contract volume		100.0	100.0	100.0
Corporation tax	Total effect	**0.8**	**1.0**	**0.9**
	direct	0.1	0.3	0.1
	indirect	0.3	0.4	0.4
	induced	0.4	0.4	0.3
Income tax	Total effect	**15.2**	**10.4**	**12.3**
	direct	9.7	3.1	5.7
	indirect	2.2	4.3	3.8
	induced	3.4	3.0	2.8
Trade tax	Total effect	**1.2**	**1.7**	**1.5**
	direct	0.2	0.4	0.3
	indirect	0.4	0.7	0.7
	induced	0.7	0.6	0.5
Value added tax	Induced effect	3.5	3.1	2.9
Total taxes	Total effect	**20.7**	**16.1**	**17.5**
	direct	10.0	3.7	6.1
	indirect	2.8	5.4	4.9
	induced	7.9	7.1	6.6

Source: DIW Econ.

4.2.4 The Value Chain of the Defence Sector of the Aerospace Industry

Due to the complex value chain of the aerospace industry, indirect economic effects occur in numerous sectors of the economy. Sections 4.1.1 and 4.1.2 already indicate that the share of the production volume sourced from the value chain differs between the three segments of the defence sector of the aerospace industry. For instance, indirect value-added effects per 100 million euro net public contract volume are substantially larger in manufacturing and maintenance than in research and development. This section presents the value chains of the three segments more in detail.

Table 4-5 displays the ten most important supplying branches for the segment research and development in terms of indirect value added and indirect employment. Per 100 million euro net contract volume, the commissioned companies set off substantial production activities at supplying firms. In terms of indirect value added, computer programming and information services play the largest role in the supply chain with an indirect value added of 2.4 million euro. Companies engaging in real estate services and legal or accounting services are also of importance. In contrast to the indirect value added effects, the largest indirect employment effects occur in the security and administrative services sector and the employment service sector.

Table 4-5:
The ten most important sectors in terms of indirect value added and indirect employment in Germany per 100 million euro contract volume (net) for the segment research and development

Supplying branches	Gross value added (in million euro)
Computer programming, consultancy and related services; information services	2.4
Real estate services	1.9
Legal and accounting services; services of head offices; management consulting services	1.5
Education services	1.4
Security and investigation services; services to buildings and landscape; office administrative, office support and other business support services	1.0
Architectural and engineering services; technical testing and analysis services	0.9
Land transport services and transport services via pipelines	0.9
Employment services	0.9
Wholesale trade services, except of motor vehicles and motorcycles	0.9
Scientific research and development services	0.8
Supplying branches	**Persons employed (in persons)**
Security and investigation services; services to buildings and landscape; office administrative, office support and other business support services	38
Employment services	30
Education services	29
Legal and accounting services; services of head offices; management consulting services	25
Computer programming, consultancy and related services; information services	24
Land transport services and transport services via pipelines	18
Architectural and engineering services; technical testing and analysis services	16
Constructions and construction works	14
Wholesale trade services, except of motor vehicles and motorcycles	13
Retail trade services, except of motor vehicles and motorcycles	13

Source: DIW Econ.

Table 4-6 displays the most important suppliers of commissioned companies in the segment manufacture of aircraft and spacecraft. Regarding indirect value added, other transport equipment including manufacturing of aircraft and spacecraft (6.7 million euro), metal products (5.1 million euro), and employment services (4.0 million euro) generate the largest indirect effects. These three supplying branches also account for the largest indirect employment effects, however, in reverse order. While other transport accounts for 66 persons employed, employment services and metal products account for 128 and 90 persons employed, respectively.

Table 4-6:
The ten most important sectors in terms of indirect value added and indirect employment in Germany per 100 million euro contract volume (net) for the segment manufacture of aircraft and spacecraft

Supplying branches	Gross value added (in million euro)
Other transport equipment (including aircraft and spacecraft)	6.7
Fabricated metal products, except machinery and equipment	5.1
Employment services	4.0
Wholesale and retail trade and repair services of motor vehicles and motorcycles	2.9
Real estate services	2.3
Wholesale trade services, except of motor vehicles and motorcycles	2.1
Architectural and engineering services; technical testing and analysis services	1.7
Legal and accounting services; services of head offices; management consulting services	1.4
Computer programming, consultancy and related services; information services	1.3
Machinery and equipment n.e.c.	1.2
Supplying branches	**Persons employed (in persons)**
Employment services	128
Fabricated metal products, except machinery and equipment	90
Other transport equipment (including aircraft and spacecraft)	66
Wholesale and retail trade and repair services of motor vehicles and motorcycles	54
Retail trade services, except of motor vehicles and motorcycles	43
Security and investigation services; services to buildings and landscape; office administrative, office support and other business support services	37
Wholesale trade services, except of motor vehicles and motorcycles	33
Architectural and engineering services; technical testing and analysis services	31
Legal and accounting services; services of head offices; management consulting services	25
Machinery and equipment n.e.c.	15

Source: DIW Econ.

Table 4-7 displays the most important suppliers of the maintenance and repair of aircraft and spacecraft. In terms of value added, wholesale trade services account for 3.9 million euro indirect value added, followed by metal products (3.5 million euro) and employment services (3.4 million euro). The same three sectors generate also the largest indirect employment effects.

Table 4-7:
The ten most important sectors in terms of indirect value added and indirect employment in Germany per 100 million euro contract volume (net) for the segment repair and maintenance of aircraft and spacecraft

Supplying branches	Gross value added (in million euro)
Wholesale trade services, except of motor vehicles and motorcycles	3.9
Fabricated metal products, except machinery and equipment	3.5
Employment services	3.4
Real estate services	2.4
Legal and accounting services; services of head offices; management consulting services	2.1
Machinery and equipment n.e.c.	1.6
Architectural and engineering services; technical testing and analysis services	1.6
Other transport equipment (including aircraft and spacecraft)	1.3
Computer programming, consultancy and related services; information services	1.3
Warehousing and support services for transportation	1.1
Supplying branches	**Persons employed (in persons)**
Employment services	108
Wholesale trade services, except of motor vehicles and motorcycles	62
Fabricated metal products, except machinery and equipment	61
Retail trade services, except of motor vehicles and motorcycles	43
Security and investigation services; services to buildings and landscape; office administrative, office support and other business support services	41
Legal and accounting services; services of head offices; management consulting services	36
Architectural and engineering services; technical testing and analysis services	28
Machinery and equipment n.e.c.	20
Postal and courier services	16
Warehousing and support services for transportation	15

Source: DIW Econ.

In summary, the development, manufacturing, and maintenance of military aircraft in Germany is associated with substantial effects on domestic value added and employment as well as returns to public funds. These effects would not be realized if the respective project was commissioned to companies producing in foreign countries. Nonetheless, the associated government expenditures would have to be financed – e.g. through taxes or debts.

5. Methodological Details

This section outlines the key methodological techniques used for estimating the economy-wide effects of a public contract that is awarded to the defence sector of the aerospace industry.

5.1 Economic Impact Model

The economic impact model compiled by DIW Econ is based on detailed input-output tables (IO tables) provided by the German Federal Statistical Office (Destatis).[7] These tables capture the interconnections within the national economy as well as the product flows between the national economy and the rest of the world. With his article "Quantitative Input and Output Relations in the Economic System of the United States", the economist Wassilly Leontief developed the basis for future research using this technique.[8] In 1973, this research and numerous publications building on it resulted in the award of a Nobel Prize in Economics for the development of the input-output method and for its application to important economic problems. For an in-depth description of input-output analysis, see Miller and Blair (2009).[9] Fletcher (1989)[10] provides a gentle introduction of the methodology using the example of the economic impact of tourism.

Today the basic concept introduced by Leontief is frequently used for the analysis of the economic impact of specific industries and the impact of public policies. For instance, input-output analysis is routinely used to estimate total greenhouse gas emissions associated with specific economic activities.[11] The application of IO tables is also internationally widespread, IO tables have been consolidated in global frameworks (e.g. OECD, WIOD).[12]

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[7] Destatis (2017):Volkswirtschaftliche Gesamtrechnung. Input-Output-Rechnung 2013, Fachserie 18 Reihe 2.

[8] Leontief, W. (1936): Quantitative Input and Output Relations in the Economic System of the United States." The Review of Economics and Statistics, Volume 18, Issue 3, Pages 105-125.

[9] Miller, R. and P. Blair (2009): Input-Output Analysis: Foundations and Extensions. 2nd Edition, Cambridge University Press.

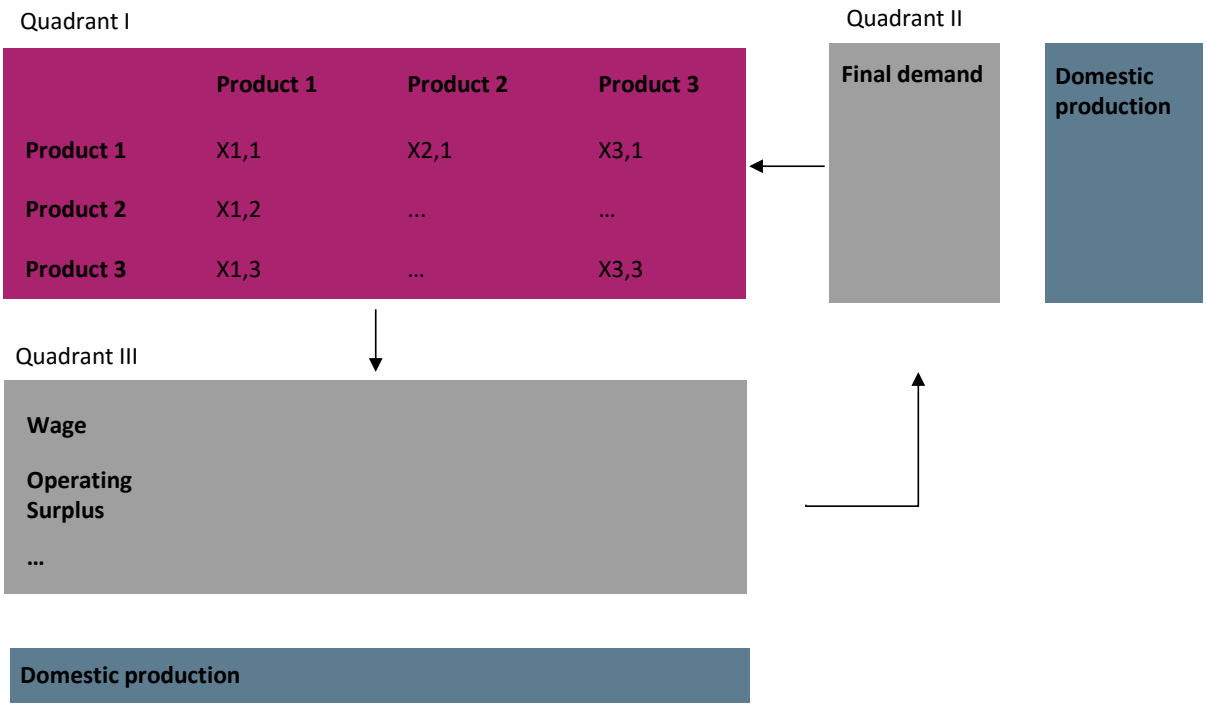
[10] Fletcher, J. (1989): Input-output analysis and tourism impact studies. Annals of Tourism Research, Volume 16, Issue 4, Pages 514-529.

[11] See Wiedmann, T. (2009): A review of recent multi-region input–output models used for consumption-based emission and resource accounting. Ecological Economics, Volume 69, Issue 2, Pages 211-222.

[12] See http://www.oecd.org/trade/input-outputtables.htm or http://www.wiod.org/project, the official WIOD Project, for example, was funded by the European Commission as part of the 7th Framework Programme and launched in 2012.

IO tables are constructed from observed economic data for a country or region. In Germany, IO accounts are compiled centrally at the Federal Statistical Office. The underlying data of the latest officially published IO tables by the Federal Statistical Office are based on the year 2013. Since compiling IO tables requires large amounts of data and time, IO tables are usually published with a considerable time lag. However, the year-to-year changes of the underlying economic and technological structure are not large, because structural change usually takes place in periods of decades and not in a few years. Therefore, using the 2013 IO table is a viable approach. Figure 5-1 provides a simplified picture of the structure of IO tables.

Figure 5-1:
Simplified structure of IO tables



Source: DIW Econ.

IO tables specify production processes and interlinkages within an economy in a given year. The heart of the table is Quadrant I showing the simplified three-by-three matrix. It represents the intermediate good flows between producers. Quadrant II represents final demand by households, governments or export. Domestic production is allocated to Quadrant I or Quadrant II, i.e. to intermediate demand or to final demand. Total domestic production is given by the sum of both quadrants.

Primary inputs are displayed in Quadrant III. The input of primary production factors is measured by the components of value added. These are wages, operating products, depreciation and indirect taxes less subsidies.

Based on these IO tables, we calculate the economic activity that is stimulated by a given amount of final demand (e.g. a public contract of 100 million euro) while accounting for the entire supply chain.

In matrix notation, the following equation represents the starting point

$$\boldsymbol{X} - \boldsymbol{AX} = \boldsymbol{Y},$$

where $\boldsymbol{X}$ is a gross output vector, $\boldsymbol{A}$ is the technical coefficient matrix, which is calculated using the official IO tables, and $Y$is the final demand vector.

Using a series of matrix algebra operations, the system yields

$$(\boldsymbol{I} - \boldsymbol{A})\boldsymbol{X} = \boldsymbol{Y}$$

$$(\boldsymbol{I} - \boldsymbol{A})^{-1}(\boldsymbol{I} - \boldsymbol{A})\boldsymbol{X} = (\boldsymbol{I} - \boldsymbol{A})^{-1}\boldsymbol{Y}$$

$$\boldsymbol{X} = (\boldsymbol{I} - \boldsymbol{A})^{-1}\boldsymbol{Y}.$$

(I-A)$^{-1}$ matrix is called Leontief inverse and is central for calculating direct and indirect effects. It can be derived as follows. If final demand for the product category 1 increases by one unit ($\Delta \mathrm{Y}_1 = 1$), then production in sector 1 directly increases by one unit ($\Delta \mathrm{Y}$). This requires intermediate inputs from supplying sectors of sector 1 where economic activity is stimulated ($\mathrm{A}\Delta \mathrm{Y}$). Supplying sectors of sector 1 in turn require inputs from other sectors ($\mathrm{A}^2\Delta \mathrm{Y}$) and so forth,

$$\boldsymbol{\Delta X} = \boldsymbol{\Delta Y} + \boldsymbol{A\Delta Y} + \boldsymbol{A}^2\boldsymbol{\Delta Y} + \boldsymbol{A}^3\boldsymbol{\Delta Y} + \ \ldots$$

$$\boldsymbol{\Delta X} = (\mathbf{I} + \boldsymbol{A} + \boldsymbol{A}^2 + \boldsymbol{A}^3 + \ \ldots)\boldsymbol{\Delta Y}$$

$$\boldsymbol{\Delta X} = (\mathbf{I} - \boldsymbol{A}\ )^{-1}\boldsymbol{\Delta Y}.$$

Hence, the total change in production can be divided into a direct (ΔY) and an indirect effect $(A + A^2 + A^3 + \ \ldots)\Delta Y$ (see Miller, R. and P. Blair, 2009).[13]

In addition to the effects on production and value added, the employment effect can be calculated. Basis for the calculation is an auxiliary table on employment published by Destatis. This auxiliary table contains the number of persons employed whose place of work is in Germany in accordance with the European System of Accounts and in line with the standards set up by the International Labour Organization (ILO).

[13] Miller, R. and P. Blair (2009): Input-Output Analysis: Foundations and Extensions. 2nd Edition, Cambridge University Press.

Keep in mind that the model rests upon several assumptions. Important assumptions include the absence of supply constraints, the emphasis on short-term effects or the assumption of fixed prices.[14]

- Supply-side constraints: The model assumes that production capacity can sufficiently accommodate the additional workload, implying that extra output can be produced without taking away resources from other activities.
- Constant returns to scale and fixed prices: Relative price changes play no role in the allocation of scarce resources between activities that would actually affect the economic impact.
- Short-term consideration: The analysis is based on characteristics of an economy at a single point in time and does not account for long-term adjustments within an economy.

These assumptions are implicit in the linear structure of the model. For relatively small changes in demand, relative prices and production structures can reasonably be assumed to be constant, see section 5.4.

5.2 Keynesian Multiplier Analysis

In addition to direct and indirect effects, this study quantifies induced effects. Directly and indirectly generated value added constitutes profits and labour income. This income stimulates additional demand, which in turn translates into a higher level of economic activity in the total economy (induced effects). To quantify these effects, the study makes use of a Keynesian **multiplier analysis**. The multiplier analysis takes into account that consumers can spend only a fraction of their income as leakages occur through saving, taxes or spending outside the local economy.

[14] Coughlin and Mandelbaum (1991): A Consumer's Guide to Regional Economic Multipliers, ABS (2012): Australian System of National Accounts: Concepts, Sources and Methods or Gretton (2013): On input-output tables: uses and abuses.

The country-specific multiplier *m* can be calculated based on an approach well documented in the economic literature and is smaller when there are more leakages in an economy:[15]

$$m = \frac{1}{1-[(1-s)(1-t)(1-k)]}$$

with *s* as savings rate, *t* tax ratio on incomes, *k* import quota.

Despite the common use of the multiplier suggesting that economists, governments and firms have found them useful, there is an ongoing debate regarding their suitability stemming from the theoretical basis and from measurement problems.[16] In frameworks analysing an exogenous stimulus, e.g. increased government demand, in contrast to analysing the importance of an entire sectors, it is conceded, that models concentrating exclusively on direct and indirect effects underestimate the economic impact. However, there is less consensus about the size of the multiplier. Because of the rigid assumptions about labour incomes and associated consumer spending, the multiplier for induced effects might be overestimated.[17] Miller and Blair (2009) state that the theoretical induced effect can be interpreted as an upper bound for the empirical one.

To understand the potential limitations of the theoretical Keynesian multiplier, consider a change in final demand, like a change in government demand for aircraft, which causes an increase in the number of persons employed and associated income. This increase translates into higher household spending. However, if the newly employed persons previously received unemployment benefits, the gain in spending is smaller than the theoretical induced effect. Moreover, additional spending must be financed, e.g. through taxes or borrowing. Tax increases lead to decreases in disposable income, government borrowing leads to increased interest rates, both of which result in decreased demand. This will to some extent offset of the additional spending. Thus the multiplier would overstate the effect.

Despite the uncertainty in the correct size of the multiplier, the extension of the standard input output analysis by the Keynesian multiplier allows for a more comprehensive representation of the expected economic effects.

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[15] See, e.g. Armstrong and Taylor (2000): Regional Economics and Policy (3rd edition), Oxford: Blackwell.

[16] Bess and Ambargis (2011): Input-Output Models for Impact Analysis: Suggestions for Practitioners Using RIMS II Multipliers.

[17] Miller, R. and P. Blair (2009): Input-Output Analysis: Foundations and Extensions. 2nd Edition, Cambridge University Press.

5.3 Taxation and Social Security Contributions

The economic activity supported by a hypothetical public programme generates substantial returns to public funds. The production activity by businesses in the value chain directly leads to increases in trade tax, corporate tax, and value added tax. Moreover, people employed in these companies pay income tax and social contributions. Further cash flow to public funds is generated through the induced economic activity. Based on several primary administrative data sources, DIW Econ expanded the input-output model in order to quantify these effects.

- **Income tax**: For every sector, the average compensation per person employed is calculated. Multiplied with the economy-wide average income tax rate, we obtain a sector-specific income tax coefficient. To obtain the income tax effect generated in a particular sector, the coefficient is multiplied by the estimated sector-specific employment effect.[18]
- **Social security contributions:** Social contributions paid by employees and employers in a given sector are calculated equivalently to income taxes. To obtain the social contributions coefficient, which denotes the average social contributions paid per additional person employed, the average compensation per person employed is multiplied by the economy-wide average social contributions rate.[19]
- **Value added tax:** In a first step the economy-wide average value added tax per value added sourced from domestically used products is calculated based on official tax data. [20] This coefficient is then multiplied by the induced value added.
- **Corporation tax:** The total corporation tax paid is available at the sector level.[21] This figure is divided through sectoral gross value added to obtain the corporation tax coefficient. Multiplying this coefficient by the additional gross value added yields additional tax corporation tax returns.

[18] Source: Destatis (2017): Volkswirtschaftliche Gesamtrechnung. Input-Output-Rechnung 2013, Fachserie 18 Reihe 2 and Destatis (2017) Volkswirtschaftliche Gesamtrechnungen des Bundes: Steuereinnahmen: Deutschland, Jahre, Steuereinnahmearten und Sozialbeiträge.

[19] Source: Destatis (2017): Volkswirtschaftliche Gesamtrechnung. Input-Output-Rechnung 2013, Fachserie 18 Reihe 2 and Eurostat: http://ec.europa.eu/eurostat/statistics-explained/index.php/Tax_revenue_statistics.

[20] Source: Destatis: Genesis data base. www.genesis.destatis.de.

[21] Source: Destatis (2016): Finanzen und Steuern. Jährliche Körperschaftsteuerstatistik 2012.

- **Trade tax:** The tax base of the trade tax (*Steuermessbetrag*) is available at the sector level, which is multiplied with the economy-wide tax factor (*Hebesatz*).[22] This figure is divided through value added at sector level to obtain the trade tax coefficient. Multiplying this coefficient by additional value added yields additional trade tax returns.

Often, available aggregate data are more recent than **sectoral data**. This is the case for trade taxes, where total taxes at sector level are available for the year 2012, while the aggregate is available for 2016. In these cases, sectoral values **are extrapolated** based on the economy-wide growth rate of the specific tax.

5.4 Range of Valid Contract Volumes

IO analysis is a linear modelling framework, which is scalable. However, it is based on statistical averages and a linear homogenous production function with constant returns to scale. The latter implies a constant relationship between input and output. Suppose that the value of aircraft production in a given year is 50 million euro and the producing industry purchased 10 million euro of metal as intermediate inputs. If aircraft production were to double to 100 million euro, the input-output model then assumes that the intermediate inputs of metal that the aircraft producer purchases would double as well to 20 million euro. The upper limit of scalability is reached if the contract volumes reach a magnitude in which the productive capacity of the defence sector in the aerospace industry and its suppliers are exhausted and cannot be expanded for technical reasons in the short run. Contract volumes exceeding the productive capacity would involve significant price adjustments. In this case, the defence sector would for example need to recruit workers from abroad at much higher costs. The IO model does not account for price changes that may result from the shortage of the workforce or intermediate inputs. In this case, the assumption of linear production function does not hold.

It is therefore reasonable to apply contract volumes that do not exceed actual capacities of the defence sector of the aerospace industry. The annual contract volume of the exemplary project is 1,400 million euro annually on average, which amounts to just a small share of the total annual production in the sector. Based on this expertise of industry experts, the estimation of economic effects of public procurement contracts of this magnitude seems plausible.

[22] Source: Destatis (2017): Finanzen und Steuern. Gewerbesteuer 2012.

5.5 Classification of the Defence Sector of the Aerospace Industry and Data Availability

The defence sector of the aerospace industry involves different production activities. The relevant activities and corresponding statistical classification of products by activity, abbreviated as CPA (2008)[23], are listed below:

- manufacture of air and spacecraft and related machinery (CPA 30.3)
- repair and maintenance of aircraft and spacecraft (CPA 33.16)
- RDTE (research, development, test and evaluation) (CPA 72.1)

However, the underlying data of IO tables of the Federal Statistical Office – consequently, also the information on input structure, employment intensity and the share of value added – are not available in such detail. Instead, information is only available for CPA divisions (two-digit numerical codes) of product categories: CPA 30, CPA 33 and CPA 72. This information can be used to approximate the input structure, employment intensity and share of value added of the corresponding, more detailed three-digit or four-digit CPA levels.

However, DIW Econ adjusted the aggregate information to the specificities of the defence sector of the aerospace industry as far as additional detailed data is available. Based on different sources, adjustments were made especially with respect to the input structure, employment intensity and the share of value added of CPA 30.[24] For example, value added relative to production value for CPA 30.3 is higher than for the average of the aggregate CPA 30. Similarly, labour productivity is slightly higher in the subsector.

5.6 European Armament Cooperation Programmes

Impact studies usually asses the economic impact of an activity within the geographic area of interest, in this case Germany. Correspondingly, economic activity will only take effect on the economy if goods and services are produced domestically. Thus, any import from other countries will not contribute to domestic value added, employment or returns to public funds (*standard approach*).

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[23] Eurostat CPA 2008 – Statistical classification of product by activity.

[24] VDI (2015): Analyse der strukturellen Lage der Verteidigungsindustrie in Deutschland, Study commissioned by the Federal Ministry of Economic Affairs and Energy, detailed supply and use tables of the Federal Statistical Office, Employment statistics 2015 of the Federal Employment Agency.

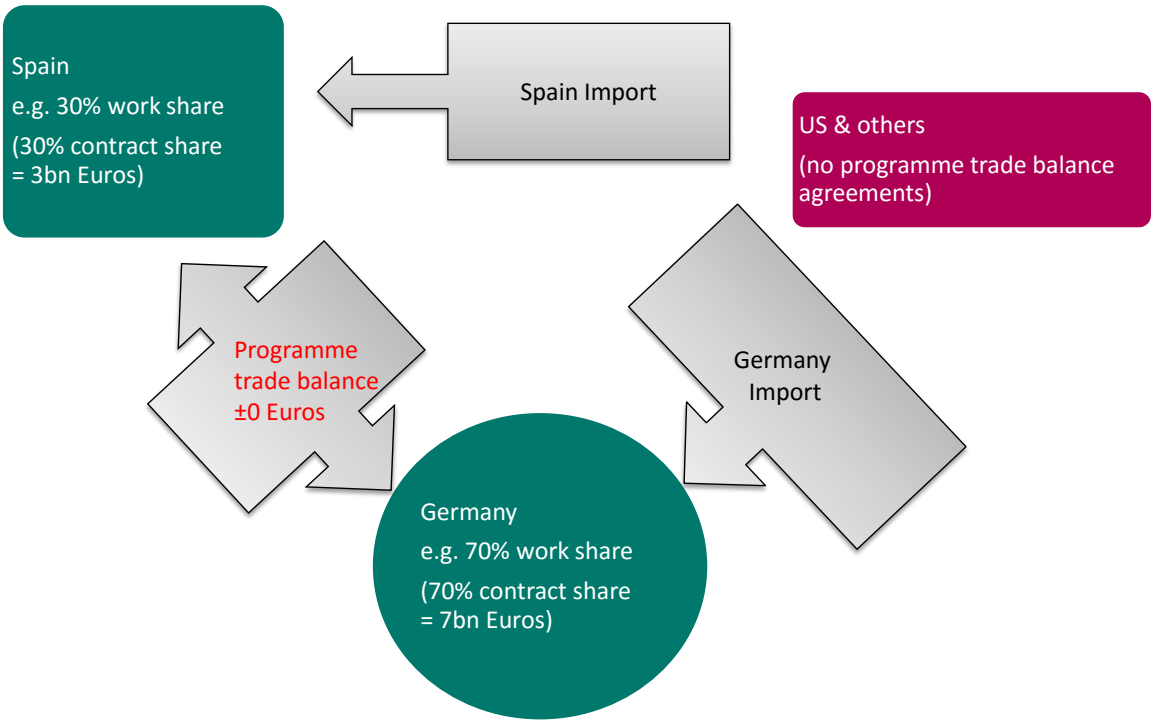
This study however goes further. It takes into account the specific structure of European cooperation programmes in the defence sector of the aerospace industry. Cooperative programmes in Europe have a long tradition and history for spreading the supply chain over Europe. However, cross-country subcontracting among participating countries usually balances within the project phase or over several projects.[25] This means that a public contract awarded to German aerospace firms might oblige the German firms to purchase intermediate inputs from participating countries, for example Spain. The cooperation programme also ensures that, within the programme framework or related procurement programmes, Spanish firms are in turn required to purchase inputs from Germany (*adjustment of imports*). The subcontracts are supposed to involve imports of equal value as illustrated in Figure 5-2. This implies that within the procurement programme or over several projects the value of inputs imported from the partner country is the same in the two participating countries.[26]

To account for this, imported intermediate goods used for the direct additional production of the three involved sectors are added to the domestic production. As imports of intermediate products from the other participating country lead to exports of intermediate goods of the same value, they are directly treated as domestic production. This results in slightly higher estimates regarding value added, employment, and public revenue. Throughout the study, results with adjusted imports are shown.

[25] CSIS (2017): Designing and managing successful international joint development programs or Institute for security studies: Armaments cooperation in Europe.

[26] http://www.wiod.org/database/wiots16 Database, Timmer, M. P., Dietzenbacher, E., Los, B., Stehrer, R. and de Vries, G. J. (2015): An Illustrated User Guide to the World Input-Output Database: the Case of Global Automotive Production.

Figure 5-2:
European programme subcontracting balance



Source: DIW Econ.

Table 5-1 shows that the treatment of imports from participating countries has **no substantial impact on results**. For instance, in the segment manufacture of air and spacecraft 100 million euro programme value (net) lead to an employment of 1,461 persons under using the method with *adjustment of imports* compared to 1,447 persons estimated using the *standard approach*.

Table 5-1:
Total economic effects under different treatments of imports and exports

Overview of Economic effects	Unit	Economic effects: standard approach	Economic effects: adjustment of imports
Net contract volume of manufacture of air and spacecraft	Million euro	100.0	100.0
Gross value added	Million euro	113.4	114.3
Persons employed	Persons	1,447	1,461
Taxes	Million euro	16.0	16.1
Taxes and social contributions	Million euro	31.3	31.5

Source: DIW Econ.

6. Tabular Appendix

Table 6-1:
Average annual effects of the exemplary project by project phase

		Unit	Total average	Research and development phase	Manufacturing phase	Repair and maintenance phase
				(acc. to phase definition in section 4.1.4)		
Net contract volume[27]		Million euro	**1,400.0**	**1,433.2**	**2,027.9**	**1,171.1**
Corresponding gross value		*Million euro*	*1,666.0*	*1,705.5*	*2,413.2*	*1,393.6*
Gross value added	Total effect	Million euro	**1,563.8**	**1,825.4**	**2,267.5**	**1,245.6**
	direct	Million euro	608.4	945.6	802.5	447.7
	indirect	Million euro	487.4	333.4	786.3	425.1
	induced	Million euro	468.0	546.3	678.7	372.8
Persons employed	Total effect	Persons	**23,061**	**23,847**	**31,246**	**19,980**
	direct	Persons	7,740	10,204	7,677	7,084
	indirect	Persons	8,203	5,334	13,248	7,227
	induced	Persons	7,118	8,309	10,321	5,670
Taxes	Total effect	Million euro	**248.6**	**293.1**	**337.0**	**205.5**
	direct	Million euro	86.7	137.7	91.1	71.1
	indirect	Million euro	65.1	42.3	105.5	57.3
	induced	Million euro	96.9	113.1	140.4	77.1
Social security contributions	Total effect	Million euro	**257.0**	**318.8**	**331.8**	**213.8**
	direct	Million euro	120.2	198.0	119.2	99.1
	indirect	Million euro	75.0	48.6	123.1	65.4
	induced	Million euro	61.8	72.1	89.6	49.2
Taxes and social security contributions	Total effect	Million euro	**505.6**	**611.8**	**668.8**	**419.3**
	direct	Million euro	206.9	335.7	210.2	170.2
	indirect	Million euro	140.1	90.9	228.6	122.7
	induced	Million euro	158.6	185.2	230.0	126.4

Source: DIW Econ.

[27] Net contract value at basic prices according to the System of National Accounts, i.e. excluding value added tax.

Table 6-2:
Effects per 100 million euro net contract volume for each segment of the defence sector of the aerospace industry

Indicator		Unit	Research and development	Manufacture of air and spacecraft	Repair and maintenance of aircraft and spacecraft
Net contract volume[28]		Million euro	**100.0**	**100.0**	**100.0**
Corresponding gross value		*Million euro*	*119.0*	*119.0*	*119.0*
Gross value added	Total effect	Million euro	**128.2**	**114.3**	**106.4**
	direct	Million euro	67.6	40.0	38.2
	indirect	Million euro	22.2	40.1	36.3
	induced	Million euro	38.4	34.2	31.8
Persons employed	Total effect	Persons	**1,676**	**1,461**	**1,706**
	direct	Persons	739	267	605
	indirect	Persons	354	673	617
	induced	Persons	583	520	484
Corporation tax	Total effect	Million euro	**0.8**	**1.0**	**0.9**
	direct	Million euro	0.1	0.3	0.1
	indirect	Million euro	0.3	0.4	0.4
	induced	Million euro	0.4	0.4	0.3
Income tax	Total effect	Million euro	**15.2**	**10.4**	**12.3**
	direct	Million euro	9.7	3.1	5.7
	indirect	Million euro	2.2	4.3	3.8
	induced	Million euro	3.4	3.0	2.8
Trade tax	Total effect	Million euro	**1.2**	**1.7**	**1.5**
	direct	Million euro	0.2	0.4	0.3
	indirect	Million euro	0.4	0.7	0.7
	induced	Million euro	0.7	0.6	0.5
Value added tax	Induced effect	Million euro	3.5	3.1	2.9
Total taxes	Total effect	Million euro	**20.7**	**16.1**	**17.5**
	direct	Million euro	10.0	3.7	6.1
	indirect	Million euro	2.8	5.4	4.9
	induced	Million euro	7.9	7.1	6.6
Social security contributions	Total effect	Million euro	**22.7**	**15.4**	**18.3**
	direct	Million euro	14.4	4.6	8.5
	indirect	Million euro	3.2	6.3	5.6
	induced	Million euro	5.1	4.5	4.2
Taxes and social security contributions	Total effect	Million euro	**43.4**	**31.5**	**35.8**
	direct	Million euro	24.4	8.3	14.5
	indirect	Million euro	6.0	11.7	10.5
	induced	Million euro	13.0	11.6	10.8

Source: DIW Econ.

[28] Net contract value at basic prices according to the System of National Accounts, i.e. excluding value added tax.