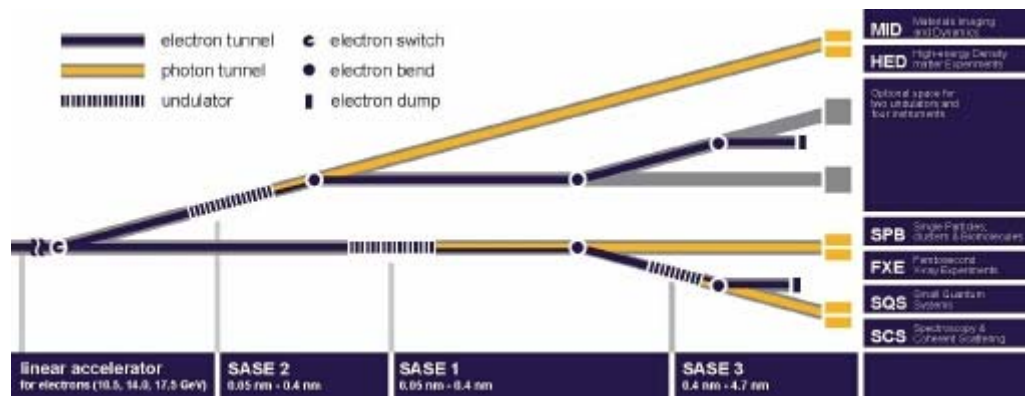


# Regional and Sectoral Demand Effects of Research Infrastructure Facilities (RIFs)

## - The case of the X-FEL at Desy, Hamburg –

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University of Hamburg



# Overview

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- I. Short Introduction: Dilemma of Financing Basic Research
- II. Survey and classification of socio-economic effects of RIFs
- III. Stakeholders of RIFs & their interests in (short-run) economic demand effects
- IV. Demand Effects of the X-FEL at DESY: Method and selected results of multi-staged, regionalized IO-Analysis
  - 1. Project and Complementary Expenditure
  - 2. Direct Effects
  - 3. Indirect Effects
  - 4. Project-specific ( = 2. direct + 3. indirect) Effects
  - 5. Induced Effects
  - 6. Outside (= 3. indirect + 4. induced) Effects
  - 7. Total (= 2. direct + 3. indirect + 4. induced) Effects
- V. Critical Appraisal and Overall Conclusion

# 1. Short Introduction: Dilemma of Basic Research

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In economic terms, **basic research** characterized by

- uncertainty or high risk with respect to both
  - > scientific results and
  - > economic value (= expected NPV of future net returns) of scientific results
- high-cost of large scale, indivisible of research facilities / instruments
- non-diversifiable risk of investment in large-scale research facility
- high social time preference rate (low estimation of future benefits)
- public good properties (joint-use, non price-excludability) of research result
- information asymmetries between researchers and financing agencies

All these economic characteristics give rise to **market failure** and the need of **government provision / financing of basic research** (which, in turn, is itself confronted with various causes of government failure)

*See in detail Pfähler, W. and H. Hoppe (2001): Ökonomie der Grundlagenforschung und Wissenschaftspolitik, Perspektiven der Wirtschaftspolitik 2(2): 125-144, and the literature cited therein.*



# 1. Short Introduction: Dilemma of Basic Research

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**Government and legislative bodies**, on the other hand,

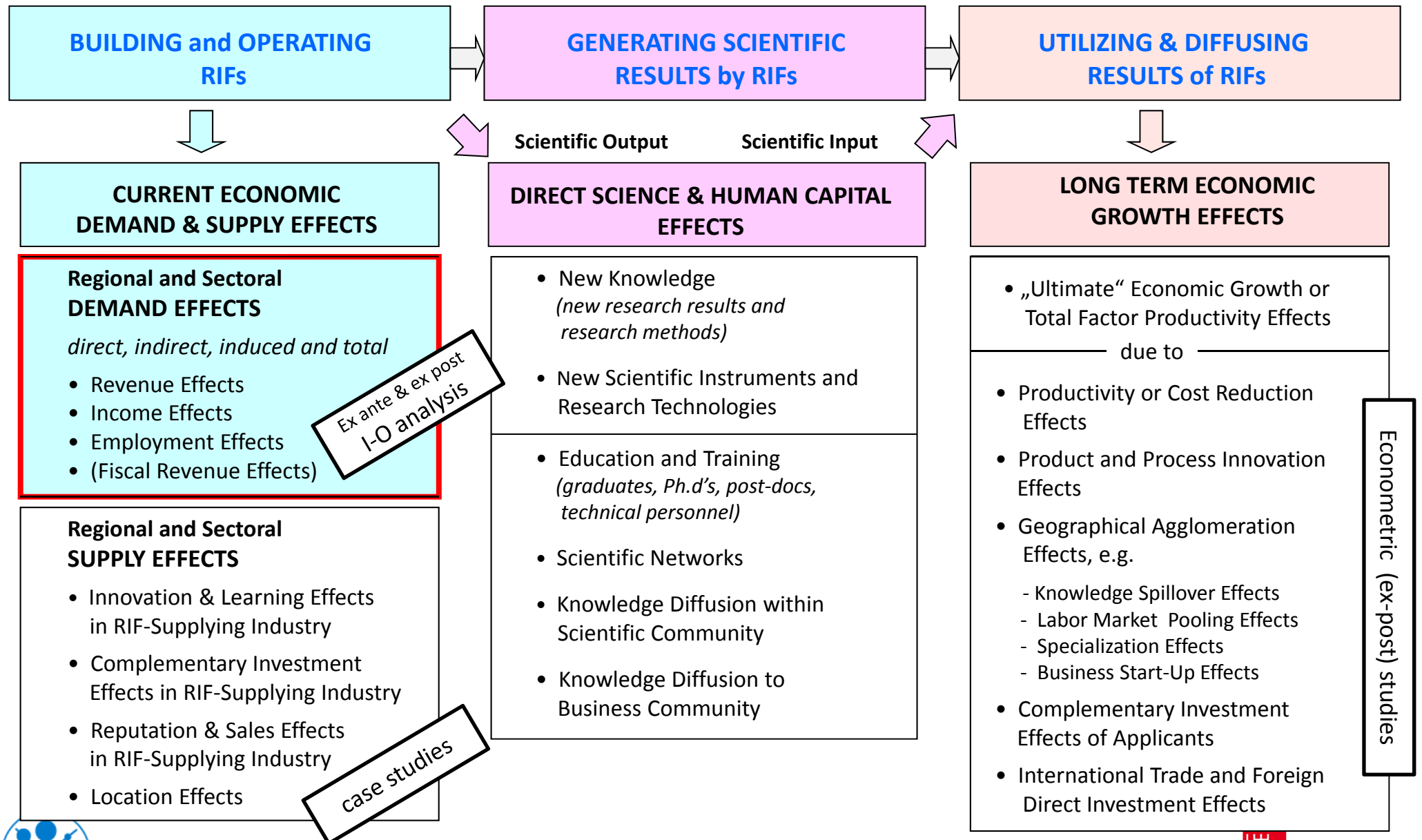
- have a limited understanding of the logic and content of basic research,
- are confronted with tight public budgets, intense rivalry among different uses of public funds (taxes and debt), and strong lobby pressure for partisan policies
- face short political voting cycles encouraging a high social time preference (undervaluation of future benefits) and high preference for job creation.

Hence, **government and legislative bodies, suffer under a dilemma**: They should take responsibility of financing basic research (market failure) and, at the same time, they are unable / unwilling to take on this responsibility (government failure).

One **way out of this dilemma** seems to be to call for more empirical evidence of more immediate beneficial **socio-economic (side) effects of basic research**.



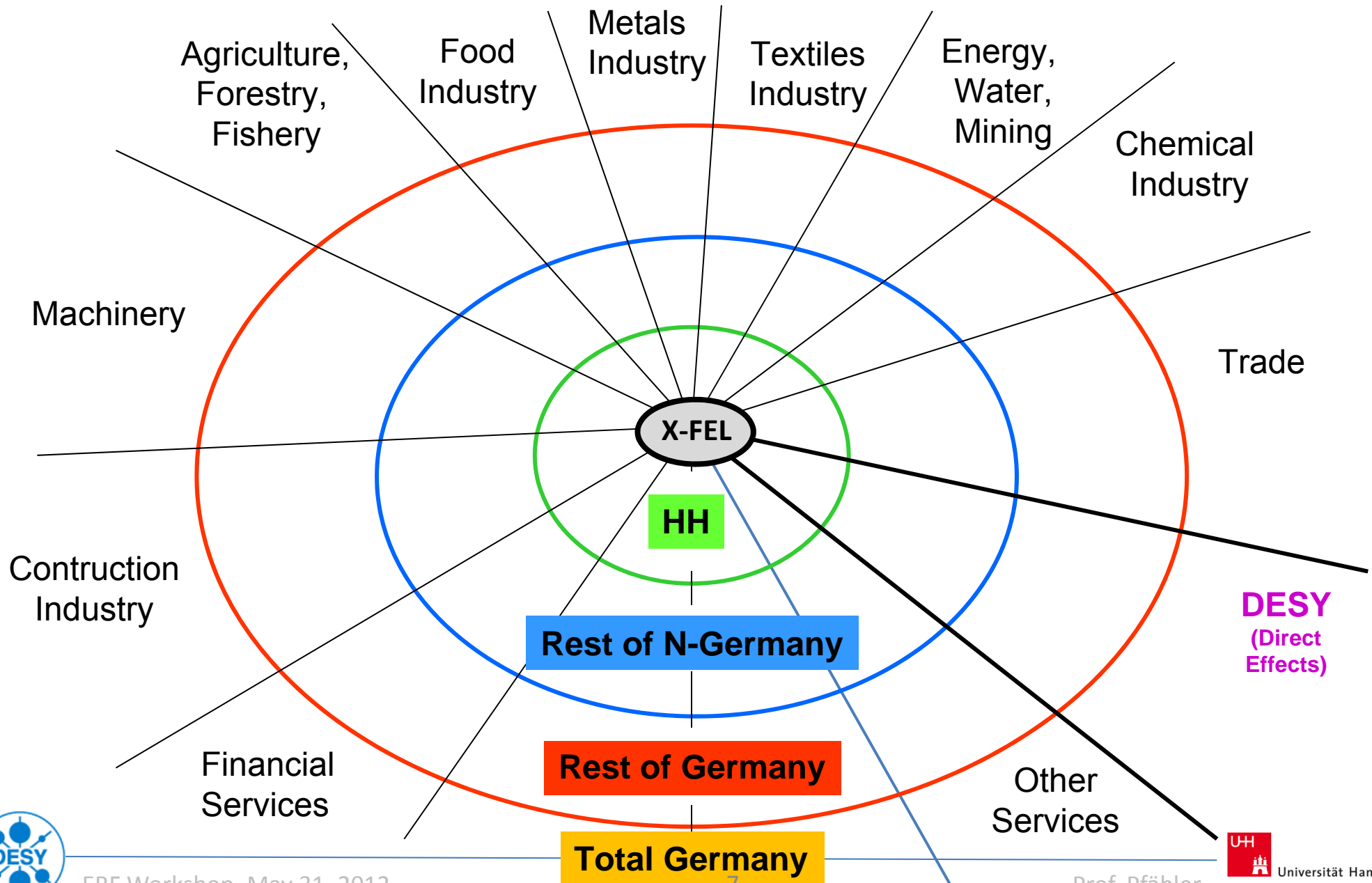
## II. Socio-Economic Effects of Basic Research Infrastructure Facilities (RIFs)



### III. Stakeholders of RIFs and their interests/objectives in Demand Effects

	Stakeholders	Interests / Objectives in Short-run Demand Effects
1	<b>DESY</b> - Board of Directors - Administrative Council - Scientific Council	Gain support of policy-makers and non-scientific private and business community by proving beneficial “economic side-effects” to various <b>regional levels</b> (local, state, federal, foreign) and <b>sectors of the economy</b> (industry, services, trade, etc.)
2	<b>Financiers of DESY, e.g.</b> - German State and Federal Parliaments & Ministries - International Partners	Gain support / reduce opposition of domestic taxpayers and international partners by promising beneficial “economic side-effects” to various <b>sectors and regions of the economy</b> , including tax revenue effects to public budgets (“self-financing effect”)
3	<b>Regional &amp; Local Approval Authorities</b> of construction & operation of RIF	Gain support of / reduce frictions with regional & local approval authorities by indicating beneficial <b>regional</b> and local economic side effects of the RIF
4	<b>Private Business Partners of DESY in construction &amp; operation of the RIF</b>	Gain specific support by lobby partners of construction and supply industry of DESY at all <b>regional levels and sectors of the economy</b>
5	<b>Private Business Partners of DESY in utilization and diffusion of DESY instruments and results</b>	Gain support by lobby partners of the business community willing and able to directly and indirectly benefit from the scientific effects and instrumental use of the RFI in their <b>regions and sectors of the economy</b>
<b>Conclusion: Need for regional and sectoral decomposition of demand effects</b>		

### III. Demand Effects in Regional and Sectoral Perspective: Domestic, multi-staged, regionalized I-O Analysis



## IV. Demand Effects of the X-FEL at DESY: Seven steps of analysis of exp. flow (1)

The method of multi-stage regionalized IO-Analysis has been applied by Pfähler et. al. to

1. Ex-post IO-analysis of HERA at DESY
2. Ex-ante IO-Analysis of Linear Collider at DESY
- 3. Ex-ante IO-Analysis of X-FEL at DESY**
4. Ex-post IO- and productivity analysis of regional effects of State-funded Education and Research in the city states of
  - a. Bremen
  - b. Hamburg

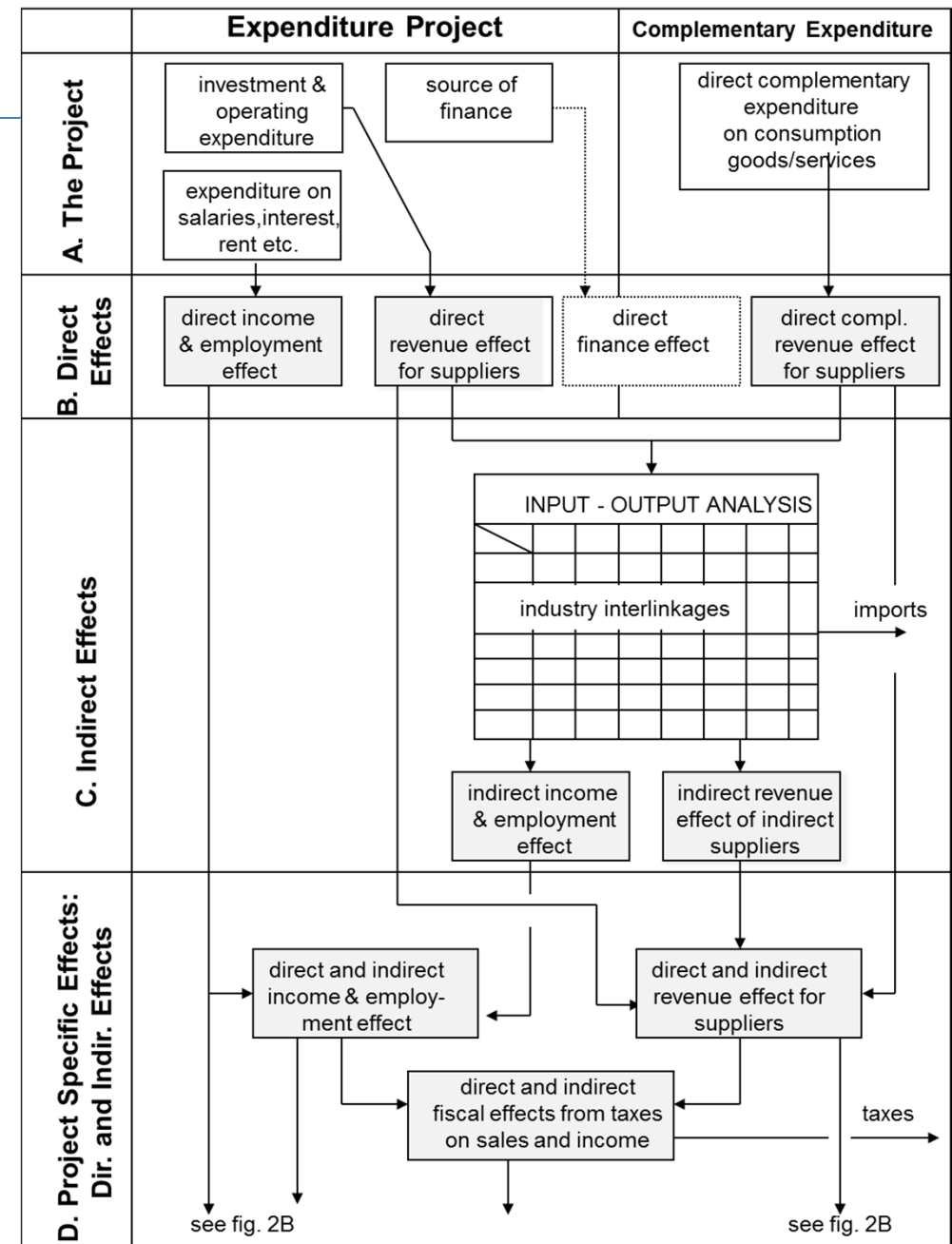


Figure 2A: Stages of IO-Analysis



## IV. Demand Effects of the X-FEL at DESY: Seven steps of analysis of exp. flow (2)

A detailed description of the IO-method applied can be found in

*Pfähler, W. : IO-Analysis: A User's Guide and Call for Standardization, in Pfähler, W. ed. (2001): Regional Input-Output Analysis, Nomos Verlagsanstalt, pp. 11-43*

and is available as pdf-document from the conference organizers.

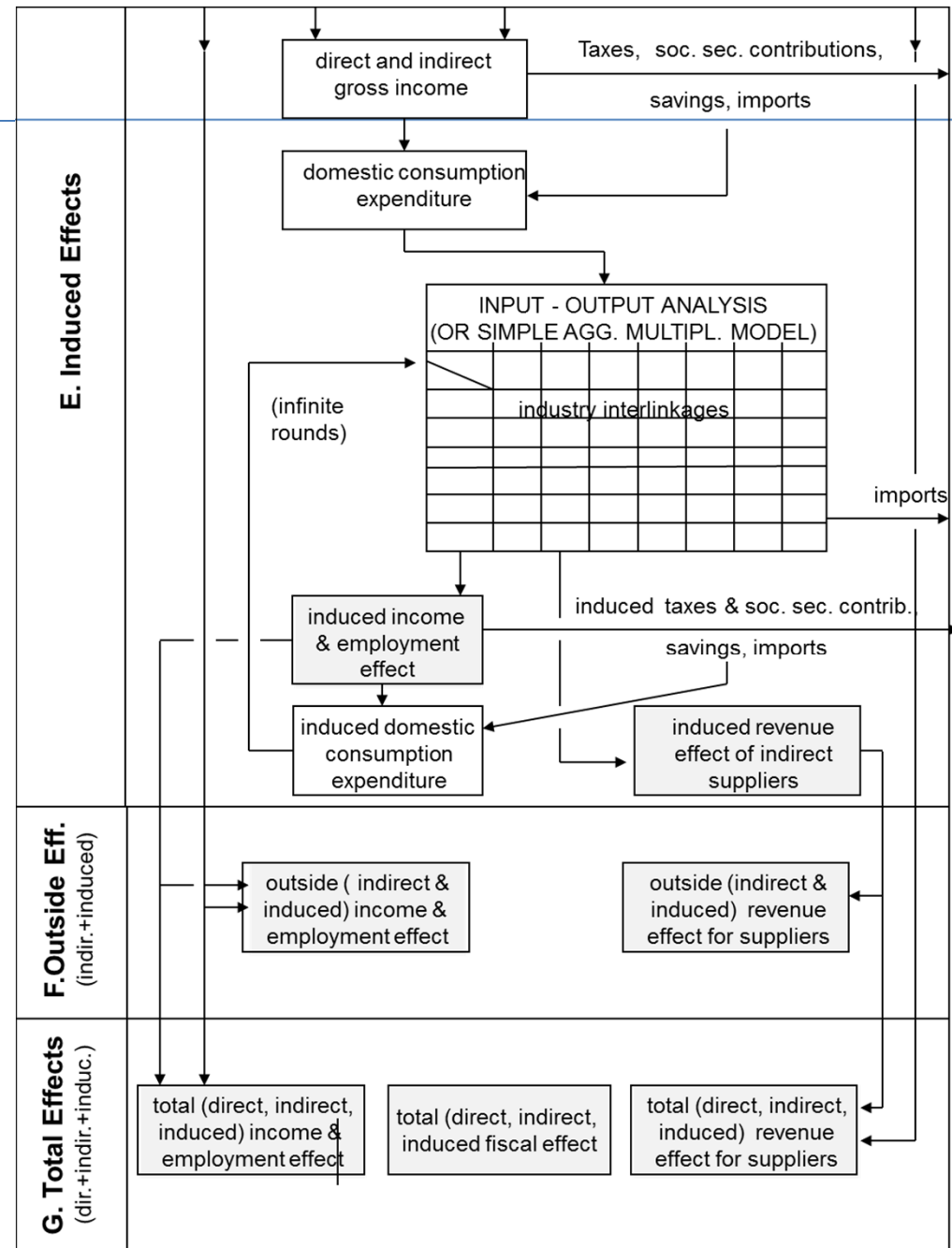


Figure 2B: Stages of IO-Analysis (cont'd)

## IV. Demand Effects of the X-FEL at DESY: Seven steps of analysis of exp. flow (3)

### Method of Regionalized IO-Analysis

Start with 3 separate I-O- Analysis of

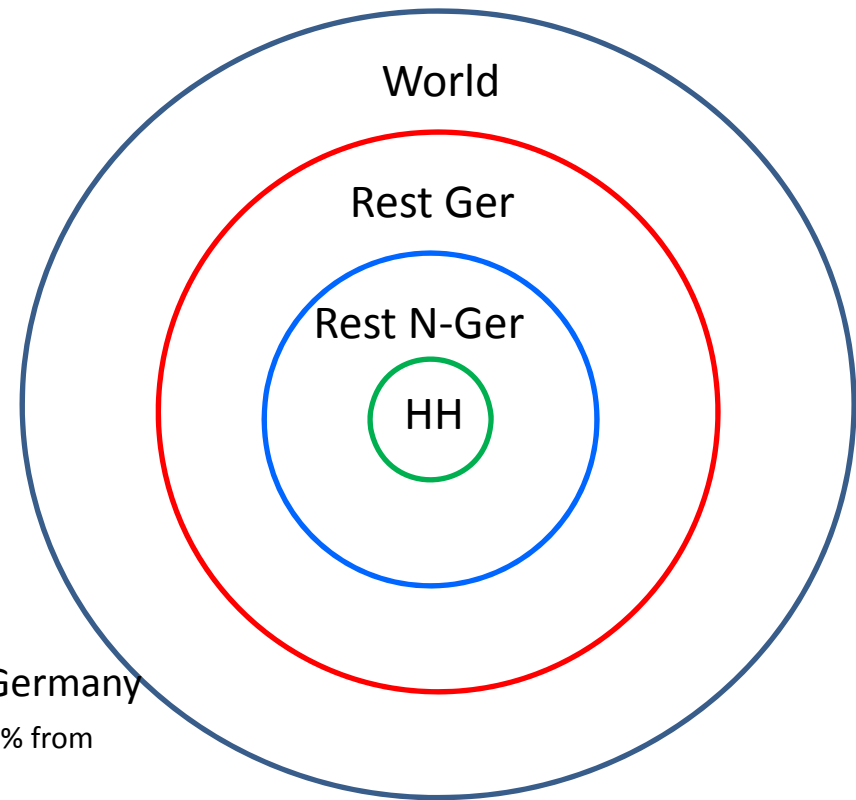
1. **I-O HH and Rest of World**
2. I-O Northern Germany and Rest of World
3. I-O Germany and Rest of World

And, by substraction of values in IO-tables, find

4. **I-O or Rest of Northern Germany** (2. – 1.)
5. **I-O of Rest of Germany** (3. – 2.)

### Basic Assumptions

1. Sectoral interlinkage: Identical technology matrix for Germany and its subregions (e.g. if German construction industry sources 5% from chemical industry, so does HH construction industry)
2. Regional interlinkage: Choose coefficient between „minimum regional preference (0)“ and „maximum regional preference“ (1) on the basis of reasonable assumptions and experience
3. Simulate results with different regional preference factors



For details see: Gabriel, Ch., Constructing regionalized Input-Output tables: A new simple-to-use method, in Pfähler, W. ed. (2001), Regional Input-Output Analysis, Nomos Verlagsanstalt, pp. 75-88.

## IV. Demand Effects of the X-FEL at DESY:

### Step A: Defining Project and Complementary Expenditure

#### The X-FEL Project (ex-ante)

##### Issues:

- „Define“ size and scope, duration and time structure, value and categories of expenditure
- What staff and complementary expenditure to include? Test: Would they dis-appear, if project were stopped?
- What source of finance? Defining the reference case (see back-up). Here: fully debt financed without any “crowding-out”-effects (see V.)

	Total Expenditure during <b>8 y</b> of Construction & Equipment Time (in Mill. EUR)	Yearly Expenditure (pro rata temporis)  (in Mill. EUR)
<b>I. Investment Expenditure</b>		
Construction	140,0	17,5
Technical Equipment	404,0	50,5
Sub-Total	<b>544,0</b>	<b>68</b>
<b>II. (Add.) Staff and Complementary Expenditure</b>		
Additional DESY Staff Expenditure	70,0	8,8
Consumption Expenditure of Non-Residents at DESY	2,5	0,3
<b>Sub-Total</b>	<b>72,5</b>	<b>9,1</b>
<b>III. Total</b>	<b>616,5</b>	<b>77,1</b>
Thereof DESY-Expenditure	614,0	76,8

Source: DESY 2002



## IV. Demand Effects of the X-FEL at DESY:

### Step B: Direct (domestic) Effects of Project Expenditure (*"Primary Beneficiaries"*)

#### The X-FEL Project (ex-ante)

#### Note:

Primary allocation of expenditure to regions and sectors is based on de facto information, experience and assumptions

Direct Revenue Effects (in Mill. EUR p.a.)							
Expenditure	Sector	HH	Rest N-Ger	Rest Ger	Germ	Rest of World	Total
technical equipment	MACHINERY	2,8	0,9	14,5	18,2	32,3	50,5
construction	CONSTRUCTION	7,0	5,2	3,5	15,7	1,8	17,5
total investment expenditure		9,8 (29%)	6,1 (18%)	18 (53%)	34 50% (100%)	34,1 50%	68 100%
Direct Income Effects (in Mill. EUR p.a.)							
X-FEL additional staff expenditure	(DESY)	5,5 (62,6%)	3,19 (35,7%)	0,1 (1,7%)	8,7 (100%)		
Direct Employment Effects (in number of full-time jobs)							
X-FEL additional staff expenditure	(DESY)	109 (62,6%)	62 (35,6%)	3 (1,7%)	174 (100%)		
Complementary Consumption Effects (in Mill. EUR p.a.)							
complementäry consumption expenditure	-	0,27 (90%)	0,03 (10%)	0,0	0,3 (100%)		
Quelle: DESY und eigene Berechnung							

## IV. Demand Effects of the X-FEL at DESY:

### Step C: Indirect Effects of Project Expenditure ("*Secondary Beneficiaries*")

#### The X-FEL Project (ex-ante)

Sectors of  
economy

Reg. Revenue Effect  
(in mill EUR p.a.)

Reg. Income Effect  
(in mill EUR p.a.)

Reg. Employ. Effect  
(in no. of full-time jobs)

#### Note:

1. The indirect effects are the effects occurring outside the DESY through the expenditure for construction and equipment, staff and complementary expenditure of DESY-guests.

2. The 4 major sectoral secondary beneficiaries are the sectors construction, machinery, trade, financial services

Sektor	Umsatzeffekt (in Mill. EUR p.a.)				Einkommenseffekt (in Mill. EUR p.a.)				Beschäftigungseffekt (in Arbeitsplätzen)			
	HH	üND	üD	D ges.	HH	üND	üD	D ges.	HH	üND	üD	D ges.
LANDW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	1	1
ENERGIE	0.0	0.2	0.5	0.7	0.0	0.1	0.2	0.3	0	1	4	5
CHEMIE	0.3	1.0	2.2	3.5	0.1	0.3	0.7	1.1	1	5	16	22
METALLE	0.2	0.5	2.2	2.9	0.0	0.2	0.7	0.9	2	7	18	27
MASCHINEN	0.3	0.8	4.5	5.6	0.8	0.5	5.6	6.9	14	10	132	156
TEXTILIEN	0.1	0.3	0.9	1.3	0.0	0.1	0.3	0.4	1	3	7	11
NAHRUNG	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0	0	1	1
BAU	0.0	0.2	0.4	0.6	2.6	2.3	1.6	6.5	70	74	48	192
HANDEL	0.3	0.8	2.9	4.0	0.1	0.4	1.4	1.9	3	15	46	64
F-DIENSTE	0.6	1.9	6.1	8.6	0.2	0.9	2.8	3.9	3	12	40	55
SM-DIENSTE	0.0	0.0	0.1	0.1	0.0	0.0	0.1	0.1	0	1	3	4
SNM-DIENSTE	0.0	0.1	0.4	0.5	0.0	0.1	0.2	0.3	0	2	7	9
Summe	1.8	5.8	20.3	27.9	3.8	4.9	13.6	22.3	94	130	323	547

Quelle: Eigene Berechnung

3

17%

2

24%

1

59%

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/Gabriel 2003

2 29%

1 35%

3 12%

4 10%

3. The major regional beneficiary is Rest-Germany (= outside North-Germany)



## IV. Demand Effects of the X-FEL at DESY:

### Step D: Project-Specific (= Direct & Indirect) Effects of Project Expenditure

#### The X-FEL Project (ex-ante)

##### Note:

- These effects are specific to the X-FEL project in terms of primary and secondary beneficiaries.
- The 4 major sectoral beneficiaries are the construction ind. (27%), Desy employees (24%), machinery industry (22%), and trade (9%).
- The major regional beneficiary is Rest-Germany (45%).

#### Sectors of economy

#### Reg. Revenue Effect (in mill EUR p.a.)

#### Reg. Income Effect (in mill EUR p.a.)

#### Reg. Employ. Effect (in no. of full-time jobs)

Sektor	Umsatzeffekt (in Mill. EUR p.a.)				Einkommenseffekt (in Mill. EUR p.a.)				Beschäftigungseffekt (in Arbeitsplätzen)			
	HH	üND	üD	D ges.	HH	üND	üD	D ges.	HH	üND	üD	D ges.
Zusatz-Pers.	-	-	-	-	5.5	3.1	0.1	8.7	110	62	2	174
LANDW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	1	1
ENERGIE	0.0	0.2	0.5	0.7	0.0	0.1	0.2	0.3	0	1	4	5
CHEMIE	0.3	1.0	2.2	3.5	0.1	0.3	0.7	1.1	1	5	16	22
METALLE	0.2	0.5	2.2	2.9	0.0	0.2	0.7	0.9	2	7	18	27
MASCHINEN	3.1	1.6	19.1	23.8	0.8	0.5	5.6	6.9	14	10	132	156
TEXTILIEN	0.1	0.3	0.9	1.3	0.0	0.1	0.3	0.4	1	3	7	11
NAHRUNG	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0	0	1	1
BAU	7.0	5.4	3.9	16.3	2.6	2.3	1.6	6.5	70	74	48	192
HANDEL	0.3	0.8	2.9	4.0	0.1	0.4	1.4	1.9	3	15	46	64
F-DIENSTE	0.6	1.9	6.1	8.6	0.2	0.9	2.8	3.9	3	12	40	55
SM-DIENSTE	0.0	0.0	0.1	0.1	0.0	0.0	0.1	0.1	0	1	3	4
SNM-DIENSTE	0.0	0.1	0.4	0.5	0.0	0.1	0.2	0.3	0	2	7	9
Summe	11.6	11.8	38.4	61.8	9.3	8.0	13.7	31.0	204	192	325	721

Quelle: Eigene Berechnung

2  
28%

3  
27%

1  
45%

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## IV. Demand Effects of the X-FEL at DESY:

### Step E: Induced Effects of Project Expenditure ("Tertiary Beneficiaries")

#### The X-FEL Project (ex-ante)

##### Note:

1. The induced effects result from spending the direct and indirect incomes. They are **not project-specific**; any other public expenditure project yielding the same income effects would have the same induced effects.

2. However, here the **induced effects are derived by IO-analysis**, yielding regional and sectoral effects, rather than by simple aggregate multiplier model.

#### Sectors of economy

#### Reg. Revenue Effect (in mill EUR p.a.)

#### Reg. Income Effect (in mill EUR p.a.)

#### Reg. Employ. Effect (in no. of full-time jobs)

Sektor	Umsatzeffekt (in Mill. EUR p.a.)				Einkommenseffekt (in Mill. EUR p.a.)				Beschäftigungseffekt (in Arbeitsplätzen)			
	HH	üND	üD	D ges.	HH	üND	üD	D ges.	HH	üND	üD	D ges.
LANDW	0.1	0.3	0.8	1.2	0.0	0.1	0.3	0.4	1	6	19	26
ENERGIE	0.2	0.4	1.1	1.7	0.1	0.2	0.4	0.7	1	2	9	12
CHEMIE	0.1	0.4	1.1	1.6	0.0	0.1	0.3	0.4	0	2	8	10
METALLE	0.0	0.1	0.5	0.6	0.0	0.0	0.2	0.2	0	2	4	6
MASCHINEN	0.2	0.6	1.8	2.6	0.1	0.2	0.5	0.8	1	4	13	18
TEXTILIEN	0.3	0.7	1.9	2.9	0.1	0.2	0.6	0.9	2	7	16	25
NAHRUNG	0.4	1.0	2.3	3.7	0.1	0.2	0.5	0.8	2	5	21	28
BAU	0.0	0.2	0.8	1.0	0.0	0.1	0.3	0.4	0	3	9	12
HANDEL	1.6	3.8	9.7	15.1	0.7	1.9	4.6	7.2	17	71	152	240
F-DIENSTE	1.6	4.6	13.5	19.7	0.6	2.2	6.1	8.9	9	30	88	127
SM-DIENSTE	0.4	0.9	2.1	3.4	0.2	0.6	1.3	2.1	8	21	42	71
SNM-DIENSTE	0.4	0.9	2.2	3.5	0.2	0.6	1.4	2.2	5	16	42	63
Summe	5.3	13.9	37.8	57.0	2.1	6.4	16.5	25.0	46	169	423	638

1 38%  
2 20%  
3 11%  
4 10%

Quelle: Eigene Berechnung

2 7% 3 26,5% 1 66,5%  
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3. As usual, the **4 major beneficiaries** (from spending the direct and indirect incomes) are the trade sector, financial, market and non-market services.

## IV. Demand Effects of the X-FEL at DESY:

### Step F: Outside (= indirect and induced) Effects of Project Expenditure

#### The X-FEL Project (ex-ante)

##### Note:

1. Outside effects are the indirect and induced effects occurring outside the DESY through the expenditure for construction and equipment and complementary expenditure of DESY-guests.

2. The 5 major outside secondary beneficiaries are the sectors trade, construction, financial services and machinery

Sectors of economy	Reg. Revenue Effect (in mill EUR p.a.)				Income Effect (in mill EUR p.a.)				Employment Effect (in no. of full-time jobs)			
	HH	üND	üD	D ges.	HH	üND	üD	D ges.	HH	üND	üD	D ges.
LANDW	0.1	0.3	0.9	1.3	0.0	0.1	0.3	0.4	1	6	20	27
ENERGIE	0.2	0.6	1.6	2.4	0.1	0.2	0.6	0.9	1	2	13	16
CHEMIE	0.5	1.4	3.3	5.2	0.1	0.4	1.0	1.5	2	7	23	32
METALLE	0.2	0.6	2.7	3.5	0.1	0.2	0.9	1.2	2	9	22	33
MASCHINEN	0.5	1.4	6.4	8.3	0.9	0.7	6.1	7.7	15	14	145	174
TEXTILIEN	0.4	1.0	2.8	4.2	0.1	0.3	0.9	1.3	3	10	23	36
NAHRUNG	0.4	1.0	2.4	3.8	0.1	0.2	0.5	0.8	2	5	22	29
BAU	0.1	0.4	1.2	1.7	2.6	2.4	2.0	7.0	70	77	58	205
HANDEL	1.9	4.6	12.7	19.2	0.8	2.2	6.0	9.0	20	86	198	304
F-DIENSTE	2.2	6.5	19.6	28.3	0.9	3.0	8.9	12.8	12	42	128	182
SM-DIENSTE	0.4	0.9	2.2	3.5	0.2	0.6	1.4	2.2	9	22	44	75
SNM-DIENSTE	0.4	1.0	2.6	4.0	0.2	0.6	1.6	2.4	5	18	49	72
Summe	7.3	19.7	58.4	85.4	6.1	10.9	30.2	47.2	142	298	745	1185

Quelle: Eigene Berechnung

2

12%

3

25%

1

63%

4 15%

2 17%

1 26%

3 15%

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## IV. Demand Effects of the X-FEL

### Step G: Total Effects

#### The X-FEL Project (ex-ante)

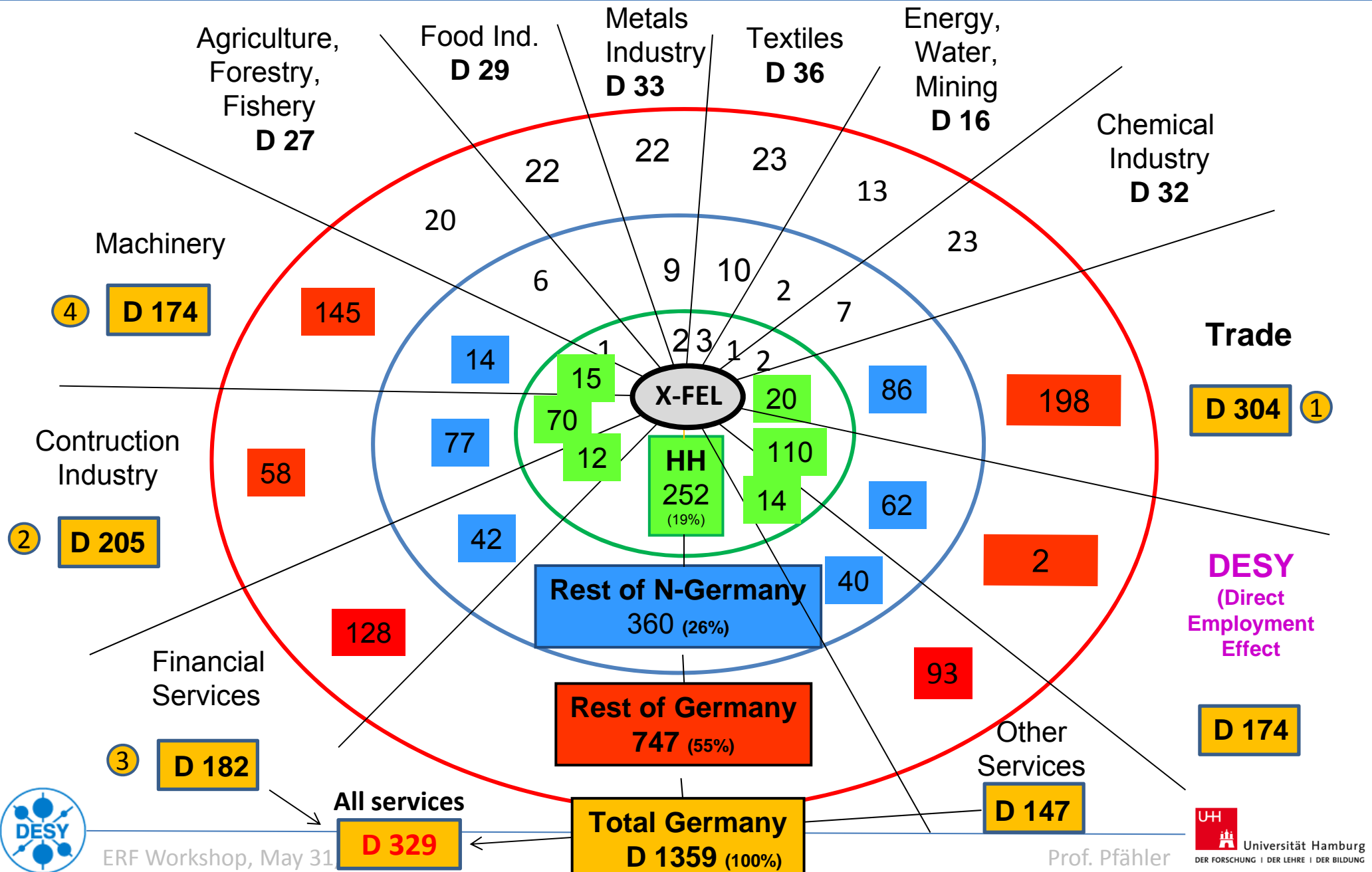
#### Essential results (p.a.)

1. The X-FEL project of 77 m p.a. expenditure secures nationwide circa 120 m in revenue, 56 m in income and 1400 jobs, each year (for 8 years)
2. However, circa 50% of these effects are not project-specific induced effects. The “employment multiplier” is 1.9 for Germany, 1.6 for N-Germany and 1.2 for Hamburg
4. The major regional (job) beneficiaries are Rest-Germany (55%) and Rest-Northern Germany (26%)
5. The major sectoral (job) beneficiaries are trade (22%), construction (15%) financial services (13,4%), machinery (12,8%) and DESY (12,8%).

	Reg.Rev. Effect (in mill EUR p.a.)				Reg.Inc. Effect (in mill EUR p.a.)				Reg. Empl. Effect (in no. of full-time jobs)				
	HH	üND	üD	D ges.	HH	üND	üD	D ges.	HH	üND	üD	D ges.	
B. Direct Effects	9.8 0.3	6.1 0.0	18.0 0.0	34.0 0.3	5.5 -	3.1 -	0.1 -	8.7 -	110 -	62 -	2 -	174 -	4 12,8%
C. Indirect Effects	1.8	5.8	20.3	27.9	3.8	4.9	13.6	22.3	94	130	323	547	
D. Proj.-spec. Effects	11.6	11.8	38.4	61.8	9.3	8.0	13.7	31.0	204	192	325	721	53%
E. Induced Effects	5.3	13.9	37.8	57.0	2.1	6.4	16.5	25.0	46	169	423	638	47%
F. Outside Effects	7.3	19.7	58.4	85.4	6.1	10.9	30.2	47.2	142	298	745	1185	
G. Total Effects	17.2	25.8	76.4	119.4	11.6	14.0	30.3	55.9	252 19%	360 26%	747 55%	1359 100%	
LANDW	0.1	0.3	0.9	1.3	0.0	0.1	0.3	0.4	1	6	20	27	
ENERGIE	0.2	0.6	1.6	2.4	0.1	0.2	0.6	0.9	1	2	13	16	
CHEMIE	0.5	1.4	3.3	5.2	0.1	0.4	1.0	1.5	2	7	23	32	
METALLE	0.2	0.6	2.7	3.5	0.1	0.2	0.9	1.2	2	9	22	33	
MASCHINEN	3.4	2.3	20.9	26.6	0.9	0.7	6.1	7.7	15	14	145	174	4 12,8%
TEXTILIEN	0.4	1.0	2.8	4.2	0.1	0.3	0.9	1.3	3	10	23	36	
NAHRUNG	0.4	1.0	2.4	3.8	0.1	0.2	0.5	0.8	2	5	22	29	
BAU	7.1	5.6	4.7	17.4	2.6	2.4	2.0	7.0	70	77	58	205	2 15%
HANDEL	1.9	4.6	12.7	19.2	0.8	2.2	6.0	9.0	20	86	198	304	1 22%
F-DIENSTE	2.2	6.5	19.6	28.3	0.9	3.0	8.9	12.8	12	42	128	182	3 13,4%
SM-DIENSTE	0.4	0.9	2.2	3.5	0.2	0.6	1.4	2.2	9	22	44	75	
SNM-DIENSTE	0.4	1.0	2.6	4.0	0.2	0.6	1.6	2.4	5	18	49	72	
Sectors of economy	17												



# IV. Demand (= Employment) Effects in Regional and Sectoral Perspective - The Case of X-FEL p.a. -



## V. Critical Appraisal of regionalized IO-Analysis of Demand Effects

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1. Basic Research is not and shouldn't be regarded as a „business cycle“ program to boost employment. The demand effects are socio-economic “side effects”.
2. Knowledge of demand effects, however, can help to gain political / administrative support by regional and sectoral *secondary and tertiary beneficiaries* via indirect and induced demand effects
3. A reasonable method to elaborate the demand effects for these beneficiaries is a static, multi-stage, regionalized IO-analysis, in which direct, indirect and induced effects are decomposed into regional and sectoral effects. The method is not too costly and the results are easy to communicate to a wider public.
4. However, the results of such a static, multi-stage regionalized IO-analysis have to be taken with care. Many
  - explicit and implicit assumptions of this type of analysis (see below)
  - and very limited availability of original data on the sub-national level (see below)contribute to an
  - > overestimation of the demand effects on the national level
  - > misrepresentation of the demand effects on the various regional levels



## V. Critical Appraisal of regionalized IO-Analysis of Demand Effects

### 5. Implicit assumptions of static IO-Analysis:

- Keynesian (non-structural) unemployment in the economy (*=> positive real income and employment effects*)
- No price effects and money does not matter (*=> real = nominal effects*)
- Economically perfectly neutral debt-financing of the project, i.e. *no “crowding-out” effects* because of perfectly interest and wealth inelastic private consumption and investment expenditures (*=> „gross effects“ = „net effects“*)
- Linear input expenditure structure of the economy in static IO analysis (*=> no factor substitution effects, no innovation effects, no technical progress, i.e. no supply-side effects*)
- Timeless world, all effects “happen within one period” (*=> instantaneous multiplier effects*)

**Conclusion:** Every single assumption contributes to the **overestimation of demand effects in IO-analysis**.

### 6. Regional vs regionalized IO-Analysis and data availability

- In general, no original regional IO-data available; to generate own data set would be too costly and time-consuming. Thus, regional IO-tables are based on assumptions and simulations.
- Various more or less ambitious and cost-intensive methods of regionalization are available. (*see Pfähler, ed. (2001): Regional Input-output Analysis*).

**Conclusion:** Regionalization can lead to **misrepresentation of results** if regions differ significantly in their economic structure.

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**Thank you for your attention**



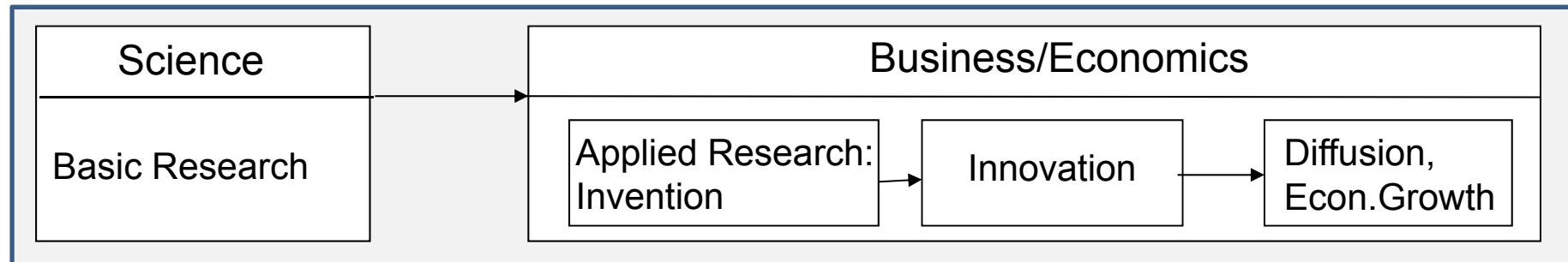
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# Back-up

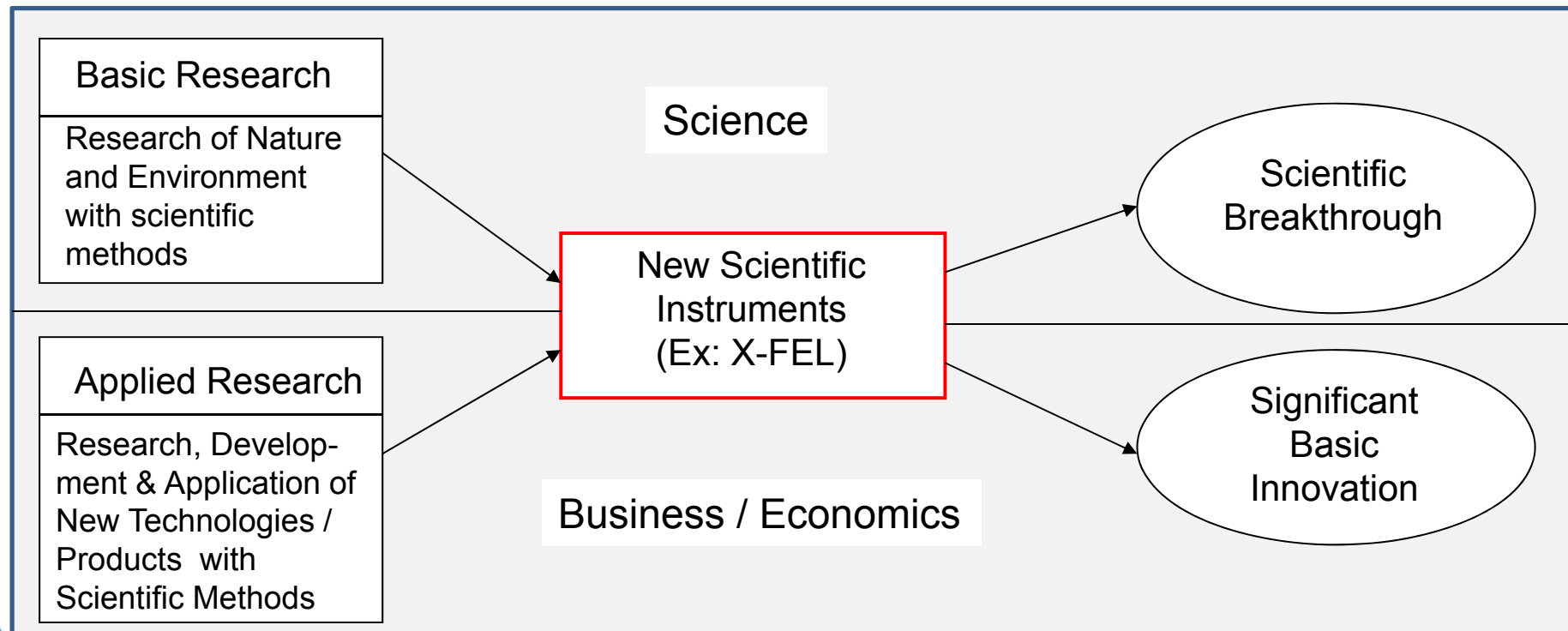


## II. Socio-Economic Effects of Basic Research Infrastructure Facilities (RIFs)

### Traditional Linear Model of Innovation Process



### Innovation Process according to de Solla Price (Research Policy, 1984)



# IV. Demand Effects of the X-FEL at DESY:

## 1. Step: Defining Project and Complementary Expenditure

### Alternative reference cases & sources of finance in Demand Effect I-O-Analysis

<i>Case of I-O-Analysis</i>	<i>Reference Case</i>
<b>Building and/or Operating a New Project</b>	
1. new project, financed by new debt	no new project, no new debt
2. new project, finance by higher taxes/fees	no new project, no taxes/fees
3. new project, financed by new debt	new project, financed by taxes/fees
4. new project I, financed by new debt or higher taxes/fees	new project II, financed by new debt or higher taxes/fees
<b>Operating a Current Project</b>	
5. current project, financed by new debt	close down current project, repay debt
6. current project, financed by higher taxes/fees	close down current project, lower taxes/fees
7. current project, financed by new debt or higher taxes/fees	alternative project, financed by new debt or higher taxes/fees
8. current project, financed by new debt or higher taxes/fees	downsize current project, repay debt, or lower taxes/fees

No „crowding-out“  
via finance effect or  
via expenditure effect

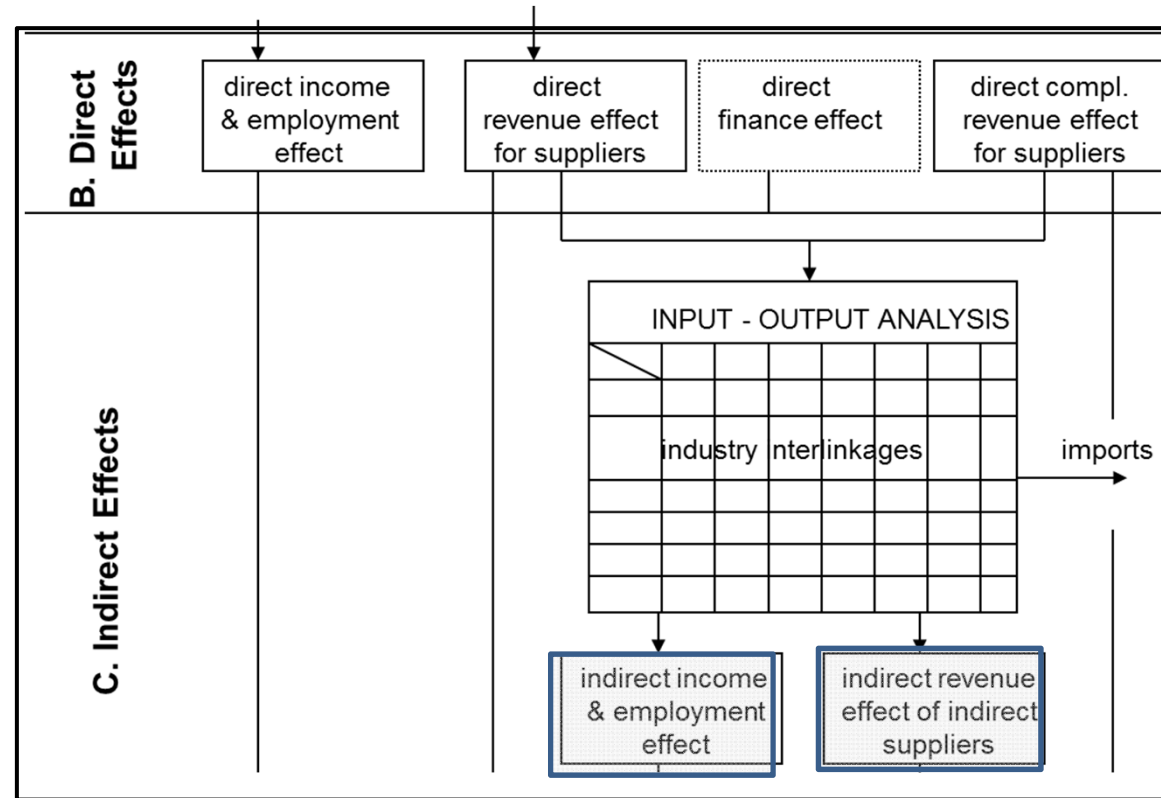


## IV. Demand Effects of the X-FEL at DESY:

### Step C: Indirect Effects of Project Expenditure

#### Note:

1. The indirect effects are derived by a „multi-stage regionalized I-O analysis“, in order to identify regional and structural effects.
2. However, the „multi-stage regionalized I-O analysis“ is not based on original regional empirical data (would be too expensive!!), but rather on regional adjustments of the national I-O table. The „regionalization method“ allows for simulations of these adjustments.



3. Income and employments effects are derived via the formulae:

$$\Delta nat.income_{sector i}^{X-FEL} = ni_{sector i} \cdot gross\ value\ added_{sector i}$$

$$\Delta employment_{sector i}^{X-FEL} = \frac{\Delta earned\ income_{sector i}^{X-FEL}}{av.earned\ income_{sector i}} = \frac{ai_{sector i} \cdot \Delta nat.income_{sector i}^{X-FEL}}{av.earned\ income_{sector i}} = \frac{ai_{sector i} \cdot ni_i \cdot \Delta gross\ value\ added_{sector i}^{X-FEL}}{av.earned\ income_{sector i}}$$

where  $ai = \frac{earned\ income}{national\ income}$  and  $ni = \frac{national\ income}{gross\ value\ added}$

## IV. Demand Effects of the X-FEL at DESY:

### Step G: Total (= dir. + indirect + induced) Effects of Project Expenditure

#### The X-FEL Project (ex-ante)

##### Note:

1. These multipliers do not take into account the negative repercussion effects from the financing and tax side, i.e. they are gross rather than net multipliers.
2. The multipliers are the larger the larger the area (economy), thus, local or regional multipliers are typically (very) small.
3. Never trust multipliers larger than 1,6 – 1,8!

#### Regional Multipliers

	Hamburg	North-Germany	Germany
„income multiplier“	1,2	1,6	1,8
„employment multiplier“	1,3	1,5	1,9

„income multiplier“ (or, equivalently, “employment multiplier”)

$$M_Y = \frac{\Delta Y^{\text{total}}}{\Delta Y^{\text{dir.+indir.}}} = \frac{\text{dir. + indir. + induced income effects}}{\text{dir. + indir. income effects}} \geq 1$$

total income effect

$$\Delta Y^{\text{total}} = M_Y \times \Delta Y^{\text{dir.+indir.}}$$

induced income effect

$$\Delta Y^{\text{induced}} = \Delta Y^{\text{total}} - \Delta Y^{\text{dir.+indir.}} = (M_Y - 1) \times \Delta Y^{\text{dir.+indir.}}$$