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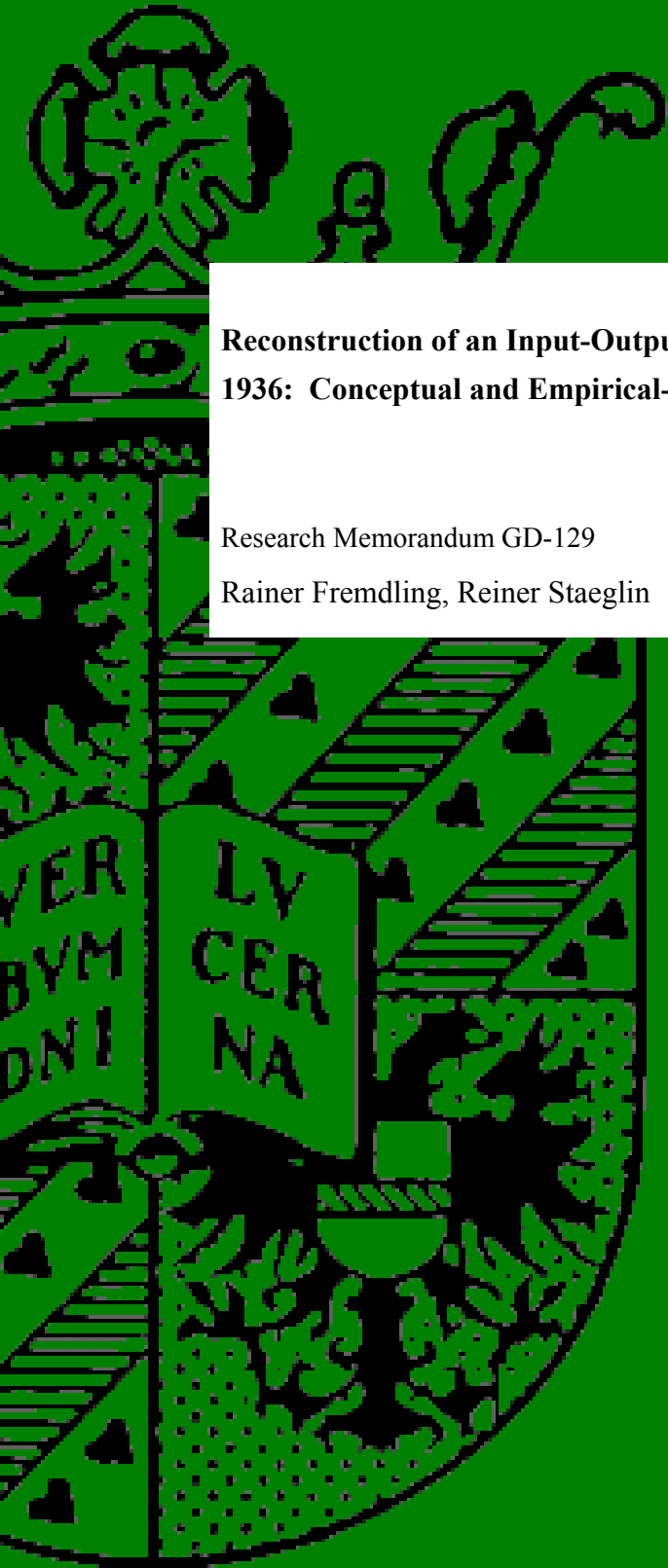
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**Reconstruction of an Input-Output Table for Germany in
1936: Conceptual and Empirical-Statistical Problems**

Research Memorandum GD-129

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Reconstruction of an Input-Output Table for Germany in 1936: Conceptual and Empirical-Statistical Problems*

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Abstract

The objective of this contribution is to present the final results of a long-term research project which aimed at constructing an input-output table for Germany in 1936. Our research can be seen as follow-up of the activities of the German Imperial Statistical Office (Statistisches Reichsamt) which worked on a “matrix of economic interdependencies” (Volkswirtschaftliche Verflechtungstabelle) for Germany as early as in the thirties of the last century.

The symmetric table for 1936 is completely based on original statistical data and does not refer to separate supply and use tables. The input-output table for Germany in 1936 covers 40 branches. This paper depicts its aggregated version with 13 sectors, five final demand categories and five primary inputs.

Government is placed as an intermediate sector into quadrant I. In quadrant II it appears with only one figure (government gross production minus fees for specific government services). Government is delimited into three subsectors as can be seen from Table 1: public administration, military spending and social security. In addition, public investment for civilian purposes is assigned to the investment vector of quadrant II. Military expenditure, however, is treated as government consumption and not as investment.

The input-output table offers a new benchmark for gross domestic product and thus income, expenditure and production of the German Empire in 1936. We found a comparably high level of GDP and a significantly higher mixed income/operating surplus which confirms rudimentary and qualitative evidence on exceptionally high incomes and hidden profits of armament industry. Due to our unique production approach of calculating GDP these hidden profits could be revealed.

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* We are grateful for the possibility of using the infrastructure of DIW Berlin.

Reconstruction of an Input-Output Table for Germany in 1936: Conceptual and Empirical-Statistical Problems*

Rainer Fremdling¹, Reiner Staeglin²

1. Background and aim of the input-output oriented activities

The objective of this contribution is to present the final results of a long-term research project which aimed at constructing an input-output table for Germany in 1936³. Our research can be seen as follow-up of the activities of the German Imperial Statistical Office (Statistisches Reichsamt) which worked on a “matrix of economic interdependencies” (Volkswirtschaftliche Verflechtungstabelle) for Germany as early as in the thirties of the last century. The Statistical Office had chosen 1933 as base year to be followed by 1936 because for that year an industry census was carried out. This census provided comprehensive information of input and output data for all branches of German industry.

In connection with rearmament, however, this endeavour was given up and instead, these data were used for compiling detailed material balance sheets which served as statistical basis for preparing the war. Using the hitherto secret archival records and additional statistical information we finally achieved to fulfil the original plan of the German Imperial Statistical Office of constructing the desired input-output table.

The symmetric table for 1936 is completely based on original statistical data and does not refer to separate supply and use tables. The input-output table is integrated into national accounts and accordingly offers a new benchmark for historical gross national product⁴ and thus income, expenditure and production of the German Empire in 1936.

2. Major data sources of the input-output table

The data sources of the input-output table are manifold. Most of them come from published and above all archival material of the Imperial Statistical Office,

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² German Institute for Economic Research (DIW Berlin).

³ Interim results of the research project were already published in the Input-Output Conference Volumes of the Institute for Economic Research Halle: *Fremdling; Staeglin* (2004, 2007).

⁴ For that reason it can also be seen as alternative for the publication of *Hoffmann et al.*(1965).

among them secret records of the industrial census of 1936, work sheets and internal documents.

Additional information could be derived from statistical compilations produced after 1945, e.g. from Statistical Handbooks of Germany 1946 and 1949⁵, as well as from secondary historical literature about the German Empire⁶. For some input-output estimates it was helpful to recur to German input-output tables compiled after the Second World War⁷.

The industrial census of 1936 provided the main input and output data for 29 industrial groups and for construction following the classification of official statistics. In 1939, the German Imperial Office for Military-Economic Planning (Reichsamt für Wehrwirtschaftliche Planung)⁸ published results in its first and only volume on the Outcome of the Official Census of Production – German Industry (Gesamtergebnisse der amtlichen Produktionsstatistik – Die deutsche Industrie)⁹. For reasons of camouflage, however, certain industries considered important for warfare were hidden by the way of aggregating the data (e.g. iron and steel, chemicals) or by misleading categories. The foremost example is the aircraft industry which ended up hidden under “construction and others” (Bauindustrie und sonstige Industriezweige)¹⁰.

The reunification of German archives has offered historians easier access to the records of the Imperial Statistical Office of Germany. Its archive is now housed in the Federal Archive Berlin-Lichterfelde (Bundesarchiv Berlin-Lichterfelde = BA). Historical research in this archive has unearthed important new information from the industrial census of 1936, which not only permits a re-evaluation of the official 1939-publication but also supports the construction of an input-output table for 1936.

The archival material brought to light two sources (Q) of unpublished figures of the industrial census of 1936: Q1 and Q2. Q1 contains detailed information for 326 industrial branches on employment, wages, intermediate input, gross production, sales, imports and exports, which allowed the compilation of the input-output relations. The specific inputs of each of the 326 branches were

⁵ See *Länderrat des Amerikanischen Besatzungsgebiets* (1946, 1949).

⁶ See *Oshima* (1991/92, 2006), *Ritschl* (2002), *Budraß* (1998), *Scherner* (2010), *Tooze* (2001).

⁷ See *Stäglich* (1968) and *Komarnicki/Neuhaus* (1972).

⁸ Formerly, this office had been the department of industrial statistics of the Imperial Statistical Office. Renamed as Reichsamt für Wehrwirtschaftliche Planung it became an independent institution in 1938.

⁹ See *Reichsamt für wehrwirtschaftliche Planung* (1939).

¹⁰ *Fremdling; Stäglich* (2012).

assigned to the individual industrial groups from which they presumably had been purchased. Imports were separately accounted for. The other variables were aggregated and assigned to the proper fields in the input-output matrix. Source Q2 summarises some of these latter figures on the same level of aggregation for the 326 branches, however, without e.g. taking into account specific intermediate input products. Q1 is thus the preferred source for our detailed accounting, whereas Q2 serves as check and supplementary information on the aggregated numbers. Q2 is obviously based on Q1 and was calculated by the Imperial Statistical Office itself. In case of sometimes diverging numbers we opted for Q1¹¹.

Unfortunately, the 1936 census did not include all industrial firms; for certain industrial groups, data of small firms were not recorded. For our purposes, however, i.e. for estimating the input-output flows and furthermore for measuring gross domestic product (GDP) we needed a full coverage of the industrial sector in 1936. This was realized by estimating the missing number of people employed in 1936¹². The estimation of the inflated values of our input-output table for Germany in 1936, i.e. gross production, wages, gross value added and thus implicitly inputs and exports, is based on the estimated employment for small companies.

Official statistics and many different archival data, e. g. original work sheets, reflecting the original intention of the Imperial Statistical Office to construct an input-output table could be used for estimating intermediate inputs of trade, transport and other services. The compilation of final use categories and primary inputs was, as far as possible, based on sub-matrices for private final consumption, gross fixed capital formation and indirect taxes minus subsidies.

3. Conceptual problems of the input-output table

Right from the beginning of the research endeavour it was decided to develop a symmetric input-output table for the year 1936 immediately without first establishing a supply table and a use table. The decision was justified by the available survey data from the industrial census and by the existing records of the German Imperial Statistical Office in the Federal Archive.

¹¹ For a detailed description of the sources, see *Fremdling;Stäglin* (2003, 2004).

¹² For a comprehensive description of the estimation procedure, see *Fremdling* (2007).

Figure 1
Classification of the input-output table 1936

	Aggregated classification		Disaggregated classification		Aggregated classification		Disaggregated classification
1	Agriculture, forestry, fishing	1	Agriculture	7	Timber, paper, leather, textiles	18	Saw mills, timber processing
		2	Forestry, fishery			19	Manufactured wood products
2	Energy, mining	3	Mining			24	Printing and duplicating
		4	Fuel industries			25	Leather industry
		32	Electricity, gas and water			26	Textiles
3	Chemicals, building materials	15	Stone and quarrying			27	Clothing
		16	Ceramics	8	Food, beverages and tobacco	28	Edible oil and fats
		17	Glass			29	Spirits industry
		20	Chemical industry			30	Food, beverages and tobacco
		21	Chemical-technical industry	9	Construction	31	Building and construction
		22	Rubber and asbestos manufacture	10	Trade	33	Wholesale trade
4	Iron and steel, non-ferrous metals	5	Basic iron and steel products			34	Retail trade
		6	Non-ferrous metals	11	Transportation, communication	35	Transport and communication
		7	Foundries	12	Government	38	Government
		8	Fabricated iron and steel products	13	Other services	36	Banking and insurance
5	Constructional steel, machinery, vehicles	9	Machinery			37	Dwelling
		10	Constructional steel			39	Other services
		11	Vehicles and aerospace			40	Domestic services
6	Electrical engineering, hardware, metal goods	12	Electrical engineering				
		13	Precision engineering, optics				
		14	Metal products				

The input-output table for Germany in 1936 covers 40 branches in its disaggregated and 13 sectors in its aggregated version. Both classifications are listed in Figure 1. The five final demand categories are private final consumption, government consumption, gross fixed capital formation, changes in inventories, and exports. The five primary inputs consist of imports, compensation of employees, indirect taxes minus subsidies, consumption of fixed capital, and mixed income/operating surplus. Military expenditure is treated as government consumption and not as capital formation.

Statistical units in the table are generally establishments. The values in quadrant II and in quadrant III of the input-output table correspond to national accounts figures on the expenditure side and production side. The input-output flows are valued at producer's (basic) prices because additional matrices for trade margins and transport charges made this transition from purchaser's prices possible.

The symmetric input-output table of 1936 is mainly compiled according to the input procedure, i.e. by the column-wise approach. Only for intermediate outputs of banking & insurance and for government the output procedure was used. The new national accounts data for the German Empire are estimated following the bottom-up approach.

4. Empirical-statistical problems of the input-output table

By sticking to the original intention of the Imperial Statistical Office we mainly draw on the unpublished figures of the industrial census of 1936 after having improved them by covering small firms as well¹³. Difficulties came up with identifying and dividing the components of the miscellaneous branch "building and other industries".

In some cases the archival material provided only information for 1933 which required reliable extrapolation to 1936. Or the published turnover statistics presented sales for 1935 and had to be updated for our reference year. Special analysis was necessary for estimating intermediate and primary inputs of the miscellaneous branch of "other services" because it covers a wide range of production activities. Here the adoption of ratios from post-war input-output tables for Germany was sometimes unavoidable¹⁴.

Government is placed as an intermediate sector into quadrant I. In quadrant II it appears with only one figure (government gross production minus fees for

¹³ See chapter 2 for the approach of integrating small companies.

¹⁴ See footnote 7 for statistical sources.

specific government services). Government is delimited into three subsectors as can be seen from Table 1: public administration, military spending and social security. In addition, public investment for civilian purposes is assigned to the investment vector of quadrant II. Military expenditure, however, is treated as government consumption and not as investment as already mentioned.

Table 1

Government Sub-Table of the Input-Output Table for Germany in 1936 in millions of Reichsmark

	Government	Administration	Military	Social Security	Total	Investment
Input		1	2	3	4	5
1	Agriculture, forestry, fishery	286	88	25	398	
2	Energy, mining	134	62	50	246	
3	Chemicals, building materials	57	309	225	591	
4	Iron and steel, non-ferrous metals	100	560		660	10
5	Constructional steel, machinery, vehicles	225	1854	10	2089	497
6	Electrical engineering, hardware and metal goods	89	588	42	720	358
7	Timber, paper, leather, textiles	232	266	46	544	129
8	Food, beverages and tobacco	185	171	33	390	
9	Construction	74	2400	39	2513	1506
10	Trade	96	592		689	
11	Transportation, communication	121	470	22	613	
12	Government		122		122	
13	Other services	99	526	712	1338	
1-13	Domestic intermediate inputs	1698	8010	1204	10912	2500
14	Imports	14	75		89	11
1-14	Total intermediate inputs	1712	8085	1204	11001	2511
15	Compensation of employees	5140	597	415	6152	
16	Indirect taxes minus subsidies					
17	Consumption of fixed capital	600			600	
15-17	Gross value added (net production)	5740	597	415	6752	
1-17	Gross production	7452	8682	1619	17753	
	Subsidies		647		647	

Due to rearmament, government expenditure had increased enormously by 1936. More than nine billion Reichsmark were spent on military expenditure which made up eleven per cent of our newly estimated GDP of the German Empire in 1936. Especially air-craft production had expanded dramatically by 1936, even outstripping Germany's entire motor vehicle industry. Most of government expenditure for military purposes was financed through shadow budgets using the notorious MeFo-bills of exchange¹⁵ as device. In order to

¹⁵ MeFo was the abbreviated name of the newly founded Metallurgische Forschungsgesellschaft. Firms which supplied the government with military goods drew bills of exchange on this company as a means of payment.

properly assign military expenditure to the branches delivering the input, we mainly explored archival records and recent economic-historical secondary literature, based on such records. For public administration and social security the expenditure structure was derived from the original work sheets of the Imperial Statistical Office.

Balancing the symmetric input-output table for 1936 turned out a cumbersome and time-consuming process. We did not want to use a modelling approach for balancing (e.g. RAS, MODOP) but preferred the manual procedure. We started our iterative balancing process by evaluating the various output differences between row-wise adding up intermediate input figures and total outputs for the 40 branches. Stepwise we reduced the differences by revising the figures in question after having reviewed the estimation procedures and the assumptions made. In some cases, final private consumption and mixed income/operating surplus could be used as balancing item. Changes in inventories were not taken into account during the balancing process. But from time to time it was necessary to go down to the last detail of available basic data in order to identify errors made or inconsistencies ignored during the compilation process.

5. The aggregated version of the input-output table for Germany in 1936

Table 2 depicts this version of the table for 1936 with its 13 sectors, five final demand categories and five primary inputs.

Quadrant I presents the flows of intermediate goods and services between the 13 production sectors. The number in row 1 and column 8 (cell 1/8) shows for example that the value of agriculture, forestry, and fishery goods used by the sector of food, beverages and tobacco amounts to 3849 millions of Reichsmark. This amount is part of domestic intermediate output of sector 1 (cell 1/1-13) but at the same time part of domestic intermediate input of sector 8 (cell 1-13/8).

Below the quadratic intermediate transaction matrix, the primary inputs of the 13 sectors and their total inputs (gross production values) are shown in rows 14 to 18 and in row 1-18. The results in column 8 of quadrant III make clear that the sector of food, beverages and tobacco had imports of 1127 millions (cell 14/8) in 1936 and paid 1687 millions for compensation of employees (cell 15/8). The total input amounted to 16805 millions of Reichsmark (cell 1-18/8).

Quadrant II of the input-output table shows the outputs of the 13 production sectors transferred to the final demand categories. It can be seen that agriculture, forestry and fishery delivered goods for 7222 millions to private consumption (cell 1/14) which on the other hand also received food, beverages and tobacco for 11806 millions of Reichsmark (cell 8/14) in 1936. The last column of

Table2 Input-Output table 1936 at Producer's Prices in millions of Reichsmark (aggregated version)

	Output	Agriculture, forestry, fishery	Energy, mining	Chemicals, building materials	Iron and steel, non-ferrous metals	Constructional steel, machinery, vehicles	Electrical engineering, hardware and metal goods	Timber, paper, leather, textiles	Food, beverages and tobacco	Construction	Trade	Transportation, communication	Government	Other services	Domestic intermediate outputs
Input		1	2	3	4	5	6	7	8	9	10	11	12	13	1-13
1	Agriculture, forestry, fishery	205		13				604	3849			0	398	125	5195
2	Energy, mining	306	2201	554	729	139	88	307	240	12	90	643	246	366	5921
3	Chemicals, building materials	639	148	1077	363	150	171	465	96	963	55	237	591	266	5221
4	Iron and steel, non-ferrous metals	295	222	165	4566	2189	770	62	96	400	21	140	660	2	9588
5	Constructional steel, machinery, vehicles	65	105		76	367	19			236	61	280	2089	111	3407
6	Electrical engineering, hardware, metal goods	32	47	32	30	199	255	44	13	119	13	81	720	153	1739
7	Timber, paper, leather, textiles	160	173	232	42	113	90	5553	355	239	115	76	544	554	8246
8	Food, beverages and tobacco	323	5	118	21	10	3	53	2482		45	14	390	1206	4670
9	Construction	287	29	26	17	17	9	24	16	250	15	80	2513	1030	4313
10	Trade	303	141	175	251	188	80	399	493	144	1142	113	689	379	4497
11	Transportation, communication	214	396	379	373	268	144	824	598	241	1027	468	613	472	6017
12	Government	60	69	63	95	73	37	167	79	73	151	120	122	371	1480
13	Other services	527	347	256	390	361	184	669	171	158	2007	801	1338	2563	9771
1-13	Domestic intermediate and final inputs	3416	3883	3092	6954	4074	1849	9171	8487	2835	4741	3053	10912	7597	70065
14	Imports	139	89	286	445	21	45	1621	1127	0	118	385	89	718	5082
1-14	Total intermediate and final inputs	3555	3972	3378	7399	4094	1894	10792	9615	2835	4859	3438	11001	8315	75147
15	Compensation of employees	2002	1774	1565	1775	2315	1240	3855	1687	2893	2291	3495	6152	4872	35915
16	Indirect taxes minus subsidies	102	238	212	191	-397	103	538	3109	192	1611	330		601	6830
17	Consumption of fixed capital	806	839	436	261	588	171	391	224	101	239	644	600	1468	6767
18	Mixed income/operating surplus	6418	1175	1758	1399	1686	894	3831	2171	4173	1414	2060		6189	33167
15-18	Gross value added (net production)	9327	4026	3970	3626	4193	2408	8614	7191	7358	5554	6529	6752	13130	82679
1-18	Gross production/Total input	12882	7998	7348	11025	8287	4302	19406	16805	10193	10414	9967	17753	21445	157826

Table 2 Input-Output Table 1936 at Producer's Prices in millions of Reichsmark (aggregated version)

	Output	Private consumption	Government consumption	Gross fixed capital formation	Changes in inventories	Exports	Final output	Gross production/Total output	
Input		14	15	16	17	18	14-18	1-18	Input
1	Agriculture, forestry, fishery	7222			410	55	7687	12882	1
2	Energy, mining	1586			-4	495	2077	7998	2
3	Chemicals, building materials	1267			29	831	2127	7348	3
4	Iron and steel, non-ferrous metals	123		275	219	820	1437	11025	4
5	Constructional steel, machinery, vehicles	914		3244	-200	922	4880	8287	5
6	Electrical engineering, hardware, metal goods	646		1241	9	667	2563	4302	6
7	Timber, paper, leather, textiles	9761		247	123	1030	11161	19406	7
8	Food, beverages and tobacco	11806			203	127	12136	16805	8
9	Construction	207		5619		54	5880	10193	9
10	Trade	4688		325	648	255	5917	10414	10
11	Transportation, communication	2779		201		970	3950	9967	11
12	Government	155	16060	34		24	16273	17753	12
13	Other services	11260		109		305	11674	21445	13
1-13	Domestic intermediate and final inputs	52413	16060	11296	1437	6555	87761	157826	1-13
14	Imports	786		72			858	5940	14
1-14	Total intermediate and final inputs	53199	16060	11368	1437	6555	88619	163766	1-14
15	Compensation of employees							35915	15
16	Indirect taxes minus subsidies							6830	16
17	Consumption of fixed capital							6767	17
18	Mixed income/operating surplus							33167	18
15-18	Gross value added (net production)							82679	15-18
1-18	Gross production/Total input	53199	16060	11368	1437	6555	88619	246445	1-18

quadrant II presents total outputs (gross production values) of the production sectors. They are identical with total inputs, e.g. for sector 8 of food, beverages and tobacco, with the gross production value of 16805 millions (cell 8/1-18).

Another identity concerning the conformity of the expenditure side with the production side of national accounts can be derived from the input-output table: Quadrant II = Quadrant III. The corresponding totals are 87761 millions of Reichsmark (cell 1-13/1-18) and $82679 + 5082 = 87761$ millions of Reichsmark (cells 15-18/1-13 + 14/1-13) in 1936.

6. National accounts data as new benchmark for 1936

In Germany, the Anglo-Saxon concept of value added or net production was applied for the first time when gathering the data for the industrial census of 1936. By drawing on these figures and using the same concept for other sectors of the German economy, we thus estimated Gross Domestic Product (GDP) from the production side for the first time. Furthermore, our input-output-table provides new consistent national accounts figures for the other two approaches to national accounting: income and expenditure. Referring to the aggregate figures of primary inputs and final demand categories (Table 2) the GDP components of production and expenditure are summarised in Table 3.

We thus can draw on a complete set of national accounts data when comparing our results with other existing figures of the same nature, which are limited or fragmentary, however. Besides our comparably rather high level of GDP we found a significantly higher mixed income/operating surplus which confirms rudimentary and qualitative evidence on exceptionally high incomes and hidden profits of armament industry. Due to our unique production approach in calculating GDP we succeeded in revealing these hidden profits.

Table 3

Gross Domestic Product for Germany 1936 in billions of Reichsmark

Production side		Expenditure side	
Compensation of employees	35.9	Final private consumption	53.2
Mixed income/operating surplus	33.2	Final government consumption	16.1
Indirect taxes minus subsidies	6.8	Gross fixed capital formation	11.4
Consumption of fixed capital	6.8	Building	5.6
		Equipment	5.8
		Changes in inventories	1.4
		Exports	6.5
		Imports	- 5.9
Total	82.7	Total	82.7

Source: Input-Output Table for Germany 1936.

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