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The Ifo Investment Database

By Thomas Strobel, Stefan Sauer, and Klaus Wohlrabe*

1. Introduction

Investments are an important driver of economic growth and productivity. In turn both macroeconomic variables are essential to obtain a sustainable level of prosperity. In Germany, investment patterns have not been constant over time. Rather structural changes in sectoral investment patterns can be noticed in the years since the reunification in 1991. In the course of these changes the importance of some sectors for aggregate output growth has shifted. Thus, for example, there was a shift in the importance of the secondary and tertiary sector, but also of individual sectors within the manufacturing sector (German Federal Statistical Office, 2012). Besides inter-sectoral changes in investment activity, intra-sectoral changes occurred as well. Beginning in the 1970s in the former German Federal Republic, particularly leasing and other types of renting rapidly gained importance in financing of investment equipment (Gerstenberger et al., 1984).

Besides the possibility to delve into inter-sectoral changes in investments, the availability of detailed sectoral investment series by different asset types further allows the construction of aggregate capital stocks particularly accounting for the heterogeneity of assets. Although economic theory is usually based on the notion of a capital stock representing a homogenous asset, in practice a particular asset will always consist of several different sub-assets and so exhibit a certain degree of heterogeneity. Jorgenson (1963) and Jorgenson and Griliches (1967) were the first to develop aggregate capital stock measures that explicitly take into account this asset heterogeneity.

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A detailed analysis of sectoral investment growth beyond employing an aggregate series of investments requires detailed investment time series that due to limited data availability are not provided for many sectors. In this paper we present a tool that allows for a temporal structure analysis of investment activity of German industries by assets – the *Ifo Investment Database* (henceforth IIDB). It provides annual investment data for 12 investment assets for 50 industries from 1991 onward that is synchronized with the officially published national account statistics provided by the German Federal Statistical Office (GFSO). Thereby the database contains two main features: a) the diversification of aggregate investment series by assets on the sectoral level and b) the provision of the investment data both defined by the owner concept (which is the standard accounting measure) and the user concept. We finally end up with a 12 x 50 investment linkage matrix separated by year, concept of utilization and current and constant prices.

The 12 investment assets comprise 11 equipment assets (Metal Products; Machinery; Computers and Office Equipment; Electrical Generation and Distribution; Communication Equipment; Instruments, Optics and Watches; Furniture, Music and Sports Equipment; Other Machines and Equipment; Automobiles; Other Vehicles; Intangible Assets) as well as investments in Buildings and Structures according to the Product Classification 2002 by the GFSO (German Federal Statistical Office, 2002). The 50 industries correspond to the official Classification of Economic Activities 2008 (German Federal Statistical Office, 2008). Since investment matrices are not published at such a disaggregated level by German statistical offices, this gap is filled by the IIDB.

From various sources the database collects data on investments in 88 sub-assets. This detailed level of information allows the most exactly allocation of investments by asset type to each industry using an investment flow matrix. This flow matrix contains a pre-determined annually updated user structure, which relates the 88 sub-assets to the 50 industries and therefore determines how much a certain industry uses a particular sub-asset.

Furthermore leasing data from the *Ifo Investment Survey Leasing* enables the conversion of investment data by owner concept, which is typically used in national accounts, to the user concept. Thereby the user concept attributes investment assets to the actual user of the assets (and not to its owner) and accommodates the increasing importance of financing, especially by leasing assets. Abstaining from inclusion of rented equipment leads to errors in the measurement of capital employed in industries and important economic indicators such as the capital-output ratio, the capital coefficient, and the return on total investment lose their informative content on the sectoral level (Gerstenberger et al., 1986; Gerstenberger et al., 1989). Thus the distinction of owner and user concept in the IIDB offers a unique feature for investment research as it provides insights into the development of companies' equipment financing.

However, due to lack of detailed sectoral leasing information across countries statistical bureaus agreed to only provide figures by owner concept.

The IIDB is updated annually and the results tables are available in English and German language. Current publications and updates can be obtained from the EBDC data center at the Ifo Institute.

The paper is structured as follows: Section 2 details the composition of the database and describes the applied methodology to derive investment series by sector and asset. Section 3 focuses on the differences between owner and user concept. Section 4 presents a brief look at the structure of the database, while Section 5 provides information on the access to the data. Section 6 concludes.

2. Structure and Methodology

In investment research it is common sense that the formation of the capital stock usually is a heterogeneous aggregate. This is not provided sufficiently by the limited view on the two aggregated classes of equipment and buildings. By including and analyzing various data sources the IIDB disaggregates the investment of 50 German industries into 12 asset classes for reunified Germany from 1991 onward. These classes cover 11 equipment assets as well as investments in structures and buildings (see Table 1). This is accomplished by calculating investment matrices, whose extensive data inputs are explained in more detail in the following.

In its national accounts the German Federal Statistical Office provides annually updated gross fixed capital formation by asset classes and by industries separately, whereas the latter is divided into the aggregated groups of equipment and other assets as well as the asset group of structures and buildings. An important feature of the IIDB is its synchronisation with this data from national accounts.[1] Because of the disaggregated level used in the IIDB there is, however, a delay of two years in the data. Due to the lack of more updated data, the database currently can only be calculated up to the year $t-2$.

On its most detailed level the IIDB collects data on 88 detailed sub-assets from various sources.[2] Based on the official data of the national accounts, the asset classes are disaggregated into sub-assets to enable a better allocation into specific industries. Asset classes are also sub-divided, whenever there is information about the development of main industries' investments. The latter applies in particular for Automobiles, Other Vehicles, and Communication Equipment. This avoids that special cases of investments performed by main indus-

[1] A complete list of sources is provided by Strobel et al. (2013).

[2] A detailed list of the sub-assets and their mapping to the 11 asset classes (excluding structures and buildings) is provided by Strobel et al. (2013).

tries is wrongly transferred to the estimation of product-specific investment of other industries. Hence, the sub-division into sub-assets occurs, on the one hand, by different types of products or by the investing industries, on the other. Furthermore, leasing of investment equipment is specified into separate sub-assets in order to ease the conversion from the owner to the user concept, whenever it is relevant.

The IIDB obtains annual investment data on all sub-assets. Specifically, in case of automobiles the numbers of new car registrations and trailers by groups of users and by car types are collected. In order to obtain the automobile investment by industries,

Table 1

IIDB Classifications in Accordance with National Accounts

Seq. Nr.	Industry	Seq. Nr.	Assets
1	Agriculture, Forestry, Fishing	1	Metal Products
2	Mining and Quarrying	2	Machinery
3	Food and Tobacco	3	Computers and Office Equipment
4	Textiles and Apparel	4	Electrical Generation and Distribution
5	Wood Products	5	Communication Equipment
6	Paper, Pulp	6	Instruments, Optics and Watches
7	Printing	7	Furniture, Music and Sports Equipment
8	Coke, Petroleum	8	Other Machines and Equipment
9	Chemicals	9	Automobiles
10	Pharmaceuticals	10	Other Vehicles
11	Rubber, Plastic	11	Intangible Assets
12	Non-Metallic Mineral Products	12	Structures and Buildings
13	Basic Metals		
14	Fabricated Metal Products		
15	Computers, Electronics, Optics		
16	Electrical Equipment		
17	Machinery		
18	Motor Vehicles		
19	Other Transport Equipment		
20	Furniture and Other Manufacturing		
21	Rep. and Install. of Machinery and Equip.		
22	Electricity, Gas		
23	Water Supply		
24	Sewerage, Waste, Material Recovery		

25	Construction
26	Sale and Repair of Motor Vehicles
27	Wholesale Trade
28	Retail Trade
29	Land Transport
30	Water Transport
31	Air Transport
32	Warehousing, Support Activities
33	Postal and Courier Activities
34	Accommodation and Food Services
35	Publishing Activities
36	Communications
37	Information Services
38	Financial Services
39	Insurance
40	Aux. Financial and Insurance Activities
41	Real Estate
42	Professional, Scientific and Technical Act.
43	Administrative and Support Service
44	Public Admin., Defense, Social Security
45	Education
46	Human Health and Social Work
47	Arts, Entertainment, Recreation
48	Membership Organizations
49	Repair of Computers and Personal Goods
50	Other Personal Services

Source: IIDB (2010).

these numbers are weighted with the prices of different car types. Additionally, industry data on production, export, and import is collected, which allows the computation of *domestically available production* by subtracting exports from domestic production while adding imports. In particular, this approach applies to the subsequent asset classes: Machinery; Electrical Generation and Distribution; Communication Equipment; Instruments, Optics and Watches. In case of lacking industry data to calculate domestically available production in sub-assets, gross fixed capital formation provided by the GFSO is used instead. The latter applies to the following assets: Metal Products; Computer and Office Equipment; Furniture, Music and Sports Equipment; Other Machines and Equipment; and Intangible Assets. For Other Vehicles investments by sub-as-

sets are provided by the German Federal Ministry of Transport, Building and Urban Development (FMTBU). Annual leasing data by sub-assets is provided by the *Ifo Investment Survey Leasing*.[3]

For allocation of the GFSO-adjusted investments by sub-assets to industries, an annually updated investment flow matrix is applied. This flow matrix contains a pre-determined user structure, which relates 88 sub-assets to 50 industries and therefore determines how much a certain industry uses of a particular sub-asset. More precisely, the user structure defines cells with zero percentages, i.e. industries which do not use any of the sub-assets, and those with non-zero percentages. Sources for the determination of the percentages are the *Ifo Investment Survey*, implicit industry-specific information on a sub-asset category (e.g. main user of the asset Rubber and Plastic Machines is the Rubber and Plastic Industry), and explicit information of industry-related associations (e.g. the Association of German Electrical and Electronic Manufacturers and the German Engineering Federation). If none of the above sources is available, auxiliary indicators such as the size of an industry are used. This step results in a 50 x 88 investment matrix.

To eventually obtain a sectoral sub-asset-investment matrix that is consistent with the GFSO, total GFSO investments by industries and GFSO aggregate investments by asset type serve as controls in each dimension of the matrix. To assure that column sums and row sums match the GFSO controls, the RAS-procedure is applied (Stone, 1961, Stone et al., 1963; Bacharach, 1970). This procedure is an iterative algorithm, whose goal is to leave the original user structures as unchanged as possible and at the same time to erase any discrepancies to the GFSO controls. Finally, after aggregation across sub-assets and including sectoral investments for the 12th asset structures and buildings (as provided by the GFSO), a 50 x 12 industry-asset investment matrix is obtained. This industry-asset investment matrix is available in current prices and in prices of the year 2000. For the methodology of price adjustment, see Nierhaus (2004) and Strobel et al. (2012).

3. Owner and User Concept

Following the national accounts conventions, investments in new buildings and equipment assets are allocated to the owner of an asset (owner concept). In addition the IIDB also calculates investments by user concept allocating investments in new buildings and equipment assets to the industry that is actually using it. Thus, detailed information from the *Ifo Investment Survey Leasing* about leasing assets and leasing costumer sectors is employed. The leasing in-

[3] All data sources for the calculation of investments by sub-assets are listed in detail in Strobel et al. (2013).

vestment is then added to the self-financed investment. This procedure derives the exact volume of the investment assets actually used in an industry, which is, for example, very important for studying structural changes in the employment of capital goods.

Since detailed information about leasing investments by users and by assets is not adequately collected by the statistical offices, detailed German investment series for leasing is not officially published. Moreover, there is no reliable source on relationships between leasing assets and the leasing sectors. Using the data from the *Ifo Investment Survey Leasing* the IIDB fills this gap by providing the only available investment data for Germany by user concept.

In the *Ifo Investment Survey Leasing* the Ifo Institute annually surveys – in collaboration with the Federation of German Leasing Companies (FGLC) – all German leasing companies. Since no official data is available helping to make projections, the investment survey is conducted as a full survey. The results of the tests include several leasing statistics, as e.g. the total amount of annual leasing investments and their share of the overall investment (leasing rate). In addition, the leasing investments are also evaluated by products and by sectors. Thus, the *Ifo Investment Survey Leasing* provides important insights for investment surveys in other industries and for the IIDB, and it represents a valuable analytical tool for one of the major service sectors.[4]

Leasing and other forms of capital asset renting proved to be the most important alternative for investment financing of German companies over the last decades. As the assets remain the property of the leasing companies, investment expenditures according to the owner concept diverge from those measured via user concept by sectors, thereby reflecting the varying sectoral importance of leasing. High proportions of leasing are reached, for example, in the trade and the construction sector, while in those sectors that account for the leasing companies (e.g. the aggregate sector of Professional Services) the owner concept overstates actual investments (see Table 2). Thus, a consideration of investments solely by owner concept can lead to severe misinterpretation and estimation error of an industry's actual capital employment.

Regarding the importance of leasing, it is not surprising that aggregate investment series measured by owner concept increasingly lose their significance, especially when it comes to questions of capital requirements in various industries and the development of the sectoral production potential. For the analysis of investment behavior and forecasting of sectoral investments employing data by user-concept is also appropriate. For the analysis of capital formation and capital distribution, however, using investment data by owner concept remains indispensable.

[4] For an exact documentation of the survey, see Goldrian (2007).

Table 2

Investments in Equipment and Other Assets by Owner and User Concept

Industry	Investments in Equipment and Other Assets 2010 (in nominal prices)		
	Owner Concept (in bill. Euro)	User Concept (in bill. Euro)	Deviation (in %)
Agriculture, Forestry, Fishing	5,81	6,02	3,6
Mining and Quarrying	1,46	1,56	6,8
Manufacturing	49,05	57,16	16,5
Energy, Water, Sewerage, Waste	10,93	11,75	7,5
Construction	4,44	7,21	62,4
Trade	12,07	17,15	42,1
Transportation and Storage	24,85	29,31	17,9
Accommodation and Food Services	1,79	2,36	31,8
Information and Communication	15,77	17,75	12,6
Financial and Insurance Activities	4,92	7,12	44,7
Real Estate	2,72	2,72	0,0
Professional Services, Science	55,91	24,46	–56,3
Public Services, Education, Health	20,56	22,27	8,3
Other Personal Services	5,03	8,47	68,4
Total	215,31	215,31	0,0

Source: IIDB (2010).

4. A Brief Look at the Data

For a presentation of the IIDB, this section will provide a brief look at the data structure. As shown in Table 3, the investment data is published in an excel sheet format, which can be transferred to different statistical software packages. As the extract of the 2010 investment matrix for the owner concept in current prices shows, there are two dimensions that link investments by industries and asset groups. For example, in 2010 the Machinery sector, which invested a total amount of around 5600 Million Euros, invested 26 Million Euros in metal products, while 3059 Million Euros were invested in machinery equipment. Other investments in computers and intangible assets account for 137 and 391 Million Euros, respectively. Due to illustration purpose the investment matrix only provides an extract of the entirely available investment data by sectors and asset groups.

Table 3

Extract of an Investment Matrix

	Germany - Investments by Owner Concept, nominal prices								
	year: 2010								
	Amounts in Mill. EUR, creation date: 07.02.2013								
	Ifo Investment Database - period: 2010								
		Asset Groups:							
	Industries:	**Metal Products**	**Machinery**	**Computers and Office Equipment**	...	**Intangible Assets**	**Structures and Buildings**	**Equipment and Other Assets**	**Assets**
1	Agriculture, Forestry, Fishing	320	4684	58	...	63	1760	5810	7570
02-25	**Producing Industries**	1274	33744	1357	...	3198	17290	65880	83170
2	Mining and Quarrying	90	715	8	...	15	60	1460	1520
03-21	**Manufacturing**	737	28272	823	...	1914	4500	49050	53550
3	Food and Tobacco	67	3056	67	...	137	560	4620	5180
4	Textiles and Apparel	2	497	5	...	5	50	570	620
⋮	⋮	⋮	⋮	⋮	⋱	⋮	⋮	⋮	⋮
17	Machinery	26	3059	137	...	391	630	4930	5560
⋮	⋮	⋮	⋮	⋮	⋱	⋮	⋮	⋮	⋮
50	Other Private Services	156	235	84	...	80	290	1280	1570
01-50	**All Industries**	4558	54095	10316	...	27690	236810	215310	452120

Source: IIDB (2010).

5. Access to Data

The IIDB can be accessed only via the LMU-ifo Economics & Business Data Center (EBDC) located at the Ifo Institute in Munich (Germany). Due to data security reasons and the protection of the data providers' confidence in the Ifo Institute, the admission to the IIDB has to comply with high security standards. The guest researchers and the EBDC enter into a contractual agreement that serves the interests of all parties. The EBDC is located in a separate, closed-off area at the Ifo Institute and is subject to strict physical access controls; access for unauthorized parties is prohibited. The data can only be accessed on computers, which have no internet access, printer, or other external storage media and which can only be used in the presence of an EBDC staff member. Individuals can apply for access to EBDC datasets by completing a form at the Ifo website www.ifo.de/ebdc. In addition, a short description of the research project and accompanying information as to scheduling must be submitted to gain permission. The EBDC expressly supports empirical research projects and is thus free-of-charge.[5] The data will be available in Excel and STATA format. Upon request, extracts of the data of the IIDB can also be obtained at the user's expense.

[5] See Seiler (2012) for further details on the EBDC.

6. Conclusion

With the calculation of investment by industries and assets the IIDB provides a solid database for the analysis of complex relationships and structural changes in the investment activities of German companies. New technological developments and structural changes in investments, which usually starts with a higher leasing rate for new introduced products (Staedtler, 1986), can be identified early based on the distinction of investments by owner and user concept.

Furthermore, the collection of sectoral investment series offers various aspects of applied empirical research on sectoral and aggregate productivity analysis. In addition to parametric estimation approaches usually applied in case of firm-level data, growth accounting is a common method by which sectoral and economy-wide productivity growth can be decomposed into its components of capital, labor, and technological progress.[6] The data provided by the IIDB plays an essential role in the determination of the influence of the input factor capital, whereas investment series are employed to calculate capital stocks and services (e.g. Eicher and Roehn, 2007; Eicher and Strobel, 2009). Moreover, the disaggregated level of the asset classes allows examination of the importance of information and communication technologies during the emergence of the New Economy in the mid-1990s.

Future research intends to link the IIDB with other data of the Ifo Institute. In particular, with the involvement of the *Ifo Business Survey* and the *Ifo Investment Survey*[7] the potential of increasing the accuracy of current investment series as well as analyzing future trends shall be examined. Econometric-based projections of investment series by sector and assets beyond the two-year-delay up to the present will be research projects of primary concern.

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[6] For an application of growth accounting exercises including former versions of the *Ifo Investment Database*, see Eicher et al. (2007).

[7] For documentation of surveys, see Goldrian (2007).

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