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**Article**

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## ANALYSING THE STRUCTURE OF GERMAN INVESTMENTS – THE IFO INVESTMENT DATABASE

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### 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. 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. As of the 1970s leasing in particular, as well as other types of renting, rapidly gained importance in the financing of investment equipment in the former German Federal Republic (Gerstenberger *et al.* 1984).

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 the following 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 consistent with the officially published national account statistics provided by the German Federal Statistical Office (GFSO).

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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.

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. Current publications and updates can be obtained from the EBDC data center at the Ifo Institute.

### Structure and methodology of the Ifo Investment Database

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

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 consistency with this data from national accounts.<sup>1</sup> Due to 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 can only currently be calculated up to the year  $t-2$ .

The IIDB obtains annual investment data on a number of sub-assets. Specifically, in the 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, 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. For Other Vehicles investments by sub-assets are pro-

vided 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*.<sup>2</sup>

For allocation of the GFSO-adjusted investments by sub-assets to industries, an annually updated investment flow matrix is applied, which contains a pre-determined user structure relating 88 sub-assets to 50 industries and therefore determines how much a certain industry uses of a particular sub-asset. Sources for the determination of the user structure stem from the *Ifo Investment Survey*, implicit industry-specific information on a sub-asset category (the main user of the asset Rubber and Plastic Machines, for example, is the Rubber and Plastic Industry), and explicit information from industry-related associations.

To eventually obtain a sectoral sub-asset-investment matrix that is, in its aggregates, consistent with the officially available GFSO figures, 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 with 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 for the year 2000.<sup>3</sup>

### 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 customer sectors is employed. The leasing investment 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.

<sup>2</sup> All data sources for the calculation of investments by sub-assets are listed in detail in Strobel *et al.* (2013).

<sup>3</sup> For the methodology of price adjustment – see Nierhaus (2004) and Strobel *et al.* (2012).

<sup>1</sup> A complete list of sources is provided by Strobel *et al.* (2013).

Since detailed information about leasing investments by users and by assets is not adequately collected by the statistical offices, a 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 – all German leasing companies. Since no official data is available to help make projections, the investment survey is conducted as a full survey. The results of the tests include 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. Furthermore, the results also provide a) information on the annual number of new contracts, b) the investment plans of the leasing companies for the current year –separately for equipment and real estate – as well as c) information on fixed assets of the leasing sector. 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.<sup>4</sup>

#### A descriptive look at the data

For a presentation of the IIDB and its possible applications, this section will provide a descriptive look at the data from different perspectives. As shown in Table 1, the investment data is published in an excel sheet format, which can be transferred to different statistical software packages. As the extract of the 2005 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 2005 the Machinery sector, which invested a total amount of around 5,700 million euros, invested 29 million euros in metal products, while 3,462 million euros were invested in machinery equipment. Other investments in computers and intangible assets account for 241 and 413 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.

<sup>4</sup> For an exact documentation of the survey – see Goldrian (2007).

Table 1

| Extract of an Investment Matrix   |                                |                |           |                                |     |                   |                          |                            |        |
|---|--------------------------------|----------------|-----------|--------------------------------|-----|-------------------|--------------------------|----------------------------|--------|
| Germany – Investments by Owner<br>Concept, nominal prices<br>Year: 2005<br>Amounts in Mill. EUR |                                |                |           |                                |     |                   |                          |                            |        |
|   |                                | Asset Groups:  |           |                                |     |                   |                          |                            |        |
|   |                                | Metal Products | Machinery | Computers and Office Equipment | ..  | Intangible Assets | Structures and Buildings | Equipment and Other Assets | Assets |
| Industries:   |                                |                |           |                                |     |                   |                          |                            |        |
| 1   | Agriculture, Forestry, Fishing | 391            | 4380      | 109                            | ... | 71                | 1480                     | 5450                       | 6930   |
| 02–25   | <b>Producing Industries</b>    | 1250           | 33832     | 1972                           | ... | 2855              | 15060                    | 59750                      | 74810  |
| 2   | Mining and Quarrying           | 74             | 663       | 10                             | ... | 12                | 60                       | 1160                       | 1220   |
| 03–21   | <b>Manufacturing</b>           | 782            | 28706     | 1358                           | ... | 1924              | 4520                     | 46540                      | 51060  |
| 3   | Food and Tobacco               | 88             | 2830      | 137                            | ... | 167               | 530                      | 4380                       | 4910   |
| 4   | Textiles and Apparel           | 2              | 529       | 8                              | ... | 5                 | 60                       | 590                        | 650    |
| ...   | ...                            | ...            | ...       | ...                            | ... | ...               | ...                      | ...                        | ...    |
| 17  | Machinery                      | 29             | 3462      | 241                            | ... | 413               | 530                      | 5140                       | 5670   |
| ...   | ...                            | ...            | ...       | ...                            | ... | ...               | ...                      | ...                        | ...    |
| 50  | Other Private Services         | 127            | 348       | 105                            | ... | 60                | 260                      | 1390                       | 1650   |
| 01–50   | <b>All Industries</b>          | 4551           | 54601     | 12969                          | ... | 24410             | 198930                   | 199260                     | 398190 |

Source: IIDB (2010).

Figure 1



Since the IIDB provides a panel structure of investments by industries and sectors over the period from 1991 onward, different data representations of sectoral or asset group statistics are possible. According to Figure 1 investment shares by particular asset groups can be derived for specific sectors of interest. For example, both charts of Figure 1 show the nominal shares of four aggregate assets groups, which are machinery equipment, vehicles, electronic assets, and other assets for different time dates. Therefore the upper chart of Figure 1 depicts these four asset groups in case of the Manufacturing sector. As the asset shares indicate, the most important investment asset in the Manufacturing sector is machinery equipment, followed by the electronic assets. However, the data suggests that shares of electronic assets are declining, whereas a shift toward investments in other assets is induced.

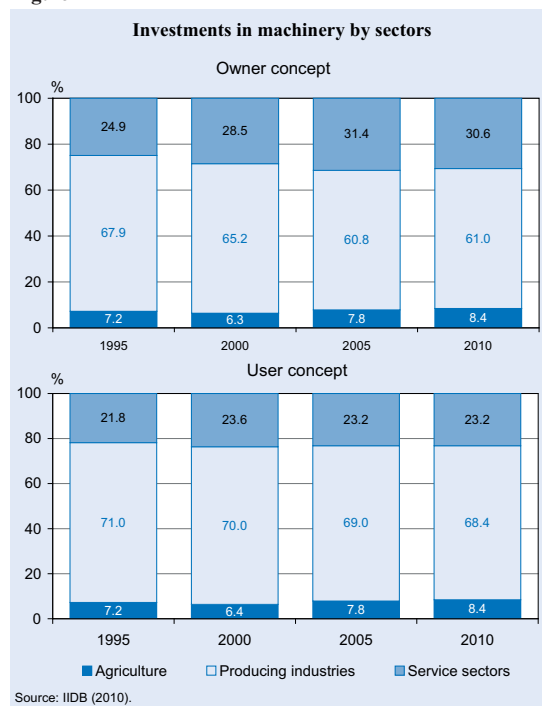
Similarly as in case of Manufacturing, the lower chart of Figure 1 shows investment shares by the four aggregate asset groups for the Trade sector. Although investment in machinery assets plays an important role in this industry, its importance is significantly lower than in Manufacturing. Nevertheless, machinery equipment increases in share post 2000. Furthermore, as the data suggests, the share of electronic assets declines as of 2000, favouring a shift toward vehicles. The use of such graphical representations allows the researcher to investigate the structural change in sectoral investment activity for specific product groups.

Analogously to the representation of investment shares by sectors and assets, the data can also be employed to focus on the importance of a particular asset throughout the entire economy. Therefore economy-wide asset data for a specific asset separated by different sectoral groups and concepts can be analysed. The upper chart of Figure 2 shows an example of machinery assets by owner concept invested by three broad industry groups: Agriculture, Producing industries, and Services sectors.

The data suggests that it is mainly the Producing industries that invest in machinery assets, while Services sectors invest about half the size in this asset compared to Producing industries. However, this picture changes as soon as the user concept is regarded.

The lower chart of Figure 2 illustrates that, when investment data accounted for, leased machinery assets is employed, it is also the Producing industries that invest the largest share in machinery assets and that those sectors' shares significantly increase compared to their investment shares in machinery assets measured by owner concept. The investment shares in machinery assets by Services sectors, on the other hand, are much less important when measured by user concept. This effect results from the reallocation of leasing investments accounted for by leasing companies (owner concept), which are included in the Services sectors, to other sectors actually using these investments (user concept).

Figure 2





## 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). For data security reasons and the protection of the data providers' confidence in the Ifo Institute, 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](http://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 to access the data. The EBDC expressly supports empirical research projects and is thus free-of-charge.<sup>5</sup> Upon request, extracts of the data of the IIDB can also be obtained at the user's expense.

## Conclusion

With its 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 begin at 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 the parametric estimation approaches usually applied in the 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.<sup>6</sup> The data provided by the IIDB plays an essential role in determining 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 makes it possible to examine the importance of information and communication technologies during the emergence of the New Economy in the mid-1990s.

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<sup>5</sup> See Seiler (2012) for further details on the EBDC.

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