DIGITAL PROCESS DATA FROM TRUCK TOLL COLLECTION AS NEW BUILDING BLOCK OF OFFICIAL SHORT-TERM STATISTICS

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ABSTRACT

Economic activity generates and requires transport services – hence there is a close
connection between the economic development and the freight traffic by trucks. As
part of toll collection, digital process data are generated, among other things, on the
mileage of trucks subject to toll. The Federal Office for Goods Transport has used these
data to develop a truck-toll-mileage index, which indicates the change in mileage for
comparable basic variables and excludes structural changes as far as possible. Due
to its early availability and economic meaningfulness, the Federal Statistical Office
has included this index in its publication programme. This article describes the new
element of official short-term economic statistics and explains its relation to existing
short-term statistics.

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The truck-toll-mileage index

1.1 Truck toll data

A distance-based toll was introduced for heavy goods vehicles (trucks) in Germany at the beginning of 2005. The toll obligation initially applied to trucks with a gross vehicle weight rating (GVWR) of 12 tonnes and above on the approximately 12,800 km of federal motorways. In the ensuing years, the toll obligation was successively extended and now applies to all trucks of 7.5 tonnes GVWR and above on all federal motorways and federal roads. The amount payable depends on the distance travelled on the tollable roads, the number of axles of a vehicle or vehicle combination and its emission class. The Federal Office for Goods Transport performs the sovereign tasks regarding the implementation of the truck toll. A private operator, Toll Collect GmbH, was entrusted as officially appointed agent with setting up and operating the toll collection system.

Users of the tollable road network have to log in to the toll system for the settlement of truck tolls. Various options are available: Users can log in automatically via the vehicle device, or they can do so manually at toll terminals or via the Internet. The automatic log-in system is based on a combination of mobile phone (GSM) and satellite positioning (GPS) technologies. Automatic log-in uses a vehicle device, the so-called On-Board Unit (OBU). It uses satellite signals to determine the position

of and distance covered by the vehicle, and transmits the data to the operator's computer systems via mobile communication. This log-in method was used for around 96% of all tollable journeys in 2017. ↘ **Figure 1**

When truck toll collection was introduced, the Federal Office for Goods Transport set up an information system which allowed central evaluation of all the key figures required for controlling and monitoring the operator. These include data on truck toll receipts, tollable journeys and mileage. These truck toll data are collected by the truck toll operator and forwarded to the Federal Office for Goods Transport. They can be broken down by various criteria – for example, country of origin of the truck, number of axles, emission class or log-in source. Truck toll data have been processed since 2008 in the form of administrative statistics and published monthly and annually on the Federal Office for Goods Transport website.[1] The monthly toll statistics reports are usually published 15 working days after the end of the reference month and contain numerous evaluations of truck toll data that can be used for traffic management studies. For example, tollable journeys and mileages are displayed graphically and in tabular form, differentiated by country of registration, axle class and emission class. In addition, the monthly toll revenues for each tollable section of road are made available on the websites of the Federal Office for Goods Transport or the mCLOUD research platform in accordance with Section 9 (7) of the German Federal Trunk Road Toll Act, differentiated by emission class and axle class.[2]

↘ Excursus

mCLOUD is a research platform containing open data on mobility and related topics. In mCLOUD, the Federal Ministry of Transport and Digital Infrastructure provides central access to all its open data (and those of its subordinate authorities) and also allows private mobility sector providers to offer their data there.

The tollable truck traffic recorded in the truck toll data is almost identical to the actual truck traffic of 7.5 tonnes GVWR and above on the German trunk roads and thus

Figure 1

On-Board Unit for satellite-based vehicle log-in to the truck toll system

With permission of Toll Collect GmbH.

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1 See Federal Office for Goods Transport. [Accessed on 25 October 2018]. Available at www.bag.bund.de

2 Act on the Levying of Distance-Related Charges for the Use of Federal Motorways and Federal Highways (Federal Trunk Road Toll Act – BFStrMG) of 12 July 2011 (Federal Law Gazette I, p. 1378), last amended by Section 21 of the Act of 14 August 2017 (Federal Law Gazette I, p. 3122).

Overview 1

Introduction and extensions of toll obligation

Introduction or extension of toll obligation	
01.01.2005	Truck toll obligation for 12t GVWR and above on all federal motorways (12,800 km)
01.01.2007	Toll extension: + 42 km of federal roads to tollable road network
01.08.2012	Toll extension: + 1,100 km of federal roads to tollable road network
01.07.2015	Toll extension: + 1,100 km of federal roads to tollable road network
01.10.2015	Reduction of the tonnage limit to vehicles of 7.5 t GVWR and above
01.07.2018	Toll extension: + all federal roads (38,000 km) to the tollable road network

A total of 53,000 kilometres of road are now tollable.
Source: Federal Office for Goods Transport

represents a quasi complete count in this area. There are only a few exceptions to the toll obligation (e.g. armed forces and police vehicles) and the proportion of violations of the truck toll obligation is assessed as very low. Since most of the data are satellite-generated process data, there is low susceptibility to revision. At the same time, the truck toll data are available in unprocessed form within a few days of the end of each reference month. Short delays only occur by the OBU sending collected sets of information to the operator, who then forwards them to the Federal Office for Goods Transport with a time lag.[3] Finally, anonymisation and processing of the data also require a certain amount of time.

However, the fact that the truck toll has been gradually extended since its introduction is relevant, depending on the intended use of the data.[4] ↘ Overview 1

↘ Figure 2 shows the development of toll road mileages since 2005. The vertical lines mark the dates of the toll extensions. Accordingly, the reduction in the tonnage limit for the determination of the truck toll from the end of 2015 and the extension of the toll obligation to include all federal roads from mid-2018 led to significant increases in the tollable truck mileage.

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3 At present, the OBU transmits data whenever the engine of the truck is started and then subsequently every four hours in Germany, and once a day abroad. When the engine is off, no information collected since the last transmission is sent until the engine is restarted.

4 The individual tollable road sections can be viewed. See Federal Highway Research Institute. [Accessed on 25 October 2018]. Available at www.Mauttabelle.de. Section 1 of the Federal Trunk Road Toll Act states that individual sections of the A5 and A6 federal motorways on the German-French and German-Swiss borders are permanently exempt from tolls.

Figure 2

Total monthly tollable mileage and toll extensions
Billions of km
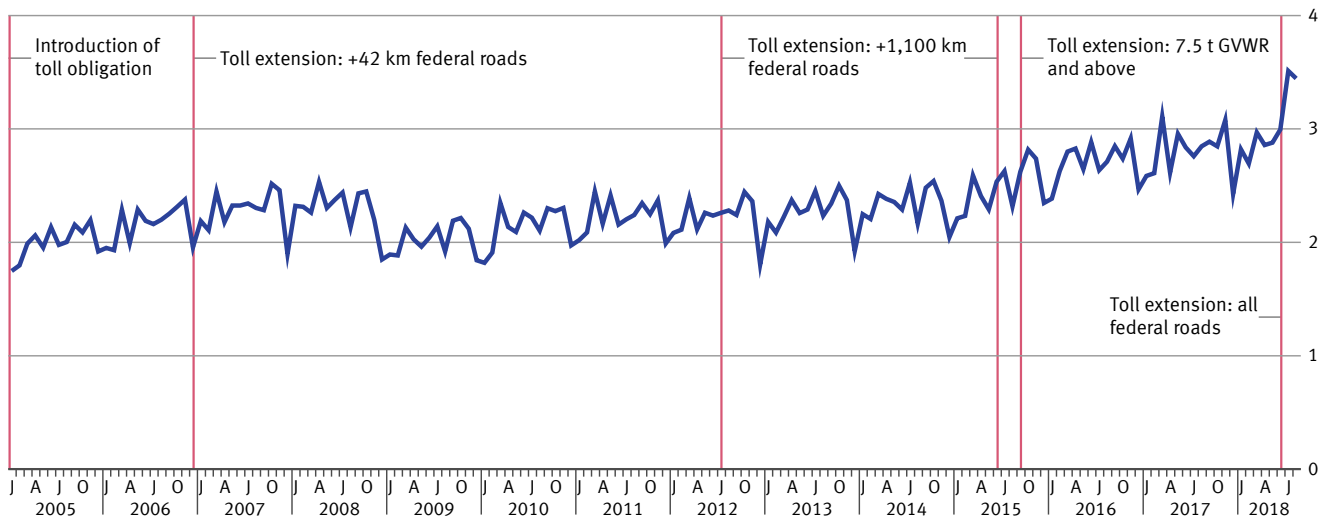
Source: Federal Office for Goods Transport

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1.2 The truck-toll-mileage index

The time series of the toll statistics accurately reflects the development of the truck toll mileage. Any attempts to relate this to the development of goods transport or the short-term economic development are, however, undermined by the fact that the toll extensions restrict any comparability of the truck toll data over time. The Federal Office for Goods Transport developed the "Truck-toll-mileage index" in order to exclude changes in the observed mileage from the time series that are caused by toll obligation extensions. This index represents the development of mileage as a fixed base index for a subpopulation that can be presented in unchanged form over time.[5] First, the truck-toll-mileage index only includes the mileage of trucks on federal motorways, as the road section-based extensions of the toll obligation were always related to federal roads. Second, only mileages of trucks with at least four axles are included in the fixed base index, since in most cases these are

not affected by the toll extensions to include trucks with a GVWR of up to 12 tonnes.[6] Since the last extension of the toll obligation in July 2018, the truck-toll-mileage index has included an average of around 72% of all toll mileages. Up to autumn 2015, this share was between 90 and 95%. Only with the larger truck toll extensions, the lowering of the tonnage limit and the extension to include all federal roads, did the share decrease significantly.

↘ **Figure 3** shows the development of the truck-toll-mileage index in comparison with the total tollable mileage presented above. For simplification, both time series were standardised to their average 2005 values. The difference between the truck-toll-mileage index and the total tollable mileage initially rises only slightly following the first extensions to the toll obligation, with significant differences only becoming apparent from autumn 2015.

In addition to representing the truck-toll-mileage index as a fixed base index, it is also possible to compute a

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5   In a "fixed base index", the observation units refer to a part of the population which is delimited equally over the whole index period.

6   Direct breakdown by GVWR is currently not possible with the truck toll data.

Figure 3

Truck-toll-mileage index and total mileage of all tollable vehicles
2005 = 100
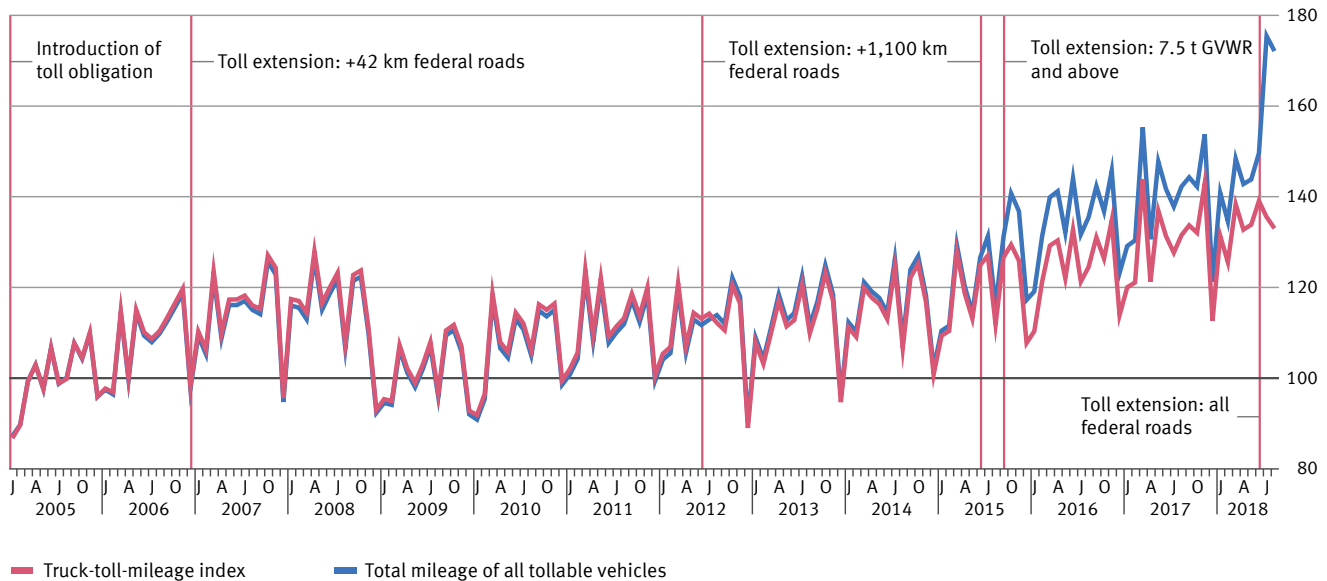
Source: Federal Office for Goods Transport

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chain index.[7] Here, the index includes the total mileage of trucks tollable at a given time, on all roads tollable at this time. Informed estimates of the month-on-month rate are made for the months with toll extensions. For example, the mileage for the month of July 2018 is estimated for the tollable roads on the basis of the June 2018 status. The estimated values of hypothetical, unchanged road networks and tonnage limits are used for back calculations based on month-on-month change rates. A comparison between the truck-toll-mileage index as a fixed base index and as a chain index revealed only very small differences between the two time series. Since the fixed base index is easier to interpret and, above all, because it can be calculated automatically even in the event of toll extensions, the truck-toll-mileage index is published as a fixed base index.

Automation of the calculation and data provisioning processes is important because the mileage index is issued within a few days of the end of each reference month.

Analyses by the Federal Office for Goods Transport have shown that the toll data are almost complete ten days into the following month. After that, the further toll data added to the overall database amounts to less than one per cent of the total. This is the case, for example, if the On-Board Unit in a truck is switched off for several weeks and the remaining data are not forwarded to the toll system until it is switched on again.

The truck-toll-mileage index of the Federal Office for Goods Transport provides an indicator with early availability. Much of the goods traffic on trunk roads can be assigned to the motorways, meaning that the truck-toll-mileage index provides a good indicator of total road freight transport.[8] In the future it could be useful to publish a further index which reflects the road freight transport on federal roads. At present, however, only a short time series of truck toll data is available for the

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7 In the case of a "chain index", the delimitation of the relevant observation units may change during the life of the index.

8 Approximately 80 % of tollable mileage is driven on federal motorways, with federal roads only accounting for about 20 %. No information is available on the truck mileage on the secondary road network (Land roads, district roads and municipal roads).

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entire federal road network (from July 2018).[9] Road freight transport accounts for a large proportion of the total transport performance in all transportmodes. It thus represents a large proportion of all domestic freight transport (BMVI, 2017, p. 242).

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Relationship between mileage and industrial production

2.1 Short-term statistics of the Federal Statistical Office

The relationship between the truck-toll-mileage index and the results of short-term statistics from the Federal Statistical Office was examined based on the production index for manufacturing as part of the cooperation project between the Federal Office for Goods Transport and the Federal Statistical Office.[10] Short-term statistics are used to measure, among other things, the economic activity of establishments and enterprises in Germany. Statistical characteristics include the development of industrial production volume, trade turnover or the results of quarterly domestic product calculations for the German economy as a whole.

Short-term statistics often focus more on the development of results over time than on the absolute values of individual reference months or quarters. Publications therefore give priority to rates of change referring to an earlier period, for example the change in the production index in relation to the previous month, which is referred to as month-on-month rate. Month-on-month or quarter-on-quarter changes are often strongly influenced by seasonal effects which make it difficult to assess current developments. The results of short-term statistics are therefore usually seasonally adjusted (including a cal-

endar adjustment in most cases). Furthermore, trends are calculated which indicate the medium-term developmentof short-term statistics.

The development of the non-seasonally adjusted production index for the manufacturing sector is compared below with the truck-toll-mileage index (also non-seasonally adjusted). This is followed by an analysis of the respective seasonally adjusted values and finally the trend developments.

2.2 Statistical relationship in the rates of change of the unadjusted indices

↘ Figure 4 shows the month-on-month rates of the non-seasonally adjusted production index for manufacturing on the Y-axis and the corresponding changes in the truck-toll-mileage index on the X-axis. The Bravais-Pearson correlation and a regression line for simple linear regression are given to provide orientation regarding the strength and direction of the statistical relationship.[11]

Figure 4

Month-on-month rates of the non-seasonally adjusted indices, percent, correlation coefficient (r), regression line
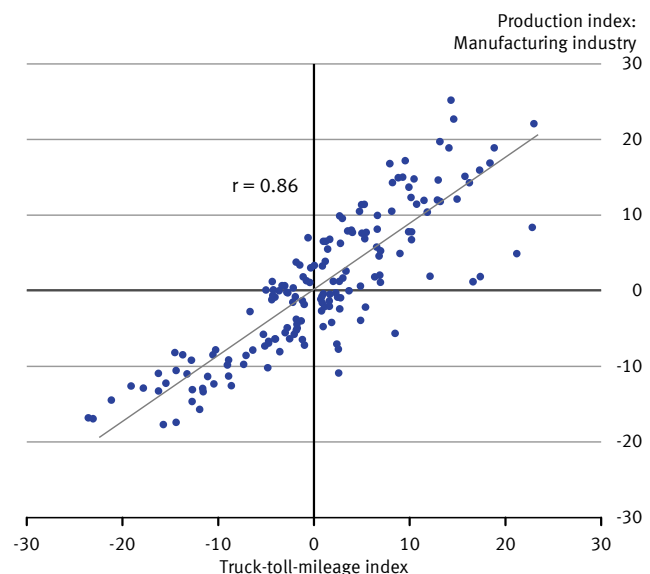
February 2005 to August 2018.

Source: Federal Statistical Office, Federal Office for Goods Transport

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9 A separate analysis of truck traffic on federal roads could provide additional information, as it differs from traffic on federal motorways at the system level. For example, there is proportionately more regional and local traffic on federal roads than on federal motorways, meaning that there are comparatively more German and small trucks on the federal roads.

10 The project work corresponding to the Federal Statistical Office was carried out as part of the EU grant agreement number 822695-2018-DE-ESS-VIP-ADMIN.

11 The possibilities of more complex modelling of the relationship between mileage and production are discussed in Section 3.4.

The correlation coefficient of 0.86 indicates a clear statistical relationship between production and mileage. Raw materials and intermediate products have to be transported to the production sites, and industrial products have to be delivered to the customers. Freight services may therefore occur before, during or after production. In many areas of industry, however, delivery, production and transport are closely interwoven in just-in-time supply chains. The analysis of time series shifts has shown that the relationship is strongest between the production index and the mileage index for the same period – the statistical relationship is significantly weaker when comparing the production index with the mileage in previous or subsequent months.

Figure 5

Month-on-month rates of the non-seasonally adjusted indices, percent, correlation coefficient (r), regression line
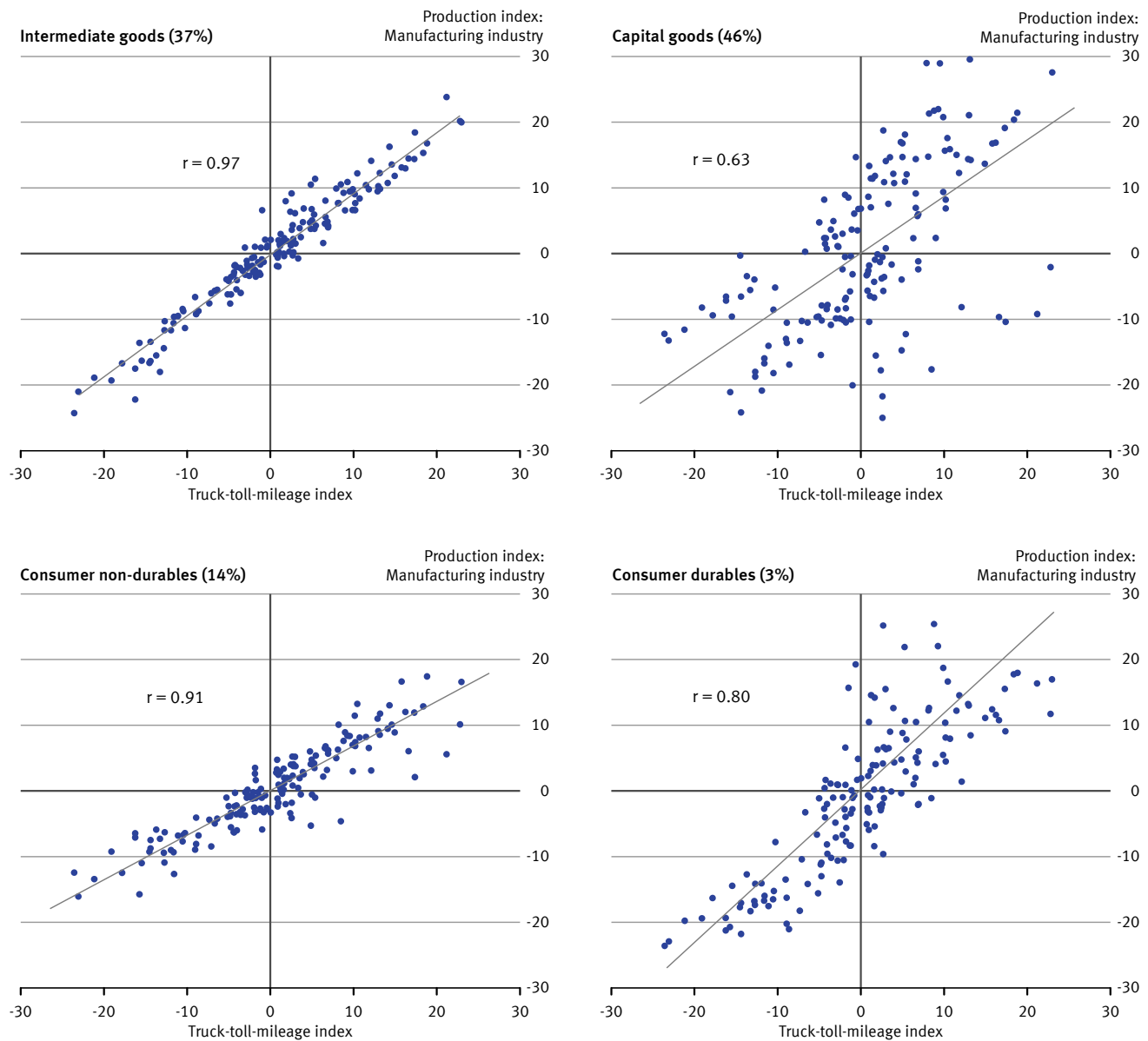
February 2005 to August 2018. – In brackets: Share of the main industrial grouping in value added in manufacturing.

Source: Federal Statistical Office, Federal Office for Goods Transport

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The production index is calculated as a weighted average of the indices for individual economic activities.[12] The weighting reflects the share of the total value added that was achieved in the individual economic activities in the base year 2015. ⬎ **Figure 5** shows the production index for different sub-sectors. The weight of the subdivisions in the total manufacturing index is indicated in brackets in each case. They are classified into the main industrial groupings; that is, sub-aggregates of economic activities.[13] The diagrams in figure 5 always show the same truck-toll-mileage index; no differentiation by type of goods or economic activity is possible here.

One such main industrial grouping is intermediate goods, for example the production of basic chemicals or fabricated metal products. The relationship between production and mileage is particularly clear here, with a correlation coefficient of 0.97 for the non-seasonally adjusted month-on-month rates.

Another main industrial grouping is capital goods, for example the manufacture of machinery or vehicles. Capital goods play a major role in the production index for the manufacturing sector, accounting for almost 50 percent of value added. The correlation coefficient here is only 0.63. The production of these goods can take a long time and some finished products, such as ships, aircraft or trains, are not transported by road. On the output side, a looser relationship between production and mileage can be assumed for the production of capital goods, but substantial transportation is likely to be needed for the procurement of raw materials and intermediate products as input for production.

The main industrial groupings also distinguish between consumer durables and consumer non-durables. Consumer non-durables include pharmaceutical products, foodstuffs or even clothing; a very close relationship is apparent here, too, from the correlation coefficient of 0.91. For consumer durables, such as furniture or household appliances, the relationship between mileage and production may be distorted to some extent by production in stock, which is included in the production index – yet the correlation coefficient of 0.80 is still relatively high.

In summary, with regard to the month-on-month rates of the non-seasonally adjusted data, a strong statistical relationship can be observed between production in manufacturing and mileage; this varies in strength between the various sectors. Similar results can be seen when comparing the month-on-month rates of the turnover index or the new orders index for manufacturing with the development of mileage, although the relationship is somewhat weaker than in the production index. A clear statistical relationship between mileage and economic activity could also be observed for domestic trade sectors (such as wholesale trade, motor vehicle trade), the latter being measured by turnover. Furthermore, a clear statistical relationship can be measured between the quarterly mileage and the quarterly rates of change of the gross domestic product from the national accounts. Finally, as expected, the quarterly turnover in the "Freight transport by road and removal services" sector also correlates with the mileage.

2.3 Statistical relationship in the rates of change of the seasonally adjusted indices

As mentioned above, the developments in short-term statistics are often strongly influenced by seasonal effects, which is why short-term statistics are usually seasonally adjusted.[14] This is based on the assumption that a time series can be divided into a number of components. The seasonal component includes annually movements recurring in the same months in similar intensity. The calendar component contains the average influence of the calendar constellations that result, for example, from the shift in the number of working days in months of the same name. The trend-cycle component tracks short-term fluctuations and long-term development trends. The irregular component comprises both random and economically explicable influences which have a short-term effect and which do not belong to the other components – such as the effects of strikes on production within an industry. In seasonal adjustment, the seasonal and calendar components are excluded from the results, since the expected fluctuations of

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12 For calculation of the production index, see Linz et al, 2018a.

13 For the main groupings, see: Commission Regulation (EC) No 586/2001 of 26 March 2001 implementing Council Regulation (EC) No 1165/98 concerning short-term statistics: Definition of Main Industrial Groupings (MIGS).

14 The term seasonal adjustment is used in this paper as a collective term for the adjustment of seasonal fluctuations and calendar effects. Regarding seasonal adjustment by the Federal Statistical Office see Linz et al, 2018b.

Figure 6
Seasonal components
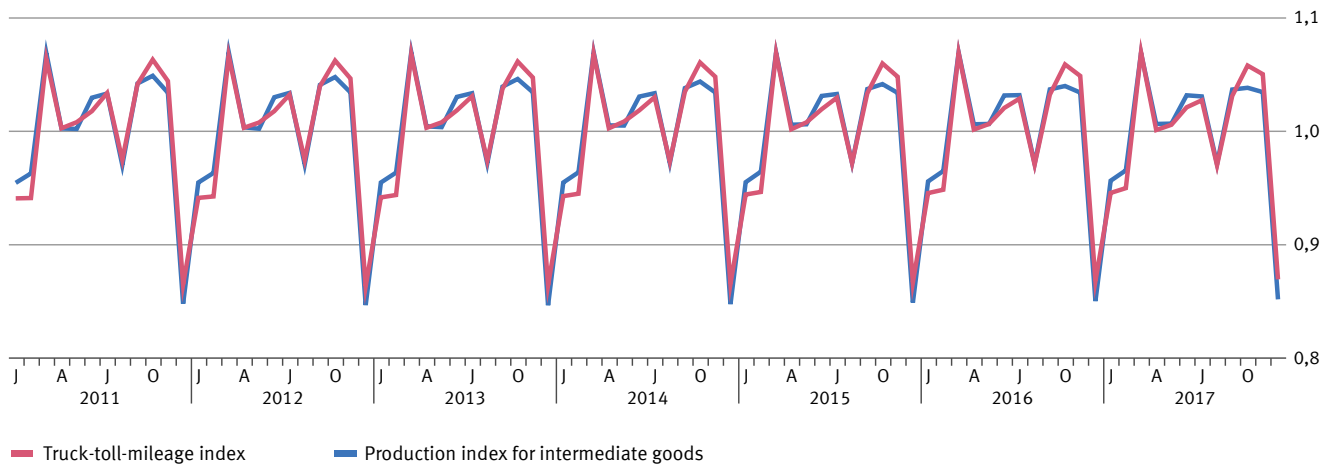
Source: Federal Statistical Office, Federal Office for Goods Transport

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these components can obscure the relevant movements in a time series.

The seasonal adjustment method X13 in JDemetra+, which is used by the Federal Statistical Office to calculate the seasonally adjusted data of the production index, was also applied to the truck-toll-mileage index. ↘ Figure 6 shows, as an example, the seasonal component of the production index for intermediate goods together with the seasonal component of the truck-toll-mileage index.[15] The seasonal components are shown for the months January 2011 to December 2017. There is strong accordance between the course of both seasonal components. The decline in December and the subsequent spring revival are somewhat stronger in the production index for intermediate goods than in the mileage index. In June the mileage is regularly slightly below, and in autumn above, the production of intermediate goods. Otherwise both seasonal patterns are almost identical. The specification parameters of the production index for intermediate goods were adopted for the seasonal adjustment of the truck-toll-mileage index in figures 7

and 8.[16] There is also very strong accordance between the seasonal patterns if the specification parameters for controlling the seasonal adjustment for the production index and the mileage index are determined independently of each other.

↘ Figure 7 shows the month-on-month rates of the four time series components in scatterplots. The correlation coefficient is 0.98 for the month-on-month rate of the seasonal component. The statistical relationship in the calendar component is even stronger; differences in the working days of the individual months have a very similar effect on production and mileage.[17]
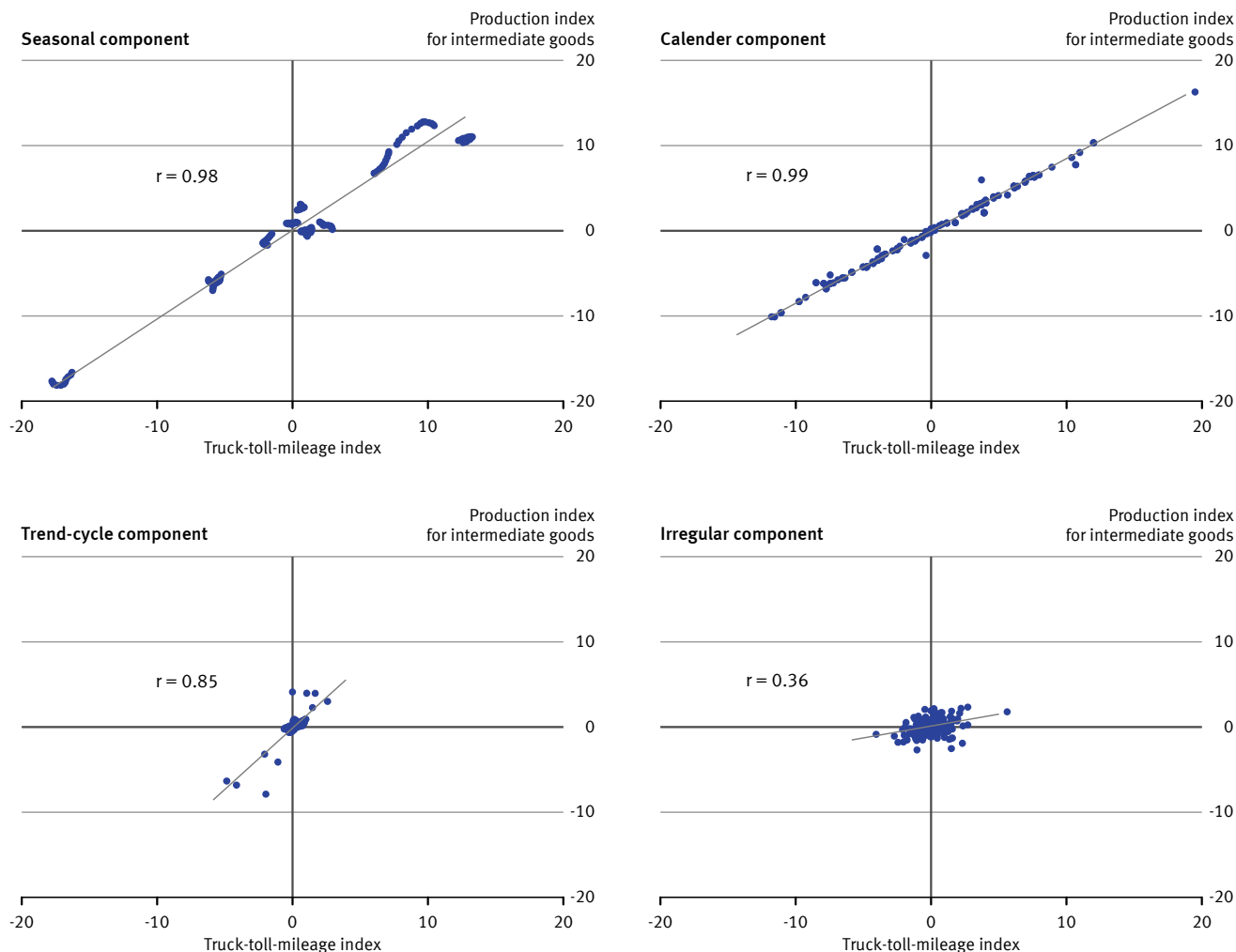
The calendar and seasonal components are removed from the time series in the adjustment, meaning that

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15 Seasonal adjustment of the production index for manufacturing is carried out at the breakdown level of the main industrial groupings in the X13 method in JDemetra+. Intermediate goods are presented here as an example because the strongest statistical relationship with mileage can be observed for this main industrial grouping.

16 The X13 method in JDemetra+ offers various possibilities for taking the specific conditions of a time series into account when determining the time series components. In order to use these, various specification parameters must be defined with regard to the RegARIMA model being used, the trend and seasonal filters and other options.

17 Since the same seasonal adjustment method was chosen for the truck-toll-mileage index and the relevant production index, the same calendar regressors are used as explanatory variables in the RegARIMA model. However, the coefficients of the regressors are estimated separately for each time series. Accordingly, the number of working days in a month may have a different influence on the mileage than on the production of goods. For a description of the calendar adjustment in the intermediate goods production index see Linz et al, 2018b.

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Figure 7

Month-on-month rates for the time series components of the indices, percent, correlation coefficient (r), regression line

February 2005 to August 2018.

Source: Federal Statistical Office, Federal Office for Goods Transport

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both the trend-cycle component and the irregular component are included in the calendar and seasonally adjusted result. The lower part of Figure 7 compares the month-on-month rates of the production index for intermediate goods and the truck-toll-mileage index for these two components. Looking at the trend, the accordance between the development of mileage and production is weaker than for the seasonal component, however the correlation is relatively high here at 0.85. The variance caused by trend movements is weak compared to the seasonal variations, especially after the strong movements caused by the economic, financial and euro cri-

ses. There is no significant change in the strength of the statistical relationship between the trend developments in mileage and intermediate goods production if only the period from 2012 is considered. The cyclical characteristics of the time series for mileage and production are discussed in more detail in the following section.

The scatterplot of the month-on-month rates for the irregular component shows that the irregular movements of the truck-toll-mileage index may differ significantly from those of the intermediate goods production index. Irregular fluctuations are relatively weakly correlated. In

production for example, irregular movements can occur due to technical disruptions in the production processes in the establishments or due to unusual holiday constellations. In the case of truck mileage, traffic restrictions on larger stretches of road due to major roadworks or snow and icy roads can lead to irregular movements, for example. Official statistics provide little information on the relevance, frequency and impact of such events; this information cannot be gathered because of the burden on respondents.[18] Some of the influencing variables, such as lengthy strikes, could affect both production and mileage. In many cases, however, there are presumably different causes of irregular fluctuations in production and mileage, or common causes of fluctuations are reflected differently in production and mileage.

As mentioned above, the seasonally adjusted result includes both the irregular component and the trend-cycle component. In a retrospective analysis, the trend-cycle component is very well suited for identifying economic turning points. In practice, however, it is hardly used in the analysis of current economic developments. Due to its calculation method, the trend reflects changes but with a time lag, and deviations from the previous trend (assuming a constant calendar and seasonal pattern) are initially included in the irregular component. Only if the new tendency is confirmed by further data points will it be reflected by the trend. For analysing the most recent economic developments, the use of seasonally adjusted results has therefore become common practice (see, for example, Deutsche Bundesbank, 1999, p. 41 ff.).

Conversely, the strong accordance between the seasonal mileage and goods production patterns as shown above means that the use of seasonal adjustment excludes a significant degree of covariance between the two variables from the data. ↘ **Figure 8** shows the month-on-month rates of the calendar and seasonally adjusted indices in a scatterplot. Here the development of the production index for the manufacturing sector as a whole is once again shown on the Y-axis and the cor-

Figure 8

**Month-on-month rates of the seasonally adjusted indices,
percent, correlation coefficient (r), regression line**
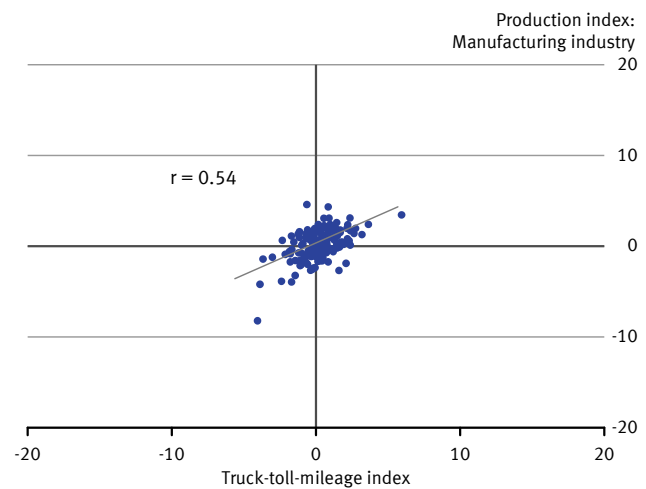
February 2005 to August 2018.

Source: Federal Statistical Office, Federal Office for Goods Transport

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responding changes in the truck-toll-mileage index are plotted on the X-axis. The correlation coefficient is 0.54, which is significantly lower than in the non-seasonally adjusted time series. In the production index for manufacturing it is still relatively high, while the other main industrial groupings or aggregates yield a somewhat lower correlation.

## 2.4 Common path in economic cycle

Cyclical economic movements can be presented, for example, as deviations of a medium-term trend from the long-term growth path of a time series. The Federal Statistical Office uses the BV4.1 method to calculate medium-term trends (Speth, 2004). It is particularly suitable for mapping economic movements that span three or more years. At the same time it smoothes out intra-annual fluctuations to a considerable extent. Cyclical economic movements can be presented in isolation by examining the deviation of a BV4.1 trend from its long-term growth path. ↘ **Figure 9** shows the cyclical developments of the production index for manufacturing and the truck-toll-mileage index.[19]

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18 The ifo Institute for Economic Research also gathers rough appraisals of the relevance of certain impediments to production in its manager surveys. Managers are asked, for example, whether production in their own company has been hindered in the current month through a lack of raw or intermediate materials or through insufficient technical capacity. However, such questions are only included in the questionnaire on a quarterly basis. A comparison with the irregular components of the production index for intermediate goods and the truck mileage index aggregated to quarterly results reveals little accordance.

19 The long-term growth component was calculated by applying a Hodrick-Prescott filter (HP trend) with smoothing parameter λ = 1 million. For HP trend see Hodrick/Prescott,1997.

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Figure 9

Economic cycle as deviation of medium-term trend from long-term trend: Truck-toll-mileage index and production index for the manufacturing industry
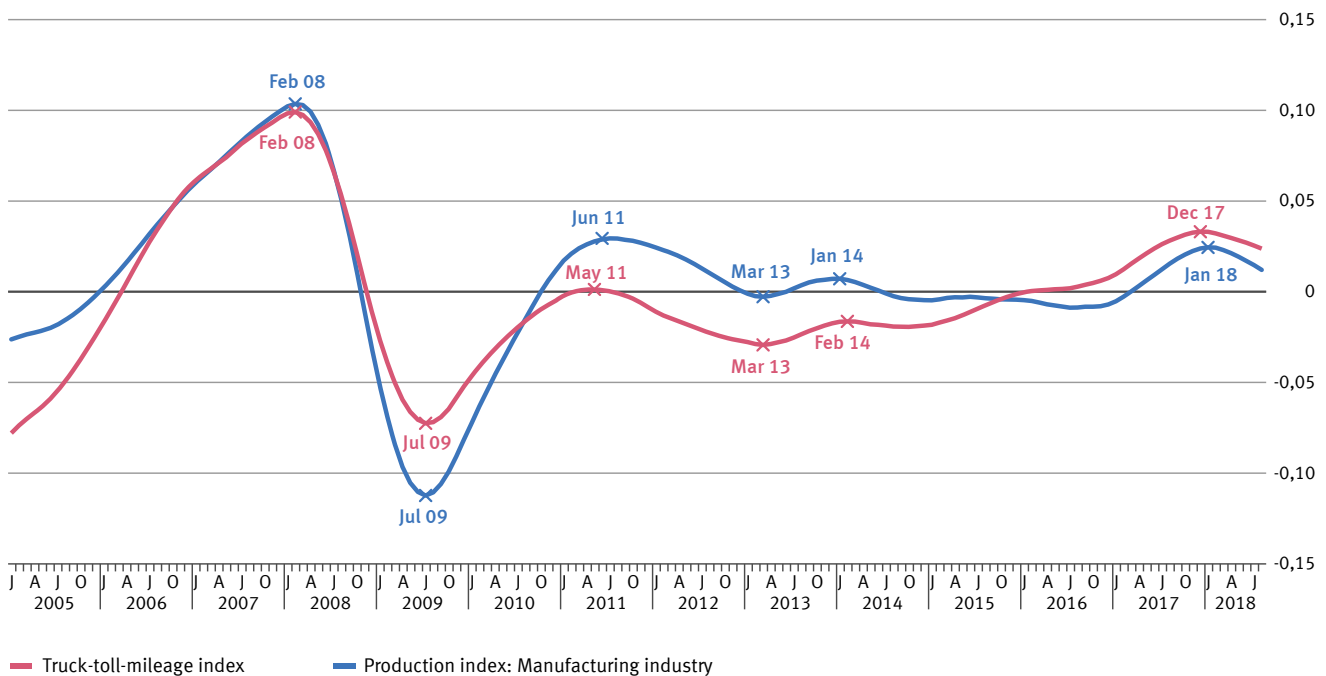
Source: Federal Statistical Office, Federal Office for Goods Transport

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A review of the entire time series reveals several examples of precise accordance between the economic turning points; at other points, however, there are divergent developments. For both time series, the downward movement caused by the economic and financial crisis begins simultaneously in February 2008, with both dips coinciding in July 2009. The decline caused by the euro crisis appears two months earlier in the truck-toll-mileage index than in the production index for the manufacturing sector – while the dip occurs at exactly the same time in both time series; the peaks of the subsequent recovery also coincide. In the years 2015 and 2016, the development of the mileage index seems to have decoupled itself from the development of production; this period is characterised by less pronounced cyclical movements in the production index. A common turning point can be observed again at the turn of 2017/2018. This appears in the mileage index only one month earlier.

When interpreting the common economic cycle, it should be noted that mileage and production are very different variables. The truck mileage indicates the total distance travelled, it contains no information on the value and is only indirectly related to the quantity of goods transported. The production index, on the other hand, also refers to monetary variables and its purpose is to show the development of the total value of goods produced, at constant prices.[20] The statistical relationship between mileage and production, which is nevertheless clearly discernible, can be influenced by structural changes in industrial demand for freight services. For example, it is noted that increasing volumes of higher-value goods are being transported, an increasing proportion of which by road and involving longer transport distances. The transport of bulk goods, by contrast, is declining (SSP Consult, 2018, pp. 31 and 38). Higher-value goods are to be found, for example, in the main industrial grouping of consumer durables. ↘ **Figure 10** shows the production

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20 Since the weighting of the production index is based on the sum of gross value added in the economic activities, it can also be regarded as a calculation system for the monthly rolling forward of gross value added at constant prices (see Strohm, 1985, here: page 23).

Figure 10

Economic cycle as deviation of medium-term trend from long-term trend: Truck-toll-mileage index and production index for consumer durables

Truck-toll-mileage index ▬ Production index: Consumer durables
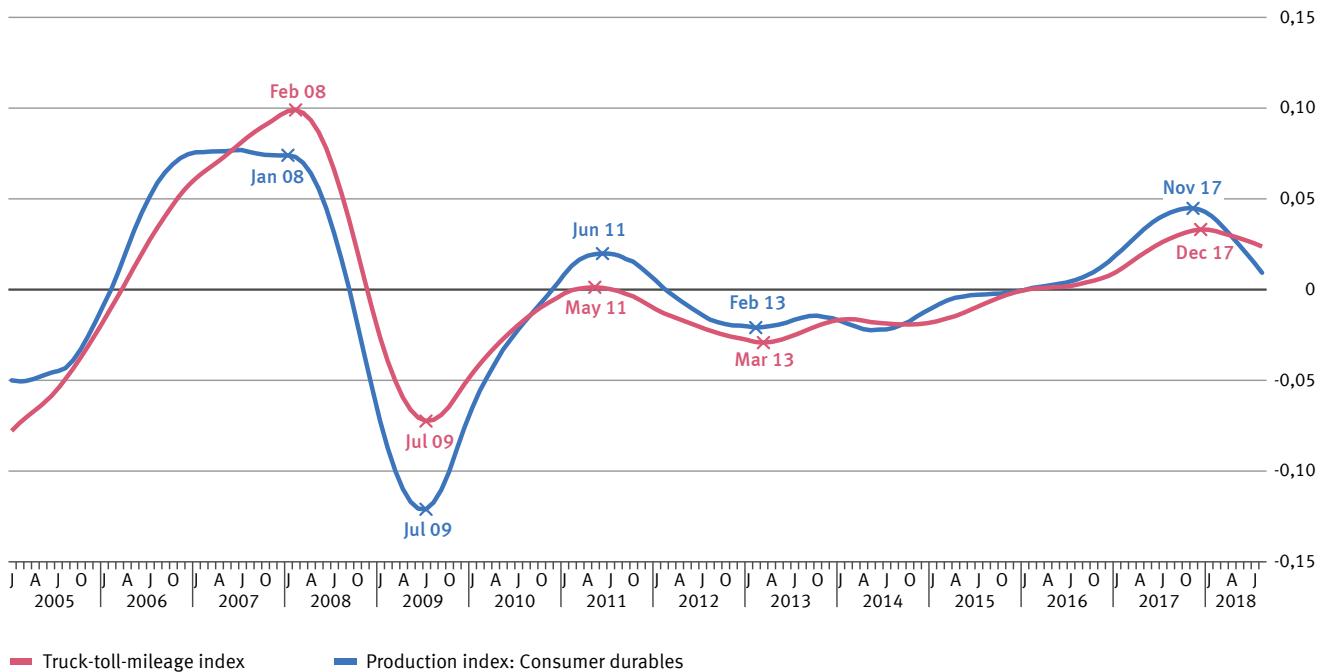
Source: Federal Statistical Office, Federal Office for Goods Transport

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index cycle for consumer durables alongside the development of the truck-toll-mileage index.

There was a joint upward tendency in 2015 and 2016, with both the production of consumer durables and road freight transport increasing during this period. The increase in this industrial production sector is scarcely reflected in the production index for total manufacturing, as this main industrial grouping only accounts for roughly 3 % of the total index. Other possible factors that could have influenced the growth in mileage during this particular period include the increasing sales of German industrial companies to euro area countries, and low fuel prices.[21]

The total freight mileage required by industry can also be provided by different combinations of transport types – the share of road freight transport may change within the total domestic freight transport volume. Transport statistics show, however, that the modal split (distribution of transport volumes across different means of transport) is relatively stable in the long term on the basis of annual averages. One of the reasons for this is that individual branches of industry have an affinity for certain modes of transport.

The link between mileage and production may also be affected by shifts within road freight transport, for example by an evasive response to the extension of the toll obligation to federal roads. Studies show that there have only been isolated instances of traffic evasion on certain sections of road. Toll evasion evidently yields little or no cost advantage for the transport companies in most cases, and it can lead to lost time for the companies (Deutscher Bundestag, 2016). Nor is there any particularly pronounced trend towards the use of trucks below the limit of 7.5 t GVWR. Structural changes in road freight traffic as measured by the truck-toll-mileage index may

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21 For example, the industrial turnover index shows that sales posted by German industrial companies to the euro area countries have risen significantly since around 2014, but this is not reflected in the production index: the destination of the goods produced is not taken into account in the calculation of the production index.

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also occur if, for example, the mileage share of trucks with at least four axles on journeys with no freight (empty runs) increases on federal motorways. These cannot be distinguished in the toll data from freight transport journeys. Furthermore, from the truck toll data it is not possible to identify transit journeys in which the German road network is used by trucks containing goods which are neither loaded nor unloaded in Germany. Here, too, the proportion of transit journeys can change over time. It is beyond the scope of this paper to discuss the effect of such factors in more detail.

When using toll data for economic monitoring purposes, it should always be borne in mind that truck mileage can only provide a rough basis for assessing the development of economic activity in Germany. Too much importance should therefore not be attached to the latter factors.

2.5 Conclusions regarding the relationship between mileage and industrial production

The non-seasonally adjusted values show a clear statistical relationship between the production and truck-toll-mileage indices. Much of this is probably attributable to common seasonal movements. Regular intra-annual fluctuations in production may impact on truck mileage as the result of production company demand for freight transport; in some cases, factors such as typical annual weather fluctuations may have a similar effect on production and freight traffic.

The strong similarities in both the seasonal pattern and the calendar effect imply that applying seasonal adjustment methods excludes some of the covariance from the data. The irregular movements as part of the seasonally adjusted time series reveal scarcely any accordance between production and mileage development. In road freight transport and the production of intermediate goods, there would appear to be few common causes of the exceptional short-term influences, or they have very different effects on the two variables. Seasonally adjusted results, which play an important role in the analysis of recent economic developments, also show a correlation between mileage and industrial production. However, this is significantly lower than in the non-adjusted figures.

As mentioned above, the trend-cycle component is very well suited for the retrospective identification of economic turning points, despite its rarely being used for current economic development. The cyclical course of economic activity, measured by the deviation of medium-term developments from the long-term trend, reveals a number of common developments, particularly at the economically relevant turning points. The peaks and dips during the economic, financial and euro crises are often shown in exactly the same month, and in some cases the economic turning points are only a few months apart. In 2015 and 2016, the two indices followed different trends. In this phase, structural changes in industrial activity may be relevant which are reflected in the truck-toll-mileage index but not in the production index for manufacturing. Such structural changes could form the subject of future investigations.

Overall, there is a clear statistical relationship between the truck-toll-mileage index and various short-term statistics, in particular the production index. Since the truck-toll-mileage index is available roughly one month earlier than the production index, it could make a useful contribution to the statistical description of short-term economic development in Germany.

3

# Truck-toll-mileage index as a new building block of official short-term statistics

3.1 Deployment of the truck-toll-mileage index in the short-term indicators

The truck-toll-mileage index is to be used as an additional short-term indicator due to the characteristics outlined above and its early availability. With the aim of offering the index at a place where data users regularly access short-term information, the truck-toll-mileage index was included in the data offered by the Federal Statistical Office within the framework of a partnership between the Federal Office for Goods Transport and the Federal Statistical Office. Existing official short-term statistics, such as the production index for the manufactur-

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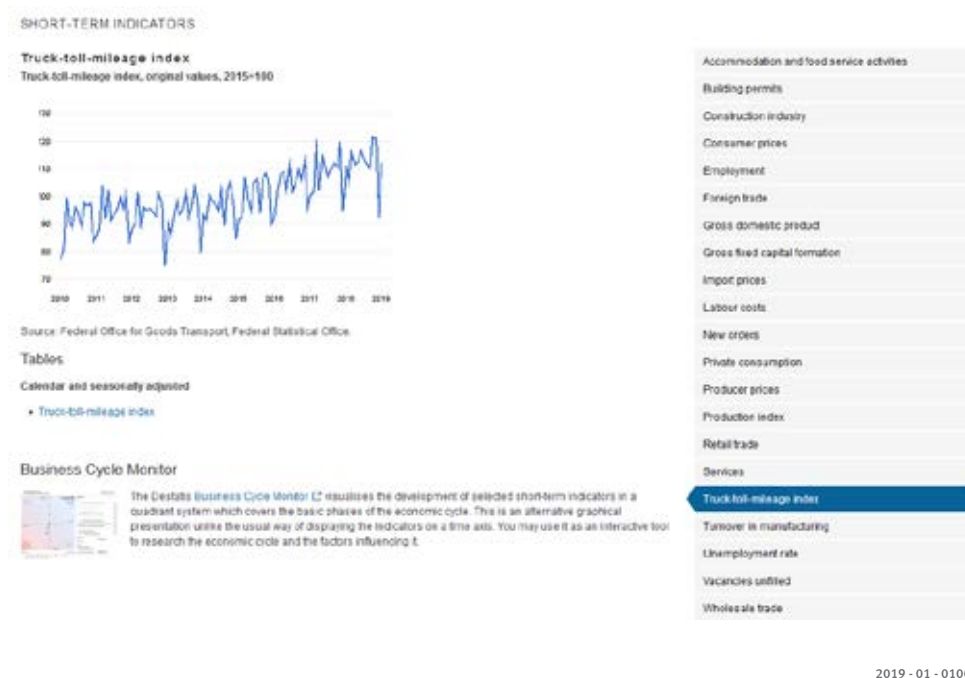
ing sector, provide a much more accurate picture of economic developments, broken down by economic activity (they are the results of surveys on production activities or turnover in production, trading or service enterprises). However, this information is not available until at least 35 days after the end of the reference month. The truck-toll-mileage index provides a rough approximation of production or trading activities and does not allow any breakdown by economic activity. However, its results are available within roughly ten days and thus much earlier than the established official statistics on economic activity.

In the first project step, the truck-toll-mileage index was made available in the "Short-term indicators" section on the website of the Federal Statistical Office. This part of the Federal Statistical Office's website provides an overview of time series from official statistics with economic relevance. The data are displayed in figures and tables.[22] The truck-toll-mileage index is presented as a time series starting in reference month January 2005. Once the regular data delivery processes in the Federal Office for Goods Transport and the data processing

processes in the Federal Statistical Office are properly established, the results of every new month will regularly be included in the truck-toll-mileage index – and the index will be updated if necessary – from the beginning of 2019. This will take place on pre-determined dates, approximately ten days after the end of each reference month. ↘ Figure 11

The delayed data transmissions from On-Board units to the toll system described in the first chapter may result in revisions of the truck-toll-mileage index in the month following the first publication, but in most cases these only increase the levels by a small degree. Experience has shown that, in later months, the number of automatically delivered time-lagged transmissions is so small as to render further adjustments to the index unnecessary. The truck-toll-mileage index is presented as a non-seasonally adjusted time series, in seasonally adjusted form and as a BV4.1 trend. Seasonally adjusted results and trend values may include additional revisions of previous results due to updates of seasonal and trend estimates. The base year of the truck-toll-mileage index is determined by the publications of the Federal Statistical Office concerning industrial short-term indices. It is therefore initially set at 2015 and updated every 5 years.

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22 Certain web browsers (e.g. the Windows Internet Explorer) can export the data from the tables and save them, for example, in MS Excel.

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Differentiations in the tollable mileage, for example by country of registration or emission class, are available in the existing publication programme of the Federal Office for Goods Transport (see Section 1.1), albeit with a longer time lag and without adjustment for structural changes in the toll collection through index calculation. No subdivisions of the mileage index are therefore being offered in the publication programme of the Federal Statistical Office in the first step of the cooperation project. Similarly, no variants of the truck-toll-mileage index, such as an index for the number of tollable journeys, are provided. The time lag in the provision of the relevant short-term statistical information is to be kept as short as possible by reducing the toll data publication programme of the Federal Statistical Office.

3.2 Deployment of the truck-toll-mileage index in the Business Cycle Monitor of the Federal Statistical Office

The truck-toll-mileage index has also been included in the so-called Business Cycle Monitor of the Federal Statistical Office. The Business Cycle Monitor is an interactive web application of the Federal Statistical Office, the purpose of which is to illustrate the short-term economic development in Germany. Here, the medium-term cyclical movement of an indicator is compared with the level of the long-term trend of the same indicator. An indicator which increasingly exceeds its long-term trend, for example, heralds a boom phase. The cyclical trend development is determined using the method described in Section 2.4, which is based on the deviation of the medium-term from the long-term development.

The Business Cycle Monitor includes quadrant and diagram views. The quadrant view shows the movement of the various indicators in a four-field system covering the basic economic phases. The indicators pass through the fields over time as dynamically moving data points. In the diagram view, the relationship between the medium-term and long-term trends is displayed as a static line chart. In both views, the desired time series can be clicked on to select it for display. ↘ **Figure 12**

Comparing the medium-term movement of a time series with its own long-term trend, the indicators are presented dimensionless in the Business Cycle Monitor. This also allows indicators from different areas to be compared and contrasted; the development of retail sales, industrial production, gross domestic product and the truck-toll-mileage index can be compared, for example. Here again, the truck-toll-mileage index has the advantage of being available at a very early stage. The addition of the mileage index means that the Business Cycle Monitor can provide an initial indication of the economic development in Germany within ten days or so of the end of a reference month. In addition to the quadrant and diagram views, the Business Cycle Monitor includes table

Figure 12
Business Cycle Monitor of the Federal Statistical Office

Quadrant view

Diagram view
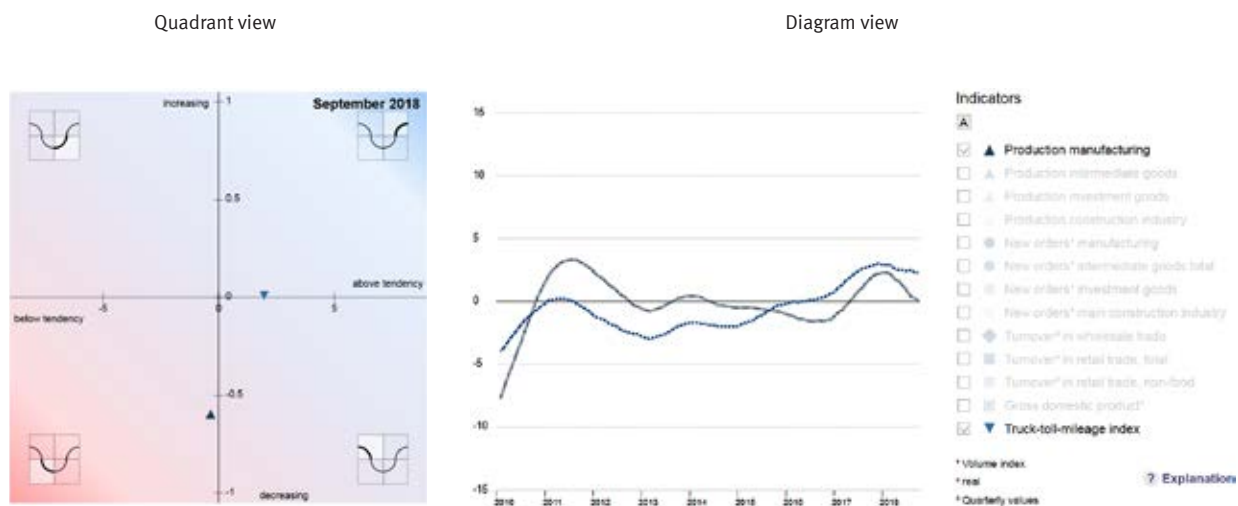
www.destatis.de › Business Cycle Monitor
Source: Federal Statistical Office, Federal Office for Goods Transport

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views containing the underlying data. These show the original values, on which the presentation is based, as well as medium-term and long-term trends.

3.3 Other possible publication formats

The next project step involves offering the truck-toll-mileage index in GENESIS-Online, the central publication database of the Federal Statistical Office. Here the results can be downloaded conveniently and in different formats, for example in MS Excel, CSV or HTML. Registered users can also retrieve the data automatically. There is no charge for retrieving tables; they can be adapted to individual requirements by selecting certain options. The extent to which subdivisions and variants of the truck-toll-mileage index should be offered here is being examined and will have to be weighed up in various ways (such as breadth of range versus rapid availability, added benefit versus provision costs).

3.4 Use of toll data to shorten the time lags in short-term statistics?

The statistical relationship between mileage and industrial production which is being observed gives rise to the question of whether the data from the truck toll collection could be used to shorten the time lags in short-term statistics. For example, it can be investigated whether the truck-toll-mileage index as an explanatory variable in regression analyses would be suitable for calculating early estimates for the production index on an ongoing basis. The results of such estimates are referred to below as "nowcasts" to indicate that their purpose is not to make forecasts about economic developments.[23] Rather, the toll data would be used as a basis for investigating whether digital process data can be deployed to improve the timeliness of official statistics without increasing the burden on respondents.

A nowcast would have to be based on the seasonally adjusted results, since these are the main focus of the first publications of the Federal Statistical Office.[24]

Studies on the generation of nowcasts for the seasonally adjusted production development on the basis of truck toll data have been carried out for example by the Deutsche Bundesbank (2010), Askitas/Zimmermann (2013) and Döhrn (2011). The studies at that time were based on total mileage, as the truck-toll-mileage index was not yet available. However, temporal comparability problems arising from toll extensions were still of little relevance at the time. In the studies, different estimation methods were tested using regressions and RegARMA modelling. While Askitas/Zimmermann were optimistic about the potential of the toll data, Döhrn's first preliminary results were rather sobering. All authors referred to the short time series at that time which only allowed preliminary conclusions to be drawn, but expressed great interest in the toll data.

Similar studies are being carried out as part of the above-mentioned cooperation project between the Federal Office for Goods Transport and the Federal Statistical Office based on the longer time series of almost 13 years which is now available. The newly introduced data, adjusted for structural changes, can be used for this purpose. First results indicate that the explanatory force of the toll data has not improved significantly as a result of the longer time series which is now available. The time series component of irregular movements has a strong influence on the seasonally adjusted results. There is still little accordance between irregular fluctuations in mileage and production. An analysis of cyclical trend movements, however, indicates that business cycle developments are certainly reflected in the development of mileage, in some cases showing clear accordance in the economic turning points. In the future, the project must investigate how this information content could be used.

In principle, linking the mileage information with the results of the existing surveys seems meaningful.[25] Toll statistics will not be able to replace the existing official statistics surveys because the development of the truck mileage can only provide a rough approximation of the target variable, the development of the production value at constant prices. Nor can the mileage data be used to draw conclusions about the development in different economic branches; however, data on the development

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23 For definition of terms see Berg, 2017, here: p. 120.

24 The European Union recommends prioritising seasonally adjusted results in the press releases for the first publication of short-term statistics (see Eurostat, 2015, here: page 46: "Seasonally adjusted data are the most appropriate figures to be presented in press releases").

25 For deliberations on the interlinking of digital process data with the results of official statistics, see Wiengarten/Zwick, 2017.

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of production differenciated by branch belong to the scope of the industrial production index. Also, whether or not it is possible to generate meaningful estimates always depends on the strength of the actual economic relationship between truck mileage and industrial production – and also on its long-term stability.

4

Conclusions and categorisation of the project

Toll data hold high information value. The data were therefore published on the Federal Statistical Office website both as a non-seasonally adjusted index and in a seasonally adjusted form. They were also displayed as a trend and are to be updated regularly from the beginning of 2019 on pre-determined dates, approximately ten days after the end of each reference month. The truck-toll-mileage index has also been included in the Business Cycle Monitor of the Federal Statistical Office.

The question of whether digital process data can be used to increase the timeliness of official statistics without increasing the burden on respondents is currently being considered. First analyses of the joint project of the Federal Office for Goods Transport and the Federal Statistical Office show that there is a strong correlation between the non-seasonally adjusted results of mileage and production. A clear correlation can also be observed with domestic trade, certain service sectors and the overall economy. However, for monitoring current economic developments, the development of seasonally adjusted results is relevant. The statistical relationship between mileage and economic activity is significantly weaker in seasonally adjusted results. A review of the cyclical development of the economy since 2005 reveals some very clear examples of coincidence between the economic turning points, however. In the years 2015 and 2016 there is less coincidence, structural changes are likely to play a role here.

The Federal Office for Goods Transport is eager to make its transport findings available to researchers, political and economic decision-makers and the interested public. Inter-agency cooperation with the Federal Statistical Office enables the Federal Office for Goods Transport

to contribute its expertise in the field of transport data analysis and to make a contribution to official short-term statistics with the truck-toll-mileage index. The Federal Statistical Office, too, is of the view that cooperation with partners from various fields must be intensified in order to develop new digital data for official statistics (Thiel/Meinke, 2017). The provision of the truck-toll-mileage index in the Federal Statistical Office's short-term statistics service, also as a seasonally adjusted time series, represents a step in this direction.

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Abbreviations

WISTA	=	Wirtschaft und Statistik
JD	=	annual average
D	=	average (for values which cannot be added up)
Vj	=	quarter of a year
Hj	=	half-year
a. n. g.	=	not elsewhere classified
o. a. S.	=	no main economic activity
St	=	piece
Mill.	=	million
Mrd.	=	billion

Explanation of symbols

–	=	no figures or magnitude zero
0	=	less than half of 1 in the last digit occupied, but more than zero
.	=	numerical value unknown or not to be disclosed
. . .	=	data will be available later
X	=	cell blocked for logical reasons
I or —	=	fundamental change within a series affecting comparisons over time
/	=	no data because the numerical value is not sufficiently reliable
( )	=	limited informational value because numerical value is of limited statistical reliability

Figures have in general been roundes without taking account of the totals, so that there may be an apparent slight discrepancy between the sum of the constituent items and the total as shown.