

# **Do Business-related Services Really Lag Behind Manufacturing Industries in the Business Cycle?**

**Empirical Evidence on the Lead/Lag Relationship Between  
Business-related Services and Manufacturing Industries for  
Germany**

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## **Abstract**

In an a priori view, it is usually assumed that the business cycle of manufacturing industries leads the business cycle of the service sector. This seems to be even more plausible for the relationship between business-related services, whose high growth rates in recent years were largely due to increased outsourcing activities of the manufacturing sector. In this paper it is shown that the relationship is not as simple as it appears at first sight. We run Granger causality tests between sales growth rates of the business-related service sector against growth rates of various series of the manufacturing sector. It turns out that the relationship between business-related services and manufacturing is either contemporaneous or bi-directional, while no evidence is given for manufacturing leading business-related services.

**Keywords:** business cycle, Granger causality, business-related services

**JEL-classification:** C22, E32

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## **Non-technical summary**

Is it really true that the service sector lags behind manufacturing industries in the business cycle? Or is there some other relationship between them? Although some researchers have found evidence that fluctuations in the business cycle are less severe in services than they are in manufacturing industries, nothing is known about the lead/lag relationship between services and manufacturing. Increased outsourcing activities of the manufacturing sector – as it is often argued – may have caused the service sector to be more immediate dependent on the state of the business cycle in manufacturing industries.

Business-related services have been a sector which has gained much from the increased outsourcing activities of the manufacturing sector. Hence, if manufacturing leads business-related services in the business cycle, most other branches of the service sector might lag behind as well.

Despite the growing overall economic importance especially of business-related services in Germany, there is no empirical evidence on their relationship to manufacturing industries in the business cycle since data on services are scarce. This study uses data taken from a business survey in the business-related service sector and tests the lead/lag relationship between business-related services and manufacturing by means of bivariate Granger causality tests. The empirical evidence shows that manufacturing does not lead business-related services in the business cycle. Instead, the relationship instead is either contemporaneous or two-way causal.

## I. Introduction

In recent years, no other sector of the German economy has developed as dynamically as the service sector. The structural change from manufacturing to services has deepened in the last decade. While the share of services in the Gross National Product (GNP) of Germany<sup>1</sup> was 46 percent in 1980, it has risen to 58 percent in 1997. The share of manufacturing has declined by nine percent the same period. Moreover, structural shifts did not only occur across the economic sectors but also within the service sector itself. As it becomes apparent from inspection of Figure 1, the heterogeneous segment “other” services is particularly gaining in importance, whereas traditional services, such as trade, banking and insurance and transport remain stagnant in terms of market shares. One of the driving forces of the increase in GNP of “other” services is the dynamic development of business-related services<sup>2</sup> (Klodt et al., 1997). The reason for the increased economic importance especially of the business-related services is the growing interrelation between the manufacturing and the service sector. Two main phenomena contribute to this development. Firstly, goods – even if produced in the manufacturing sector – nowadays integrate an increasing amount of services (Krämer 1999, Grömling et al. 1998; Klodt et al. 1997). Secondly, many of the services that manufacturing firms used to generate themselves have been outsourced to service firms (Krämer 1999; Grömling et al. 1998; Fredebeul-Krein and Schürfeld 1998; Klodt et al. 1997). These increased outsourcing activities are mainly responsible for the high growth rates of the business-related service sector.<sup>3</sup> Many of the services previously provided by manufacturing firms have shifted to the business-related service sector.<sup>4</sup>

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<sup>1</sup> Source: Federal Statistical Office (1998). The data actually refer to West Germany before 1991 and to Germany afterwards. The fact that there is no evidence of a structural break justifies to present the data as it is done here. The Federal Statistical Office does not provide data on GNP for East and West Germany separately for the time period after 1991.

<sup>2</sup> Following Klodt et al. (1997), we define business-related services by enumeration of the following business fields (NACE Rev. 1 code in parenthesis): Computer services (72100, 72201-02, 72301-04, 72601-02, 72400), Legal and book-keeping activities (74123, 74127, 74121-22), Business management (74131-32, 74141-42), Architectural activities (74201-04), Technical testing and planning (74205-09, 74301-04), Advertising (74844, 74401-02), Vehicle renting (71100, 71210), Machine renting (45500, 71320, 71330), Cargo handling and storing (63121, 63403, 63401) and Waste and refuse disposal (90001-90007).

<sup>3</sup> According to Krämer (1999), the expected growth rate for this sector between 1996 and 2001 is about 5 percent p.a.

<sup>4</sup> About 13 percent of the production of business-related services is directly consumed; the remaining part is used as an intermediate input. A total of 40 percent of this remaining part of the business-related services firms' production is taken up by the manufacturing industry (Institut der deutschen Wirtschaft, 1998).

Many manufacturing firms use business-related services as an intermediate input in order to increase the flexibility of their production while at the same time reducing production costs. Another reason for increased outsourcing activities in the manufacturing sector is that, with products becoming more and more similar, customers demand consultancy and maintenance services to be provided along with the purchased product. Instead of providing these services themselves, many manufacturing firms transfer them to the business-related service sector. A presumably large share of services is also produced in manufacturing industries but does not occur in official statistics (Deutsches Institut für Wirtschaftsforschung, 1996 and 1997) since the Federal Statistical Office classifies firms by their main economic activity. In any case, business-related services thus contribute to the enhancement of industrial production.

The increasing overall economic importance of business-related services stands in contrast to the availability and periodicity of current data on this sector. A systematic and up-to-date recording of business-related services is still missing even if some progress has been achieved in the last few years.<sup>5</sup> Due to the lack of appropriate data, not much is known about the relationship between business-related services and manufacturing industries in a business cycle context. If there was a stable relationship between the fluctuations in manufacturing and the business-related services sector, one could use information on the manufacturing sector – for which numerous indicators exist – and infer from these data the state of the business cycle in business-related services.

Over the past few decades, the service sector has experienced less severe cyclical fluctuations during recessions than the manufacturing sector (c.f. Beyfuß and Grömling 1999; Döpke 1995; Layton and Moore 1989, Moore 1987). This is observed for employment growth as well as for aggregate value added. Döpke (1995) shows, however, that in the heterogeneous segment “services not listed elsewhere” – which besides business-related services also includes hotels and restaurants – the intensity of cyclical fluctuations has risen slightly. He argues that the growing number of industrial firms outsourcing service activities is mainly responsible for this increase.

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<sup>5</sup> Although the Federal Statistical Office has now adopted the international NACE Rev. 1 industrial classification – where services are reported with more detail than in the classification scheme formerly used – business-related services are still put together with banking and insurance in the quarterly national accounts data, rendering inference on business cycle issues impossible.

It thus seems plausible a priori that manufacturing industries lead the service sector in terms of the business cycle. We use data from a business survey in the business-related service sector and various indicators for the manufacturing sector's economic performance. We run Granger causality tests between the time series in order to enlighten the lead/lag relationship between the two sectors. Our main finding is that there is no uncausal relationship between manufacturing and business-related services. Instead, we find two-way causality and contemporaneity.

## II. Data

The strong growth of the service sector and especially that of business-related services has led to a heightened attentiveness as far as the public, the media and politics are concerned. In official statistics, however, business-related services play a rather subordinate role. As far as these official statistics are concerned, around 80 separate statistics are available in total, covering varying characteristics such as the number of businesses, firms and employees, yet a systematic recording of services is missing.<sup>6</sup> This lack of data has recently been criticized by Hax (1998) and the Council of Economic Advisors (Sachverständigenrat, 1998).

Niggemann (1999) calculates employment growth rates of various branches of the service sector on the basis of a bundle of different databases. She shows that technical services (including architectural activities as well as technical testing and planning) have grown by 65 percent between 1982 and 1996 in West Germany. "Other business-related services" (by and large including the rest of the ten sectors listed in footnote 1) have grown by 89 percent. As a comparison: Employment in manufacturing industries has declined by eleven percent in the same period. The share of business-related services in West Germany's total employment was 11.9 percent in 1999.<sup>7</sup>

To compensate for the lack of up-to-date data for business-related services, the Centre for European Economic Research (ZEW) has been carrying out a quarterly business survey in this sector in cooperation with Germany's largest credit rating agency, Creditreform, since June 1994. The ZEW sends out a single-sided questionnaire every three months to about 4000 firms belonging to the business-related services sector.

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<sup>6</sup> Niggemann (1999) refers to the usability of official statistics for the services sector in great detail.

<sup>7</sup> Source: Institut für Arbeitsmarkt und Berufsforschung.

The survey is constructed as a panel. It is a stratified random sample, stratified with respect to ten sectors, regional affiliation (East/West Germany) and five size classes (two for East, three for West Germany). Details on the survey design and on the way expansion factors are constructed are presented in Kaiser et al. (1999). The data collection period starts three weeks prior to the end of a quarter. The questionnaires are mostly sent back to the ZEW by fax. After two weeks, those firms who still have not replied receive a reminder. Altogether, the response rate amounts to about 30 per cent. As a thank you for filling out the questionnaire, the participating firms receive a four page report containing the results of the survey. In addition, they exclusively retrieve further information over the internet.<sup>8</sup>

The questionnaire is divided into two parts. In the first part, firms are asked to indicate on a three-point Likert scale whether their sales, prices, demand, profits and number of employees have, in the respective previous quarter, either increased, remained unchanged, or decreased. Moreover, they are asked to give an assessment of the five indicators for the coming quarter. The second part of the survey deals with present-day economic and political issues and is not considered in this paper.<sup>9</sup>

In this paper, we use the firms assessment of the change in sales they experienced in the current quarter compared to their sales in the previous quarter. This information is transformed into quarterly sales growth rates by the quantification technique proposed by Carlson and Parkin (1975).<sup>10</sup> Prior to the quantification, the data are seasonally adjusted by a method proposed by Kaiser and Buscher (1999).<sup>11</sup> The quarterly growth rates yielded by this procedure are annualized in order to make them comparable to the time series we use as proxy variables for the state of the business cycle of the manufacturing sector.

The following set of variables is chosen as indicators for economic activity in manufacturing industries: (1.) gross national product (GNP) production sector, (2.) GNP manufacturing, (3.) production index manufacturing and (4.) capacity utilization index

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<sup>8</sup> The internet address is: <http://www.zew.de/aktuell/branchenreport/wb-BreportStart.html>

<sup>9</sup> On request a copy of the questionnaire is available.

<sup>10</sup> Details on the procedure in the present case can be downloaded as a PDF-file from the internet: [http://ftp.zew.de/pub/zew\\_docs/div/kurzinfo.pdf](http://ftp.zew.de/pub/zew_docs/div/kurzinfo.pdf). In brief, the quantification approach suggested by Carlson and Parkin (1975) is basically equivalent to estimating an ordered probit model with known thresholds and a constant term in both the conditional mean and the conditional variance function.

manufacturing. The data source of the first three variables is the Federal Statistical Office, the last time series is taken from the ifo Institute. The three series can be differentiated into “soft” and “hard” data following Winker (1997, ch. 2.6). The ifo capacity utilization index is calculated on the basis of survey data. Firms are asked indicate on a five point scale the interval of capacity utilization their actual capacity utilization lies in. This leads to the effect that the actual capacity utilization is not exactly measured rendering the capacity index – just as the ZEW/Creditreform business survey – a “soft” data. The other three time series considered are called “hard” data since they are measured more accurately.<sup>12</sup> We use beside the GNP manufacturing also the GNP of the production sector – which includes the sectors (1) mining and quarrying, (2) manufacturing, (3) electricity, gas and water supply and (4) construction – in order to take into account dependencies between architectural activities as well as of technical testing and planning and the construction sector.

All time series under consideration are collected on a quarterly basis. We calculate annual growth rates for all five time series to avoid seasonality and to make them comparable to the quantified sales growth rates.

We restrict ourselves to study West Germany alone since the time series for the West and East German business-related service sector have an entirely different shape. During the first four waves of the ZEW/Creditreform business survey (II/94-I/95), sales growth rates were much higher in East than in West Germany. After I/95, however, things reversed with the business climate being better in West than in East Germany. For this reason, we have run Granger causality tests on sales growth rates of business-related services in West Germany alone. Likewise, the time series related to the manufacturing sector correspond to West Germany only.

Before coming to the empirical part of this paper, it has to be stressed that the time series we use here are rather short. Our analysis covers 20 waves of the ZEW/Creditreform business survey. However, by keeping in mind the increased interest in business-related services and their growing overall importance, it is clearly desirable to learn more about the behavior of this sector in the business cycle.

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<sup>11</sup> Note that the time series under consideration has a length of only 20 quarters so that the usual seasonal adjustment methods do not apply.

<sup>12</sup> Clearly, there are numerous advantages of survey data over “hard” data as discussed in detail by Oppenländer (1997).

### III. Empirical investigation

To start with, Figure 2 plots the sales growth rates of business-related services (West Germany) and the annual growth rate of the production index of the manufacturing sector (construction sector excluded) against time. Between II/94 and I/95, business-related services appear to be contemporaneously related to the growth rate of the production index. Business-related services then have a turning point in 95/IV while the growth rate of the production index has one in the successive quarter, indicating that business-related services lead manufacturing. The period between 96/II and 97/I does not show any lead/lag relationship between the two time series. After 97/II, the manufacturing series seems to lead that of the business-related services by one quarter. It is, however, difficult to tell from visual inspection of Figure 2 if the manufacturing sector actually leads the business-related service sector in the business cycle or not.

In order to analyze this question in greater detail and in order to formally test if the business-related services are causal to the time series of the manufacturing sector and/or vice versa, we run bivariate regressions in the sense of Granger (1969).

A time series  $Y$  is said to be Granger-caused by a series  $X$  if lagged values of  $X$  help to predict  $Y$  in the sense of improving the Mean Square Error. To abbreviate the notation, we hereafter denote the manufacturing time series by  $Y$  and denote the business-related services' sales growth by  $X$ . Table 1 summarizes the results of the bivariate Granger causality tests for West Germany.

In a first step, we estimate univariate autoregressions for each time series  $X$  and  $Y$  using the Akaike information criterion to determine the optimal lag length for the respective time series. We stepwise add the respective second time series – e.g., we add lagged values of  $X$  in the estimating equation of  $Y$  –, also using the Akaike criterion to determine the optimal lag length. To check for reverse causality, we change the order of the approach and rerun the estimations. If lagged values of  $Y$  were regressed on current values of  $X$  in the previous step, we now regress lagged values of  $X$  on current values of  $Y$ . In order to check for contemporaneous correlation, contemporaneous val-



ues of the right-hand-side variables are added and a t-test applied to test for contemporaneous causality.<sup>13</sup> Estimation results are shown in Table 1.

The results displayed in Table 1 are in sharp contrast to the traditional view that business-related services lag behind manufacturing industries in the business cycle: Both the annual growth rates of the GNP of the production sector and of the manufacturing sector exhibit a contemporaneous correlation to the annual sales growth of business-related services. The annual growth rates of the capacity utilization index and the annual growth rates of the production index show a two-way causality with business-related services.

One explanation for the contemporaneity and two-way causality of the relationship between manufacturing and business-related services is that business-related service firms can process received orders more rapidly than manufacturing industries since labor is the most important input factor in the production of services.<sup>14</sup> Labor inputs can be adjusted more easily to changing product demand conditions than capital by, e.g., adjusting working hours.<sup>15</sup> Contrary to this, capital – often considered as a quasi-fixed factor in production (c.f. Morrison, 1986) – plays a subordinate role in the production of services. Adjustment of factor inputs – especially of quasi-fixed inputs – is costly so that firms aim at minimizing cost by smoothing their course of production. While manufacturing firms can produce to stock, this is usually impossible for services. This implies that manufacturing industries may react less rapidly to weakened demand conditions than business-related services. Contrary, in times of good business conditions, it is likely to be less costly for business-related services firms to increase production than for manufacturing firms. The timing of adjustment to changing product demand thus may serve as a key determinant of the contemporaneous or two-way causal relationship between business-related services and manufacturing.

#### **IV. Summary and suggestions for further research**

This paper aims at uncovering the lead/lag relationship between manufacturing industries and business-related services in the business cycle. We use data from a business

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<sup>13</sup> We do not report the results of these estimations here for the sake of brevity. All results presented in this paper are available from the authors upon request.

<sup>14</sup> See Maleri (1997) for more details on service production issues.

survey in the German business-related service sector and a set of indicators for the manufacturing sector to run Granger causality tests.

Even for the business-related service sector, where much of its strong economic growth is attributable to increased outsourcing activities of manufacturing industries, no evidence is found in favor of the hypothesis that manufacturing leads services in the business cycle. The Granger causality tests show that the relationship between manufacturing industries and business-related services is either contemporaneous or two-way causal rather than leading as could be assumed at first sight. Since labor is the most important input factor in the production of business-related services, business-related service firms are able to react to demand changes more rapidly than manufacturing firms. This might explain why manufacturing does not lead business-related services in the business cycle.

Further research is clearly needed as soon as additional data on business-related services are available. The recent revision of the German national accounts system is a first step in this direction. The Federal Statistical Office has now adopted the international NACE Rev. 1 classification scheme which differentiates in more detail the different segments of the service sector than the classification scheme formerly used. However, the quarterly national accounts data can still not be used for analyzing the business cycle of business-related services since they are grouped together with banking and insurance.

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<sup>15</sup> In fact, changes in hours worked is by far the most commonly used method to react to demand changes in the business-related service sector (Zentrum für Europäische Wirtschaftsforschung, 1998).

## References

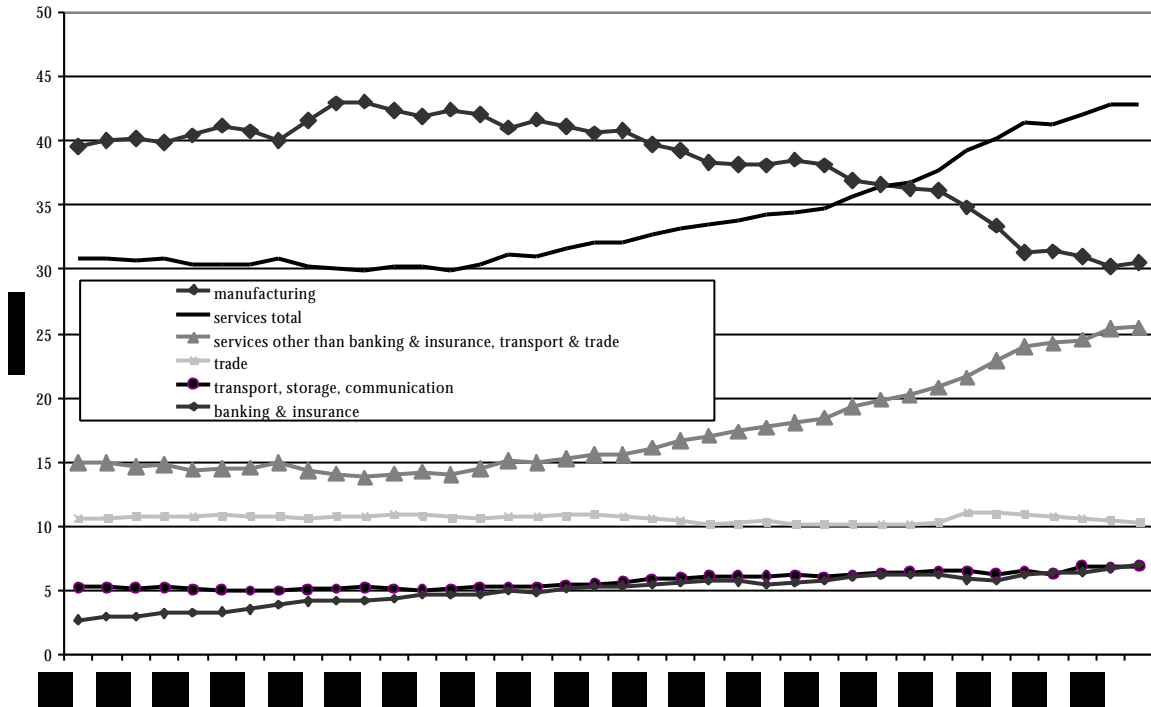
- Beyfuß, J. and M. Grömling* (1999), Konjunkturelle Schwankungsanfälligkeit der deutschen Wirtschaft und der europäische Konjunkturverbund, iw-trends 1.
- Deutsches Institut für Wirtschaftsforschung* (1996), Keine Dienstleistungslücke in Deutschland, DIW Wochenbericht 14, 221-226.
- Deutsches Institut für Wirtschaftsforschung* (1997), Rückstand beim Anteil von Dienstleistungstätigkeiten aufgeholt, DIW Wochenbericht 34, 613-617.
- Döpke, J.* (1995), Konjunkturzyklen im Dienstleistungssektor, in: Die Weltwirtschaft 3, 311-324.
- Fredebeul-Krein, M. and A. Schürfeld* (1998), Marktzutrittsregulierungen im Handwerk und bei technischen Dienstleistungen – Eine ökonomische Analyse, Köln.
- Carlson, J.A. and M. Parkin* (1975), Inflation Expectations, *Economica* 42, 123-138.
- Federal Statistical Office (Statistisches Bundesamt)* (1998), Volkswirtschaftliche Gesamtrechnungen: Fachserie 18, Reihe 1.3, Metzler-Poeschl.
- Granger, C.J.W.* (1969), Investigating Causal Relations by Econometric Models and Cross-Spectral Methods, *Econometrica* 37, 424-438.
- Grömling, M., K. Lichtblau and A. Weber* (1998), Industrie und Dienstleistungen im Zeitalter der Globalisierung, Köln.
- Hax, H.* (1998), Anforderungen an die Statistik zur Konjunkturbeobachtung durch den Sachverständigenrat, *Allgemeines Statistisches Archiv* 82, 15-24.
- Institut der deutschen Wirtschaft* (1998), Industrie und Dienste – Zusammen in einem Boot, Informationsdienst IWD-Online 22, Köln.
- Kaiser, U. and H.S. Buscher* (1999), The Service Sentiment Indicator - A Business Climate Indicator for the German Business - Related Services Sector, Center for Finance and Econometrics at the University of Konstanz discussion paper 99/06.
- Kaiser, U., M. Kreuter and H. Niggemann* (1997), Calculation of Expansion Factors for a Business Survey in the Service Sector, ZEW discussion paper.
- Klodt, H., R. Maurer, A. Schimmelpfennig* (1997), Tertiärisierung in der deutschen Wirtschaft, Tübingen.

- Krämer, H.* (1999), Dienstleistungen: Motor für Wachstum und Beschäftigung in Deutschland?, Schriftenreihe des Promotionsschwerpunkts Makroökonomische Diagnosen und Therapien der Arbeitslosigkeit, Stuttgart-Hohenheim.
- Layton, A. P., G. H. Moore* (1989), Leading Indicators for the Service Sector, *Journal of Business & Economic Statistics* 3, 379-384.
- Maleri, R.* (1997), Grundlagen der Dienstleistungsproduktion, Berlin.
- Moore, G. H.* (1987), The Service Industries and the Business Cycle, in: *Business Economics* 22, 12-17.
- Morrison, C.J.* (1986), Structural Models of Dynamic Factor Demand with Nonstatic Expectations: An Empirical Assessment of Alternative Specifications, *International Economic Review* 27, 141-158.
- Niggemann, H.* (1999), Der statistische Erhebungsumfang und die volkswirtschaftliche Bedeutung von Dienstleistungen, *Allgemeines Statistisches Archiv* (forthcoming)
- Niggemann, H.* (1999), Strukturen und Entwicklung im Dienstleistungssektor, in: Janz, N. and G. Licht (eds.), *Innovationsaktivitäten der deutschen Wirtschaft*, Schriftenreihe des ZEW/ZEW Wirtschaftsanalysen, Baden-Baden.
- Oppenländer, K.* (1997), Characteristics and Classification of Business Cycle Indicators, in: Oppenländer, K: (ed.), *Business Cycle Indicators*, Aldershot.
- Sachverständigenrat* (1998), Jahresgutachten des Sachverständigenrates 1998/1999 "Vor weitreichenden Entscheidungen", Stuttgart.
- Winker, P.* (1997), *Empirische Wirtschaftsforschung*, Springer.
- Zentrum für Europäische Wirtschaftsforschung* (1998), *ZEW Branchenreport Dienstleistungen IV/98*, Mannheim.

Figure 1

Share of Selected Sectors in Gross National Product

(data refer to West Germany only until 1991 and to Germany thereafter)



Source: Federal Statistical Office (1998).

Figure 2

**Annualized Quarterly Growth Rate of Business-related Services and  
Annual Growth Rate of the Production Index (Construction Sector Included)**

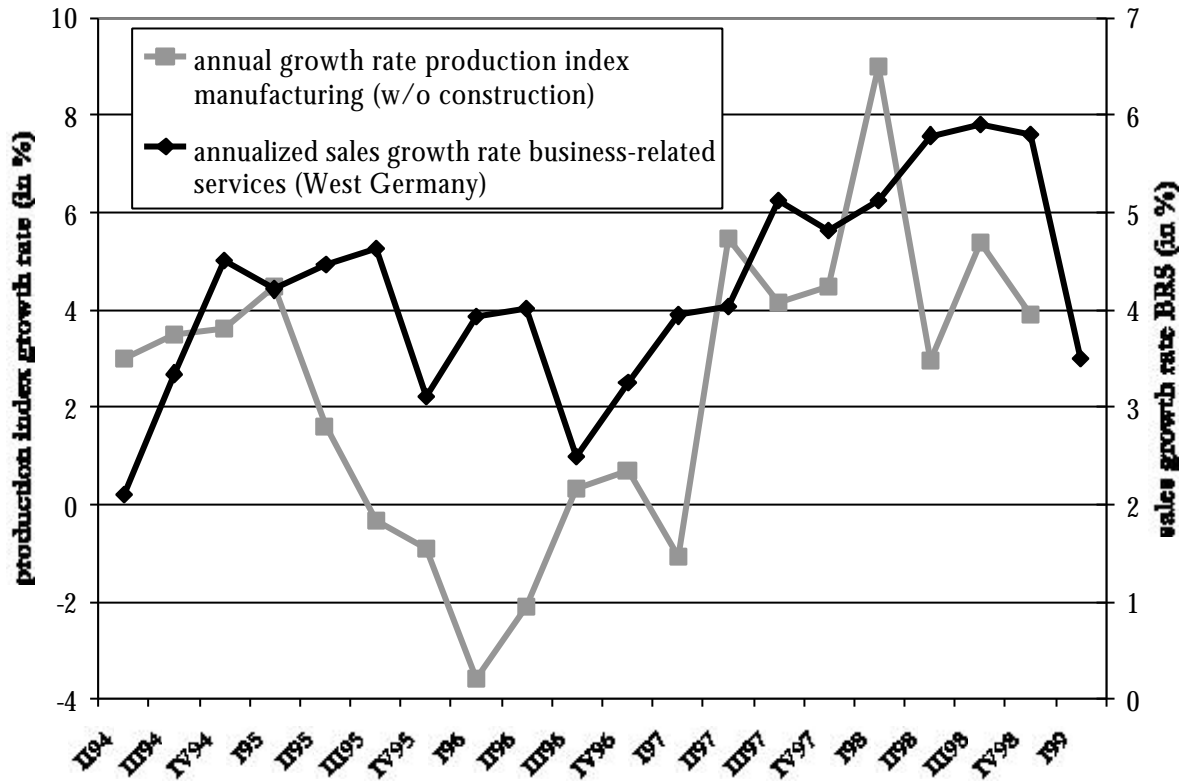


Table 1

**Results of the Bivariate Granger Causality Tests: West Germany**

<b>Y</b>	<b>direction</b>	<b>X</b>	<b>F-Test</b>
GNP prod. sector	contemp.	sales growth BRS	3.88**
GNP manufacturing	contemp.	sales growth BRS	4.46**
Capacity utilization index manu- facturing	→	sales growth BRS	Y→X: 3.63**
	←		X→Y: 5.85**
Production index manufacturing	→	sales growth BRS	Y→X: 7.96***
	←		X→Y: 6.73***

**Table 1** summarizes bivariate Granger causality estimation results. The sales growth rate of business-related services (BRS) is calculated for West Germany. The causality runs from X to Y if “←” is indicated. The reverse is true if “→” is shown. Contemporary causality is present if “contemp.” appears. In this case, the F-test is a test of significance of the current value of Y in an OLS regression on X.