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The Development of the Information and Communications Sector in Germany

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Summary

On the basis of the usually applied narrow definition of the Information and Communication (IC) sector, which encompasses only those industrial sectors whose outputs include modern IC technology and services as well as content, it could be said that, during the last 20 years, Germany has experienced neither above-average growth in IC production nor above-average growth in IC employment compared to the economy as a whole. In 1998, these sectors' share of employment stood at a mere 4.1% of total employment, and was thus lower than it had been in 1980.

In the case of Germany, the transition from an industrial society to an information society can be demonstrated more clearly if the development of those industrial sectors is also taken into account, in which the use of modern IC technologies and services plays a significant role. Thus, for example, if one were to apply the concept of a primary information sector (as used by the OECD in the 1970s and 1980s in two comparative cross-country studies), which includes information production, processing and transmission independently of the underlying IC technologies, these part of the economy is shown to have increased his contribution towards GDP from of 15% in 1970 to 25% in 1998.

1. Concepts and Problems in Measuring Information Society Statistics

1.1 Basic Measuring Concepts: What Constitutes the IC Sector?

Given the prominence of the term "Information Society" in public discussion during the 1990s, it is easy to forget that the phrase had already been coined in the 1960s, and that, for a long time, it was synonymous with Daniel Bell's 1959 expression of the "post-industrial society" and Fritz Machlup's 1962 concept of the "knowledge society". Ultimately, all three expressions are based on the idea that the significance of the industrial production of goods would decline in leading industrial nations and that, instead, the importance of the production and processing of information and knowledge would rapidly increase.[1]

Nevertheless, there is neither in Germany nor at international level a generally agreed concept capturing the postulated transition from industrial to information society empirically. A study of the history of different measuring concepts reveals that they are all different, particularly as regards the three following questions:

- Should the production of all information (as well as the technological means to produce, process and transmit it) be included, or only that particular aspect of production that has been carried out using specific modern IC technologies?
- Should only the level of production of IC products as defined above be included (i. e. the output side), or also the intensity of use by companies and private households (i. e. the input side) ?
- Should all statistical variables used to describe the transition towards the information society be guided solely by the System of National Accounts, the SNA, (and thereby be expressed primarily in monetary quantities?) or would the additional use of non-monetary data — for example as SNA satellite system which is the case for environmental statistics in Germany[2] — also prove useful?

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[1] Hensel (1990), 28.

[2] Schoer (1999), 820.

A concept guided by the SNA, which provided for broad coverage of the information sector, was developed in 1976 by Marc U. Porat. This approach differentiated between a primary and a secondary information sector within a national economy. In this concept, the primary information sector includes all those industrial sectors that either produce, process and transmit information or produce the technological means for it. Both, their contribution to GDP as well as their share of total employment, was then measured. The secondary information sector includes all the information labour and its contribution to GDP in the remaining economic industrial sectors producing non-information products. This approach was used by the OECD in the late 1970s and mid-1980s in two international comparative studies.[3]

Porat's suggested definitions of information products (information goods and services) and of information labour were not linked to any specific information and communication technology. Offices and school premises plus all their inventory were thus considered to be as much information products as newspapers or computer software. Association and company officials carried out information labour just as did telephone operators or telephone engineers. This finally led to the criticism that the driving force in the evolution of the information society — the diffusion of modern IC technologies, and of microelectronics in particular — could not be properly illustrated with this method. The new 1980s phrase of "informatisation" only underlined this change in perspective. It was no longer the share of the production of information products as a proportion of all economic activity, but the degree of diffusion of modern IC technologies, that was considered a sign of modernity. Within the realm of economic debate, this approach now increasingly became the yardstick for a national economy's future economic and employment potential.[4]

Consequently, the IC sector was defined much more narrowly. The OECD's new "Information, Communication and Computer (ICC-2)" approach (as opposed to Porat's "ICC-1" concept) now only embraced manufacturing of computers, office machinery, electronic components and communications equipment, as well as telecommunications and data processing (DP) services. Under its acronym "ICT", this concept is still used today by the European Information Technology Observatory (EITO). At the request of the EU, the EITO compiles data annually on the development of "ICT" markets in Europe, Japan and the United States. Simultaneously, first attempts were made in the 1980s to complement the statistical inclusion of production aspects of the information sector with usage indicators (such as, for example, the penetration of specific IC technologies at work places and in private households).[5]

Since the mid-1990s, in various studies the definition of the IC sector has once again been broadened considerably. The reasons for this were, for one, the digitisation of media technology and its fusion with computer and communications technology and, for another, the rapid spread of internet technology and its uses in e-commerce applications. Consequently, media technology and certain aspects of content production were included on the production side of the IC sector. The currently widely used concept of "TIME" industries includes, in addition to ICT industrial sectors, also manufacturing of insulated cable and wire, of measuring instruments and industrial process control equipment, of consumer electronics as well as electronic media (film, radio and television broadcasting, on-line services, multimedia).[6]

At the same time, efforts continued to better record the application side of modern IC technology by means of appropriate indicators — and thereby also its effects on society and economy. Thus, for example, Statistics Finland developed a system of indicators to describe the information society in 1997. This contained not only data on IC industrial sectors, IC markets and IC occupations, but also indicators on technical IC infrastructure, IC qualifications among the population and IC application at work, at home and during leisure time.[7]

An initial summary can therefore conclude that there is obviously no "natural" definition of the IC sector as part of a national economy, and that the most usable definition depends ultimately on the nature of the issues to be examined. However, a definition which is too narrow can lead to problems in long-term analyses. The greater the concentration on the manufacturing and the application of certain IC technologies, the greater the need for change because of technological progress. For example, the use of optical fibre technology did never attain the level of strategic significance anticipated ten years ago. It remains to be seen whether similar conclusions will be drawn on mobile telephone and internet connections, which today are popularly used in international comparative bench-marking studies as main indicators of a modern IC infrastructure.[8]

1.2 Data Availability and Methodological Difficulties

Currently, official statistics neither offer internationally agreed concepts for cross-country comparisons on the use of modern IC technologies nor the necessary data. The market research data normally applied instead (such as, for example, on the penetration of PC equipment at

3 OECD/ICCP (1981); OECD/ICCP (1986).
4 Nora, Minc (1979), 27.
5 OECD/ICCP (1993).
6 Arthur D. Little (1996).
7 Köhler, Kopsch (1997), 753.
8 BITKOM (2000), 14.

work or at home, or on average time spend on internet use) are not, as a rule, harmonised internationally and, without additional adjustments, provide a skewed picture.

By comparison, cross-country studies on the production side of IC products can fall back on international classifications for products, industrial sectors and occupations, and can be guided by the internationally agreed statistical system of SNA variables. In principle, it is therefore possible to determine the IC sector's contribution towards GDP, the number of employees in the IC sector as a share of total employment, or the share of IC investments in equipment and plant and of intangible IC investments as a proportion of gross fixed capital formation and therefore of fixed assets of a national economy.

Even here, at least one of the two following problems will usually arise during the practical transposition:

- The industrial sector differentiation of the SNA is insufficient to illustrate the IC sector directly — however, it is defined. The additional data necessary to complement it, demonstrates substantial gaps, particularly in the area of services, which can only be narrowed or closed using rough estimates.
- Technological progress is included in the international classifications for products, industrial sectors and occupations only after a substantial time lag. The way in which new production activities, such as those of multimedia companies, are statistically recorded thus depends on the decisions of the respective national system of official statistics.

Even after the transition to the revised SNA, or, rather, to the European System Accounts (ESA), there are still data gaps concerning the production side of the IC sector in Germany. This is particularly true in recording services in telecommunications and in content production (publishers, electronic media, advertising, etc.) especially with respect to cost structure statistics (recording value added and intermediate inputs structures), to foreign trade statistics (recording the financial flows trade in services) and to employment statistics (recording the proportion of those employees not subject to the Public social insurance system). Data on gross investments in IC technology only exists for some IC products and on an aggregated level for all industrial sectors. A detailed calculation of their share in fixed assets has not yet been possible.[9] On the other hand, as a result of the transition to the European System of Accounts, there have been initial calculations on the development of intangible IC investments in Germany (e. g. software, copyrights for media products).[10]

The use of data from non-official sources on the production side of IC products — primarily turnover figures from companies and associations — can close existing data gaps or problems of outdated classifications only to a limited extent:

- First, there is the danger of double-counting, since the same IC products are frequently allocated to the same branch from different associations, with slightly altered designations;
- Second, in an era of global markets, no conclusions can be drawn from domestic market turnover data regarding domestic production;
- Finally, even in the event of the precise recording of the turnover of all domestic producers within one IC subsector, the cost structure data needed to calculate its contribution to gross value added are missing.

In addition to the problem of data availability, there is, when it comes to the statistical calculation of the output of IC products, also a methodological problem relating to price adjustments. Because of rapid technological progress in micro-electronics and the corresponding leaps in the quality of IC technology, the customary creation of price indices is problematic. This is also true for modern IC services, which are often not standardised but customer specific, so that a satisfactory definition of "output level" is almost impossible. This has consequences not only for calculating real IC sector growth. Discussion on whether macro-economic productivity growth, or the contribution of IC technology towards this, can still be properly recorded given the increasing share of IC technology in gross fixed capital formation.[11]

1.3 Aims of this Study and Definition of the IC Sector

It is generally assumed that, with the transition of industrial societies to information societies, the macro-economic significance of IC goods and services production will increase. This theory will be examined below for the period from 1980 for the main economic industrial sectors producing IC products in Germany. Specifically — and mainly on the basis of data from official statistical sources — the following questions will be explored:

- Is the IC sector a growth sector within the national economy? (indicators: share of the IC sector in terms of the value of production, of its contribution to GDP)
- What is the IC sector's employment potential? (indicators: share of the IC sector in terms of employees contributing to the Public social insurance system or all employees)
- How have external trade links of Germany's IC sector developed? (indicators: import and export ratios for IC products)
- What have been the structural changes in the demand for IC products? (indicators: share of IC products in total

[9] Faust et. al. (1999), 28.
[10] Frankford (2000), 326.
[11] Bundesbank (2000), 8.

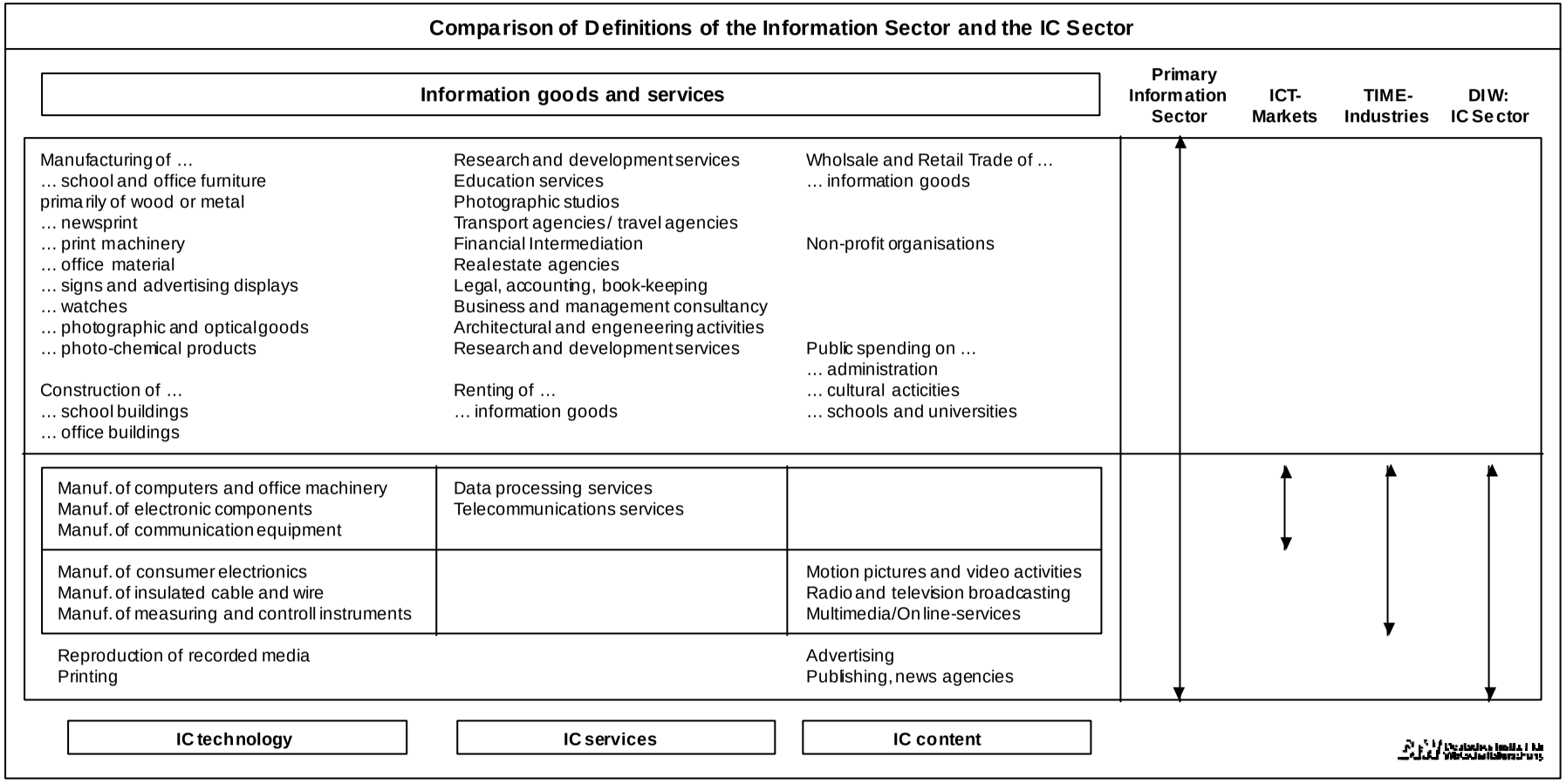
Figure 1

Definition of the IC Sector by Industrial Sectors

Definition of the IC Sector by the DIW	National Account Statistics		VAT-Statistics			Employment Statistics	
	Sub-sectors with IC Output		Industrial Sectors with IC Output	WZ' 93[1]	WZ' 79[2]	Industrial Sectors with IC Output	WS' 73[3]
IC technology							
IC electronics	Manufacturing of Electrical Machinery and Apparatus	partly	Manufacturing of Insulated Cable and Wires	311	25061 z. T.		
	Manufacturing of Office Machinery and Computers	total	Manufacturing of Office Machinery and Computers	30	243	Office Machinery Computers	331 332
	Manufacturing of Radio, Television and Communication Equipment and App.	total	Manufacturing of Radio, Television and Communication Equipment and App.	32 25071	25034, 25037, 25065	Consumer Electronics Measuring-, Controll-, Communication Equipment	348 347 partly
	Manufacturing of Medical, Precision and Optical Instruments, Watches and Clocks	partly	Manufacturing of Instruments and Appl. for Measuring, Checking, Testing, Navigating and other Purposes	332	25061 partly	Measuring-, Controll-, Communication Equipment	347 partly
			Manufacturing of Industrial Process Controll Equipment	333	25061 partly		
Printing, Reproduction	Publishing, Printing and Reproduction of Recorded Media	partly	Printing and Related Services	222	268, 2656, 25688	Bookbinding Printing	334 440
			Reproduction of Recorded Media	223	25075, 25771	Reproduction of Recorded Media	441
IC services							
Data Processing Services	Computer and Related Activities	total	Computer and Related Activities	72	79130		-
Telecommunications Services	Post and Telecommunications	partly	Telecommunications	642	518 partly	German Bundespost	640 partly
IC Content							
Advertising	Other Business Services	partly	Advertising	744	787	Advertising	820
Film, Radio and Television	Recreational, Cultural and Sporting Activities	partly	Motion Picture and Video Activities	921	7551, 7552, 7553	Motion Picture and Video Activities	763
			Radio and Television Activities	922	7555	Radio and Television Activities	764
Publishing, News Agencies			News Agency Activities	924	7894	News Agency Activities	774
	Publishing, Printing and Reproduction of Recorded Media	partly	Publishing	221	760	Publishing	770

[1] VAT statistics since 1994, employment statistics since 1998. — [2] VAT statistics until 1992. — [3] Employment statistics 1997.
Sources: Federal Employment Service; Federal Statistical Office.

Figure 2



private consumption and share of private consumption as a proportion of total IC products demand).

The basis for the definition of the IC sector in the way in which it has been done here (see figure 1) is the currently used international industrial sector classification (NACE) or, rather, the corresponding international classification of products by activities (CPA). As regards manufacturing of IC electronics and IC services, suggestions by the OECD's Statistical Panel were taken up.[12] Because of the increased significance with which IC content production has been credited in recent years, the economic activities of the printing, reproduction, publishing, advertising, film, radio and television, and news agencies sectors have been included in the analysis. Insofar as the SNA statistics deliver no differentiated data at the 2-digit-level, these are supplemented at the 3-digit-level by including other existing statistical sources, or by estimates. Figure 2 shows the relation of the definition of the IC sector used here to the above-mentioned definitions of primary information sector, ICT industries and TIME industries.

SNA statistics based on the ESA are available for Germany from 1991 onwards only. For the period 1980 to 1990, an earlier study, on the development of the media and communication sector, is the usual fall-back.[13] The data calculated in this context were adjusted to fit the definition of the IC sector as outlined in this study, and supplemented accordingly. In interpreting the time series between 1980 and 1998 on the development of the IC sector in Germany, two things must, however, be considered:

- By calculating the extent of IC sector output based on official data, suppliers of new IC services, such as Call Centers or multimedia producers, were not completely accounted for, since such activities had not yet been entered into official industrial sector classifications. On the basis of existing market estimates, this part of IC sector production is, however, very low, probably constituting no more than 1 to 1.5% of total value of production.
- The time series between 1990 and 1991 show a double structural break. This is due, partly, to the fact that German unification changed the scope of statistical information. Until 1990, data on the development of the IC sector was available only for the "old" German federal states. Partly also, the changeover of the SNA statistics to the European System of Accounts implied changes in the definitions of the gross value of production, gross value added and numbers of employees. It is not possible to completely adjust data up to 1990 to these new definitions, since important sets of information are unavailable.

These analyses for the German IC sector are supplemented by continuing calculations on the primary information sector based on Porat's concept. Since not only IC goods and services production has been included in these definition, but also those industrial sectors with a high degree of information processing, conclusions regarding the application of modern IC technology in Germany can be drawn by comparing the trends of both indicators. This is also true for calculations of the German Institute for Employment Research (IAB) concerning the development of information-related jobs in Germany.

2. The Development of the German IC Sector since 1980

2.1 Share of Production Value and Contribution to GDP

The calculations for those IC sub-sectors for which the SNA delivers no figures are based on the following statistical foundations: Gross value of production was estimated on the basis of VAT statistics available from the German Statistical Office. In the case of those IC sub-sectors whose activities are considered to be part of manufacturing, gross value added was calculated on the basis of cost structure data within the realm of business statistics for the manufacturing industries. For film, radio and television, cost structure data are available from a number of DIW surveys.[14] In advertising, the survey results of an old pilot study were used.[15]

According to this, the IC sector's gross value of production in 1998 stood at 435 billion German marks. This corresponded to 4.9% of the gross value of production of all industrial sectors. Gross value added in the same year stood at 208 billion German marks, or 5.5% of GDP. The macro-economic weight of the IC sector is therefore lower than the current high degree of public attention would lead one to suppose (see table 1).

Between 1980 and 1998 gross value added increased 2.5 times at respective prices. That growth, however, was less than total GDP. Especially after 1990 IC sector growth was below average. This was due in large part to a drop in gross value added in IC technology, although this also affected the sub-sectors IC electronics production and of printing and reproduction activities. The development of the printing sub-sector demonstrates the increasing competition of electronic media. The negative development in IC electronics production, on the other hand, can be traced back particularly to the loss of German producers' share of world market share.

The results show a dramatic change in the IC sector's internal structure since 1980. Looking at the relative share of the sections IC technology, IC services and IC content

[12] URL: *http://www.oecd.org/dsti/sti/stats/defin.htm* [Stand August 2000].

[13] Seufert (1996).

[14] BLM (1999); DLM (2000).

[15] Reim (1992), 726.

Table 1

The German IC Sector, 1980 to 1998

	1980	1982	1984	1986	1988	1990	1992	1994	1996	1998	1980	1990	1992	1998
Gross value of produchtion	in DM billion at current prices										1980 = 100			
IC technology	73	75	91	104	108	123	152	134	135	145	100	169	208	198
IC services	33	39	45	52	64	73	93	110	117	146	100	220	279	436
IC content	47	53	61	68	79	95	106	117	130	145	100	203	228	309
IC sector total	153	168	196	224	250	292	351	361	383	435	100	190	229	284
Overall economy	3 848	4 182	4 614	4 834	5 167	6 007	7 667	7 990	8 445	8 959	100	156	199	233
	in %													
Share of total gross value of production	4,0	4,0	4,2	4,6	4,8	4,9	4,6	4,5	4,5	4, 9				
Gross value added	in DM billion at current prices										1980 = 100			
IC technology	34	35	40	45	47	51	58	49	46	51	100	149	168	149
IC services	28	32	36	40	47	52	70	74	79	99	100	184	248	354
IC content	18	21	25	27	31	35	45	48	53	58	100	189	243	316
IC sector total	81	88	101	112	125	138	172	171	178	208	100	170	213	258
Overall economy	1 362	1 472	1 619	1 790	1 946	2 246	3 155	3 394	3 586	3 763	100	165	232	276
	in %													
Share of total gross value added	5,9	6,0	6,2	6,3	6,4	6,1	5,5	5,0	5,0	5, 5				
Structure of gross value added	in %													
IC technology	43	40	40	41	37	37	34	29	26	25				
IC services	35	36	35	36	38	37	40	43	44	48				
IC content	23	24	25	24	25	25	26	28	30	28				
IC sector total	100	100	100	100	100	100	100	100	100	100				

Sources: Federal Statistical Office; DIW calculations.

production of gross value added, the importance particularly of IC technology production has fallen back sharply — from 43% to 25%. Growth has been greatest in the area of IC services (up from 35% to 48%), and less evident in the area of IC content production (up from 23% to 27%).

2.2 Share of Employment

Very precise employment figures for those IC sub-sectors not covered by the SNA are available from the Federal Employment Services statistics, but only for workers liable to pay social security contributions. The industrial sector classification plan used here was adjusted to the NACE only in 1998. This means that, up that date, especially as regards IC service companies, the number of contributors to the public social security system has to be estimated. The German micro-census was used to arrive at a projection of these data for all employees (see table 2).

According to this, the number of IC sector employees is about 1.5 million, of which about 1.2 million are contributing to the public social insurance system. This corresponded to just over 4% of total employment in Germany. Since 1980, both of these sets of figures have developed along similar lines as those for gross value added. Until the late 1980s, IC sector employment initially rose more sharply than that of the economy as a whole; after that period, employment fell in absolute terms. Loss of employment was higher than average in IC technology production. Following the privatisation of Deutsche Telekom AG and the deregulation of the telecommunications markets, this IC sub-sector also saw a drop in the number of employees after 1990.

Because of the relatively large differences in value added per employee between industrial sectors, a different picture emerges for employee structures within the IC sector than for that for value added. In 1998, around one-third each of IC employees were employed in each of the three sections of IC technology, IC services and IC content production. The shift of relative share since 1980, however, corresponds to the already familiar picture: The significance of IC technology has fallen back significantly, that of IC service sections companies is strong and that of IC content producers has risen slightly.

2.3 The Development of Foreign Trade in IC Products

Exports and imports of IC technology, as well as IC content incorporated in books, video or sound recordings,

Table 2

Employment in the German IC Sector, 1980 to 1998

	1980	1982	1984	1986	1988	1990	1992	1994	1996	1998	1980	1990	1992	1998
Workers liable to pay social security contributions	in 000's										1980 = 100			
IC technology	545					563	635	531	508	522	100	103	117	96
Data processing services	32					144	205	212	222	222	100	449	641	695
Telecommunications services	90					95	104	104	99	80	100	106	115	89
IC services	122					239	309	316	321	303	100	196	253	248
Advertising	37					60	77	79	85	95	100	163	210	256
Film, Radio and Television	45	45	47	49	53	58	71	73	75	84	100	129	159	187
Publishing, news agencies	125	143	140	145	169	176	176	166	156	158	100	141	141	126
IC content	207					294	325	318	315	336	100	142	157	163
IC sector total	874					1 096	1 269	1 165	1 144	1 161	100	125	145	133
Overall economy	20 954	20 466	20 040	20 730	21 265	22 368	29 444	28 287	27 739	27 208	100	107	141	130
	in %													
Share of total employment	4,2					4,9	4,3	4,1	4,1	4, 3				
Employees	in 000's										1980 = 100			
IC technology	595	574	566	582	621	637	723	591	525	511	100	107	122	86
IC services	249	270	295	344	377	379	449	470	478	498	100	152	181	200
IC content	292	296	308	321	364	398	458	429	438	469	100	136	157	161
IC sector total	1 136	1 140	1 169	1 248	1 363	1 413	1 630	1 490	1 441	1 478	100	124	144	130
Overall economy	26 980	26 630	26 293	26 856	27 261	28 479	37 155	36 465	36 151	35 999	100	106	138	133
	in %													
Share of total employment	4,2	4,3	4,4	4,6	5,0	5,0	4,4	4,1	4,0	4, 1				
Structure of employees	in %													
IC technology	52	50	48	47	46	45	44	40	36	35				
IC services	22	24	25	28	28	27	28	32	33	34				
IC content	26	26	26	26	27	28	28	29	30	32				
IC sector total	100	100	100	100	100	100	100	100	100	100				

Sources: Federal Employment Service; Federal Statistical Office; DIW calculations.

have been included in foreign trade statistics. The German Bundesbank's balance of payments in principle provides comparative information on cross-border trade in IC services — insofar as payment flows connected with these trade flows were declared accordingly. However, industrial sector differentiation does not go far in the balance-of-payments statistics. Relevant data were available only for the areas of film production and DP services. For the purpose of this paper, the share of telecommunications services under the balance-of-payments heading "communications services" was estimated, based on data from Deutsche Telekom AG (see table 3).

According to this, in 1998 IC products constituted almost 9% of all German exports (96 billion German marks) and a share of over 11% of imports (117 billion German marks). Almost four-fifths of IC foreign trade was in IC electronic goods alone. Since 1980, both exports and imports of IC products rose much more strongly than domestic production. Exports between 1980 and 1998 increased almost fivefold and imports more than sevenfold. Both the export ratios (exports in relation to domestic production) and the import ratios (imports in relation to domestic availability, calculated as value of production minus exports plus imports) for IC products therefore rose significantly in Germany.

The foreign trade integration of IC technology production is most strongly marked in this respect (see table 4). The import ratio in 1998 stood at over 60%, that of exports was only just under this figure. By comparison, foreign trade in IC services and content production has so far played a much less important role, although here too, export and import ratios have risen significantly since 1980. Thus in 1998, export ratio for DP services (including software) already stood at almost 9%, those of publishing

products (including sound recordings) at just over 9%. These two IC sub-sectors also demonstrated a comparatively high import ratio figure in terms of services. This is also true for film, radio and television, because of the increase in purchases of foreign film and TV rights.

2.4 The Development of Domestic Demand for IC Products

IC products are considered either intermediate inputs for companies (such as, for example, on-line information services), investment products (measuring instruments) or products for private consumption (radio or television broadcasting services). From the available data, it is difficult to discern the component of total domestic demand that has experienced the greatest development since 1980. The SNA provides an adequately differentiated picture only on the structure of private consumption; where companies' intermediate inputs and investment products structures are concerned, information is insufficient.

In the 1980s, the share of IC products as part of overall private consumption initially rose strongly, from 5.4% to 6.1% (see table 5). Since then, however, it has remained almost unchanged. Since 1980, the strongest growth has been in domestic demand for telecommunications and DP services (primarily software). Compared to the development of total private consumption during this period, demand for IC technology and IC content also saw above-average increases. This, however, cannot be said of demand in print media. Since the early 1990s, also, the share of spending on IC technology has fallen continually because of the fall in prices of consumer electronics (audio and video equipment, computer and telecommunications equipment). In 1998, only 20% of IC consumer spending was on IC technology, while some 36% went on IC services and 44% on media products.

Table 3

German Foreign Trade in IC Products, 1980 to 1998

	1980	1982	1984	1986	1988	1990	1992	1994	1996	1998	1980	1990	1992	1998
Exports	in DM billion at current prices										1980 = 100			
IC electronic	15,9	20,1	25,8	32,0	32,8	37,6	40,6	48,4	60,6	76,5	100	237	256	482
Printing, Reproduction	1,2	1,5	1,7	2,0	2,2	2,3	4,6	4,6	5,6	6,3	100	198	388	528
IC Technology	17,0	21,5	27,5	34,0	35,0	39,9	45,2	53,0	66,2	82,7	100	234	265	485
Data processing services	0,1	0,1	0,2	0,2	0,4	0,4	0,8	1,5	3,5	6,4	100	415	760	6 410
Telecommunications services	0,6	0,7	0,8	0,9	1,0	1,1	1,4	0,5	1,3	1,3	100	193	258	236
IC services	0,7	0,8	1,0	1,1	1,4	1,5	2,2	1,9	4,8	7,7	100	227	334	1 171
Advertising	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0				
Film, Radio and Television	0,1	0,1	0,2	0,1	0,3	0,5	0,6	0,7	0,6	0,6	100	395	478	434
Publishing, news agencies	1,6	1,9	2,4	3,3	3,5	4,2	5,0	5,1	5,2	5,3	100	255	308	324
IC content	1,8	2,0	2,6	3,4	3,8	4,7	5,7	5,8	5,9	5,9	100	266	321	332
IC sector total	19,5	24,4	31,0	38,5	40,2	46,1	53,1	60,7	76,9	96,3	100	237	273	495
Overall economy	422,3	517,5	585,8	637,0	687,9	884,4	774,0	800,1	908,8	1 092,1	100	209	183	259
	in %													
Share of total exports	4,6	4,7	5,3	6,0	5,8	5,2	6,9	7,6	8,5	8,8				
Imports	in DM billion at current prices										1980 = 100			
IC electronic	13,5	17,0	23,9	28,0	32,8	43,5	55,8	62,3	74,8	97,9	100	322	413	723
Printing, Reproduction	0,4	0,4	0,5	0,6	0,7	1,0	2,5	2,2	2,7	3,0	100	252	656	784
IC Technology	13,9	17,4	24,5	28,6	33,5	44,5	58,4	64,5	77,5	100,9	100	320	419	725
Data processing services	0,1	0,1	0,2	0,2	0,4	0,6	0,9	1,4	2,8	5,4	100	567	890	5 420
Telecommunications services	0,4	0,6	0,7	0,8	0,9	1,2	1,5	0,9	1,4	1,8	100	330	406	489
IC services	0,5	0,7	0,9	1,1	1,3	1,8	2,4	2,3	4,2	7,2	100	381	510	1 542
Advertising	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0				
Film, Radio and Television	0,7	0,7	1,0	1,2	1,8	3,0	2,5	3,4	4,2	4,6	100	423	349	645
Publishing, news agencies	0,7	0,9	1,2	1,4	1,7	2,4	4,0	4,4	3,8	4,7	100	329	541	636
IC content	1,5	1,7	2,2	2,6	3,5	5,4	6,5	7,8	8,1	9,3	100	375	448	640
IC sector total	15,8	19,8	27,6	32,2	38,4	51,7	67,3	74,5	89,8	117,4	100	327	425	741
Overall economy	425,3	480,1	530,1	526,3	566,1	719,8	779,8	787,1	869,5	1 028,9	100	169	183	242
	in %													
Share of total imports	3,7	4,1	5,2	6,1	6,8	7,2	8,6	9,5	10,3	11,4				

Sources: German Bundesbank; Federal Statistical Office; DIW calculations.

Table 4

Import and Export Ratios for IC Products in Germany, 1980 to 1998

	1980	1982	1984	1986	1988	1990	1992	1994	1996	1998	1980	1990	1992	1998
Import ratio[1]	in %										1980 = 100			
IC electronic	27,8	34,5	37,8	38,8	43,1	47,9	46,3	57,7	68,5	77,9	100	124	136	140
Printing, Reproduction	1,8	1,8	2,2	2,2	2,5	2,6	5,7	5,8	7,2	8,2	100	97	119	123
IC Technology	19,9	24,5	28,0	29,0	31,6	34,8	35,4	44,2	52,9	61,9	100	175	178	311
Data processing services	2,3	1,6	2,3	1,7	1,9	2,1	2,3	3,1	5,3	7,4	100	90	98	320
Telecommunications services	1,3	1,9	2,0	2,2	2,1	2,6	2,8	1,3	2,3	2,5	100	206	217	197
IC services	1,4	1,8	2,1	2,0	2,1	2,4	2,6	2,1	3,6	5,0	100	172	181	353
Advertising	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0				
Film, Radio and Television	7,6	7,1	8,0	8,4	10,2	13,9	9,1	10,1	11,0	9,3	100	182	120	123
Publishing, news agencies	3,2	3,5	4,0	4,3	4,7	5,6	9,7	9,1	7,1	8,3	100	173	300	258
IC content	3,1	3,2	3,7	3,9	4,5	5,7	6,1	6,5	6,1	6,3	100	182	194	201
IC sector total	10,6	12,1	14,4	14,8	15,4	17,4	18,4	19,9	22,7	25,7	100	164	174	243
Overall economy	11,0	11,6	11,6	11,1	11,2	12,3	10,2	9,9	10,3	11,6	100	112	92	105
Export ratio[2]	in %										1980=100			
IC electronic	31,0	38,4	39,6	42,0	43,1	44,3	38,6	51,5	63,8	73,4	100	124	128	135
Printing, Reproduction	5,4	6,4	6,6	7,3	6,9	6,1	9,9	11,5	13,9	15,4	100	118	123	135
IC Technology	23,3	28,7	30,4	32,7	32,5	32,4	29,8	39,5	49,0	57,2	100	139	128	245
Data processing services	2,3	1,6	2,3	1,3	1,9	1,5	1,9	3,2	6,4	8,6	100	66	84	374
Telecommunications services	1,9	2,2	2,2	2,4	2,4	2,3	2,7	0,7	2,0	1,9	100	121	139	97
IC services	2,0	2,1	2,2	2,1	2,2	2,0	2,4	1,7	4,1	5,3	100	103	120	269
Advertising	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0				
Film, Radio and Television	1,5	1,1	1,3	0,7	2,0	2,8	2,5	2,2	1,8	1,3	100	180	165	84
Publishing, news agencies	6,8	6,9	7,8	9,4	9,0	9,2	11,8	10,4	9,4	9,3	100	134	173	135
IC content	3,8	3,8	4,2	5,0	4,8	4,9	5,3	4,9	4,5	4,1	100	131	141	107
IC sector total	12,7	14,6	15,9	17,2	16,1	15,8	15,1	16,8	20,1	22,1	100	124	119	174
Overall economy	11,0	12,4	12,7	13,2	13,3	14,7	10,1	10,0	10,8	12,2	100	134	92	111

[1] Imports as a proportion of domestic availability;domestic availability equals value of production minus exports plus imports. — [2] Exports as a proportion of gross value of production.

Sources: German Bundesbank; Federal Statistical Office; DIW calculations.

On the basis of the available data it is not possible to precisely determine the share of domestic IC consumption as a share of total domestic demand for IC products:

- For one, private consumption is calculated on the basis of consumer prices, whereas IC production and IC foreign trade figures are calculated on the basis of producer prices. In the context, more precise information on usual trade margins and distribution costs for IC products is lacking.
- For another, the value of production of the IC sector partly includes turnover figures from several stages of the value chain — in the film sector, for example, the value of production includes turnover of film and television producers, of film rentals and cinemas. The latter would also explain that the data concerning the domestic availability of IC products, lies above the sum of turnover figures that has been provided by the various associations of the German IC sectors (see table 6). As producer prices are usually lower than consumer prices, it should be the opposite.

Indications on a slightly higher increase in business demand for IC products compared with the demand of private households are derived from the differing development of IC domestic availability and consumer spending. While domestic availability of IC products has trebled in Germany since 1980, private consumption has risen just under 2.9 times.

3. Causes of Low Employment Growth in the IC Sector

Many of Germany's largest growth markets during the past 20 years have been markets for IC products. Thus, it is surprising that, since 1980, employment in the IC sector has remained virtually unchanged in relation to the national economy. The following section of the article analyses possible causes for that result in detail. These might be the restructuring of value chains in the production of IC goods and services, substitution and productivity effects.

Table 5

Private Consumption of IC Products in Germany, 1980 to 1998

	1980	1982	1984	1986	1988	1990	1992	1994	1996	1998	1980	1990	1992	1998
Private consumption	in DM billion at current prices										1980 = 100			
IC technology	9	12	12	14	19	22	27	25	25	25	100	262	316	293
IC services	14	17	19	20	21	23	33	37	41	46	100	157	229	317
Print media	15	15	16	18	20	22	30	31	33	35	100	151	205	240
Electronic media	7	7	8	9	10	12	15	17	18	20	100	181	235	312
IC content	21	22	24	26	29	34	45	48	51	56	100	161	215	262
IC sector total	44	51	54	60	69	79	105	111	117	126	100	179	239	286
Overall economy	819	918	1 004	1 069	1 154	1 300	1 714	1 832	1 950	2 062	100	159	209	252
Share of total private consumption	5,4	5,5	5,4	5,6	6,0	6,1	6,2	6,0	6,0	6,1				
Structue of private consumption	in %													
IC technology	19	23	21	23	27	28	26	23	21	20				
IC services	33	34	34	33	31	29	31	34	35	36				
IC content	48	43	44	44	43	43	43	44	44	44				
IC sector total	100	100	100	100	100	100	100	100	100	100				

Sources: Federal Statistical Office; DIW calculations.

Table 6

Comparison of Official and Non-official Data on IC Demand in Germany, 1980 to1998

	1980	1982	1984	1986	1988	1990	1992	1994	1996	1998	1980	1990	1992	1998
Domestic availability[1]	in DM billion at current prices										1980 = 100			
IC technology	70	71	87	97	105	125	159	139	142	158	100	179	227	225
IC services	33	39	45	52	64	74	93	110	117	145	100	222	281	437
IC content	46	53	60	67	79	96	107	118	132	147	100	206	230	317
IC sector total	150	163	192	216	248	295	359	368	391	450	100	197	240	301
Overall economy	3 851	4 145	4 558	4 723	5 045	5 843	7 673	7 977	8 406	8 896	100	152	199	231
	%													
Share of total domestic supply	3,9	3,9	4,2	4,6	4,9	5,0	4,7	4,6	4,7	5,1				
Turnover figures[2]	in DM billion at current prices													
IC technology							75	75	76	78				
IC services							96	107	113	129				
IC content							102	110	123	135				
IC sector total							273	292	312	342				
Relation of domestic availability and turnover figures	%						0,76	0,79	0,80	0,76				

[1] Equals value of production plus imports minus exports. — [2] Market research data: BDZV; Börsenverein; DLM; EITO; FFA; IIE; ifpi; VDZ; VUD; ZAW.

Sources: German Bundesbank; Federal Statistical Office; DIW calculations.

3.1 Rising Foreign Trade Deficit and Falling Rate of Value Added

One possible reason for the different trends of market and employment growth could be the fact that the domestic demand for IC products during this period grew more quickly than domestic production of the German IC sector, as measured against gross value added. Figure 3 illustrates that, in principle, one has to investigate three different areas:

- Structural changes in foreign trade resulting in a trade deficit in IC products;
- Structural changes at different production stages, which lead to a falling ratio of value added (gross value added as a proportion of the value of production) in

the IC sector. This may be due to higher intermediate input necessitated by production technology or due to stronger sector-specific specialisation or to price effects.

- Structural changes in the marketing stages for IC products, which leads to a higher share of distribution costs (trade margin and/or transport costs) as a proportion of end user prices.

The foreign trade balance in IC products has experienced significantly negative developments since 1980 (see table 7). While there was still an export surplus in 1980 of 3.6 billion German marks, this had been transformed into an import surplus of more than 21 billion marks by 1998. The main reason for this was the high deficit in the foreign trade of IC electronics, which had occurred since the early 1990s. In addition, there are growing deficits in the trade of film copyrights, particularly because of the large market share of US films in cinemas, on videos and of US programming in private TV stations. Low export surpluses are currently only achieved in the IC sub-sectors of printing, publishing and DP services.

In IC technology and IC services, the fall in the ratio of value added has continued since 1980 (see table 8). Concerning the production of IC electronics and the printing industry, the share of intermediate inputs as part of the gross value of production has experienced a continuous rise because of changed production technologies and increasing company specialisation. In the area of telecommunications services, the falling ratio of value added can be partly explained by altered competitive conditions. Here, a certain amount of market growth is due to the deregulation in the 1990s of network services. This has meant that in the case of trans-network communication competing network providers now charge each other interconnection fees for transmission.

3.2 Substitution Effects Between IC Sub-Sectors

The described developments of foreign trade balance and the structure of the value chain, only partially explain the moderate growth of employment in the IC sector. A further reason can be found in the substitution relations between individual IC goods and services.

When examining the growth path of individual IC subsectors, a differentiated picture emerges: Since 1980, value added among DP service companies has increased 25 times, in film production, radio and television broadcasting four times, and in both the publishing and advertising industry three times. In IC technology production and IC telecommunications services, on the other hand, growth was much lower than that of the economy as a whole (see table 9).

One reason for this is the substitution relationship between print media and electronic media. During the analysis of private consumption it had already become clear that the share of consumer spending on media products had barely increased on the whole. Rather, growth in spending on cinemas, videos, pay television, and sound recordings had come at the expense of spending in print media (books, newspapers, magazines). This not only had direct repercussions on growth in the publishing sector, but also indirect repercussions in the IC sub-sector of printing and reproduction.

3.3 Development of Productivity in the IC Sector

A further possible reason for the restrained development of employment in the IC sector is an above-average increase in labour productivity compared to the economy as a whole.

If one measures productivity against nominal value added per employee at current prices, this was the case only in the two IC sub-sectors of DP services and publishing (see table 10). In all other IC industries, the growth in labour productivity then fell below that of the national economy. A completely different picture emerges, however, when price effects are extracted and real value added per employee is examined at 1995 prices (see table 11). For the period after 1980, in this scenario the increase in productivity, in production of IC electronics as well as in DP and telecommunications services, was above that of the whole economy.

It must be considered, however, that price indices for IC products, as mentioned earlier, must be studied with caution: Speedy technological progress in microelectronics and the, as yet, non-standardised products of IC service companies make it very difficult to measure the real output in these IC sub-sectors.

4. Information Related Activities Outside the IC Sector

4.1 The Production and/or Application of IC Products

The hypothesis that the transition from industrial to information society would lead to a noticeably higher macroeconomic significance of those economic industrial sectors that produce information and communication goods and services can therefore not be proven in the case of Germany — at least if the IC sector is defined as narrowly as in the analysis up to now.

This picture changes once the concept of information production is defined much more broadly and also includes all economic activities related to the production,

Figure 3

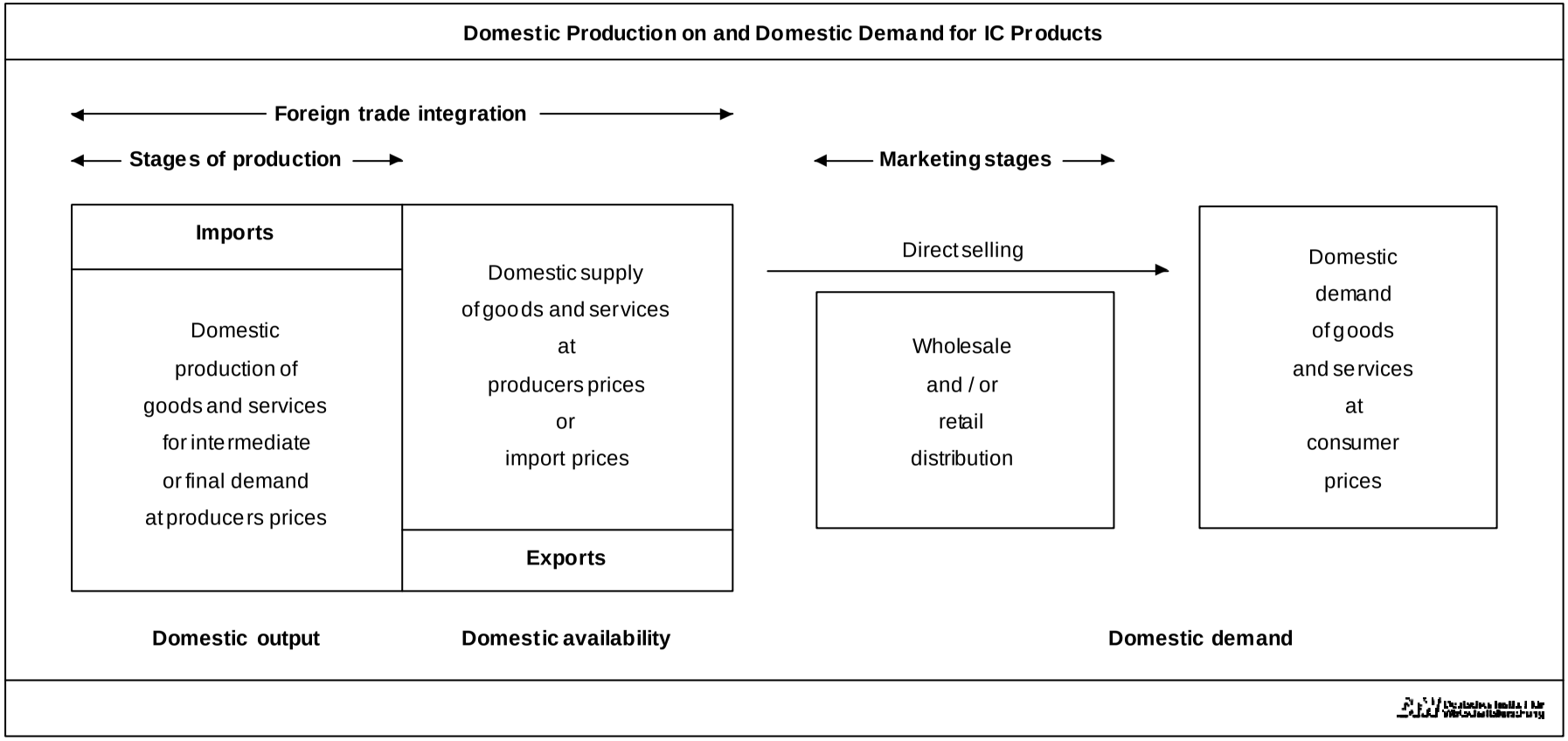


Table 7

German Trade Balance with IC Products, 1980 to 1998

	1980	1982	1984	1986	1988	1990	1992	1994	1996	1998	1980	1990	1992	1998
Trade balance[1)]	in DM billion at current prices										1980=100			
IC electronic	2,3	3,1	1,9	4,0	0,0	–6,0	–15,2	–13,8	–14,2	–21,4	100	–257	–653	–919
Printing, Reproduction	0,8	1,1	1,2	1,4	1,4	1,4	2,1	2,4	2,9	3,2	100	172	257	403
IC Technology	3,1	4,1	3,0	5,5	1,5	–4,6	–13,2	–11,4	–11,3	–18,2	100	–147	–421	–582
Data processing services	0,0	0,0	0,0	–0,1	0,0	–0,2	–0,1	0,0	0,7	1,0				
Telecommunications services	0,2	0,1	0,1	0,1	0,1	–0,1	0,0	–0,4	–0,1	–0,5	100	–70	–26	–249
IC services	0,2	0,1	0,1	0,0	0,1	–0,3	–0,2	–0,3	0,5	0,5	100	–149	–93	267
Advertising	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0				
Film, Radio and Television	–0,6	–0,6	–0,9	–1,1	–1,5	–2,5	–1,8	–2,7	–3,6	–4,0	100	429	320	694
Publishing, news agencies	0,9	1,0	1,2	1,8	1,7	1,7	1,0	0,7	1,4	0,6	100	194	113	64
IC content	0,3	0,4	0,3	0,7	0,3	–0,7	–0,8	–2,0	–2,2	–3,4	100	–234	–261	–1 080
IC sector total	3,6	4,6	3,4	6,2	1,8	–5,6	–14,2	–13,8	–12,9	–21,1	100	–155	–390	–581
Overall economy	–3,0	37,4	55,7	110,7	121,8	164,6	–5,9	13,0	39,3	63,3	100	–5 487	196	–2 109

[1)] Exports minus Imports.

Sources: German Bundesbank; Federal Statistical Office; DIW calculations.

Table 8

Value Added Ratios in the German IC Sector, 1980 to 1998

	1980	1982	1984	1986	1988	1990	1992	1994	1996	1998
Gross value added as a share of gross value of production	in %									
IC technology	47,0	47,2	44,3	43,7	43,3	41,6	38,1	36,8	34,2	35,3
IC services	83,9	80,1	80,0	75,9	74,3	70,1	74,6	67,1	67,5	68,0
IC content	39,4	39,6	41,2	39,6	39,5	36,6	42,0	40,7	40,7	40,3
IC sector total	52,7	52,5	51,5	50,0	50,0	47,2	49,0	47,2	46,6	47,9
Overall economy	35,4	35,2	35,1	37,0	37,7	37,4	41,2	42,5	42,5	42,0
	1980 = 100									
IC technology	100	100	94	93	92	89	81	78	73	75
IC services	100	96	95	90	89	84	89	80	80	81
IC content	100	100	104	100	100	93	107	103	103	102
IC sector total	100	100	98	95	95	89	93	90	88	91
Overall economy	100	99	99	105	106	106	116	120	120	119

Sources: Federal Statistical Office; DIW calculations.

processing or transmission of information and knowledge — independent of which IC technology is being used in each case. The importance of those industrial sectors in which the application of IC technology plays a prominent role has, on this basis, increased dramatically in Germany during the past few years when considering the long-term development of two indicators:

- Gross value added of the primary information sector based on Porat's definition concept;
- The share of employees with information occupations based on the definition concept of the German Institute for Employment Research (IAB).

4.2 Value Added in the Primary Information Sector

In various studies for the years 1970, 1980 and 1990, the DIW calculated the value added of the primary information sector using Porat's concept.[16] In so doing, the share of information products as a share of total output is initially measured for all industrial sectors. This share is then transposed respectively to the gross value added that has been calculated for this economic industrial sec-

[16] Filip-Köhn et. al. (1984); Schrape et.al. (1996).

Table 9

Gross Value Added in IC Sub-Sectors in Germany, 1980 to 1998

	1980	1982	1984	1986	1988	1990	1992	1994	1996	1998	1980	1990	1992	1998
Gross value added	in DM billion at current prices										1980=100			
IC electronic	23	24	28	32	32	33	37	31	27	32	100	144	160	140
Printing, Reproduction	11	11	13	13	15	18	21	18	19	19	100	159	185	167
IC Technology	34	35	40	45	47	51	58	49	46	51	100	149	168	149
Data processing services	2	3	4	8	11	13	28	32	39	54	100	583	1 280	2 502
Telecommunications services	26	28	31	32	36	39	42	41	41	45	100	151	162	174
IC services	28	32	36	40	47	52	70	74	79	99	100	184	248	354
Advertising	6	6	7	8	10	11	16	15	16	17	100	200	275	301
Film, Radio and Television	4	4	5	5	6	7	10	10	11	14	100	198	271	397
Publishing, news agencies	9	11	13	13	15	16	20	22	26	27	100	178	212	293
IC content	18	21	25	27	31	35	45	48	53	58	100	189	243	316
IC sector total	81	88	101	112	125	138	172	171	178	208	100	170	213	258
Overall economy	1 362	1 472	1 619	1 790	1 946	2 246	3 155	3 394	3 586	3 763	100	165	232	276

Sources: Federal Statistical Office; DIW calculations.

Table 10

Gross Value Added per Employee in IC Sub-Sectors in Germany, 1980 to 1998

	1980	1982	1984	1986	1988	1990	1992	1994	1996	1998	1980	1990	1992	1998
Gross value added per employee	in 000's DM at current prices										1980 = 100			
IC electronic	71	79	87	99	97	99	88	101	104	124	100	138	124	173
Printing, Reproduction	42	42	51	52	51	60	68	65	72	75	100	144	165	181
IC Technology	58	62	71	78	75	81	80	84	88	100	100	139	138	173
Data processing services	52	60	62	67	78	82	127	136	150	190	100	159	245	366
Telecommunications services	125	130	140	139	154	172	181	178	184	211	100	138	145	169
IC services	113	117	121	116	125	136	155	156	166	199	100	121	138	177
Advertising	110	120	129	139	142	136	144	138	135	138	100	124	131	125
Film, Radio and Television	74	79	105	97	106	112	109	128	129	138	100	153	148	188
Publishing, news agencies	48	56	62	64	65	65	75	93	111	111	100	136	156	232
IC content	63	71	81	84	86	88	98	111	121	124	100	139	155	197
IC sector total	71	77	86	90	92	97	106	115	124	141	100	137	148	198
Overall economy	50	55	62	67	71	79	85	93	99	105	100	156	168	207

Sources: Federal Statistical Office; DIW calculations.

tors in the SNA. The German Statistical Office's business statistics are important statistical foundations for calculating the share of IC products in manufacturing industries. Statistics on VAT are used in the sections of trade, transport and communications as well as for other service sectors, private households and private non-profit organisations. Statistics on German construction activity are used to calculate the share of IC related output in the construction sector. The share of information related output of the public sector is equated with public spending for general administration as well as for education, culture and research purposes.

For 1998, the classification plan developed by Porat in the 1970s for IC products has to be adapted to the new international industrial sector and product classification. Here, especially where manufacturing industry, other services and non-profit organisations are concerned, there were significant structural breaks in the time series, particularly due to the reallocation of the publishing industry to the manufacturing sector. Although these have only marginal influence on the final result.

On the whole, there is a continued increase in the share of IC products in relation to the output of the total economy (see table 12). Thus the gross value added of the primary information sector increased — from just under 94 billion German marks (15% of GDP) in 1970 to 873 billion DM (25% of GDP) in 1998. Since, as we have already seen, the share of the more narrowly defined IC sector remained virtually unchanged during this period, these figures clearly show that the macro-economic significance of those indus-

Table 11

Prices and Productivity in IC Sub-Sectors in Germany, 1980 to 1998

	1980	1982	1984	1986	1988	1990	1992	1994	1996	1998	1980	1990	1992	1998
Price indices	1995 = 100										1980 = 100			
IC electronic	113	117	119	119	117	115	115	101	100	101	100	101	101	89
Printing, Reproduction	66	69	75	81	87	91	95	95	101	101	100	138	144	153
IC Technology	92	96	101	104	106	105	107	99	100	101	100	115	116	110
Data processing services	63	69	74	78	82	89	97	100	100	100	100	140	154	158
Telecommunications services	97	98	97	96	96	98	100	101	101	96	100	101	103	99
IC services	93	94	94	92	92	96	99	100	101	98	100	103	106	105
Advertising	60	65	69	73	78	84	93	99	102	105	100	140	156	176
Film, Radio and Television	52	57	62	67	71	78	93	98	102	112	100	149	179	216
Publishing, news agencies	52	58	63	68	73	79	86	97	112	120	100	153	167	234
IC content	54	60	65	69	74	80	90	98	107	113	100	149	167	211
IC sector total	79	83	86	89	91	94	99	99	102	103	100	119	124	129
Overall economy	64	70	73	77	80	85	92	98	101	102	100	132	144	159
Real gross value added per employee	in 000's DM at 1995 prices										1980 = 100			
IC electronic	63	67	73	83	83	86	77	99	104	122	100	136	122	194
Printing, Reproduction	63	61	67	64	58	66	72	68	71	75	100	105	114	119
IC Technology	63	64	70	75	71	77	75	84	88	99	100	122	119	157
Data processing services	82	86	84	86	95	93	130	136	150	190	100	113	159	232
Telecommunications services	129	133	144	144	160	175	181	177	182	220	100	136	141	171
IC services	121	124	130	125	136	142	156	156	164	202	100	118	130	168
Advertising	184	184	185	189	183	163	155	139	133	132	100	88	84	71
Film, Radio and Television	141	139	168	145	149	144	117	130	127	123	100	102	83	87
Publishing, news agencies	93	97	98	94	88	83	87	96	99	92	100	89	93	99
IC content	117	119	125	120	116	109	109	113	113	109	100	93	93	93
IC sector total	90	93	100	100	101	103	107	115	121	137	100	115	119	153
Overall economy	79	79	84	86	89	93	92	95	98	102	100	119	117	130

Sources: Federal Statistical Office; DIW calculations.

trial sectors has increased significantly, that process information and apply modern IC technology to a large extent.

4.3 The Share of Information Occupations Total Employment

In connection with the concept of the secondary information sector, also developed by Porat, i. e. the statistical inclusion of information labour in industrial sectors producing non-information products, the German Institute for Employment Research (IAB) developed a concept on information occupations tailored to the German occupational classifications. On the basis of the main areas of occupational activity, as collated in microcensus surveys and population censuses, all occupations in which more than three-quarters of those employees had listed information activities as their main area of work, were classified as information occupations.[17]

If all employees in these information occupations were to be grouped into their own information sector, the following development could be said to apply to Germany (see table 13): In the non-information occupations, the development of the national economy's "classic" sectors conveys the expected picture, i. e. a fall in the share of agricultural jobs from 7% in 1970 to 2% in 1998, and a fall in the share of jobs in manufacturing industries from 40% to 26% during the same period. However, during the same period, the share of jobs in the services sector rose from 24% to 26%. The share of information sector occupations increased even more dramatically — from 29% in 1970 to 44% in 1998 (although this increase has seen a significant slowdown since the mid-1980s).

5. Conclusions

On the basis of the usually applied narrow definition of the IC sector, which includes only those economic industrial sectors whose outputs include modern IC technology

[17] Filip-Köhn, Filip (1981); Dostal (1995).

Table 12

Gross Value Added in the Primary Information Sector in Germany 1970, 1980, 1990 and 1998

Economic sector	1970[1]			1980[1]			1990[1]			1998		
	Gross value of production	Share of information products	Gross value added	Gross value of production	Share of information products	Gross value added	Gross value of production	Share of information products	Gross value added	Gross value of production[2]	Share of information products	Gross value added
	DM billion	%	DM billion	DM billion	%	DM billion	DM billion	%	DM billion	DM billion	%	DM billion
Agriculture	39,1	0,0	0,0	65,4	0,0	0,0	72,7	0,0	0,0	88,7	0,0	0,0
Energy,mining, maufacturing, construction	790,8	8,0	26,3	1 662,4	7,0	43,6	2 472,2	10,8	100,9	2 823,6	9,7	78,8
Distributive trade	499,2	6,0	3,9	1 071,3	6,3	8,4	1 524,7	7,0	14,8	596,7	7,9	29,7
Transport, communication	68,0	23,0	8,8	158,4	27,5	23,5	259,8	30,3	40,7	386,2	68,1	138,7
Finance, insurance	32,8	100,0	3,6	99,7	99,8	12,4	182,4	97,6	20,2	331,0	100,0	181,1
Other services	142,5	35,5	33,0	407,1	35,2	95,7	893,9	35,0	207,0	1 967,4	29,4	370,2
Non-profit organisations, private households	14,1	13,0	1,3	44,7	13,0	4,0	82,3	15,4	8,9	43,4	22,2	7,5
Public administration	118,2	26,7	16,7	339,1	26,8	46,2	519,4	24,9	63,1	583,3	30,6	67,9
Overall economy	1 704,7	13,1	93,6	3 848,1	14,6	233,8	6 007,4	16,7	455,6	6 820,3	24,7	873,9
Share of GDP in %			14,9			17,2			20,3			25,1

[1] Former Federal Republic of Germany only. — [2] includes

Sources: Federal Statistical Office; DIW calculations.

Table 13

Employees in Information Occupations in Germany 1970, 1985 and 1998

	1970[1]	**1985[1]**	**1998**
	share of total employment[2] in %		
Non-Information Occupations of which	71	59	56
Agriculture	7	5	2
Energy,mining, maufacturing, construction	40	31	28
Services	24	23	26
Information Occupations	29	41	44
Overall economy	100	100	100

[1] Former Federal Republic of Germany only. — [2] Workers liable to pay social security contributions.

Sources: Employment Research Institute (IAB); DIW calculations.

and services as well as content, Germany can be said to have experienced neither above-average IC productivity growth nor above-average IC employment growth compared to the economy as a whole in the last 20 years.

This can be partly explained by an increasing foreign trade deficit (especially in IC electronics and film copyrights), by substitution effects (particularly between print media and electronic media) and by above-average increases in productivity (in IC electronics as well as DP and telecommunications services).

The transition from an industrial society to an information society is more evident in Germany if one also takes into account the development of those industrial sectors in which the application of modern IC technology and IC services plays an important role. IC technology application is currently normally illustrated using non-monetary indicators (for example, the penetration of IC equipment or time budget structures). However, these convey little of the macro-economic structural change that is connected with this development. In cross-country comparisons

there is also a danger of misinterpretation, since data usually come from national non-official sources (e. g., associations, market research institutes, etc.) that use different research methods.

Internationally comparative results on IC technology application, which ought to be embedded into a macroeconomic framework, could be delivered by the further development of Porat's concept, initially developed in the 1970s, on primary and secondary information sectors. This concept defines information activities very broadly and applies international classifications on products, industrial sectors and occupations. An example how to proceed could be the German Account of Environment Statistics, which is designed as a satellite system of SNA. Activities related to the production, processing and transmission of information, are calculated independently of the underlying IC technology under Porat's method. The criticisms levelled against this approach during the 1980s, namely that it was too broad to adequately include the diffusion of modern IC technologies, is, however, becoming ever less relevant as these become more prevalent within the economy as a whole.

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Zusammenfassung

Die Entwicklung des IuK-Sektors in Deutschland

Geht man von einer heute üblichen engen Definition des IuK-Sektors aus, die lediglich diejenigen Wirtschaftszweige einschließt, zu deren Output moderne IuK-Techniken und IuK-Dienste sowie IuK-Inhalte gehören, so zeigt sich, dass es in Deutschland in den beiden letzten Jahrzehnten im Vergleich zur Gesamtwirtschaft weder zu einem überdurchschnittlichen IuK-Produktionswachstum noch zu einem überdurchschnittlichen IuK-Beschäftigtenzuwachs gekommen ist. Im Jahr 1998 lag der Anteil dieser Branchen an allen Erwerbstätigen bei lediglich 4,1% und damit niedriger als 1980.

Der Übergang von einer Industriegesellschaft zur Informationsgesellschaft zeigt sich in Deutschland deutlicher, wenn man auch die Entwicklung derjenigen Wirtschaftsbereiche betrachtet, in denen die Nutzung moderner IuK-Technik und IuK-Dienste eine wesentliche Rolle spielt. Verwendet man beispielsweise das in den 70er-Jahren von der OECD für Mehrländervergleiche eingesetzte Konzept eines primären Informationssektors, das die Produktion, Verarbeitung und Übermittlung von Informationen unabhängig von der zugrundeliegende IuK-Technik erfasst, so errechnet sich ein Anstieg des Beitrags dieser Wirtschaftszweige zum Bruttoinlandsprodukt von 15% im Jahr 1970 auf 25% im Jahr 1998.