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Jahrbücher für Nationalökonomie und Statistik

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Suggested Citation: Klodt, Henning (1988) : De-industrialization in West Germany, Jahrbücher für Nationalökonomie und Statistik, ISSN 0021-4027, Lucius & Lucius, Stuttgart, Vol. 204, Iss. 6, pp. 531-540

This Version is available at:

<https://hdl.handle.net/10419/1364>

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De-Industrialization in West Germany Deindustrialisierung in der Bundesrepublik

Von Henning Klodt, Kiel

According to the "three-sector-hypothesis" of Clark (1940) and Fourastie (1949) the share of the industrial sector in the economy will increase at early stages of industrial development, whereas it will decline as the economy matures. The observable patterns of structural change in industrialized countries actually show a good fit to this hypothesis (Chenery, 1960; Kuznets, 1957, 1966, 1973; Fels, Schatz, Wolter, 1971; Fuchs, 1981; Donges, Klodt, Schmidt, 1986).

Most of these studies are based either on sectoral output shares at current prices or on the sectoral distribution of jobs. It is often argued that the "three-sector hypothesis" only holds in terms of these categories. In real terms, it is said, the sectoral output shares remain rather stable across countries and over time (Kravis, 1984; Kravis, Heston, Summers, 1981, 1983; Lawrence, 1984). This assertion is open to doubt at least in the case of the West German economy. Here, the share of manufacturing in real gross domestic product rose from 24.9 percent in 1950 to 36.3 percent in 1970 and decreased to 31.4 percent in 1983 (at 1980 prices). Up to 1986, however, this share recovered to a level of 32.5 percent.

In what follows, an attempt is made to reveal whether these recent gains should be interpreted as a step "back to normal" or a transitory deviation from the long-term path of structural change. For this purpose, some basic forces generating sectoral shifts are examined more closely. In section I, a two-sector model along the lines of Baumol (1967), Dornbusch (1973) and Heitger (1987) is presented. Section II provides empirical evidence on productivity-biases, non-homothetic preferences and changes in the balance of international trade as the most prominent determinants of structural change in West-Germany, covering the period from 1960 to 1985. The final section draws some conclusions related to the policy debate on de-industrialization in West Germany and elsewhere.

I. The Model

a) The Closed Economy

In an economy with no external trade, structural changes of output arise from changes in the internal supply and demand conditions. At full-employment equilibrium these changes may be analyzed in terms of transformation curves and indifference curves. For simplicity, the model refers to a two-sector economy with the first sector producing industrial goods and the second one producing services. In accordance with

Dornbusch (1973, p. 875) "each class of goods itself is taken to be a composite commodity so that the relative prices of goods within each group are invariant". In addition, strictly concave transformation curves and strictly convex indifference curves are assumed.

Firstly, structural changes due to asymmetric shifts of the transformation curve are considered. There are two major reasons for such asymmetries: technology biases and substitution biases. With a rate of technical progress in industry above average, e.g., the productive capacity of this sector will increase by a higher rate than the capacity of services at any point of the initial transformation curve. This effect may be called the technology bias. Similar asymmetries would occur if the aggregate composition of inputs varies. With two production factors, e.g. capital and labour, and sectorally different production functions an increase in the aggregate capital-labour ratio will enhance most the production possibilities of the sector with a comparably high output elasticity of capital. Since in both cases the productivity of input factors is affected, these biases usually are denominated as productivity biases.

On the left hand side of Fig. 1, the outcome of a productivity bias in favour of the industrial sector is shown. The indifference curves I_1 and I_2 are assumed to represent homothetic preferences. Due to the shift of the transformation curve from T_1 to T_2 the output share of industry increases and the relative price of services (measured in terms of industrial goods) will increase as well.

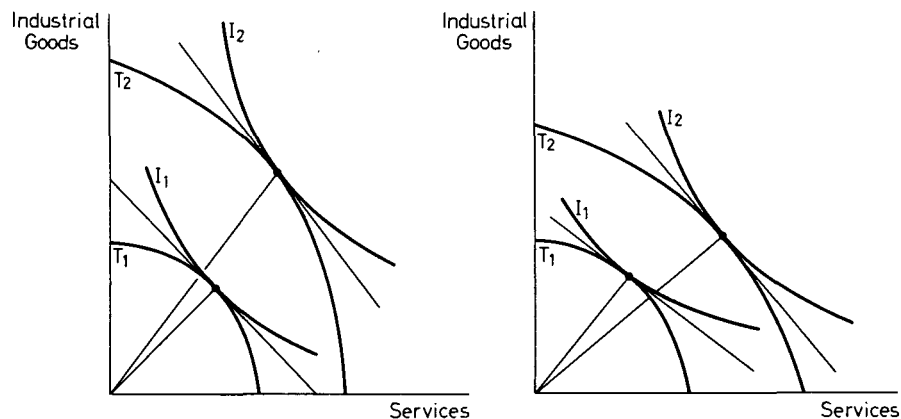


Figure 1

Secondly, shifts on the demand side should be taken into account. On the right hand side of Fig. 1, the transformation curve shifts outwards with no productivity bias. Instead, there is a bias in the system of indifference curves resulting from non-homothetic preferences. If the income elasticity of demand for services is higher than that for industrial goods, a structural change from industry to services would arise as the economy grows. In this case, too, the relative price of services will increase over time. In this model, therefore, changing shares of industry in total output mainly depend on sectorally different increases of productive capacities and on Engel-curve effects associated with a rise in total expenditures.

As a matter of fact, almost all empirical studies reveal a productivity bias in favour of industry and a demand bias in favour of services¹). Hence, in closed economies structural change from services to industry is achieved by a dominance of the productivity bias, whereas shifts to the opposite direction would indicate a dominant demand bias. A transition from expanding to shrinking output shares of industry – as described by the three-sector hypothesis – could thus be attributed either to a diminishing productivity bias or to an increasing demand bias or, finally, to a combination of both effects.

b) The Open Economy

In the following, industrial goods are assumed to be internationally traded, whereas the whole category of services is taken as non-traded goods. This approach may well be justified in the case of industrial goods, as almost all of them actually are traded across national borders to a more or less extent. The concordance between services and non-tradeables is, of course, less pronounced. Especially in banking, insurance and communication a substantial international division of labour has occurred in past years. Nevertheless, there are lots of services with hardly any international trade, notably in the group of personal services.

Some figures for West Germany may illustrate the sectoral importance of international trade: Within the whole service sector (including wholesale and retail trade, transport, communication, banking and insurance; excluding government and private households) the ratio of exports to gross output reached a level of 2.0 percent in 1984, whereas this ratio was 29.2 percent in manufacturing²). Hence if a separation of tradeables from non-tradeables at the sectoral level is required, services may still be ascribed to the latter category³).

The structural impact of international trade could be discerned by sectoral shifts due to changes in the balance of trade. In Fig. 2 A represents the consumption point of an

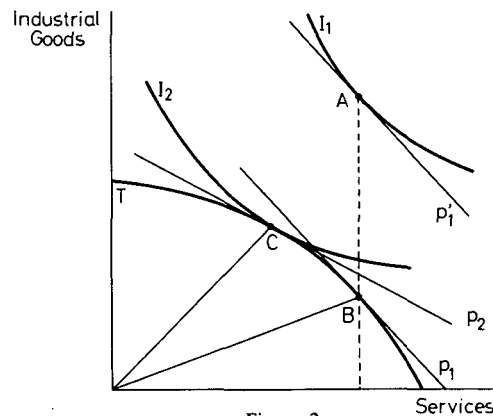


Figure 2

¹) This explains why the relative price of services within countries tends to increase over time and why services are cheaper in less developed countries (Kravis, Heston, Summers, 1978, 1983; Bhagwati, 1984).

²) See Statistisches Bundesamt (1987).

³) A very similar sectoral separation of tradeables from non-tradeables is given by Deardorff and Stern (1985).

economy running a trade deficit⁴). The slope of p_1 gives the relative price of industrial goods against services. With this price-ratio, which is identical to the slope of p_1 , the production point is in B. The consumption of services (nontradeables) is equal to domestic output, whereas the consumption of industrial goods exceeds domestic supply by an amount of AB.

If the trade deficits cannot be financed by permanent capital inflows, they will induce a depreciation of the domestic currency (in real terms). Under the assumption of the law of one price to hold on world markets for industrial goods the internal price relation between industrial goods and services increases as the exchange rate deteriorates. The new price ratio is given by p_2 . As a consequence, the demand for industrial goods will diminish and the profitability of industrial activities will rise as compared to service activities. The new equilibrium is in C, which represents the consumption point as well as the production point under the condition of balanced flows of imports and exports.

Thus external shocks, perhaps resulting from extreme shifts of raw-material prices like those in the seventies or from substantial disturbances of the exchange rate system like those in the eighties, could cover the long-term patterns of structural change – at least temporarily. A real currency depreciation causes re-industrialization whereas an appreciation accelerates the process of de-industrialization.

II. Structural Change in West Germany

For an empirical evaluation of the above described model the manufacturing sector, which is most exposed to international competition, will be compared to the aggregate group of remaining sectors in the West German economy. Some information on structural change since 1960 is provided by Tab. 1, showing a transition from industrialization in the sixties to de-industrialization in the seventies and eighties⁵). The main hypothesis to be tested is that these output shifts are explained by varying supply and demand biases and disturbances from international trade.

An approximate measure of asymmetric shifts of transformation curves is given by the difference of sectoral growth rates of labour productivity⁶): Over the whole period from 1960 to 1985 the productivity increase in manufacturing exceeded the increase in the rest of the economy. In the aftermath of the oil price shock in 1973, however, the productivity slowdown in manufacturing was more distinct than in other sectors. In consequence, the productivity bias in favour of manufacturing substantially diminished.

The statistical significance of this reduction was examined by an F-test for linearity of the sectoral productivity differences over time (see Kmenta, 1986, pp. 522 f.). The OLS-regressions on top of Tab. A2 in the appendix are supportive of significantly different productivity biases in the two sub-periods⁷).

⁴) This is a slightly modified version of the "Salter-Diagram" presented in *Corden* (1977, p. 20).

⁵) For more detailed statistical information see Tab. A1 in the appendix.

⁶) On the difference between productivity bias and labour productivity bias see *Bhagwati* (1984).

⁷) Tab. A2 shows the unadjusted R^2 instead of \bar{R}^2 because this coefficient is required for the calculation of the F-value.

Table 1: Indicators of Structural Change in West Germany (at 1980 prices)

	Share of Manufacturing in GDP	Average annual growth rate of value added per employee			Private consumption	
		Manufacturing	Other Sectors	Difference between manufacturing and other sectors	Expenditure share of manufactured goods	Relative price of manufactured goods (a)
		percent				
1960	32.7	×	×	×	53.7	1.16
1973	35.8	×	×	×	58.2	1.02
1985	32.2	×	×	×	55.5	0.98
1960-73	3.1	4.97	3.78	1.19	4.5	0.14
1973-85	-3.6	2.89	2.12	0.77	-2.7	-0.04

(a) Compared to the implicit deflator of total expenditures on private consumption.

Source: Statistisches Bundesamt (various issues); own calculations.

An assessment of asymmetries in the system of indifference curves requires the measurement of income elasticities of demand for manufactured and other goods. At this level of aggregation, the appropriate data base are national accounts statistics on private consumption by commodity groups. As shown in Tab. 1, the budget share of manufactured goods declined since 1973 and the relative price of this type of commodities as compared to the price index to total expenditures of private households declined as well. This observation indicates an income elasticity of demand for manufactured goods below unity and – due to the adding-up condition – a corresponding average elasticity for non-manufactured goods above unity. At least for the period since 1973, therefore, the data presented in Tab. 1 point to a demand bias at the expense of manufacturing.

In order to ensure whether this bias took effect in the sixties and early seventies as well, a double-logarithmic approach was applied revealing an income elasticity of demand for manufactured goods of about 0.8 (see bottom of Tab. A 2 in the appendix⁸). The results of an F-test similar to that described above did not support the presumption of significant changes in consumer preferences since 1973 as compared to previous years. Hence, the data on private consumption give evidence of permanent and unchanged Engel-curve effects involving a structural change away from manufacturing. Up to the early seventies, this tendency was excelled by a strong productivity bias, whereas in more recent years the demand bias became predominant.

This pattern evidently corresponds to the expansion of manufacturing in the sixties and the relative decline afterwards. It does not match, however, the ongoing re-industrialization since 1984. The recent increase of the share of manufacturing in gross domestic product could perhaps be attributed to the growing surplus in international trade due to the strong dollar. In fact, the West German balance of trade reached a

⁸) In order to take account of cyclical fluctuations which probably would not disturb the structure of private consumption, the data on total expenditures are calculated from moving five-year averages.

previously unattained surplus of 112 billion DM in 1986, which is more than twice as high as in 1984. Whether these changes in international trade flows, which are associated to shifting price-ratios of tradeables and non-tradeables, brought about a temporary deviation from the long-term trend of structural change, will be examined by means of regression analysis. According to the model described above the output of manufacturing (x_m) will depend on the output per employee in manufacturing (y_m) as compared to the remaining sector of the economy (y_{nm}), on gross domestic product per capita (Y) as a measure of the demand bias, and on the balance of international trade as a percentage of gross domestic product (XM). This relationship could be written as follows:

$$\ln x_m = a_1 + b_1 \ln (y_m/y_{nm}) + c_1 Y + d_1 XM \quad (1)$$

Equivalently the aggregate output of non-manufacturing sectors is given by:

$$\ln x_{nm} = a_2 + b_2 \ln (y_{nm}/y_m) + c_2 Y + d_2 XM \quad (2)$$

Subtracting equation (2) from equation (1) yields the following approach for the empirical test:

$$\ln (x_m/x_{nm}) = (a_1 - a_2) + (b_1 + b_2) \ln (y_m/y_{nm}) + (c_1 - c_2) Y + (d_1 - d_2) XM \quad (3)$$

Again the influence of the demand bias is measured by five-year averages of per-capita income. In order to reduce distortions from auto-correlated error terms, the aggregate capacity utilization rate (cap) is included as an additional variable. An OLS-regression on annual data for the period from 1962 to 1983⁹⁾ generated the following estimate¹⁰⁾:

$$\ln (x_m/x_{nm}) = -2.25 + 1.00 \ln (y_m/y_{nm}) - 0.02 Y + 0.02 XM + 0.02 cap$$

(-4.5) (2.5) (-2.8) (2.9) (5.3)

$$\bar{R}^2 = 0.81 ; \quad F = 23.25 ; \quad DW = 1.59$$

All coefficients show the expected signs and each of them is statistically significant at the five-percent level.

III. Concluding Remarks

The relative decline of manufacturing in West Germany during the seventies and early eighties has raised many concerns about the prospects for growth, international competitiveness and the dislocation of production factors. Indeed, there is a widespread fear of de-industrialization among researchers and policy-makers as well (for a survey, see Norton, 1986; Lawrence, 1986; Lindner, 1987). In this context the ongoing re-industrialization showing up since 1984 would be regarded as a compensation of the previous de-industrialization.

⁹⁾ The calculation of moving five-year averages of per-capita income reduces the number of observations from 26 to 22.

¹⁰⁾ t-statistics in parantheses. For data see Tab. A 1 in the appendix.

In this paper, by contrast, the recent increase of the share of manufacturing in gross domestic product is interpreted as a transitory deviation from the long-term trend of structural change resulting from a sharp depreciation of the West German currency since 1980 and a corresponding increase of the surplus in international trade. Hence, it could be argued that the decline of the dollar in 1985/86 should bring about an accelerated shift back from manufacturing to services.

As there is no evidence of substantial structural changes in the preferences of consumers, the Engel-curve biases on the demand side will probably give effect to further relative declines of manufacturing. This outcome could only be modified by a strong productivity bias in favour of manufacturing. Services of today, however, are not by any means technically backward. The spread of microelectronics and other new technologies in services evidently tends to support a further levelling of sectoral productivity growth rates in the future. In years to come, therefore, output shifts at the expense of manufacturing will arise again – in nominal terms as well as in real terms.

Table A 1: Indicators of Economic Activity in West Germany (at 1980 prices)

Year	Share of manufacturing in GDP	Value added per employee		Gross domestic product per capita	Balance of internat. trade in relation to GDP	Capacity utilization rate	Private consumption of manufactured goods per capita	Total expenditures on private consumption per capita	Relative price of manufactured goods (a)
		Manufac-turing	Other sectors						
	%	1000 DM		%	1000 DM		%		
1960	32.7	23.5	28.3	13.1	1.73	99.3	3.59	6.69	1.16
1961	33.2	24.3	29.3	13.6	1.99	98.7	3.80	6.99	1.15
1962	33.3	25.4	30.5	14.1	.96	97.8	4.00	7.29	1.13
1963	33.0	26.0	31.2	14.3	1.58	95.9	4.06	7.42	1.12
1964	33.7	28.3	32.9	15.1	1.45	97.6	4.30	7.73	1.11
1965	34.5	30.0	34.3	15.8	.26	98.3	4.60	8.17	1.10
1966	34.1	30.9	35.6	16.1	1.63	96.9	4.72	8.35	1.08
1967	33.4	32.1	36.8	16.0	3.41	93.6	4.74	8.42	1.07
1968	34.8	35.2	38.2	16.8	3.45	95.8	5.04	8.78	1.05
1969	36.2	37.8	40.2	17.9	2.61	99.5	5.44	9.39	1.03
1970	36.3	38.8	41.8	18.7	2.32	100.0	5.85	10.01	1.03
1971	35.7	39.5	42.7	19.0	2.12	98.4	6.10	10.41	1.02
1972	35.4	41.7	44.5	19.7	2.46	98.3	6.35	10.81	1.02
1973	35.8	44.2	45.9	20.5	3.60	99.1	6.45	11.09	1.02
1974	35.4	45.0	46.8	20.5	5.16	96.6	6.41	11.14	1.01
1975	34.3	45.3	47.4	20.3	3.63	93.2	6.69	11.55	1.00
1976	35.1	49.8	49.5	21.5	3.07	96.0	7.02	12.03	1.00
1977	34.7	50.8	51.5	22.2	3.21	96.6	7.33	12.57	.99
1978	34.3	51.7	52.9	22.8	3.21	96.9	7.59	13.07	.99
1979	34.4	53.9	54.1	23.8	1.61	98.5	7.81	13.53	.99
1980	33.9	53.7	54.4	24.0	.61	97.3	7.78	13.66	1.00
1981	32.1	54.2	55.0	24.0	1.80	95.5	7.68	13.56	1.00
1982	31.5	54.8	55.8	23.9	3.21	93.2	7.49	13.39	1.00
1983	31.4	57.7	56.9	24.3	2.51	93.3	7.67	13.67	.99
1984	31.4	59.8	58.2	25.1	3.08	94.2	7.77	13.93	.98
1985	32.2	62.1	59.0	25.8	3.99	95.4	7.89	14.21	.98
1986	32.5	.	.	.	5.95	96.1	.	.	.

(a) Compared to the implicit deflator of total expenditures on private consumption.

Source: Statistisches Bundesamt (various issues); Sachverständigenrat zur Begutachtung der gesamtwirtschaftlichen Entwicklung (1986); own calculations.

Table A 2: F-Tests for Linearity (a)

Estimated equations: $\ln y_m - \ln y_{nm} = a + bt + cD + dDt$							
$\ln y_m - \ln y_{nm} = a + b_t$							
a	b	c	d		R ²	SSE(b)	n
- .213 (-22.97)	.012 (11.20)	.086 (2.87)	.006 (-3.60)		.9546	.00592	26
- .191 (-23.60)	.009 (17.35)				.9262	.00963	26
					F = 6.42		
Estimated equations: $\ln x_m = a + b \ln p_m + c \ln Y + dD + eDY$							
$\ln x_m = a + b \ln p_m + c \ln Y$							
a	b	c	d	e	R ²	SSE(b)	n
-13.571 (-4.26)	-.873 (-1.26)	.953 (4.85)	1.438 (.48)	-.090 (-.49)	.9935 (-.49)	.00718	22
-10.713 (-9.01)	-1.388 (-3.90)	.776 (10.65)			.9928	.00794	22
					F = 3.08		
<p> y_m = value added per employee in manufacturing y_{nm} = value added per employee in other sectors t = time D = dummy for 1974 and following years x_m = private consumption of manufactured goods per capita p_m = relative price of manufactured goods as compared to the implicit deflator of total expenditures on private consumption Y = total expenditure on private consumption per capita (moving five-year average) </p> <p>(a) OLS-estimated based on annual data at 1980 prices; t-statistics in parantheses. - (b) Sum of squared residuals</p>							

Source: For data see Table A1

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Zusammenfassung

In diesem Beitrag wird der in zahlreichen Ländern beobachtbare Übergang von der Industrialisierung zur Deindustrialisierung mit einem im Zeitverlauf abnehmenden Produktivitätsvorsprung des industriellen Sektors und einer unterdurchschnittlichen Einkommenselastizität der Nachfrage nach Industriewaren erklärt. Außenwirtschaftliche Schocks vom Zuschnitt der Energieverteilung in den späten siebziger Jahren oder der Dollar-Aufwertung in den frühen achtziger Jahren können jedoch zu derart starken Verzerrungen der internen Preisstruktur führen, daß dieser Trend vorübergehend durchbrochen wird. Dementsprechend werden die in den letzten Jahren zu verzeichnenden Anteilsgewinne des industriellen Sektors am Bruttoinlandsprodukt in der Bundesrepublik nicht als Beginn einer Reindustrialisierung, sondern als kurzfristige Unterbrechung einer andauernden Reindustrialisierung interpretiert.

Summary

This paper provides a theoretical framework and some empirical information on the shift from industrialization to de-industrialization which typically occurs in the course of economic growth. It is suggested that such a non-monotonic structural change is caused by a diminishing productivity bias and a constant demand bias between the industrial sector and other sectors of the economy. This pattern could be covered by short-term reversals of relative price trends resulting from external shocks. Hence, the recent gains of the industrial sector in West Germany are interpreted as a temporary deviation from the long-term trend of de-industrialization.

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