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Factor Proportions, Technology and West German Industry's International Trade Patterns - Worldwide and Regional

by

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Introduction

1. Among the hypotheses which have been advanced to explain a country's international trade patterns the neo-factor proportions hypothesis and, more recently, the neo-technology hypothesis have exerted particular appeal both in theory and in empirical testing[1]. The former introduces intercountry differences in human capital endowment and interindutry differences in human capital requirements as decisive determinants of international specialization into the framework of a Heckscher-Ohlin world; the latter stresses intercountry differences in the capability to innovate and interindustry differences in susceptibility to innovations as the major force governing structure and change of a country's comparative advantage. Although formulated as two separate hypotheses, the difference between them is not immediately obvious. The main difficulty in differentiating stems from the comprehensive character of the human capital concept, as such surely encompassing innovativeness, the key variable of the neo-technology

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[1] For presentations and empirical tests of the hypotheses see Jagdish Bhagwati, The Pure Theory of International Trade: A Survey. "Economic Journal", Vol. 76 (1965), pp. 1 sqq. - William Gruber, Dileep Metha and Raymond Vernon, The R&D Factor in International Trade and International Investment of United States Industries. "The Journal of Political Economy", Vol. 75 (1967), pp. 20 sqq. - Raymond Vernon (ed.), The Technology Factor in International Trade. New York and London 1970.- Robert M. Stern, Testing Trade Theories. In: Peter B. Kenen, International Trade and Finance - Frontiers for Research. Cambridge, London, New York, Melbourne, 1975 pp. 3 sqq.

hypotheses. Yet this very comprehensiveness means that characteristics other than innovativeness can also account for human capital. Put differently, human capital is a necessary but not a sufficient condition for innovativeness, both across countries and across industries. Further, innovativeness differs from other possible components of human capital in that in leads to intercountry differences in production technology - a determinant of trade flows explicitely ruled out by the neo-factor proportions hypothesis.

2. Whether the hypotheses are competitive or complementary, or, indeed, one of the hypotheses is dominant, therefore is essentially an empirical question. Viewed from an advanced country such as West Germany one might expect an inconclusive answer for the overall trade pattern because the relative explanatory power of each hypothesis may vary with particular regional trade flows[1]. In trade with developing countries, differences in relative factor prices may be sufficiently large allowing the bulk of trade flows to be explained by the neo-factor proportions hypothesis. In contrast, trade with centrally planned economies would seem to be more susceptible to explanation by the neo-technology hypothesis. For one thing, relative prices still play a relatively weak role in economic decision making in these countries; for another, in these economies systemic constraints on innovativeness seem to operate, making "availability" of innovations in advanced market economies a key determinant of exchange between these two groups of countries. Finally, in trade with other developed market economies, the neo-factor proportions hypothesis would seem to be inferior because of broadly simular relative factor endowments. On the other hand, here the role of the neo-technology hypothesis is not clear cut, because all advanced countries enjoy some potential for innovations. However, it can be argued that large-scale technological leadership is a characteristic of the most advanced among these countries because first, they possess relatively more resources required to undertake the risks involved, and second, the scope for imitation narrows down the (relatively)

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[1] Baldwin has shown that bilateral conclusions cannot necessarily be drawn from global results. See Robert E. Baldwin, Determinants of the Commodity Structure of U. S. Trade. "American Economic Review", Vol. LXI (1971), pp. 143 sqq.

more advanced a country is. For the same reason, one might expect an intertemporal improvement in the neo-technology account's comparative explanatory power for countries like West Germany whose relative development stage advanced considerably since the early 1960s.

3. The ensuring analysis attempts to assess the relative pertinence of the neo-factor proportions hypothesis and the neo-technology hypothesis for total and regionalized West German trade patterns on a comparable basis. Previous studies of the two trade accounts for West Germany are not adequate for this purpose because each is adressed to only one hypothesis and utilizes different samples, time spans, regions, and measurement concepts for the exogenous and, most importantly, for the endogenous variables[1]. Therefore it is difficult to reconcile results for each trade account alone, to say nothing of discriminating between them. The present tests are carried out against the same endogenous variable on an identical sample at uniform points in time. In addition, a consistent regional breakdown, explicitly including the centrally planned economies is employed. Further extensions consist of consideration of natural resources and scale economies as determinants of West

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[1] See Karl W. Roskamp and Gordon C. McMeekin, Factor Proportions, Human Capital and Foreign Trade: The Case of West Germany Reconsidered. "The Quarterly Journal of Economics", Vol. 82 (1968), pp. 152 sqq. - Gerhard Fels, The Export Needs of Developing Countries and the Adjustment Process in Industrial Countries. In: Herbert Giersch (ed.), The International Division of Labour - Problems and Perspectives. Tübingen, 1974, pp. 176 sqq.- Robert M. Stern, Some Evidence on the Factor Content of West-Germany's Foreign Trade. "The Journal of Political Economy", Vol. 84 (1976), pp. 131 sqq. - Ernst-Jürgen Horn, Technologische Neuerungen und internationale Arbeitsteilung: Die Bundesrepublik Deutschland im internationalen Vergleich. Kieler Studien, Tübingen, 1976, forthcom. - Hans-Joachim Bodenhöfer, Technischer Fortschritt, Forschung und Entwicklung und internationaler Handel: der Fall der Bundesrepublik Deutschland. "Jahrbücher für Nationalökonomie und Statistik", Bd. 190 (1976), pp.152 sqq.

German industry's international trade patterns. Finally, an effort is made to discriminate between the explanatory power of each trade account for West German foreign trade, both regionally and intertemporarily.

Specification and Measurement

4. The hypotheses were tested by regressing the structure of factor intensities and technological characteristics on the structure of revealed comparative advantage[1] of West German industries. Basically, the relationships were formulated as follows:

$$(1)\quad \ln\left(\frac{x_{ijt}}{m_{ijt}} : \frac{X_{jt}}{M_{jt}}\right) \cdot 100 = f\,(HCI_{it},\ PCI_{it})$$

$$(2)\quad \ln\left(\frac{x_{ijt}}{m_{ijt}} : \frac{X_{jt}}{M_{jt}}\right) \cdot 100 = f\,(HCI_{it},\ PCI_{it},\ RMI_{it})$$

$$(3)\quad \ln\left(\frac{x_{ijt}}{m_{ijt}} : \frac{X_{jt}}{M_{jt}}\right) \cdot 100 = f\,(RD_{it},\ SE_{it})$$

where

i is an industry index;
j is a regional index;
t is a time index;
x_i denotes industry i's exports in DM;
m_i denotes industry i's imports in DM;
X denotes total manufacturing exports in DM;
M denotes total manufacturing imports in DM;
HCI_i denotes human capital intensity in industry i measured as a capitalized difference between the actual hourly wage and an unskilled workers wage in DM[2];

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[1] See Bela Balassa et al., Studies in Trade Liberalization - Problems and Prospects for the Industrial Countries. Baltimore, 1967. For empirical analyses the measurement concept chosen here is advantageous compared to those proposed by Balassa et al. because it is at the same time continuous, unbounded, and symmetric.

[2] For a discussion of this measurement concept see Gerhard Fels, The Choice of Industry Mix in the Division of Labour between Developed and Developing Countries."Weltwirtschaftliches Archiv",Vol. 108 (1972),pp. 77 sqq.

PCI_i denotes <u>physical capital intensity</u> in industry i measured as fixed plant and equipment per hours worked in DM;

RMI_i denotes <u>raw material intensity</u> in industry i measured as inputs from agriculture forestry, fishery and mining in p.c. of value added at factor costs;

RDI_i denotes <u>innovativeness</u> in industry i measured as expenditures on R&D in p.c. of sales;

SE_i denotes <u>scale economies</u> in industry i measured as employment in establishments with 500 and more employees in p.c. of industry i's total employment.

Relationships (1) and (2) refer to a simple and to an extended version of the neo-factor proportions approach (further on named HO I and HO II); relationship (3) refers to the neo-technology explanation of international trade flows (named NT below)[1].

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[1] Four of the exogenous variables were measured by several alternative concepts: human capital intensity by various concepts of skill structures, raw material intensity by a dummy variable, scale economies by value added per establishment, and innovativeness by R&D expenditures per employee and various skill concepts involving R&D employees. Apart from a short survey on results for different measures of innovativeness, the results presented in the tables refer only to the variables as defined above, because these measurement concepts generally performed better in explaining trade structures. Concerning innovativeness the different results may be of particular interest because some data - especially for the R&D skill measures - have only become available very recently.

5. For each region three additional relationships were estimated for purposes of comparison namely, two combined equations (HOI/NT; HOII/NT),

$$(4)\quad \ln\left(\frac{x_{ijt}}{m_{ijt}} : \frac{X_{jt}}{M_{jt}}\right) \cdot 100 = f\,(HCI_{it},\ PCI_{it},\ RD_{it},\ SE_{it})$$

$$(5)\quad \ln\left(\frac{x_{ijt}}{m_{ijt}} : \frac{X_{jt}}{M_{jt}}\right) \cdot 100 = f\,(HCI_{it},\ PCI_{it},\ RMI_{it},\ RD_{it},\ SE_{it})$$

and a "best fit" equation explicitely including market distortions as measured by effective rates of protection (ERP)[1]:

$$(6)\quad \ln\left(\frac{x_{ijt}}{m_{ijt}} : \frac{X_{jt}}{M_{jt}}\right) \cdot 100 = f\,(HCI_{it},\ PCI_{it},\ RMI_{it},\ RD_{it},\ SE_{it},\ ERP_{it})$$

The tests were run for West German industry's structure of revealed comparative advantage in 1972/73 and 1963/64[2] in trade with the world (World), the developed market economies (MDCs), the developing countries (LDCs) and centrally planned economies (CPEs)[3]. Furthermore, MDCs were split into the former EEC (FEEC)[4], other Northern

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[1] The effictive rates of protection were taken from Jürgen B. Donges, Gerhard Fels, Axel D. Neu et al., Protektion und Branchenstruktur der westdeutschen Wirtschaft, Kieler Studien Nr. 123, Tübingen 1973.

[2] The years investigated were chosen for reasons of data availability.

[3] World excluding MDCs and LDCs.

[4] Belgium, France, Italy, Luxemburg, the Netherlands, excluding of course, West Germany.

and Western Europe (ONWE)[1], other Southern Europe (OSE)[2], North America (NA), Japan (JAP), and other developed market economies (ODME)[3], LDCs were split into developing Africa (DA)[4], Latin America (LA) and developing Asia and Oceania (DAO)[5]. Data were available for 27 out of 34 industries which constitute manufacturing according to the West German industrial classification scheme; these industries represent approcimately 90 p.c. of sales (1975) of West Germany's manufacturing sector. For statistical reasons, the sample had to be aggregated for 18 observations for 1972/73 and to 14 observations for intertemporal comparisons between 1963/64 and 1972/73.

The Findings

6. The main premise of the investigation is that the two trade accounts offer independent explanations for the structure of comparative advantage (para. 1). In statistical terms this presupposes no significant correlation among the central explanatory variables[6]. Therefore, the analysis should start with a test of whether this proposition holds. Simple coefficients of correlation between the explanatory variables are given in Table 1. Evidently, various exogenous variables are significantly correlated. Thus, West German industries tend

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[1] Austria, Denmark, Finland, Iceland, Ireland, Norway, Sweden, Switzerland, United Kingdom.

[2] Andorra, Gibraltar, Greece, Malta, Portugal, Spain, Turkey.

[3] Australia, New Zealand, South Africa.

[4] Africa excluding South Africa.

[5] Asia and Oceania excluding PR China, North Korea, North Vietnam, Mongolia, Australia, New Zealand and Japan.

[6] Al reports of significance in the text refer to the 5 p.c. level. In addition; 1 p.c. tests are shown in the tables.

Table 1 - Coefficients of Correlation between Exogenous Variables[a,b], West German Industry, 1972/73 (N = 18)

		HCI	ln HCI	PCI	ln PCI	RMI	ln RMI	RD	ln RD	SE	ln SE	ERP	ln ERP
Human capital intensity:	HCI	1	.	+ 0.70*	+ 0.72*	+ 0.51*	+ 0.25	+ 0.24	+ 0.13	+ 0.80*	+ 0.75*	+ 0.49*	+ 0.28
	ln HCI		1	+ 0.61*	+ 0.68*	+ 0.41	+ 0.19	+ 0.29	+ 0.17	+ 0.84*	+ 0.81*	+ 0.39	+ 0.19
Physical capital intensity:	PCI			1	.	+ 0.93*	+ 0.66*	- 0.30	- 0.47*	+ 0.39	+ 0.34	+ 0.93*	+ 0.71*
	ln PCI				1	+ 0.74*	+ 0.68*	- 0.34	- 0.49*	+ 0.48*	+ 0.43	+ 0.74*	+ 0.63*
Raw material intensity:	RMI					1	.	- 0.32	- 0.52*	+ 0.06	+ 0.21	+ 0.98*	+ 0.76*
	ln RMI						1	- 0.48*	- 0.62*	+ 0.22	+ 0.01	+ 0.67*	+ 0.76*
Innovativeness:	RD							1	.	+ 0.25	+ 0.28	- 0.39	- 0.55*
	ln RD								1	+ 0.21	+ 0.21	- 0.57*	- 0.70*
Scale economies:	SE									1	.	+ 0.24	+ 0.20
	ln SE										1	+ 0.22	+ 0.18
Effective rate of protection:	ERP											1	.
	ln ERP												1

*Significant at 5 p.c. according to F- test.

[a]For concepts of measurement see para 4. - [b]ln: Natural logarithm.

Source: Statistisches Bundesamt Wiesbaden, Fachserie M: Preise, Löhne, Wirtschaftsrechnungen, Reihe 15: Arbeitnehmerverdienste in Industrie und Handel, I.: Arbeiterverdienste. Stuttgart und Mainz, var. iss. - Ibid, Fachserie D: Industrie und Handwerk, Reihe 4: Sonderbeiträge zur Industriestatistik - Beschäftigte nach der Stellung im Betrieb. Stuttgart und Mainz, var. iss. - Ibid, Fachserie N: Volkswirtschaftliche Gesamtrechnungen, Reihe 2: Input-Output-Tabellen 1965. Stuttgart und Mainz. - Ibid, Input-Output-Tabelle 1970. In: "Wirtschaft und Statistik", 1974. - R. Krengel u. Mitarb., Produktionsvolumen und -potential. Produktionsfaktoren der Industrie im Gebiet der Bundesrepublik Deutschland einschließlich Saarland und Berlin (West). Statistische Kennziffern. Berlin, var. issues. - H. Echterhoff-Severitt, Forschung und Entwicklung (FuE) in der Wirtschaft 1973. Beilage zu "Wirtschaft und Wissenschaft", 23. Jg., Heft 4 (Dezember 1975). - H. Echterhoff-Severitt, Wissenschaftsausgaben der Wirtschaft 1964 - Beitrag des Stifterverbandes zum internationalen statistischen Jahr. Reihe "Wissenschaft und Wirtschaft", Arbeitsschrift des Stifterverbandes für die Deutsche Wissenschaft (C 1967). Essen, 1967. - J.B. Donges, G. Fels, A.D. Neu, u.a., Protektion und Branchenstruktur der westdeutschen Wirtschaft, Tübingen, 1973. - Own calculations.

to be the more physical capital intensive the more raw material intensive[1], human capital intensive or protected they are; and West German industries tend to benefit the more from economies of scale the more human capital intensive they are. On the other hand, the R&D intensive or "new" industries tend to be none raw-material intensive, none physical capital intensive and unprotected[2]. Most notably, however, the matrix of correlation coefficients shows that there is no significant correlation between the central variables of the neo-factor proportions account and the neo-technology account, namely human capital intensity and innovativeness. This observation suggests that in the case of German manufacturing the hypotheses can indeed be tested independently.

7. The 1972/73 cross section estimates for the determinants of West German industries' structure of competitiveness in trade with the world, with major economic regions and with economic sub-regions are summarized in Tables 2, 3 and A1[3]. Generally, both the neo-factor proportions hypotheses and the neo-technology hypothesis are clearly

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[1] A positive correlation between physical capital intensity and raw material intensity was already observed by Vanek and Weiser in the case of the United States. See Jaroslaw Vanek, The Natural Resource Content of United States Foreign Trade, 1870 - 1955. Cambridge, 1963. - Lawrence A. Weiser, Changing Factor Requirements of United States Foreign Trade, "The Review of Economics and Statistics", Vol. 50 (1968), pp. 356 sqq. On the other hand, in Japan this complementarity could not be detected. See Seiji Naya, Natural Resources, Factor Mix and Factor Reversal in International Trade. "The American Economic Review", Vol. 57 (1967), pp. 561 sqq.

[2] The correlation results for ERP clearly shows that the protective system in West Germany tends to discriminate against the new industries.

[3] Each table first shows results for the neo-factor proportion hypotheses (HO I and HO II); second for the neo-technology hypothesis (NT); third for the two combined estimates (HO I/NT and HO II/NT); and fourth for the "best fit" estimates ("Best Fit"). The latter equations refer to estimates which among all possible arithmetic-linear or logarithmic combinations of the exogenous variables, including the effective rate of protection maximized $\bar{R}^2$; these estimates serve more as a reference system than as a test of any particular hypothesis.

Table 2 - Determinants of West German Industry's Structure of Competitiveness[a] in Trade with the World, 1972/73 (n = 18)

Eq.No.	Hypothesis[b]	Region	Period	Coefficients[c]													R^2	$\bar{R}^2$	F
				C	HCI	ln HCI	PCI	ln PCI	RMI	ln RMI	RD	ln RD	SE	ln SE	ERP	ln ERP			
2.1	HO I	World	1972/73	-132.167	+5.788** (+4.300)		-2.725** (-5.190)										0.65	0.60	13.91**
2.2	HO II[d]	World	1972/73	-104.950	+4.653** (+3.589)		-1.706* (-2.627)			-14.877* (- 2.250)							0.74	0.68	13.47**
2.3	NT[d]	World	1972/73	-140.613								+52.956** (+4.448)		+26.898 (+1.360)			0.63	0.58	12.66**
2.4	HOI/NT	World	1972/73	-185.094	+2.969 (+1.163)		-1.937* (-2.493)				+11.870 (+1.227)			+25.802 (+0.822)			0.69	0.59	7.40*
2.5	HOII/NT	World	1972/73	-157.792	+2.457 (+1.058)		-1.193 (-1.496)			-13.595 (- 1.972)	+8.434 (+0.945)			+23.976 (+0.844)			0.77	0.67	8.01*
2.6	"Best Fit"	World	1972/73	- 90.373	+2.776* (+2.456)					-13.642* (- 2.164)	+8.276 (+1.050)				-1.080* (-2.297)		0.78	0.71	11.41**

*Significant at 5 p.c. according to t- / F- test. - **Significant at 1 p.c. according to t- / F- test. - t-values in brackets.

[a]Measured as $\ln \frac{x_{ijt}}{m_{ijt}} : \frac{X_{jt}}{M_{jt}}$ where x_{ijt} and m_{ijt} refer to exports and imports of branch i in trade with region j at time t and X_{jt} and M_{jt} refer to the respective figures for manufacturing. - [b]HO I: Factor-Proportions-Theorem without natural resources; HO II: Factor-Proportions-Theorem with natural resources; NT: Neo-Technology hypothesis; HO/NT: Combined hypothesis. - [c]C: Constant term; ln: Natural logarithm; HCI: Human capital intensity; PCI: Physical capital intensity; RMI: Raw material intensity; RD: Innovativeness; SE: Scale economies; ERP: Effective rate of protection. For measurement concepts see para.4. - [d]Competing hypotheses. For details see para 10.

Source: Statistisches Bundesamt Wiesbaden, Fachserie G: Außenhandel, Reihe 7: Sonderbeiträge - Außenhandel nach Ländern und Warengruppen und -zweigen des Warenverzeichnisses für die Industriestatistik. Stuttgart und Mainz, var. iss. - Ibid, Fachserie M: Preise, Löhne, Wirtschaftsrechnungen, Reihe 15: Arbeitnehmerverdienste in Industrie und Handel, I.: Arbeiterverdienste. Stuttgart und Mainz, var. iss. - Ibid, Fachserie D: Industrie und Handwerk, Reihe 4: Sonderbeiträge zur Industriestatistik - Beschäftigte nach der Stellung im Betrieb. Stuttgart und Mainz, var. iss. - Ibid, Fachserie N: Volkswirtschaftliche Gesamtrechnungen, Reihe 2: Input-Output-Tabellen 1965. Stuttgart und Mainz. - Ibid, Input-Output-Tabelle 1970. In: "Wirtschaft und Statistik", 1974. - R. Krengel u. Mitarb., Produktionsvolumen und -potential. Produktionsfaktoren der Industrie im Gebiet der Bundesrepublik Deutschland einschließlich Saarland und Berlin (West). Statistische Kennziffern. Berlin, var. issues. - H. Echterhoff-Severitt, Forschung und Entwicklung (FuE) in der Wirtschaft 1973. Beilage zu "Wirtschaft und Wissenschaft", 23. Jg., Heft 4 (Dezember 1975). - H. Echterhoff-Severitt, Wissenschaftsausgaben der Wirtschaft 1964 - Beitrag des Stifterverbandes zum internationalen statistischen Jahr. Reihe "Wissenschaft und Wirtschaft", Arbeitsschrift des Stifterverbandes für die Deutsche Wissenschaft (C 1967). Essen, 1967. - J.B. Donges, G. Fels, A.D. Neu, u.a., Protektion und Branchenstruktur der westdeutschen Wirtschaft, Tübingen, 1973. - Own calculations.

Table 3 - Determinants of West German Industry's Structure of Competitiveness[a] in Trade with Major Economic Regions, 1972/73 (n = 18)

Eq.No.	Hypothesis[b]	Region[c]	Period	Coefficients[d]													R^2	$\bar{R}^2$	F
				c	HCI	ln HCI	PCI	ln PCI	RMI	ln RMI	RD	ln RD	SE	ln SE	ERP	ln ERP			
3.1	HO I[d]	MDCs	1972/73	-114.645	+ 4.945** (+3.835)		-2.423** (-4.818)										0.61	0.56	11.82**
3.2	HO II	MDCs	1972/73	+ 76.472	+ 4.722** (+3.424)			-77.711* (-2.207)	-0.195 (-1.774)								0.61	0.53	7.30**
3.3	NT[d]	MDCs	1972/73	-122.478								+48.961** (+4.535)		+22.135 (+1.234)			0.63	0.58	12.80**
3.4	HOI/NT	MDCs	1972/73	-174.807	+ 1.774 (+0.746)		-1.540* (-2.128)				+13.244 (+1.470)			+29.275 (+1.002)			0.66	0.56	6.91*
3.5	HOII/NT	MDCs	1972/73	-158.981	+ 1.478 (+0.624)		-1.109 (-1.364)			-7.881 (-1.121)	+11.252 (+1.237)			+26.218 (+0.974)			0.71	0.59	5.69*
3.6	"Best Fit"	MDCs	1972/73	+110.865	+ 4.288** (+3.884)			-66.228* (-2.348)	+0.752* (+2.311)						-4.466** (-3.036)		0.77	0.70	11.00**
3.7	HO I	LDCs	1972/73	-1585.968		+516.317** (+3.971)	-5.061** (-3.432)										0.54	0.46	8.70**
3.8	HO II[e]	LDCs	1972/73	-1170.870		+306.544** (+3.644)	-1.306 (-0.834)			-59.923** (-3.437)							0.75	0.70	13.92**
3.9	NT	LDCs	1972/73	-430.209								+104.568* (+2.715)		+114.895 (+1.796)			0.47	0.40	6.63**
3.10	HOI/NT	LDCs	1972/73	-1511.959		+480.993 (+1.742)	-4.746* (-2.200)				+ 6.821 (+0.223)			+ 6.224 (+0.054)			0.54	0.40	3.80*
3.11	HOII/NT	LDCs	1972/73	-1279.491		+439.925 (+2.031)	-1.698 (-0.898)			-62.158* (-3.237)	-11.665 (-0.486)			- 9.355 (-0.107)			0.75	0.65	7.35*
3.12	"Best Fit"	LDCs	1972/73	-880.691		+374.803** (+4.303)				-51.159* (-2.825)	-18.864 (-0.890)					-97.553 (-1.826)	0.79	0.73	12.27**

Table 3 - continued

Table 3 - continued

Eq.No.	Hypothesis[b]	Region[c]	Period	Coefficients[d]													R^2	$\bar{R}^2$	F
				c	HCI	ln HCI	PCI	ln PCI	RMI	ln RMI	RD	ln RD	SE	ln SE	ERP	ln ERP			
3.13	HO I	CPEs	1972/73	-791.954		+260.435* (+2.198)	-3.806* (-2.833)										0.36	0.27	4.19*
3.14	HO II	CPEs	1972/73	-619.437		+206.501 (+1.654)	-2.246 (-1.218)			-24.904 (-1.214)							0.42	0.30	3.37*
3.15	NT	CPEs[e]	1972/73	-206.696								+101.991** (+3.563)		+44.035 (+0.926)			0.51	0.44	7.83**
3.16	HCI/NT	CPEs	1972/73	-678.297	-12.134 (-1.902)			+163.005 (+1.324)				+156.527* (+3.109)		+133.268 (+1.946)			0.62	0.50	5.38*
3.17	HOII/NT	CPEs	1972/73	-781.729	-12.864 (-2.043)			+228.816 (+1.725)		-22.633 (-1.210)		+147.899* (+2.959)		+120.114 (+1.762)			0.66	0.52	4.75*
3.18	"Best Fit"	CPEs	1972/73	-206.696								+101.991** (+3.563)		+44.035 (+0.926)			0.51	0.44	7.83**

*Significant at 5 p.c. according to t- / F- test. - **Significant at 1 p.c. according to t- / F- test. - t - values in brackets.

[a]Measured as ln $\frac{x_{ijt}}{m_{ijt}} : \frac{X_{jt}}{M_{jt}}$, where x_{ijt} and m_{ijt} refer to exports and imports of branch i in trade with region j at time t and X_{jt} and M_{jt} refer to respective figures for manufacturing as a whole. - [b]HO I: Factor-Proportions-Theorem without natural resources; HO II: Factor-Proportions-Theorem with natural resources; NT: Neo-Technology hypothesis; HO/NT: Combines hypothesis. - [c]MDCs: Developed market economies; LDCs: Developing market economies; CPEs: Centrally planned economies. - [d]c: Constant term; ln: Natural logarithm; HCI: Human capital intensity; PCI: Physical capital intensity; RMI: Raw material intensity; RD: Innovativeness; SE: Scale economies; ERP: Effective rate of protection. For measurement concepts see para.4. - [d]Competing hypotheses. For details see para. 10. - [e]Dominant hypothesis. For details see para. 10.

Source: See Table 2.

supported in case of West German manufacturing. Most estimates are highly significant, although the explanatory power - attaining up to 77 p. c. (Equ. A 1.50) - varies markedly both among hypotheses and among regions. Indeed, only for West German industries' structure of competitiveness in trade with Japan does neither hypothesis seem to offer a significant explanation (Equ. A 1.25 to A 1.30)[1]. Apart from that, single hypotheses are rejected in trade with some of the other regions: HO II for the former EEC, North America and centrally planned economies and NT for North America (Eq. 3.14; A 1.2; A 1.20 and A 1.21).

8. Since in most cases more than one explanation turns out to be significant, the question of which hypothesis dominates in each individual case acquires relevance. The propositions initially advanced concerning this question (para. 2) were tested by applying the following procedure[2]:

   a) To begin with the simple Heckscher-Ohlin hypothesis (HO I) was tested against the extended version to include natural resource intensity (HO II)[3]. HO II is said to dominate HO I if the additional explanatory power was revealed to be significant. Contrarywise, HO I is said to dominate HO II if this test failed.

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[1] Despite still prevailing differences in the stage of development as measured by GDP per capita, by now Japan and Germany may enjoy a similar relative abundance of skills and suffer from a similar relativ scarcity of natural resources provoking an intra-industrial rather than an inter-industrial division of labour between both countries.

[2] Of course, all equations for which the F-test was not significant or for which no slope variable was significant according to t-test were excluding from further consideration.

[3] The tool employed is a test of an extended model against a simple model. An appropriate test statistic is

$$\frac{R^2_E - R^2_S}{1 - R^2_E} : \frac{Q - K}{n - Q} \sim F$$

where S refers to the simple model, E refers to extended model, K and Q equal the number of exogenous variables of the simple and extended models respectively, and n refers to the number of observations. See Jan Kimenta, Elements of Econometrics. New York, 1971, pp. 370 sq.

b) Then, an attempt was made to discriminate between the dominant Heckscher-Ohlin model and the neo-technology hypothesis. This test was conducted by first defining appropriate extended models to include the neo-technology variables plus the dominant Heckscher-Ohlin model. Since either the relevant Heckscher-Ohlin hypothesis or the neo-technology hypothesis could serve as the simple model, the test against the extended model had to be carried out from both sides. This, in turn, means that a total of four outcomes is possible: First, the additional explanatory power of the extended model could be significant when specifying the neo-technology hypothesis as the simple model, but not when specifying the neo-factor proportions hypothesis as the simple model. In this case, the relevant neo-factor proportions hypothesis is said to be the dominant explanation. Second, the reverse could be the case. Here, the neo-technology hypothesis is said to be dominant. Third, the additional explanatory power of the extended model could be significant coming from either direction. Since each hypothesis significantly adds explanatory power to the other one, the two hypotheses may be termed complementary. Fourth, the additional explanatory power of the extended model could be insignificant coming from either direction. In this final case, the test is inconclusive and the hypotheses may be termed competing.

9. As posited, the results of these tests indicate that the factors explaining the structure of West German industries' competitiveness in foreign trade differ from region to region; and it is hardly surprising to find HO II and NT competing in explaining West German industries' performance in trade with the world[1]. The regional breakdown discloses

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[1] The respective hypotheses which are dominant, competing or complementary in explaining the structure of West German industries' competitiveness in trade with the various regions are marked in the tables.

what lies behind this observation: a dominant influence of innovativeness in trade with centrally planned economies, a dominant influence of human capital intensity and raw material intensity in trade with developing countries[1] and a competing influence of human capital intensity, physical capital intensity and innovativeness in trade with developed market economies. On the sub-regional level the results are still more differentiated, although the findings for the major economic regions are by and large supported[2]. In summary, the expected dominance of technological factors in explaining West German manufacturing's comparative advantage in trade with centrally planned economies and of Heckscher-Ohlin factors in trade with developing countries tends to be corroborated by the empirical results. On the other hand, in trade with developed market economies the outcome is not as clear, for HO I and NT offer competing explanations. The reason for this inconclusive result for the division of labour among developed market economies may be sought in the intra-industry nature of this trade which could not be analyzed with the data available; examining this phenomenon in more detail will be left for further investigations. Finally, it is also noteworthy that the "Best Fit" approach never explains significantly more of the variation of the endogenous variables than at least one of the original hypotheses.

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[1] Contrary to the results for HO I, the estimates for HO II strongly suggest that in trade with developing countries Germany does not have comparative disadvantages in physical capital intensive lines of production. Rather, as a comparison of Equations 3.7 and 3.8 reveals, the significance of physical capital intensity in these estimates seems to be due to the correlation between this variable and raw material intensity (Table 1).

[2] The qualifications refer to the following hypotheses and regions: HO I and NT complementary in trade with the FEEC; HO I dominant in trade with North America; and HO II and NT competing in trade with OSE. In the latter case, the relevance of HO II (instead of HO I) may be due to the fact that among all advanced economic regions other Southern Europe is the least developed. Furthermore, in trade with developing Africa and Latin America HO II turns out to be competing with NT.

10. Having tested for the general relevance of each hypothesis in trade with the several regions, it remains to be seen whether the posited relationships are reflected in the signs of significant coefficients. Here, the estimates reveal a very clear picture:

a) Both the relationship between international competitiveness and human capital intensity and the relationship between international competitiveness and innovativeness[1] of West German industries is positive whenever these factors significantly influence the structure of revealed comparative advantage.

b) Scale economies seem not to exert any particular influence on the structure of competitiveness as the coefficients for this variable are in no case significant. Thus the contention that a large domestic market offers particular locational advantages to those industries in which significant economies of scales accrue is not borne out by the evidence for Germany[2].

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[1] As indicated above the relationship between international competitiveness and innovativeness seems to be best approximated by measuring innovativeness in terms of R&D expenditures in p.c. of sales. (R&D expenditures in p.c. of value added can be supposed to make an even better explanatory variable; in German information on value added, however, is not available for the years in question.) Alternative measurement concepts, which include R&D expenditures per employee, in p.c. of total employees, R&D-technicians in p.c. of total employees, and combinations thereof, usually yielded less explanatory power than the aforementioned variable (Table 2). This result is plausible because R&D expenditures in p.c. of sales measures total R&D input in terms of total output whereas the other measurement concepts have a more partial character.

[2] This result is the more noteworthy as it corroborates a phenomenon which Baldwin observed in his investigation on determinants of the commodity structure of U.S. trade. See Robert E. Baldwin, op.cit., pp. 138 sq.

c) The international competitiveness of West German industries tends to be the worse the more physical capital intensive[1], the more raw-material intensive and the more protected industries are[2].

d) The structure of effective protection in Germany tends to discriminate against successful industries, for the coefficients of ERP are consistently negative[3].

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[1] The negative signs for physical capital intensive are particularly interesting and are consistent with the German "Leontief Paradox" discovered previously by Roskamp and McMeekin. See Karl W. Roskamp and Gordon C. McMeekin, op. cit.

[2] The only exception discernible refers to raw material intensity: one estimate suggests that in trade with developed market economies West German manufacturing has a comparative advantage in raw-material intensive lines of production (Equ. 3.6). Although West Germany's endowment with natural resources may be relatively better vis-á-vis other developed countries than vis-á-vis developing countries, the above finding can hardly be explained by relative endowments of natural resources. On the contrary: with the possible exception of the (other) former EEC-countries and Japan, West Germany's relative natural endowment seems to be rather poor. Thus, it is noteworthy that the above finding for developed market economies as a whole is neither corroborated by other estimates for MDCs (e.g. Equ. 3.2 and 3.5) nor by the estimates for MDC's sub-regions: accordingly, raw-material intensity is significant except in trade with other Southern Europe; and in the latter case the coefficient is significantly negative (Equ. A 1.14; A 1.17 and A 1.18).

[3] This phenomenon was already observed by Fels. See Gerhard Fels, The Choice of Industry Mix in the Division of Labour between Developed and Developing Countries. "Weltwirtschaftliches Archiv", Vol. 108 (1972), p. 98. A possible interpretation is that causality runs in the opposite direction. See James Riedel, Tariff Concessions on the Kennedy Round and the Structure of Protection in West Germany - An Econometric Assessment. "Kiel Working Papers", No. 41, Kiel, March 1976.

In terms of the product cycle, these findings strongly suggest that the comparative advantage of West German manufacturing is in the "new goods" sector rahter than in the "mature goods" sector, be the latter (unskilled) labour intensive or physical capital intensive.

11. From the estimates given in Tables 4, 5 and A3 it is possible to test whether the explanatory power of the exogenous variables and the hypotheses has changed over time as hypothesized for a country like West Germany (para. 2). A main finding of this exercise is that the structural characteristics of weak and strong activities within West German industry seems to have seen the same in 1963/64 and 1972/73. This conclusion follows from the fact that - without any exception - all significant explanatory variables influence the structure of revealed comparative advantage in the same direction at both points in time. With respect to discriminating among the hypotheses, the estimates are less instructive. The need for aggregating the sample for purposes of intertemporal comparison (para. 5) has evidently led to a loss of information. A comparison of the two 1972/1973 cross section estimates (n = 18 and n = 14) reveals that the relevance of the neo-technology hypothesis as well as the relevance of HO II as compared to HO I is predominantly concealed by the higher level of aggregation[1]. The intertemporal comparison offers no particular clue as to an increasing or decreasing influence of one or the other hypothesis in determining West German industries' structure of competitiveness, although several significant changes in explanatory power can be observed

[1] The systematic loss of information implied by aggregation is easily demonstrated for raw material intensity since from the list of industries attached in the Annex (Table A4) it is discernible that data for (raw material intensive) intermediate industries had to be combined with data for industries at higher production stages.

Table 4 - Determinants of West German Industry's Structure of Competitiveness[a] in Trade with the World, 1963/64 and 1972/73 (n = 14)

Eq.No.	Hypothesis[b]	Region	Period	Coefficients[c]													R^2	$\bar{R}^2$	F
				C	HCI	ln HCI	PCI	ln PCI	RMI	ln RMI	RD	ln RD	SE	ln SE	ERP	ln ERP			
4.1	HO I	World	1963/64	-131.226	+21.737** (+3.635)		-5.859** (-4.046)										0.61	0.54	8.52**
4.2	HO I		1972/73	-119.690	+5.656** (+4.172)		-2.757** (-5.507)										0.74	0.69	15.27**
4.3	HO II	World	1963/64	- 14.665	+12.610* (+2.359)		-1.387 (-0.771)			-48.911* (-3.112)							0.80	0.74	13.39**
4.4	HO II		1972/73	- 92.865	+ 4.473** (+3.594)		-1.689* (-2.733)			-15.440* (-2.361)							0.83	0.78	16.26**
4.5	NT	World	1963/64	- 55.233								+83.614 (+1.668)		+20.202 (0.276)			0.37	0.26	3.20
4.6	NT		1972/73	- 18.958								+59.086 (+1.940)		- 4.303 (-0.077)			0.35	0.23	2.90
4.7	HOI/NT	World	1963/64	-290.758	+14.947 (+1.002)		-4.982 (-1.903)				+11.182 (+0.147)			+53.120 (+0.736)			0.62	0.45	3.83*
4.8	HOI/NT		1972/73	-193.103	+ 3.502 (+0.928)		-2.333* (-2.547)				+ 8.472 (+0.429)			+30.455 (+0.561)			0.75	0.64	6.63*
4.9	HOII/NT	World	1963/64	- 94.313	+13.233 (+1.165)		-1.638 (-0.702)			-48.631* (-2.750)	-21.606 (-0.366)			+24.274 (+0.434)			0.81	0.69	6.81*
4.10	HOII/NT		1972/73	-118.735	+ 4.071 (+1.240)		-1.640 (-1.892)			-15.137 (-1.994)	+ 0.673 (+0.038)			+ 9.372 (+0.194)			0.83	0.72	7.66*
4.11	"Best Fit"	World	1963/64	+ 38.923	+11.118* (+2.751)					-38.257* (-2.881)	-22.281 (-0.572)				-2.783* (-2.572)		0.88	0.83	16.24**
4.12	"Best Fit"		1972/73	- 59.227	+ 1.019 (+0.485)					-26.006* (-2.600)	+18.890 (+1.143)				+0.697 (+0.394)		0.74	0.62	6.53**

*Significant at 5 p.c. according to t- / F- test. - **Significant at 1 p.c. according to t- / F- test. - t-values in brackets.

[a]Measured as $\ln \frac{x_{ijt}}{m_{ijt}} : \frac{X_{jt}}{M_{jt}}$ where x_{ijt} and m_{ijt} refer to exports and imports of branch i in trade with region j at time t and X_{jt} and M_{jt} refer to the respective figures for manufacturing. - [b]HO I: Factor-Proportions-Theorem without natural resources; HO II: Factor-Proportions-Theorem with natural resources; NT: Neo-Technology hypothesis; HO/NT: Combined hypothesis. - [c]C: Constant term; ln: Natural logarithm; HCI: Human capital intensity; PCI: Physical capital intensity; RMI: Raw material intensity; RD: Innovativeness; SE: Scale economies; ERP: Effective rate of protection. For measurement concepts see para. 4. - [d]Dominant hypothesis. For details see para. 10.

Source: Statistisches Bundesamt Wiesbaden, Fachserie G: Außenhandel, Reihe 7: Sonderbeiträge - Außenhandel nach Ländern und Warengruppen und -zweigen des Warenverzeichnisses für die Industriestatistik. Stuttgart und Mainz, var. iss. - Ibid, Fachserie M: Preise, Löhne, Wirtschaftsrechnungen, Reihe 15: Arbeitnehmerverdienste in Industrie und Handel, I.: Arbeiterverdienste. Stuttgart und Mainz, var. iss. - Ibid, Fachserie D: Industrie und Handwerk, Reihe 4: Sonderbeiträge zur Industriestatistik - Beschäftigte nach der Stellung im Betrieb. Stuttgart und Mainz, var. iss. - Ibid, Fachserie N: Volkswirtschaftliche Gesamtrechnungen, Reihe 2: Input-Output-Tabellen 1965. Stuttgart und Mainz. - Ibid, Input-Output-Tabelle 1970. In: "Wirtschaft und Statistik", 1974. - R. Krengel u. Mitarb., Produktionsvolumen und -potential. Produktionsfaktoren der Industrie im Gebiet der Bundesrepublik Deutschland einschließlich Saarland und Berlin (West). Statistische Kennziffern. Berlin, var. issues. - H. Echterhoff-Severitt, Forschung und Entwicklung (FuE) in der Wirtschaft 1973. Beilage zu "Wirtschaft und Wissenschaft", 23. Jg., Heft 4 (Dezember 1975). - H. Echterhoff-Severitt, Wissenschaftsausgaben der Wirtschaft 1964 - Beitrag des Stifterverbandes zum internationalen statistischen Jahr. Reihe "Wissenschaft und Wirtschaft", Arbeitsschrift des Stifterverbandes für die Deutsche Wissenschaft (C 1967). Essen, 1967. - J.B. Donges, G. Fels, A.D. Neu, u.a., Protektion und Branchenstruktur der westdeutschen Wirtschaft. Tübingen, 1973. Own calculations.

Eq.No.	Hypothesis[b]	Region[c]	Period	Coefficients[d]													R^2	$\bar{R}^2$	F
				c	HCI	ln HCI	PCI	ln PCI	RMI	ln RMI	RD	ln RD	SE	ln SE	ERP	ln ERP			
5.1	HO I	MDCs	1963/64	-118.089	+18.298** (+3.263)		-4.620** (-3.401)										0.53	0.44	6.29*
5.2	HO I[d]	MDCs	1972/73	- 97.225	+ 4.730** (+4.260)		-2.434** (-5.934)										0.76	0.71	17.62**
5.3	HO II[d]	MDCs	1963/64	- 35.702	+ 7.105 (+1.104)			+24.707 (+0.284)		-55.725* (-2.381)							0.79	0.73	12.07**
5.4	HO II	MDCs	1972/73	+111.878	+ 3.110* (+2.339)			-65.062 (-1.566)		-14.803 (-1.871)							0.78	0.71	11.76**
5.5	NT	MDCs	1963/64	- 79.771								+70.615 (+1.670)		+25.366 (+0.412)			0.39	0.28	3.56
5.6	NT	MDCs	1972/73	- 0.122								+51.083 (+1.914)		- 8.205 (-0.168)			0.33	0.21	2.66
5.7	HOI/NT	MDCs	1963/64	-282.266	+10.933 (+0.787)		-3.653 (-1.498)				+14.080 (+0.199)			+54.873 (+0.816)			0.57	0.38	2.94
5.8	HOI/NT	MDCs	1972/73	-163.258	+ 2.848 (+0.925)		-2.065* (-2.762)				+ 7.227 (+0.448)			+27.194 (+0.613)			0.77	0.67	7.71*
5.9	HOII/NT	MDCs	1963/64	- 91.858	+ 9.272 (+0.912)		-0.412 (-0.197)			-47.331* (-2.981)	-17.701 (-0.336)			+26.914 (+0.538)			0.79	0.66	6.19*
5.10	HOII/NT	MDCs	1972/73	- 98.277	+ 3.345 (+1.296)		-1.460 (-2.142)			-13.227 (-2.217)	+ 0.412 (+0.030)			+ 8.773 (+0.231)			0.66	0.77	9.63*
5.11	"Best Fit"	MDCs	1963/64	-133.725	+ 7.606 (+0.741)			+ 6.840 (-0.066)	-0.358 (-1.218)		+ 4.806 (+0.093)					-79.512 (-2.005)	0.78	0.64	5.77*
5.12	"Best Fit"	MDCs	1972/73	+ 69.117	3.061 (+0.919)			-49.371 (-0.637)	-0.247 (-1.626)		- 0.153 (-0.009)					- 8.562 (-0.590)	0.79	0.66	6.08*
5.13	HO I[d]	LDCs	1963/64	-1219.856		+724.587** (+4.451)	-16.142** (-5.064)										0.72	0.67	13.84**
5.14	HO I[d]	LDCs	1972/73	-1665.469		+536.844** (+4.243)	-5.115** (-3.968)										0.66	0.60	10.52**
5.15	HO II	LDCs	1963/64	-957.819		+622.540** (+3.189)	-11.878 (-2.164)			-51.681 (-0.056)							0.74	0.66	9.46**
5.16	HO II	LDCs	1972/73	-1384.460		+447.976** (+3.801)	-2.580 (-1.574)			-40.071* (-2.123)							0.76	0.69	10.75**
5.17	NT	LDCs	1963/64	-589.808								+138.553 (+0.863)		+194.787 (+0.832)			0.29	0.16	2.21
5.18	NT	LDCs	1972/73	-283.836								+136.439 (+1.944)		+70.537 (+0.549)			0.44	0.34	4.37*
5.19	HOI/NT	LDCs	1963/64	-1584.076		+655.838 (+1.594)	-16.145* (-3.325)				-79.272 (-0.486)			+149.807 (+0.672)			0.74	0.62	6.41*
5.20	HOI/NT	LDCs	1972/73	-1550.473		+463.917 (+1.388)	- 4.783* (-2.417)				+ 9.966 (+0.203)			+ 28.269 (+0.168)			0.66	0.51	4.35*

Table 5 - continued

Eq.No.	Hypothesis[b]	Region[c]	Period	Coefficients[d]													R^2	$\bar{R}^2$	F
				c	HCI	ln HCI	PCI	ln PCI	RMI	ln RMI	RD	ln RD	SE	ln SE	ERP	ln ERP			
5.21	HOII/NT	LDCs	1963/64	-1328.174		+632.278 (+1.533)	-12.234 (-1.955)			-58.534 (-0.992)	-120.470 (-0.715)			+119.030 (+0.528)			0.77	0.63	5.31*
5.22	HOII/NT	LDCs	1972/73	-1555.464		+575.450 (+1.939)	- 2.926 (-1.488)			-44.095 (-1.965)	- 16.976 (-0.378)			- 57.073 (-0.377)			0.77	0.63	5.35*
5.23	"Best Fit"	LDCs	1963/64	+174.826		-319.281 (-1.487)				-83.440 (-1.292)	-51.691 (-0.302)					-191.333 (-1.509)	0.70	0.57	5.17*
5.24	"Best Fit"	LDCs	1972/73	-1015.826		316.693 (+1.812)				-61.443* (-2.891)	+10.666 (+0.241)					+ 6.164 (+0.199)	0.71	0.58	5.44*
5.25	HO I[d]	CPEs	1963/64	-601.524		+354.683** (+3.062)	-9.747** (-4.297)										0.63	0.56	9.26**
5.26	HO I[d]	CPEs	1972/73	-706.612		+240.312 (+1.993)	-3.893** (-3.169)										0.48	0.39	5.02*
5.27	HO II	CPEs	1963/64	-266.842		+224.346 (+1.809)	-4.301 (-1.233)			-66.008 (-1.922)							0.73	0.65	8.92**
5.28	HO II	CPEs	1972/73	-537.040		+186.685 (+1.475)	-2.363 (-1.343)			-24.181 (-1.193)							0.54	0.40	3.95*
5.29	NT	CPEs	1963/64	- 5.667								+132.964 (+ 1.292)		+19.542 (+0.130)			0.24	0.10	1.76
5.30	NT	CPEs	1972/73	+ 54.885								+107.271 (+ 1.740)		-22.834 (-0.202)			0.28	0.15	2.13
5.31	HOI/NT	CPEs	1963/64	- 55.731	+14.779 (+0.727)			-319.139* (-2.487)				- 5.778 (-0.055)		+203.421 (+1.604)			0.73	0.61	6.17*
5.32	HOI/NT	CPEs	1972/73	- 83.009	- 3.411 (-0.373)			-127.985 (-0.941)				+74.890 (+0.804)		+155.396 (+1.340)			0.63	0.47	3.91*
5.33	HOII/NT	CPEs	1963/64	-129.893	+ 6.745 (+0.265)			-176.546 (-0.619)		-39.930 (-0.566)		+ 8.117 (+0.072)		+167.707 (+1.259)			0.74	0.58	4.62*
5.34	HOII/NT	CPEs	1972/73	-111.733	- 3.729 (-0.380)			-104.618 (-0.571)		- 5.455 (-0.206)		+75.864 (+0.769)		+147.690 (+1.151)			0.64	0.42	2.80
5.35	"Best Fit"	CPEs	1963/64	- 5.667								+132.964 (+ 1.292)		+19.542 (+0.130)			0.24	0.10	1.76
5.36	"Best Fit"	CPEs	1972/73	+ 54.885								+107.271 (+1.740)		-22.834 (-0.202)			0.28	0.15	2.13

*Significant at 5 p.c. according to t- / F- test. - **Significant at 1 p.c. according to t- / F- test. - t - values in brackets.

[a]Measured as $\ln \frac{x_{ijt}}{m_{ijt}} : \frac{X_{jt}}{M_{jt}}$, where x_{ijt} and m_{ijt} refer to exports and imports of branch i in trade with region j at time t and X_{jt} and M_{jt} refer to respective figures for manufacturing as a whole. - [b]HO I: Factor-Proportions-Theorem without natural resources; HO II: Factor-Proportions-Theorem with natural resources; NT: Neo-Technology hypothesis; HO/NT: Combined hypothesis. - [c]MDCs: Developed market economies; LDCs: Developing market economies; CPEs: Centrally planned economies. - [d]c: Constant term; ln: Natural logarithm; HCI: Human capital intensity; PCI: Physical capital intensity; RMI: Raw material intensity; RD: Innovativeness; SE: Scale economies; ERP: Effective rate of protection. For measurement concept see para. 4.- [d]Dominant hypothesis. For details see para. 10.

Source: See Table 4.

(Equ. 5.2 and 5.3; A 2.1 and A 2.4; A 2.86 and A 2.87). The most interesting result may be the estimates concerning trade with Japan which indicate that in the course of time Germany has lost its comparative advantage in human capital intensive manufacutring activities in the division of labour with this country (para. 7). Another observable, although very weak tendency is that the structure of West German industries' international competitiveness is increasingly determined by technological factors. This tendency might have been expected to emerge more clearly in case of a country which from the early 1960s to the mid 1970s has changed its relative development stage from a medium to a top position within the OECD-countries.

Conclusions

12. For the specific case of West Germany, the results of this investigation have direct implications on subsidy policy, commercial policy, and adjustment policy. While the two hypotheses examined seem to compete in explaining the structure of total trade, individual estimates strongly support the presumption that successful activities are restricted to human capital intensive or innovative lines of production. Yet, current German subsidy policy largely ignores this relationship, favoring physical capital - a factor which, if at all, negatively influence comparative advantage. To promote a competitive production structure, a radical shift in promotion schemes is indicated. To the extent that a case can be made for subsidization at all, the subsidy should certainly not be tied to plant and equipment expenditures. Rather the applicant for funds should make his case on the basis of indicators reflecting human capital intensity and for innovativeness for any activity considered for subsidization[1]. Furthermore, current commercial policy also inhibits factors from moving to their most productive use. Again, factors characterising

[1] For a proposal along these lines, see Gerhard Fels, The Export Needs of Developed Countries and the Adjustment Process in Industrial Countries, op. cit., pp. 194 sq.

weak branches are subsidized by the system of protection. Instead of subsidizing physical capital and raw material intensive branches commercial policy should at least cease discriminating against innovative activities, if structural change in the direction of longer term comparative advantage is not to be hindered. It may be objected that such changes in the incentive system would result in severe adjustment costs, especially in a time of progressing international integration of low-wage countries, which by itself creates adjustment pressure. However, as follows from the regionalized analysis a change from physical capital subsidization to preference for human capital and innovativeness is not likely to result in added adjustment pressure because it negatively affects a factor which is not crucial in the division of labour between West Germany and low-wage countries. Instead, such a change would give those production factors freed by low-wage country competition incentive to migrate directly to branches which can be expected to enjoy a longer term comparative advantage. Adjustment policy, therefore, could focus upon assisting factor mobility.

13. Beside these conclusions for the West German economy, which also could have relevance for economic policy in other countries, certain aspects of the investigation may be of a more general interest of which three are particularly worth mentioning. First is the observation that human capital intensity and R&D intensity need to be highly intercorrelated as has often been presumed. Second, lack of significant correlation made it meaningful to try to identify significant differences in the explanatory power of the hypotheses. And third, as a result, regional differences in the determinants of specialization could be detected. Such information, however, is useful for policy purposes, particularly at times of accelerated regional integration, as seems to be occurring in manufacturing trade between the developed market economies on the one hand and developing countries and centrally planned economies on the other hand. Not surprisingly, the least clear-cut results were obtained for West Germany's trade with developed market economies. Especially here, comparative testing of hypotheses which had to be neglected in this investigation could yield fruitful results.

Table A 1 - Determinants of West German Industry's Structure of Competitiveness[a] in Trade with Economic Sub-Regions, 1972/73 (n = 18)

Eq.No.	Hypothesis[b]	Region[c]	Period	Coefficients[d]													R^2	$\bar{R}^2$	F
				c	HCI	ln HCI	PCI	ln PCI	RMI	ln RMI	RD	ln RD	SE	ln SE	ERP	ln ERP			
A 1.1	HO I[e]	FEEC	1972/73	+ 74.321	+ 5.135* (+2.788)			-80.305* (-2.198)									0.34	0.25	3.92*
A 1.2	HO II	FEEC	1972/73	+137.235	+ 5.206* (+2.778)			-102.343 (-2.140)	+0.109 (+0.731)								0.37	0.24	2.71
A 1.3	NT[e]	FEEC	1972/73									+33.220* (+2.191)	+0.859 (+1.399)				0.36	0.27	4.19*
A 1.4	HOI/NT	FEEC	1972/73	-512.095		+185.272* (+2.443)	-2.601 (-4.073)					-0.434 (-0.029)	-0.926 (-1.196)				0.74	0.66	9.16*
A 1.5	HOII/NT	FEEC	1972/73	-494.685		+182.674* (+2.735)	-2.100 (-3.457)			-13.011* (-2.183)		-10.445 (-0.751)	-0.985 (-1.443)				0.81	0.73	10.42*
A 1.6	"Best Fit"	FEEC	1972/73	-319.446		+111.509* (+ 2.379)	-2.342** (-4.385)				+ 2.364 (+0.296)						0.71	0.65	11.48**
A 1.7	HO I[f]	ONWE	1972/73	+121.845	+ 6.388** (+3.493)			-113.641** (-3.132)									0.46	0.39	6.50**
A 1.8	HO II	ONWE	1972/73	+ 6.151	+ 5.021*			-56.968 (-1.091)		-18.835 (-1.462)							0.54	0.44	5.37*
A 1.9	NT[f]	ONWE	1972/73	-246.397							+28.634** (+3.420)		+41.009 (+1.774)				0.57	0.51	9.96**
A1.10	HOI/NT	ONWE	1972/73	+169.857		-142 308 (-1.285)	+1.578 (+1.635)					+60.177* (+2.707)	+63.853 (+1.430)				0.47	0.31	2.84
A1.11	HOII/NT	ONWE	1972/73	+103.776		-110.097 (-0.817)	+0.607 (+0.257)		+0.1578 (+0.452)			+57.811* (+2.457)	+56.234 (+1.220)				0.48	0.26	2.16
A1.12	"Best Fit"	ONWE	1972/73								+28.634** (+3.420)		+41.009 (+1.774)				0.57	0.51	9.96**
A1.13	HO I	OSE	1972/73	-976.557		+315.809** (+ 3.804)	-3.873** (-4.114)										0.57	0.51	9.80**
A1.14	HO II[f]	OSE	1972/73	-757.182		+247.225** (+ 3.245)	-1.889 (-1.678)			-31.669* (-2.529)							0.70	0.64	11.02**
A1.15	NT[f]	OSE	1972/73	- 66.099								+101.165** (+4.778)	+0.553 (+0.645)				0.63	0.58	12.80**
A1.16	HOI/NT	OSE	1972/73	+119.998	- 2.110 (-0.380)			+54.234 (+0.526)				+119.998* (+2.852)	-0.578 (+0.377)				0.64	0.53	5.74*
A1.17	HOII/NT	OSE	1072/73	-404.154	- 3.489 (-0.789)			+163.257 (+1.823)		-36.962* (-2.954)		+106.026* (+3.150)	+0.161 (+0.132)				0.75	0.70	9.07*
A1.18	"Best Fit"	OSE	1972/73	-402.285	- 3.157 (-0.902)			-161.936 (+1.893)		-37.153** (-3.109)		+105.696** (+3.275)					0.79	0.73	12.26**

Table A 1 - continued

Table A 1 - continued

Eq.No.	Hypothesis[b]	Region[c]	Period	Coefficients[d]													R^2	$\bar{R}^2$	F
				c	HCI	ln HCI	PCI	ln PCI	RMI	ln RMI	RD	ln RD	SE	ln SE	ERP	ln ERP			
A 1.19	HO I[g]	NA	1972/73	-183.448	+ 8.075* (+2.295)		-3.818* (-2.783)										0.35	0.26	3.99*
A 1.20	HO II	NA	1972/73	+121.950	+ 7.912 (+2.141)			-125.462 (-1.330)	-0.320 (-1.084)								0.37	0.24	2.71
A 1.21	NT	NA	1972/73	-161.774								+54.478 (+1.808)	+2.150 (+1.762)				0.35	0.26	4.01*
A 1.22	HOI/NT	NA	1972/73	+363.859	+ 0.975 (+0.157)			-200.020 (-2.000)			-16.833 (-0.677)		+4.801* (+2.707)				0.56	0.45	4.57*
A 1.23	HOII/NT	NA	1972/73	+294.550	+ 1.834 (+0.280)			-178.243 (-1.625)	-0.152 (-0.566)		-18.842 (-0.730)		+4.466* (+2.331)				0.60	0.43	3.53*
A 1.24	"Best Fit"	NA	1972/73	-183.448	+ 8.075* (+2.295)		-3.818* (-2.783)										0.35	0.26	3.99*
A 1.25	HO I	JAP	1972/73	-102.836	+ 1.840 (+0.596)		+0.643 (+0.534)										0.12	0.00	1.06
A 1.26	HO II	JAP	1972/73	-100.483	+ 2.534 (+0.661)		-0.460 (-0.127)		+0.192 (+0.325)								0.13	-0.06	0.70
A 1.27	NT	JAP	1972/73	- 56.993								- 6.310 (-0.224)		+10.092 (+0.215)			0.01	-0.12	0.04
A 1.28	HOI/NT	JAP	1972/73	+ 89.709	+ 7.418 (+1.248)		-0.434 (-0.240)				- 9.022 (-0.400)			-86.327 (-1.181)			0.21	-0.03	0.87
A 1.29	HOII/NT	JAP	1972/73	+124.577	+11.180 (+1.437)		-3.981 (-0.801)		+0.520 (+0.768)		-16.076 (-0.702)			-100.809 (-1.315)			0.25	-0.06	0.79
A 1.30	"Best Fit"	JAP	1972/73	-102.836	+ 1.840 (+0.596)		+0.643 (+0.534)										0.12	0.00	1.06
A 1.31	HO I[f]	ODME	1972/73	+944.713	+21.269** (+3.640)			-468.861** (-4.044)									0.54	0.48	8.73**
A 1.32	HO II	ODME	1972/73	+577.010	+16.926* (+2.653)			-288.742 (-1.729)		-47.149 (-1.453)							0.60	0.51	6.96**
A 1.33	NT[f]	ODME	1972/73	+119.805								+174.913** (+3.172)	-0.469 (-0.210)				0.41	0.33	5.13*
A 1.34	HOI/NT	ODME	1972/73	+984.788	+30.914* (+2.613)			-499.819* (-2.279)				+ 6.073 (+0.068)	-5.098 (-1.563)				0.61	0.49	5.12*
A 1.35	HOII/NT	ODME	1972/73	+652.726	+28.898* (+2.607)			-340.441 (-1.517)		-54.034 (-1.724)		-14.352 (-0.170)	-5.708 (-1.865)				0.69	0.56	5.31*
A 1.36	"Best Fit"	ODME	1972/73	+577.010	+16.926* (+2.653)			-288.742 (-1.729)		-47.149 (-1.453)							0.60	0.51	6.96**

Table A 1 - continued

Eq.No.	Hypothesis[b]	Region[c]	Period	Coefficients[d]													R^2	$\bar{R}^2$	F
				c	HCI	ln HCI	PCI	ln PCI	RMI	ln RMI	RD	ln RD	SE	ln SE	ERP	ln ERP			
A 1.37	HO I	DA	1972/73	-986.513		+735.026** (+ 3.625)		-431.712** (-3.690)									0.52	0.46	7.97**
A 1.38	HO II[f]	DA	1972/73	-1196.770		+446.788* (+ 2.593)	-2.276 (-0.894)			-81.882* (-2.891)							0.67	0.60	9.32**
A 1.39	NT[f]	DA	1972/73	-381.032								+181.783** (+3.707)		+128.756 (+1.581)			0.57	0.51	9.80**
A 1.40	HOI/NT	DA	1972/73	-948.513		+167.854 (+0.437)	-4.216 (-1.407)				+60.161 (+1.414)			+140.263 (+0.876)			0.55	0.41	4.00*
A 1.41	HOII/NT	DA	1972/73	-670.907		+118.812 (+0.367)	-0.577 (-0.198)			-74.228* (-2.511)	+38.085 (+1.032)			+121.659 (+0.902)			0.71	0.59	5.77*
A 1.42	"Best Fit"	DA	1972/73	-1196.770		+446.788* (+ 2.593)	-2.276 (-0.894)			-81.882* (-2.891)							0.67	0.60	9.32**
A 1.43	HO I	LA	1972/73	-750.831		+599.834** (+3.281)		-383.640** (-3.638)									0.49	0.42	7.22**
A 1.44	HO II[f]	LA	1972/73	-848.231		+314.001 (+2.039)	-1.311 (-0.576)			-79.901** (-3.156)							0.66	0.59	8.87**
A 1.45	NT[f]	LA	1972/73	-269.163								+167.641** (+3.819)		+ 80.369 (+1.102)			0.55	0.49	9.20**
A 1.46	HOI/NT	LA	1972/73	-581.305		+ 53.265 (+0.154)	-3.003 (-1.111)				+66.174 (+1.725)			+114.117 (+0.792)			0.53	0.39	3.64*
A 1.47	HOII/NT	LA	1972/73	-315.649		+ 6.334 (+0.022)	+0.480 (+0.189)			-71.033* (-2.756)	+45.049 (+1.400)			+ 96.313 (+0.819)			0.71	0.59	5.91*
A 1.48	"Best Fit"	LA	1972/73	-515.868		+177.465 (+1.463)				-77.687** (-3.511)	+41.331 (+1.484)						0.70	0.64	10.64**
A 1.49	HO I	DAO	1972/73	-374.492	+18.264** (+4.626)		-6.167** (-4.006)										0.60	0.55	11.28*
A 1.50	HO II[g]	DAO	1972/73	-1406.582		+459.450** (+4.445)	-1.879 (-1.230)			-52.152** (-3.069)							0.77	0.72	15.47**
A 1.51	NT	DAO	1972/73	-459.672								+96.506* (+2.402)		+125.192 (+1.876)			0.44	0.37	5.86*
A 1.52	HOI/NT	DAO	1972/73	-1993.317		+718.507* (+2.845)	-5.945* (-3.014)				-12.169 (-0.435)			- 60.122 (-0.572)			0.63	0.52	5.42*
A 1.53	HOII/NT	DAO	1972/73	-1776.446		+680.194* (+3.600)	-3.102 (-1.826)			-57.988* (-3.363)	-29.415 (-1.366)			- 74.656 (-0.949)			0.81	0.73	10.04*
A 1.54	"Best Fit"	DAO	1972/73	- 1.604	+17.915** (+4.488)		-2.898 (-1.512)			-38.836* (-2.271)		-88.378 (-2.080)				-142.459** (-2.603)	0.85	0.79	13.28**

Table A 1 - continued

Table A 1 - continued

*Significant at 5 p.c. according to t - / F - test. - **Significant at 1 p.c. according to t - / F - test. - t - values in brackets.

[a]Measured as $\ln \frac{x_{ijt}}{m_{ijt}} : \frac{X_{jt}}{M_{jt}}$, where x_{ijt} and m_{ijt} refer to exports and imports of branch i in trade with region j at time t and X_{jt} and M_{jt} refer to the respective figures for manufacturing as a whole. - [b]HO I: Factor-Proportions-Theorem without natural resources; HO II: Factor-Proportions-Theorem with natural resources; NT: Neo-Technology-hypothesis; HO/NT: Combines hypothesis. - [c]FEEC: Former EEC (The Six"); ONWE: Other Northern and Western Europe; OSE: Other Southern Europe; NA: North America; JAP: Japan; ODME: Other developed market economies (Australia, New Zealand, South Africa); DA: Developing Africa; LA: Latin America; DAO: Developing Asia and Oceania. - [d]c: Constant term; ln: Natural logarithm; HCI: Human capital intensity; PCI: Physical capital intensity; RMI: Raw material intensity; RD: Innovativeness; SE: Scale economies; ERP: Effective rate of protection. For measurement concepts see para. 4.- [e]Complementary hypotheses. For details see para. 10. - [f]Competing hypotheses. For details see para. 10. - [g]Dominant hypothesis. For details see para. 10.

Source: See Table 2.

Tabelle A 2 - The Relationship between West German Industry's Competitiveness in Trade with the World, Major Economic Regions and Economic Sub-Regions[a] and Various Measures for Innovativeness[b] - Simple Coefficients of Correlation, 1972/73 (n = 18)

Region \ Innovativeness as measured by	RD	ln RD	RDE	ln RDE	RDS_1	ln RDS_1	RDS_2	ln RDS_2	RDS_3	ln RDS_3	RDS_4	ln RDS_4	RDS_5	ln RDS_5
World	+ 0.72	+ 0.78	+ 0.60	+ 0.58	+ 0.45	+ 0.40	+ 0.62	+ 0.70	+ 0.44	+ 0.46	+ 0.60	+ 0.61	+ 0.53	+ 0.54
Developed Market Economies	+ 0.68	+ 0.77	+ 0.57	+ 0.55	+ 0.37	+ 0.31	+ 0.59	+ 0.66	+ 0.43	+ 0.44	+ 0.55	+ 0.55	+ 0.50	+ 0.49
Developing Market Economies	+ 0.51	+ 0.60	+ 0.48	+ 0.51	+ 0.33	+ 0.41	+ 0.40	+ 0.55	+ 0.28	+ 0.36	+ 0.40	+ 0.52	+ 0.35	+ 0.44
Centrally Planned Economies	+ 0.64	+ 0.67	+ 0.51	+ 0.52	+ 0.42	+ 0.43	+ 0.66	+ 0.69	+ 0.50	+ 0.51	+ 0.61	+ 0.62	+ 0.57	+ 0.57
Former EEC ("The Six")	+ 0.52	+ 0.62	+ 0.32	+ 0.28	+ 0.26	+ 0.23	+ 0.45	+ 0.50	+ 0.26	+ 0.23	+ 0.41	+ 0.40	+ 0.34	+ 0.31
Other Northern and Western Europe	+ 0.29	+ 0.12	+ 0.35	+ 0.35	+ 0.12	+ 0.10	+ 0.26	+ 0.30	+ 0.18	+ 0.23	+ 0.24	+ 0.24	+ 0.22	+ 0.24
Other Southern Europe	+ 0.52	+ 0.44	+ 0.41	+ 0.41	+ 0.28	+ 0.31	+ 0.40	+ 0.52	+ 0.32	+ 0.32	+ 0.41	+ 0.48	+ 0.38	+ 0.40
North America	+ 0.32	+ 0.46	+ 0.23	+ 0.24	- 0.06	- 0.05	+ 0.21	+ 0.25	+ 0.08	+ 0.11	+ 0.12	+ 0.13	+ 0.10	+ 0.12
Japan	- 0.03	- 0.04	+ 0.23	+ 0.24	+ 0.15	+ 0.22	- 0.06	+ 0.15	+ 0.14	+ 0.20	+ 0.02	+ 0.19	+ 0.08	+ 0.20
Other Developed Market Economies	+ 0.60	+ 0.64	+ 0.55	+ 0.54	+ 0.37	+ 0.35	+ 0.59	+ 0.65	+ 0.45	+ 0.46	+ 0.55	+ 0.55	+ 0.51	+ 0.51
Developing Africa	+ 0 63	+ 0.70	+ 0.50	+ 0.55	+ 0.32	+ 0.40	+ 0.59	+ 0.64	+ 0.36	+ 0.43	+ 0.53	+ 0.57	+ 0.45	+ 0.50
Latin America	+ 0.65	+ 0.72	+ 0.50	+ 0.54	+ 0.41	+ 0.46	+ 0.62	+ 0.69	+ 0.49	+ 0.52	+ 0.58	+ 0.63	+ 0.55	+ 0.57
Developing Asia and Oceania	+ 0.47	+ 0.54	+ 0.50	+ 0.50	+ 0.33	+ 0.40	+ 0.33	+ 0.50	+ 0.26	+ 0.33	+ 0.36	+ 0.49	+ 0.32	+ 0.41

[a] Measured as $\ln \frac{x_{ijt}}{m_{ijt}} : \frac{X_{jt}}{M_{jt}}$, where x_{ijt} and m_{ijt} refer to exports and imports of branch i to/from region j at time t and X_{jt} and M_{jt} refer to the respective figures for manufacturing as a whole. - [b] RD: Expenditures on Research and Development in percent of turnover; RDE: Expenditures on Research and Development per employee; RDS_1: R & D- scientists in p.c. of total employees; RDS_2: R & D - engineers in per cent of total employees; RDS_3: R & D - technicians in per cent of total employees; $RDS_4 = RDS_1 + RDS_2$; $RDS_5 = RDS_3 + RDS_4$.

Source: Statistisches Bundesamt Wiesbaden, Fachserie G: Außenhandel, Reihe 7: Sonderbeiträge - Außenhandel nach Ländern und Warengruppen und -zweigen des Warenverzeichnisses für die Industriestatistik, Stuttgart und Mainz, var. iss. - H. Echterhoff-Severitt, Forschung und Entwicklung (FuE) in der Wirtschaft 1973. Beilage zu "Wirtschaft und Wissenschaft", Heft 4/1975, Dezember 1975.

Table A 2 - Determinants of West German Industry's Structure of Competitiveness in Trade with Economic Sub-Regions, 1963/64 and 1972/73 (n = 14)

Eq.No.	Hypothesis[b]	Region[c]	Period	Coefficients[d]													R^2	$\bar{R}^2$	F
				c	HCI	ln HCI	PCI	ln PCI	RMI	ln RMI	RD	ln RD	SE	ln SE	ERP	ln ERP			
A 2.1	HO I[e]	FEEC	1963/64	+343.753	+17.944** (+3.611)			-195.470** (-4.870)									0.68	0.62	11.86**
A 2.2	HO I	FEEC	1972/73	-340.203	+ 3.080* (+2.455)			-136.469** (-5.258)									0.73	0.68	15.15**
A 2.3	HO II	FEEC	1963/64	+276.018	+16.573* (+3.033)			-162.316* (-2.568)	-0.225 (-0.691)								0.70	0.61	7.69**
A 2.4	HO II[e]	FEEC	1972/73	+172.753	+ 2.872* (+2.885)			-79.437* (-2.722)	-0.233* (-2.751)								0.85	0.81	18.65**
A 2.5	NT	FEEC	1963/64	+ 40.450								+71.536 (+1.448)	-0.236 (-0.161)				0.21	0.07	1.45
A 2.6	NT	FEEC	1972/73	+ 13.632								+42.023 (+1.405)	-0.602 (-0.551)				0.16	0.01	1.02
A 2.7	HOI/NT	FEEC	1963/64	-285.488		+183.253 (+1.218)	-4.524* (-2.534)					+22.982 (+0.460)	-0.649 (-0.374)				0.59	0.41	3.22
A 2.8	HOI/NT	FEEC	1972/73	-192.595		+ 73.726 (+0.880)	-2.233* (-4.689)					+16.158 (+0.827)	+0.083 (+0.100)				0.85	0.78	12.92*
A 2.9	HOII/NT	FEEC	1963/64	-176.093		+136.900 (+1.178)	-0.065 (-0.511)			-51.231* (-2.723)		-20.131 (-0.487)	-0.344 (-0.259)				0.79	0.66	5.90*
A 2.10	HOII/NT	FEEC	1972/73	-314.528		+117.322 (+1.449)	-1.873 (-3.851)			-10.528 (-1.664)		- 1.662 (-0.080)	-0.341 (-0.427)				0.89	0.82	12.92*
A 2.11	"Best Fit"	FEEC	1963/64	-305.047		+166.233 (+ 1.565)	-4.468* (-2.752)				+13.812 (+0.225)						0.57	0.44	4.49*
A 2.12	"Best Fit"	FEEC	1972/73	-263.313		+ 94.402 (+ 1.721)	-2.436** (-5.371)				+ 5.658 (+0.489)						0.84	0.79	18.02**
A 2.13	HO I[e]	ONWE	1963/64	+123.935	+19.759** (+3.324)			-122.914* (- 2.560)									0.50	0.41	5.53*
A 2.14	HO I	ONWE	1972/73	+ 57.324	+ 4.909* (+2.718)			- 71.177 (+1.905)									0.40	0.29	3.70
A 2.15	HO II	ONWE	1963/64	- 84.313	+10.657 (+1.105)			+ 20.925 (+0.161)		-41.582 (-1.185)							0.56	0.43	4.29*
A 2.16	HO II	ONWE	1972/73	- 88.960	+ 3.543 (+1.671)			- 6.236 (-0.094)		-14.861 (-1.178)							0.47	0.31	3.01
A 2.17	NT	ONWE	1963/64	-322.098							+76.107 (+1.594)		+66.778 (+1.204)				0.46	0.36	4.63*
A 2.18	NT	ONWE	1972/73	-182.792							+26.690 (+1.738)		+32.660 (+0.716)				0.40	0.29	3.66
A 2.19	HOI/NT	ONWE	1963/64	- 89.763		- 27.807 (-0.192)	+0.031 (+0.018)					+88.605 (+1.749)	+49.932 (+0.564)				0.54	0.34	2.61
A 2.20	HOI/NT	ONWE	1972/73	+ 81.091		- 96.162 (-0.703)	+0.411 (+0.504)					+65.716 (+1.941)	+55.552 (+0.757)				0.48	0.25	2.08
A 2.21	HOII/NT	ONWE	1963/64	- 65.628		- 38.555 (-0.230)	+0.541 (+0.146)		-0.101 (-0.159)			+90.073 (+1.655)	+48.649 (+0.517)				0.54	0.25	1.87
A 2.22	HOII/NT	ONWE	1972/73	+ 60.532		- 89.922	+0.205		+0.034			+64.145	+56.658				0.48	0.16	1.48

Table A 3 - continued

Eq.No.	Hypothesis[b]	Region[c]	Period	Coefficients[d]													R^2	$\bar{R}^2$	F
				c	HCI	ln HCI	PCI	ln PCI	RMI	ln RMI	RD	ln RD	SE	ln SE	ERP	ln ERP			
A 2.23	"Best Fit"	ONWE	1963/64	-322.098							+76.107 (+1.594)			+66.778 (+1.204)			0.46	0.36	4.63*
A 2.24	"Best Fit"	ONWE	1972/73	-182.792							+26.690 (+1.738)			+32.660 (+0.716)			0.40	0.29	3.66
A 2.25	HO I	OSE	1963/64	-894.545		+472.736** (+ 4.205)	-9.275** (-4.213)										0.66	0.60	10.61**
A 2.26	HO I	OSE	1972/73	-1075.355		+348.469** (+ 4.353)	-4.209** (-5.160)										0.72	0.67	14.47**
A 2.27	HO II[e]	OSE	1963/64	-417.776		+287.066* (+ 3.151)	-1.517 (-0.592)			-94.032** (-3.727)							0.86	0.82	20.00**
A 2.28	HO II[f]	OSE	1972/73	-873.753		+284.714** (+ 4.090)	-2.390* (-2.469)			-28.748* (-2.579)							0.83	0.78	16.82**
A 2.29	NT	OSE	1963/64	- 65.130								+127.020 (+ 1.466)	+2.250 (+0.872)				0.39	0.28	3.50
A 2.30	NT[f]	OSE	1972/73	- 46.376								+116.327* (+ 2.581)	+0.140 (+0.085)				0.47	0.37	4.83*
A 2.31	HOI/NT	OSE	1963/64	+469.938	+43.271 (+3.013)			-449.754* (-4.981)				-103.077 (-1.426)	+4.759 (+3.123)				0.67	0.61	15.22*
A 2.32	HOI/NT	OSE	1972/73	+457.517	+ 6.979 (+1.077)			-242.459* (-2.628)				+ 15.079 (+0.242)	+1.737 (+1.148)				0.82	0.74	10.02*
A 2.33	HOII/NT	OSE	1963/64	+158.271	+29.334 (+1.863)			-207.221 (-1.214)		-68.095 (-1.626)		- 87.319 (-1.300)	+3.813* (+2.512)				0.90	0.84	14.93*
A 2.34	HOII/NT	OSE	1972/73	+319.045	+ 6.399 (+0.978)			-180.458 (-1.590)		-15.507 (-0.948)		+13.616 (+0.217)	+1.292 (+0.812)				0.84	0.74	8.11*
A 2.35	"Best Fit"	OSE	1963/64	- 82.091	+27.710 (+1.397)			-58.715 (-0.291)		-108.453* (-2.224)		- 43.081 (- 0.527)					0.83	0.75	10.74**
A 2.36	"Best Fit"	OSE	1972/73	+333.612	+ 9.140 (+1.661)			-189.877 (-1.714)		-19.417 (-1.267)		+ 1.377 (+ 0.023)					0.82	0.74	10.36**
A 2.37	HO I[e]	NA	1963/64	- 18.934	+13.435 (+1.353)		-7.240* (-3.011)										0.51	0.42	5.66*
A 2.38	HO I	NA	1972/73	-138.245	+ 6.686 (+1.766)		-3.378* (-2.416)										0.35	0.23	2.92
A 2.39	HO II	NA	1963/64	+ 83.781	+ 1.638 (0.154)			-27.499 (-0.224)	-1.131 (-1.783)								0.53	0.39	3.75*
A 2.40	HO II	NA	1972/73	- 61.292	+ 5.027 (+1.306)			-32.092 (-0.285)	-0.500 (-1.528)								0.38	0.19	2.05
A 2.41	NT	NA	1963/64	- 70.759								+ 13.987 (+ 0.164)	+0.885 (+0.349)				0.03	-0.15	0.17
A 2.42	NT	NA	1972/73	-172.438								+ 3.381 (+ 0.060)	+2.615 (+1.267)				0.17	0.02	1.18

Table A 3 - continued

Table A 3 - continued

Eq.No.	Hypothesis[b]	Region[c]	Period	Coefficients[d]												R^2	$\bar{R}^2$	F
				c	HCI	ln HCI	PCI	ln PCI	RMI	ln RMI	RD	ln RD	SE	ln SE	ERP	ln ERP			
A 2.43	HOI/NT	NA	1963/64	+281.941	- 6.266 (-0.313)			-162.647 (-1.342)			- 8.959 (-0.077)		+4.103 (+1.910)			0.56	0.36	2.84
A 2.44	HOI/NT	NA	1972/73	+273.809	+ 1.231 (+0.130)			-166.924 (-1.265)			-30.054 (-0.554)		+4.898 (+1.963)			0.51	0.29	2.33
A 2.45	HOII/NT	NA	1963/64	+108.882	- 5.773 (-0.289)			- 68.651 (-0.454)	-0.740 (-1.032)		-15.639 (-0.134)		+3.048 (+1.285)			0.61	0.37	2.51
A 2.46	HOII/NT	NA	1972/73	+126.536	+ 4.503 (+0.435)			-124.111 (-0.868)	-0.311 (-0.859)		-41.870 (-0.738)		+3.639 (+1.244)			0.55	0.27	1.96
A 2.47	"Best Fit"	NA	1963/64	- 18.934	+13.435 (+1.353)		-7.240* (-3.011)									0.51	0.42	5.68*
A 2.48	"Best Fit"	NA	1972/73	-138.245	+ 6.686 (+1.766)		-3.378* (-2.416)									0.35	0.23	2.92
A 2.49	HO I[e]	JAP	1963/64	-418.729	+34.933** (+3.413)		-0.139 (-0.056)									0.72	0.67	13.96**
A 2.50	HO I	JAP	1972/73	-110.473	+ 2.239 (+0.598)		+0.414 (+0.299)									0.11	-0.05	0.68
A 2.51	HO II	JAP	1963/64	-393.427	+27.850 (+2.017)		+3.898 (+0.678)		-0.752 (-0.782)							0.73	0.65	9.18**
A 2.52	HO II	JAP	1972/73	-103.050	+ 4.626 (+0.991)		-3.261 (-0.736)		+0.624 (-0.874)							0.17	-0.08	0.70
A 2.53	NT	JAP	1963/64	-939.651								+32.622 (+0.319)		+236.811 (+ 1.591)		0.36	0.24	3.05
A 2.54	NT	JAP	1972/73	+355.499								+73.273 (+1.406)		- 99.170 (- 1.039)		0.16	0.01	1.01
A 2.55	HOI/NT	JAP	1963/64	-403.898	+59.696* (+2.491)		-4.339 (-1.032)				-165.384 (-1.355)			- 18.137 (-0.156)		0.77	0.67	7.34*
A 2.56	HOI/NT	JAP	1972/73	+540.225	+ 8.688 (+0.961)		-0.299 (-0.136)				+ 14.445 (+0.305)			-224.582 (-1.724)		0.36	0.08	1.26
A 2.57	HOII/NT	JAP	1963/64	-372.934	+54.386 (+1.855)		-1.970 (-0.246)		-0.380 (-0.355)		-149.631 (-1.101)			- 22.818 (-0.186)		0.77	0.63	5.33*
A 2.58	HOII/NT	JAP	1972/73	+513.098	+11.855 (+1.076)		-3.249 (-0.559)		+0.432 (+0.552)		+ 0.742 (+0.013)			-220.024 (-1.620)		0.38	-0.01	0.99
A 2.59	"Best Fit"	JAP	1963/64	-418.729	+34.933** (+3.413)		-0.139 (-0.056)									0.72	0.67	13.96**
A 2.60	"Best Fit"	JAP	1972/73	-110.473	+ 2.239 (+0.598)		+0.414 (+0.299)									0.11	-0.05	0.68
A 2.61	HO I[e]	ODME	1963/64	-1229.977	+67.435** (+5.962)			-673.320** (-7.369)								0.83	0.80	27.34**
A 2.62	HO I[e]	ODME	1972/73	+941.246	+23.358** (+4.645)			-496.730** (-4.775)								0.70	0.65	13.13**

Table A 3 - continued

Table A 3 - continued

Eq.No.	Hypothesis[b]	Region[c]	Period	Coefficients[d]													R^2	$\bar{R}^2$	F
				c	HCI	ln HCI	PCI	ln PCI	RMI	ln RMI	RD	ln RD	SE	ln SE	ERP	ln ERP			
A 2.63	HO II	ODME	1963/64	+816.904	+49.382* (+2.707)			-388.008 (-1.576)		-82.480 (-1.243)							0.85	0.81	19.64**
A 2.64	HO II		1972/73	+772.284	+21.780** (+3.494)			-421.722 (-2.166)		-17.165 (-0.463)							0.71	0.62	8.20**
A 2.65	NT	ODME	1963/64	+376.406								+321.635* (+2.330)	-2.468 (-0.600)				0.37	0.26	3.22
A 2.66	NT	ODME	1972/73	+200.244								+296.694** (+3.632)	-3.106 (-1.040)				0.57	0.49	7.16**
A 2.67	HOI/NT	ODME	1963/64	+1205.697	+71.351* (+2.819)			-711.487* (-4.471)				-48.966 (-0.384)	+1.165 (+0.434)				0.64	0.77	11.59*
A 2.68	HOI/NT	ODME	1972/73	+1145.981	+35.443* (+2.468)			-590.106* (-2.886)				-35.014 (-0.254)	-5.660 (-1.689)				0.78	0.66	7.81*
A 2.69	HOII/NT	ODME	1963/64	+833.869	+54.723 (+1.817)			-422.139 (-1.292)		-81.239 (-1.014)		-30.167 (-0.235)	+0.035 (+0.012)				0.66	0.77	9.51*
A 2.70	HOII/NT	ODME	1972/73	+807.480	+34.026* (+2.374)			-438.541 (-1.765)		-37.907 (-1.059)		-38.590 (-0.282)	-6.746 (-1.937)				0.80	0.66	6.56*
A 2.71	"Best Fit"	ODME	1963/64	+816.904	+49.382* (+2.707)			-388.008 (-1.576)		-82.480 (-1.243)							0.85	0.81	19.64**
A 2.72	"Best Fit"	ODME	1972/73	+772.284	+21.780** (+3.494)			-421.722 (-2.166)		-17.165 (-0.463)							0.71	0.62	8.20**
A 2.73	HO I[e]	DA	1963/64	- 85.331		+662.755** (+ 3.572)		-461.132** (-3.805)									0.60	0.53	8.16**
A 2.74	HO I[e]	DA	1972/73	-760.270		+683.336** (+ 3.214)		-445.158** (-3.669)									0.58	0.50	7.45**
A 2.75	HO II	DA	1963/64	-361.195		+358.241 (+ 1.570)	-2.139 (-0.333)			-118.206 (-1.870)							0.60	0.48	5.10*
A 2.76	HO II	DA	1972/73	-1272.509		+462.181 (+ 2.207)	-2.358 (-0.810)			-76.777* (-2.289)							0.68	0.56	6.67**
A 2.77	NT	DA	1963/64	-331.935								+157.782 (+1.033)		+142.799 (+0.641)			0.26	0.15	2.18
A 2.78	NT	DA	1972/73	-216.355								+198.292 (+1.794)		+ 78.286 (+0.387)			0.38	0.27	3.42
A 2.79	HOI/NT	DA	1963/64	-670.897		+358.923 (+0.722)	-2.385 (-0.316)			-123.615 (-1.738)	- 97.662 (-0.481)			+102.875 (+0.379)			0.63	0.40	2.69
A 2.80	HOI/NT	DA	1972/73	-1050.851		+182.505 (+0.351)	-1.780 (-0.516)			- 68.400 (-1.737)	+ 20.852 (+0.264)			+175.464 (+0.652)			0.68	0.48	3.46
A 2.81	HOII/NT	DA	1963/64	-1211.319		+408.678 (+0.744)	-10.644 (-1.643)				-10.660 (-0.049)			+167.872 (+0.564)			0.49	0.26	2.13
A 2.82	HOII/NT	DA	1972/73	-1043.109		+ 9.497 (+0.017)	- 4.662 (-1.392)				+62.644 (+0.754)			+309.107 (+1.084)			0.56	0.36	2.92

Table A 3 - continued

Eq.No.	Hypothesis[b]	Region[c]	Period	Coefficients[d] c	HCI	ln HCI	PCI	ln PCI	RMI	ln RMI	RD	ln RD	SE	ln SE	ERP	ln ERP	R^2	$\bar{R}^2$	F
A 2.83	"Best Fit"	DA	1963/64	-302.875		+329.590 (+ 1.401)				-140.380* (-2.903)		- 24.559 (-0.163)					0.60	0.48	5.03*
A 2.84	"Best Fit"	DA	1972/73	-492.922		+212.057 (+ 0.794)				-82.824* (-2.651)		+ 78.775 (+0.657)					0.66	0.56	6.46*
A 2.85	HO I	LA	1963/64	+316.331		+762.722** (+ 3.996)		-680.218** (-5.455)									0.73	0.68	14.97**
A 2.86	HO I[e]	LA	1972/73	-529.328		+571.258** (+ 3.803)		-419.220** (-4.890)									0.69	0.63	12.44**
A 2.87	HO II[e]	LA	1963/64	-573.910		+535.094* (+ 2.728)	-11.219 (-2.034)			-110.430 (-2.033)							0.82	0.77	14.78**
A 2.88	HO II	LA	1972/73	-949.494		+340.073 (+ 1.999)	-1.990 (-0.841)			-66.494* (-2.441)							0.68	0.58	7.15**
A 2.89	NT	LA	1963/64	-157.117								+203.480 (+1.011)		+107.460 (+0.366)			0.22	0.08	1.53
A 2.90	NT	LA	1972/73	+204.986								+211.867* (+2.364)		- 49.281 (-0.300)			0.41	0.30	3.88
A 2.91	HOI/NT	LA	1963/64	-1440.382		+462.610 (+0.985)	-18.189 (-3.283)				+8.626 (+0.046)			+237.120 (+0.932)			0.76	0.65	7.25*
A 2.92	HOI/NT	LA	1972/73	-539.863		- 4.535 (-0.010)	- 3.825 (-1.374)				+77.750 (+1.125)			+159.142 (+0.671)			0.56	0.36	2.92
A 2.93	HOII/NT	LA	1963/64	-951.182		+417.570 (+1.006)	-10.713 (-1.701)			-111.898 (-1.864)	-70.130 (-0.414)			+178.284 (+0.786)			0.84	0.74	8.15*
A 2.94	HOII/NT	LA	1972/73	-546.652		+147.183 (+0.347)	- 1.298 (-0.462)			- 59.982 (-1.872)	+41.101 (+0.640)			+ 41.963 (+0.192)			0.70	0.51	3.69
A 2.95	"Best Fit"	LA	1963/64	+ 85.328		+239.641 (+ 1.065)				-202.189** (-4.315)	-12.890 (-0.072)						0.74	0.66	9.48**
A 2.96	"Best Fit"	LA	1972/73	-301.164		+110.935 (+ 0.567)				-70.735* (-3.086)	+49.125 (+0.924)						0.69	0.60	7.29**
A2.97	HO I[e]	DAO	1963/64	-260.890	+66.281** (+3.976)		-17.503** (-4.336)										0.64		9.90**
A2.98	HO I[e]	DAO	1972/73	-398.112	+19.138** (+ 5.803)		- 6.509 (-5.344)										0.77		18.46**
A2.99	HO II	DAO	1963/64	-1258.932		+731.551** (+3.851)	-13.791 (-2.592)			-16.528 (-0.314)							0.74		9.37**
A2.100	HO II	DAO	1972/73	-174.317		+551.409** (+ 5.073)	- 3.451* (-2.283)			-31.514 (-1.810)							0.82		14.60**
A2.101	NT	DAO	1963/64	-1161.514								+60.487 (+0.409)		+328.924 (+ 1.527)			0.36	0.24	3.08
A2.102	NT	DAO	1972/73	- 512.573								+119.836 (+1.662)		+133.348 (+ 1.010)			0.46	0.30	4.74*

Table A 3 - continued

Table A 3- continued

Eq.No.	Hypothesis[b]	Region[c]	Period	Coefficients[d] c	HCI	ln HCI	PCI	ln PCI	RMI	ln RMI	RD	ln RD	SE	ln SE	ERP	ln ERP	R^2	$\bar{R}^2$	F
A2.103	HOI/NT	DAO	1963/64	-1938.225		+797.679 (+2.294)	-16.503 (-4.022)				-176.856 (-1.284)			+175.311 (+0.930)			0.80	0.71	9.15*
A2.104	HOI/NT	DAO	1972/73	-2059.120		+658.168 (+2.234)	- 5.700 (-3.268)				- 11.921 (-0.275)			+ 6.409 (+0.043)			0.76	0.65	7.05*
A 2.105	HOII/NT	DAO	1963/64	-1813.522		+786.198 (+2.168)	-14.597* (-2.654)			-28.524 (-0.550)	-196.932 (-1.331)			+160.313 (+0.809)			0.81	0.69	6.81*
A 2.106	HOII/NT	DAO	1972/73	-2063.439		+754.675* (+2.862)	- 4.092* (-2.342)			-38.154 (-1.913)	- 35.233 (-0.882)			- 68.128 (-0.500)			0.83	0.72	8.04*
A 2.107	"Best Fit"	DAO	1963/64	- 64.555	+78.501* (+2.619)		-16.201 (-2.230)			- 3.947 (-0.051)		-152.128 (-0.959)				-141.434 (-1.124)	0.72	0.61	4.14*
A 2.108	"Best Fit"	DAO	1972/73	- 445.531	+21.610** (+3.693)		- 5.491* (-2.511)			-32.279 (-1.323)		- 76.180 (-0.910)				- 5.652 (-0.184)	0.83	0.72	7.95**

*Significant at 5 p.c. according to t- / F- test. - **Significant at 1 p.c. according to t- / F- test. - t-values in brackets.

[a]Measured as $\ln \frac{x_{ijt}}{m_{ijt}} : \frac{X_{jt}}{M_{jt}}$ where x_{ijt} and m_{ijt} refer to exports and imports of branch i in trade with region j at time t and X_{jt} and M_{jt} refer to the respective figures for manufacturing as a whole. - [b]HO I: Factor-Proportions-Theorem without natural resources; HO II: Factor-Proportions-Theorem with natural resources; NT: Neo-Technology-Hypothesis; HO/NT: Combined Hypothesis. - [c]FEEC: Former EEC ("The Six"); ONWE: Other Northern and Western Europe; OSE: Other Southern Europe; NA: North America; JAP: Japan; ODME: Other developed market economies (Australia, New Zealand, South Africa); DA: Developing Africa; LA: Latin America; DAO: Developing Asia and Oceania. - [d]C: Constant term; ln: Natural logarithm; HCI: Human capital intensity; PCI: Physical capital intensity; RMI: Raw material intensity; RD: Innovations; SE: Scale economies; ERP: Effective rate of protection. For measurement concept see para.4. - [e]Dominant hypothesis. For details see para. 10. - [f]Competing hypotheses. For details see para. 10.

Source: See table 4.

Table A 4 - List of Industries

No.	Code[a]	Industry	n=18	n=14
1	68	Erzeugnisse der Ernährungsindustrie, Tabakwaren	1	1
2	25	Steine und Erden	2	
3	51	Feinkeramische Erzeugnisse		2
4	52	Glas und Glaswaren	3	
5	27	Eisen und Stahl	4	3
6	28	NE-Metalle und -Metallhalbzeug		
7	295	NE-Metallguß	5	4
8	22	Mineralölerzeugnisse	6	5
9	40	Chemische Erzeugnisse	7	6
10	53	Schnitt-, Sperrholz und sonst.bearb.Holz		
11	54	Holzwaren	8	
12	55	Holzschliff, Zellstoff, Papier und Pappe		7
13	56	Papier und Pappewaren	9	
14	57	Druckereierzeugnisse usw.		
15	59	Gummi- und Asbestwaren	10	
16	58	Kunststofferzeugnisse	11	8
17	32	Maschinenbauerzeugnisse	12	9
18	33	Straßenfahrzeuge	13	10
19	36	Elektrotechnische Erzeugnisse	14	11
20	37	Feinmechanische und optische Erz., Uhren		
21	38	Eisen-, Blech- und Metallwaren	16	13
22	39	Musikinstrumente, Spiel-, Schmuckwaren usw.		
23	61	Leder		
24	621	Lederwaren einschl. Reiseartikel	17	
25	625	Schuhe		14
26	64	Bekleidung		
27	63	Textilien	18	

[a]Warengruppen und -zweige des Warenverzeichnisses für die Industriestatistik (German Industrial Classification).

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4. H.-R. Krämer, The Changing Principles of International Trade Policy. Kiel, November 1973, 17 p.

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