IMPORT-LED INNOVATION*)

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ABSTRACT

The Austrian textile industry responded to massive foreign competition which mainly came from other industrialized countries with the introduction of more efficient and advanced production techniques as well as with improving product quality and design. The introduction of technical progress has helped the industry to meet foreign competition successfully.

Technical advance in the Austrian textile industry was dominated by two specific features. It was imported from abroad while own research activities played only a minor role.

The import-led growth strategy persued by the Austrian textile industry seems to have been economically successful because of the following reasons.

First, economic models on international diffusion of technology suggest that the impact of diffusion on the growth-rate of productivity will be the greatest in industries with medium-sized relative technological gaps. Accordingly, with an elasticity between .39 and .15 the Austrian textile industry was able to achieve a significant part of its productivity-growth by the import of foreign best practice technology, which was of about the same size as the impact of capital deepening. Furthermore, econometric stability tests of the estimated relationship seem to indicate that the productivity gains obtained by the strategy have increased in the 1970s which might be a possible explanation for the shift that has taken place towards importing technical progress instead of producing it at home.

Second, the import of foreign process innovations has helped the industry to meet international price competition by making improvements in product quality possible thereby lowering the export price elasticity for textile products.

1. INTRODUCTION

The wide discrepancies in productivity growth between countries, industrial sectors and firms led to a debate among economists on the economic forces behind these differences in economic performance. While economists in the tradition of the growth accounting framework stress the importance of differences in the growth rate of capital per worker, economists coming from the area of industrial organization suggest that factors like the amount of R&D, elements of market structure and the degree of exposure to international competition are responsible for the observed diversity in economic success.[1)]

This paper deals with the adjustment of the Austrian textile industry to a changing environment and examines the role played by capital accumulation, technology transfer from abroad and the characteristics of market structure such as the size of firms and foreign competition for the productivity growth performance.

The paper is organized as follows. Section 2 outlines the essential elements of structural change in the Austrian textile industry. In section 3, several hypotheses with respect to the features of technical change in the textile industry are presented and their theoretical background is briefly discussed. Section 4 reports on the methodological procedure pursued in testing the hypotheses, while section 5 presents the empirical results. A final section summarizes the findings and draws policy implications.

2. INDUSTRIAL RESTRUCTURING

In the 1970s and early 1980s, the Austrian textile industry went through rapid industrial change. Between 1970 and 1983, employment has been reduced by 43 per cent, labour productivity has increased by 70 per cent while real output has remained constant. In the same period, 30 per cent of the textile firms went bankrupt. Thus, in contrast to the textile industries in many other western industralized countries, the Austrian textile industry has been able to keep her output level by introducing labor saving automation and by upgrading its equipment which allowed her to meet competition from abroad (table 1).[2)]

TABLE 1: INDUSTRIAL RESTRUCTURING IN TEXTILES

	OUTPUT 1981=100	EMPLOYMENT	PRODUCTIVITY 1981=100	NUMBER OF FIRMS	
1970	88,8	66.965	59,5	1971	714
1983	86,8	38.202	100,3	1984	499

SOURCE: IHS-Database, Austrian Textile Federation

With the beginning of trade liberalization in the late 1960s, the Austrian textile industry has been challenged by massive foreign competition. The import share on textile output rose from .46 in 1970 to .91 in 1983; the export share increased from .43 to .84. Most competitors came from other industrialized countries, while competition from developing countries played only a minor role. More than 70 per cent of all textile imports were from western industrialized countries and almost 60 per cent of textile exports went to these countries (table 2).

This trade pattern - the main concentration of textile trade between Austria and other industrialized countries that is between countries with similar capital-labour endowments - does not conform to the Heckscher-Ohlin theorem according to which trade occurs mainly between countries with different factor endowments. The growing importance of intra-industry textile trade can be explained by recent developments in international trade theory. According to this theory intra-industrial specialization takes place in order to bring the industry in the position to realize economies of scale which involves two-way trade in goods with similar factor content. Because each good is produced under conditions of increasing returns the industry chooses only a limited subset of potential products, while importing the rest with two-way exchanges of similar products resulting from it.[3)]

TABLE 2: TEXTILE TRADE

	1970	1983
EXPORT SHARE	0.43	0.84
IMPORT SHARE	0.46	0.91
TRADE BALANCE IN 1000 AS	-712.4[1)]	-997.5[2)]
MARKET SHARE IN THE OECD IN PER CENT	2.4	2.8[3)]
SHARE OF EEC ON IMPORTS IN PER CENT[4)]	49.7[6)]	69.9
SHARE OF EEC ON EXPORTS IN PER CENT[5)]	20.0[6)]	54.3

SOURCE: OECD, IHS-Database, Austrian Textile Federation

Notes:
1) Ø 1970-76
2) Ø 1977-83
3) 1979
4) not including Switzerland which has a share of about 18 per cent on total textile imports
5) not including Switzerland which has a share of about 15 percent on total textil exports
6) 1971

This specialization within textiles led to losses of shares on the home market and to gains in shares on export markets (between 1970 and 79 the share of Austrian textiles in the OECD increased by 17 per cent) with the textile trade balance somewhat unchanged (table 2).

The structural reorganization described resulted in lower concentration of the Austrian textile industry which has always been dominated by small firms. The share of firms with more than 250 employees on all textile firms has been reduced from 9.1 in 1970 to 6.4 in 1984.[4] The medium sized textile firms showed the highest productivity level which suggest that they profited most from economies of scale. The small firms, in turn, had to rely mainly on R&D in order to remain competitive as their size acted as a constraint in the ability to lower costs (table 3).

TABLE 3: MARKET STRUCTURE AND PERFORMANCE

	SHARE OF FIRMS WITH ... EMPLOYEES ON ALL TEXTILE FIRMS			
	LESS THAN 20	MORE THAN 250	MORE THAN 1000	
1971	41.7	9.1	0.7	
1984	46.1	6.4	0.4	
	TEXTILE FIRMS WITH ... EMPLOYEES			
	0-99	100-499	500-999	1000 and more
EFFICIENCY ACCORDING TO FIRM SIZE[1]	123.786	144.775	152.119	142.888
R&D ACCORDING TO FIRM SIZE[2]	2.1	1.2	0.7[3]	

SOURCE: Austrian Textile Federation, Chamber of Commerce

Notes: 1) Value added per employee in AS in 1976
2) Research and development expenditure as a percentage of sales in 1981
3) Firms with more than 500 employees

Technical change in the Austrian textile industry was dominated by a specific feature. It was imported from abroad. The share of textile machinery imports on investment continuously increased during the 1970's and reached its peak in 1980. Thus, the textile industry achieved the modernization of its equipment mainly through the import of technical know how which was embodied in the machinery acquired from abroad. This behavior of the textile industry as a free rider on foreign R&D allowed her to reduce its own R&D without loosing pace in modernizing its equipment. In the same period the number of patents registered decreased dramatically suggesting besides a different attitude towards patenting that a shift towards importing foreign technical progress instead of producing it at home has taken place (table 4).

TABLE 4: TECHNICAL CHANGE IN THE TEXTILE INDUSTRY

	FOREIGN DIFFUSION[1]	R&D[2]	PATENTS[3]	CAPITAL PER WORKER[7] IN 1000 AS
1972	60.1	0.5	307[5]	204.5
1980	99.9	1.3[4]		
1983	87.6	0.9[6]	20	361.5[8]

SOURCE: Austrian Textile Federation, Chamber of Commerce, Austrian Patent Office, IHS-Database

Notes:
1) Share of textile machinery imports on investment in per cent
2) Research and development expenditure as a percentage of sales in 1981
3) number of patents granted
4) 1975
5) 1974
6) 1981
7) based on 1964 prices
8) 1982

3. IMPORT INDUCED TECHNICAL ADVANCE: HYPOTHESES AND THEORETICAL BACKGROUND

In the paper, the following two hypotheses with respect to the features of technical progress in the Austrian textile industry are put to an econometric test.

(H 1) The Austrian textile industry achieved a substantial part of its productivity growth through an import-led-growth strategy that is by importing foreign-made innovations. The technology transfer from abroad was encouraged by appreciations of the exchange rate, which on the one hand increased the pressure on the textile industry to protect competitiveness through higher productivity and efficiency, and on the other hand reduced costs of transferring technological know how from abroad.

(H 2) In order to meet price competition from the industrialized countries, the industry improved the non-price characteristics of their products by importing high quality machinery equipment from more advanced countries which resulted in a lower price elasticity of foreign demand.

Several reasons why technological diffusion from abroad might be conducive to high productivity growth and rapid technical progress have been suggested in the literature. The view that new technology is primarily embodied in new equipment has led to the development of a class of growth models in which gross investment is the main agent of the diffusion of new technology as new vintages of machines are introduced in the economy. (Salter (1966), Solow (19)). More recently these type of models were extended to illustrate the international diffusion of technology in a world where technical knowledge is embodied in the equipment produced by countries at different stages of technological development.[5] These models of international diffusion of new technology suggest that the rate of technological progress in a relatively "backward" region is an increasing function of the gap between its own level of technology and that of the more "advanced" ones. The greater the backlog of available opportunities to exploit, measured by the distance between the advanced and backward region's current level of development, the faster its rate of growth. This hypothesis of "relative backwardness" suggests that a country or industry with medium sized technological development is an ideal candidat for an import-led growth strategy. For such countries/industries are

viewed to be still surrounded by significantly more advanced countries and at the same time to have already developed considerable absorptive capacity, thus making them potentially most conducive to technological diffusion from abroad. Accordingly, as an industry with medium-sized relative technological gap the Austrian textile industry seems to have all the attributes which makes substantial productivity gains through an import-led growth strategy feasible.

While the models of catching-up stress the importance of a technological gap for the productivity and growth potential in a country/industry, the diffusion models in the area of industrial organization examine the determinants of the willingness to adopt new techniques within a national market.[6] Thereby, it is analyzed whether elements of market structure such as firm size, concentration, R&D and the cost advantage over existing methods have an influence on the speed at which technical innovations spread to other firms and sectors. The present study is inspired by both approaches as catching up in the presence of a technological gap as well as elements of market structure are assumed to have an impact on technical advance in the Austrian textile industry.

4. MODEL AND DATA

For the empirical test of the above hypotheses it is assumed that a Cobb Douglas production function exists for the Austrian textile industry and is given by

$$Q = (A_o e^{dt}) L^{1-\beta} K^{\beta} \qquad (1)$$

where Q is output, K and L are capital and labor inputs respectively with A as a scale parameter increasing exponentially over time, which is supposed to account for shifts in the production function due to technical change. Assuming constant returns to scale, equation (1) can be rewritten in logarithmic form as

$$\ln\lambda = \alpha_o + \beta \ln K/L + dt \qquad (2)$$

relating output per worker λ to the capital labor ratio K/L and technical change t. β is the elasticity of output with respect to capital and d is the productivity residual. β represents the contribution to productivity growth of quantitative changes in the capital intensity while d gives the combined contribution of

qualitative factors such as the introduction of new products and new production techniques. As different empirical studies on productivity show, up to eighty per cent of productivity growth is explained by the productivity residual. Hypothesis 1 assumes that technical change in the Austrian textile industry is substantially influenced by the import of foreign made innovations from more advanced countries. Thus, in order to test (H 1) the residual term in equation 2 is substituted by

$$\ln\lambda = \alpha_o + \beta \ln K/L + \gamma \ln \rho_j + \delta \ln (p_x e/p_f) + \varepsilon \ln CR + d_r t \qquad (3)$$

where $\gamma > 0;\ \delta > 0;\ \varepsilon < 0$

$$\rho_j = \sum_{j=1}^{n} \frac{Im_j}{I} \lambda_j$$

which states that the productivity residual is determined by changes in the diffusion of foreign technology ρ_j, by variations in the pressure of foreign competition as given by international price competitiveness $p_x e/p_f$ and by changes in the concentration rate CR. Diffusion of technology from abroad ρ_j is measured by the share of imported textile machinery Im_j on investment in the textile industry I. The subscript j gives the country of origin of the textile machinery imports weighted by the country's productivity level λ_j which is supposed to capture the technological composition of the capital goods imported from more advanced countries. Thereby it is assumed that the technological content of the imported investment goods is the more advanced the higher the productivity level of the country of origin as compared to those of the Austrian Economy. Thus, the size of import-led productivity growth will depend on two factors. First, on increases in the share of textile machinery imports on total investment. Second, on changes in the composition of new investment imports in favour of technologically more advanced vintages measured by shifts in the structure of machinery imports towards countries with higher productivity levels. The other two variables - international price competitiveness and the concentration rate - determining technical change in equation 3 are supposed to capture the possible link between market structure and innovation assuming that a more competitive market structure provides a greater incentive for innovations.[7] International price competitiveness $p_x e/p_f$ - where p_x is the export price of the textile industry in local

currency, e is the exchange rate and p_f are prices of competitors - is seen to reflect the pressures of foreign competition on the Austrian textile industry due to cheap textile supply from low wage countries and due to the continuous revaluations of the Austrian schilling against the currencies of trading partners.[8] Low prices of textile competitors compared to those of the Austrian textile firms and/or revaluations of the nominal exchange rate are seen to force the textile industry to produce with lower costs in order to protect competitiveness. Thus, stronger foreign competition might have caused the following responses. First, it created an incentive to allocate more resources to organizational changes thereby removing slack and increasing X-efficiency.[9] Second, it created pressures for innovation forcing entrepreneurs to the introduction of more advanced and efficient production techniques which were obtained through the import of foreign-made innovation. In this way losses in price competitiveness are expected to lead to an increase in productivity growth as is suggested in Hypothesis (1). In contrast to price competitiveness which stands for international competition, the concentration rate CR is supposed to capture the degree of competition on the national market. Increases in the concentration rate are expected to lead to lower productivity growth by the same economic reasoning which was put forward for the link between foreign competition and productivity growth.[10]

Hypothesis (2) suggest that the import of foreign process innovations has been associated with the introduction of product innovations which made foreign demand less price elastic. The import-led improvement in the non-price characteristics of textile products is tested by the following export function

$$\ln X = (a_1 + a_2 \rho_j) \ln (p_x e/p_f) + b \ln q_f \qquad (4)$$

with $a_1 < 0$; $a_2 \rho_j > 0$; $b > 0$

where X denotes textile exports, $p_x e/p_f$ price competitiveness and q_f world trade in textiles. As Hypothesis (2) assumes the export price elasticity to be systematically influenced by diffusion of foreign technology ρ_j, the export price elasticity $(a_1 + a_2 \rho_j)$ is split into two parts. a_1 stands for the constant part and $a_2 \rho_j$ for the variable part of the price elasticity. a_1 is expected to have a negative sign, whereas $a_2 \rho_j$ is supposed to be positive if the import of foreign process innovation

made improvements in product quality possible which made prices less important for foreign demand.

As the Austrian trade statistics are organized by an international classification (Standard International Trade Classification SITC) which does not correspond to the Austrian industry classification, the required data for textile exports and the export price of the Austrian textile industry were obtained by a special computation which related the trade statistics to the industry statistics. Furthermore, for the calculation of price competitiveness $p_x e/p_f$ in equation (3) and (4), prices of textile competitors were needed. As international statistics in general show data only on a more aggregate level than is required for an analysis of the textile industry, export prices of OECD-countries for the SITC-category 6+8 were taken as prices of textile competitors. The use of these data cause the following problems which have to be borne in mind when interpreting the estimation results. First, the export price for the SITC category 6+8 does not consist of products of the textile industry only. Second, the SITC-export price index 6+8 of the OECD countries does not really reflect the competitive circumstances with which the Austrian textile industry is confronted. This index reflects the export price development of all OECD countries irrespective whether the respective country in fact is a competitor of the textile industry or not. Furthermore, other competitors of the Austrian textile industry are not taken into account as the export price index excludes the developing countries. The use of this price index as prices of textile competitors underestimates foreign competition of the Austrian textile industry resp. international price competitiveness of Austrian textile firms seems to be better than it really is.[11)]

LIST OF VARIABLES

λ Labour productivity in the textile industry (IHS-Database)

K/L Capital-labour ratio in the textile industry (IHS-Database)

ρ_j Foreign diffusion (Austrian trade statistics, OECD own calculations)

p_x Textile export price index in AS (IHS computation)

X Textile exports based on 1976 prices (IHS computation)

e US Dollar exchange rate AS/US $ (IHS-Database)

p_f SITC-export price index of the OECD-countries in US Dollar, SITC 6+8 (UN Year Book of International Trade Statistics)

q_f World Trade in manufactures, SITC 5-9, based on 1970 prices, (UN Year Book of International Trade Statistics)

CR Concentration rate as measured by the share of firms with more than 250 employees on all textile firms (Austrian Textile Federation)

5. ESTIMATED PROCESS AND PRODUCT INNOVATION

The quantitative impact of import-led productivity growth which is obtained by estimating productivity equation (3) is shown in table 5. The regression results provide evidence for the significant contribution of the import of foreign technical change to the productivity performance of the Austrian textile industry. Without the inclusion of $p_x e/p_f$ the estimated γ has about the same size as β which suggests that foreign diffusion has equal importance in its impact on textile productivity growth as capital deepening. A 1 per cent increase in technology diffusion from abroad due to an increase in the share of imported textile machinery on total investment and/or due to shifts in the structure of imported capital goods towards countries with higher technological development increased productivity growth by .36 per cent, while those in the capital-labour ratio by .46 per cent (row 2).

The inclusion of the real exchange rate changed the estimated γ somewhat suggesting that a certain dependence between $p_x e/p_f$ and ρ_j might have biased the coefficients due to multicollinearity (row 4 and 5). Exchange rate appreciations might have had an influence on the speed of diffusion of foreign made innovations through the following channels. First, by making foreign machinery cheaper thereby reducing the costs of transfering foreign technology, revaluations might

have made the import of foreign technology feasible also for smaller firms for which the transfer costs acted as a constraint. Second, revaluations tended to increase cash flows of exporting textile firms in the short run thereby removing potential constraints in financing the import of foreign innovations. The short run increase in cash flows occured, because exchange rate revaluations reduced costs of imported inputs immediately while leaving export performance unchanged in the short run. It took in general one year until 2/3 of the effect of an export price increase was reflected in exports (Marin 1985, 1986). The estimated δ might, therefore, capture the impact of the exchange rate on productivity via an exchange rate induced acceleration of the rate of diffusion of foreign technology as well as via exchange rate induced pressures to increase productivity in order to protect competitiveness.

TABLE 5: IMPORT-LED PROCESS INNOVATION
(Equation 3)

No.	time period	β	γ	δ	ε	d	R^2C	DW	S.E.100
1	1965-82	.35 (4.97)	.39 (6.04)				.966	0.6	5.9
2	1965-82	.46 (7.68)	.36 (7.53)		-.21 (3.75)		.974	0.8	4.4
3	1965-82	.88 (19.66)			-.26 (2.3)		.885	0.6	9.2
4	1971-80	.31 (4.17)	.15 (3.77)	.28 (3.07)		.03 (3.52)	.986	1.7	1.6
5	1971-80	.29 (2.97)	.17 (2.55)	.31 (2.56)	-.06 (.37)	.02 (3.24)	.984	1.6	1.7

Note: Equations were estimated in logarithm; t-ratios in parentheses

The concentration rate CR as measured by the share of firms with more than 250 employees on all textile firms has a statistically significant impact on textile productivity only when $p_x e/p_f$ is excluded from the regression. This indicates that

multicollinearity problems are also involved between these two variables. Although due to multicollinearity the values of the estimated coefficients should not be taken too seriously, δ and ε had in all specifications (with or without one another) the expected sign suggesting that a more competitive market structure favoured technical innovations in textiles as is assumed in (H1).

In order to investigate whether the productivity gains obtained by an import-led growth strategy have changed over time, stability tests of several versions of equation (3) were performed which are reported in table 6. The Quandt test identified a structural break in specification 1 of equation (3) in 1967 which was not rejected by the Chow test. A comparison of the estimated parameter γ between the two regimes seems to suggest that the productivity gains through the import of foreign made innovations have increased in the 1970's which might explain why a shift towards importing technical change instead of producing it at home has taken place. In contrast to this, the Chow test for the other two specifications of equation (3) suggests that no structural break has occured in the import-led productivity growth relationship.

TABLE 6: QUANDT AND CHOW TEST FOR STABILITY OF IMPORT-LED PROCESS INNOVATION

No.	time period	Parameter			Quandt-Test	Chow-Test	
1		β	γ				
	1965-67	.75	-.01		structural break 1967	Chow-statistic	9.8
	1968-82	.50	.26			Prob-value*)	.22
2		β	γ	ε			
	1965-72	.53	.37	-.41	structural break 1972	Chow-statistic	3.7
	1973-82	.51	.20	.16		Prob-value*)	4.3
3		β		ε			
	1965-67	.81		-.16	structural break 1967	Chow-statistic	3.45
	1968-82	.79		-.03		Prob-value*)	6.04

Note: Number of equations refer to those in table 5

*) Probability of obtaining an F-ratio at least as large as the test statistic under the null hypothesis. A prob-value smaller than 0.5 indicates rejection of the null hypothesis at the 5 percent significance level.

The regression results for the impact of the import of foreign technology on the ability to improve product quality and design are given in table 7. Two features are noticeable. First, the export price elasticity of the Austrian textile industry appear to be remarkably small (-.11) suggesting that textile exporters operate on markets with monopolistic competition. This is the case even when it is taken into acocunt that the estimated elasticity seems to be on the low side as price competition from developing countries are not included in the price index of textile competitors. Second, the low export price elasticity in the textile industry was also the result of the import of foreign made innovations which made improvements in product quality possible thereby making prices less important for foreign demanders. $a_2 \rho_j$ was found to be positive lowering the export price elasticity (in absolute values) from -.23 to -.11. The coefficient $a_2 \rho_j$ measuring the foreign diffusion induced reduction in the export price elasticity, however, was statistically not significant. This might indicate that product differentiation through the import of process innovation was a feasible option only for the bigger textile firms which represent a small fraction of all textile firms. This interpretation seems also to be supported by the figures reported in table 3 showing that the small firms relied mainly on own R&D in their attempt to improve product quality which suggests that their size acted as a constraint in the ability to import foreign technical progress. The findings are in accordance with those in the Comanor study (1967) in which it was found that research activity was higher in industries where products were differentiable. In these industries there was little evidence that research activity increased with concentration and firm size.

As the development of the recursive regression parameters given by the Cusum Test indicates, the size of import-led product differentiation $a_2 \rho_j$ has been dependent on the size of the constant part of the export price elasticity a_1. The null hypothesis that no structural break occured in equation (4) was not rejected by the test at the 5 per cent significance level as the calculated significance boundary lines were not crossed by the test statistic (table 7).

TABLE 7: IMPORT-LED PRODUCT INNOVATION
(Equation 4)

time period	a_1	$a_2\rho_j$	b	R^2C	DW	SE.100
71-80	-0.23 (2.8)	0.12 (0.66)	0.59 (6.66)	0.929	2.5	3.9

Cusum Test for Parameter Stability

time period	a_1	$a_2\rho_j$	b
71-74	-0.67	0.57	0.63
71-75	-0.58	0.88	0.44
71-76	-0.57	0.58	0.57
71-77	-0.35	0.22	0.62
71-78	-0.34	0.20	0.62
71-79	-0.28	0.17	0.60

Note: t-ratios in parentheses

6. CONCLUSIONS

The empirical evidence found in this paper suggest that the Austrian textile industry responded to massive foreign competition which mainly came from other industrialized countries by introducing more efficient and advanced production techniques as well as by improving product design and quality.

Technical advance in the Austrian textile industry was characterized by two features. It was imported from technological more advanced countries, while own research activities played a role only for the small firms as they were faced with an financial constraint in the technology transfer from abroad.

The import-led growth strategy pursued by the Austrian textile industry seems to have been economically successful because of the following reasons. First, economic models on international diffusion of technology suggest that the impact of diffusion on the growth rate of productivity will be the greatest in industries with medium-sized relative technological gaps. With an elasticity between .39 and .15 the Austrian textile industry achieved a significant part of its productivity

growth by the import of foreign best practice technology, which was of about the same size as the impact of capital deepening. The econometric tests on structural breaks in the estimated relationship seem to indicate that the productivity gains obtained by this strategy have increased in the 1970's which might be a possible explanation for the shift that has taken place towards importing technical progress instead of producing it at home. Second, the import of foreign process innovations has helped the industry to meet international price competition by making improvements in product quality and design possible, which lowered the export price elasticity for Austrian textile products from -.23 to -.11.

FOOTNOTES

1) Denison (1967), Griliches (1984), Growth accounting
Kamien & Schwartz (1982), Caves et al. (1980), Caves (1984), industrial organization

2) The German textile industry showed a similar development, while those of the English, French and American were faced with drastic reductions in textile output. The Italian textile industry, in turn, has even been able to increase output. OECD (1983).

3) See Helpman & Krugman (1985)

4) This measure is used as a proxy for concentration, since the more appropriate eight firm concentration ratio based on value added is not available in Austria.

5) See Gomulka (1979), Gomulka/Sylwestrowicz (1976), Findlay (1978), Gabisch (1975), earlier studies Mac Dougall (1960) and Nelson (1968).

6) See Mansfield (1968), Romeo (1977).

7) The mixture of the production function approach with elements of market structure in explaining productivity in equation 3 is incompatible from a theoretical point of view as the former assumes that firms operate under perfect competition and are always on their production frontier see Nelson (1981). For the theoretical reasoning why more competition is conducive to more innovation and efficiency see Arrow (1962), Leibenstein (1966) and Kamien/Schwartz (1982); a recent paper with a different result Zimmermann (1986).

8) In the period 1970-83 the nominal exchange rate of the Austrian schilling against the currencies of trading partners has increased by more than 50 per cent. For the effect of this policy on prices, profits and structural change see Marin (1984, 1985, 1986).

9) The existence of X-inefficiency is incompatible with the notion of the production function which assumes that firms always operate on the production frontier.

10) As the concentration rate seems not to be completely independent of international price competitiveness some multicollinearity problems might be involved here.

11) As section 2 showed, however, competition from developing countries plays only a minor role in textile trade so that the bias in the estimates through the exclusion of these countries seems not to be considerable.

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