Export-led Growth in the Former CMEA Countries? An Empirical Investigation for Eastern Europe

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Abstract

This paper tries to investigate whether the export-led growth hypothesis is valid for the former European CMEA countries, Bulgaria, Czechoslovakia, the GDR, Hungary, Poland, Romania and the Soviet Union. For testing the validity of the export-led growth hypothesis the paper applies estimations based on "traditional" production functions as well as tests for Granger causality. The estimations in a production function-type framework seem to indicate that, except for Czechoslovakia, there is some evidence for the export-led growth hypothesis. In the context of a vector autoregression the Granger causality tests yield quite different results; the export-led growth hypothesis is rejected. It is interesting that the differing results of those two methods have some tradition in the literature.

The ambiguity of the results is striking from the theoretical point of view: Following the conventional idea of trade within the rigid political framework of centrally planned economies, a clear rejection of the export-led growth hypothesis should be expected.

Zusammenfassung

Diese Arbeit versucht zu untersuchen, ob die "export-led-growth-Hypothese" für die ehemaligen europäischen RGW-Länder Bulgarien, Tschechoslowakei, die DDR, Ungarn, Polen, Rumänien sowie die Sowjetunion Gültigkeit besitzt. Zur Überprüfung dieser Hypothese werden sowohl Schätzungen, welche auf "traditionellen" Produktionsfunktionen basieren, als auch Tests auf Granger-Kausalität durchgeführt. Die Ergebnisse der Schätzungen, welche sich des Produktionsfunktions-Ansatzes bedienen, scheinen außer im Fall der ehemaligen Tschechoslowakei die "export-led-growth-Hypothese" zu bestätigen. Bei Anwendung des Vektor-Autoregressions-Ansatzes gelangt der Test auf Granger-Kausalität allerdings zu signifikant anderen Ergebnissen und legt eine Ablehnung der "export-led-growth-Hypothese" für diese Länder nahe. Das Auftreten unterschiedlicher Ergebnisse bei der Anwendung dieser beiden Methoden hat in der Literatur allerdings bereits eine gewisse Tradition.

Vom theoretischen Standpunkt aus überrascht die Zweideutigkeit der Ergebnisse dennoch: Entsprechend den konventionellen Vorstellungen über Außenhandel im starren Rahmen von Zentralverwaltungswirtschaften wäre eine deutliche Ablehnung der "export-led-growth-Hypothese" zu erwarten gewesen.

Contents

I. Introduction

The export-led growth hypothesis is a concept that tries to explain the empirically observable close relationship between openness to trade and economic growth; a country's participation in the international division of labour is interpreted as one of the most decisive factors for economic growth. This idea caused quite an avalanche of empirical research [see Michaely 1977, Balassa 1978, Heller et al. 1978, Tyler 1981, Feder 1982, Kavoussi 1984, Balassa 1985, Jung 1985, Ram 1985, Chow 1987, Bahmani-Oskooee et al. 1991 and Esfahani 1991 for developing countries and Lubitz 1973, Rothschild 1985, Kunst and Marin 1987, Kunst and Marin 1989, Kugler 1991, Marin 1992 and Serletis 1992 for industrialized countries]. Evidence for the export-led growth hypothesis is mainly available for less developed countries, but it also exists for some Western industrialized countries.

This paper tries to investigate whether in the period between the sixties and eighties a close and causal relationship between exports and growth can be found for the former European CMEA countries, namely Bulgaria, Czechoslovakia, the GDR, Hungary, Poland, Romania and the Soviet Union.

This task cannot be called trivial, since, as everybody knows, in centrally planned economies production and foreign trade were subject to special economic and political conditions, which do not necessarily fit into the line of reasoning of that theory. For instance, one central assumption of the export-led growth hypothesis is the idea of realizing comparative advantages via international trade within the framework of non-regulated, competitive markets - a framework which at first sight was not fulfilled in the former CMEA countries. Nevertheless it seems to be possible that the planned trade relations of the CMEA countries reflected the actually existing pattern of comparative advantage. At any rate an empirical investigation could at least provide some clarification.

Additionally, however, the available data cannot be considered as very reliable. Therefore the results of an empirical study based on those data should be regarded with some caution.

One further restriction to the applicability of our paper's results lies in the fundamental changes in the economic and social structures of the former CMEA countries that are taking place at present and which reduce the predictive power of our results significantly. At first sight, therefore this paper describes an already closed chapter of economic history. But even the pure historical point of view is interesting for at least two reasons:

First, even in the case of a complete break with the old economic structures, a proper analysis of *both* the strong and the weak points of the past is important for the ongoing reforms as a background for future trade policy decisions. Any serious reconstruction has to learn from the past.

Moreover, a second glance offers some additional motivation for such a research: In many cases, the present process of transformation will not be completed from one moment to the next. In the contrary, it can be expected that, differing from country to country, this procedure will take several years. Therefore it seems quite probable that the old structures and regularities will often continue to be effective, at least in the next future. Regarded from this point of view our paper's results might not completely lack any relevance.

In a first section we describe the theoretical background of the export-led growth hypothesis. Based on that, the second section shortly presents the methods which are determining the empirical research and summarizes briefly the main results of already existing studies for less developed and industrialized countries. The third section discusses once again the problematic nature of the available data and points out some crucial deficiencies. The fourth section offers our empirical results, presenting estimations within the framework of a production function as well as such based on vector autoregressions.

where D stands for the production for the domestic market, L_X and K_X represent inputs of labour and capital in the export sector and L_D and K_D the inputs of factors in the non-export sector.

In that model the external effects of the export sector on the domestic sector are simply represented by introducing exports into the production function of the domestic sector. The export sector's lead in productivity is modelled by a percental addition to the domestic sector's marginal productivities at the extent of σ:

$$\frac{X_L}{D_L} = \frac{X_K}{D_K} = 1 + \sigma.$$

Totally differentiating gross domestic product leads to:

$$dY = dD + dX,$$
$$dY = D_K I_D + D_L dL_D + D_X dX + X_K I_X + X_L dL_X ,$$
$$dY = D_K I_D + D_L dL_D + D_X dX + (1+\sigma) D_K I_X + (1+\sigma) D_L dL_X ,$$
$$dY = D_K (I_D + I_X) + D_L (dL_D + dL_X) + D_X dX + \sigma (D_K I_X + D_L dL_X),$$

where $I_D = dK_D$ and $I_X = dK_X$ represent investment and dL_D and dL_X changes in employment of the respective sectors. D_X is the marginal external effect of exports on the output of the domestic sector.

Since $D_K I_X + D_L dL_X = (X_K I_X + X_L dL_X)/(1+\sigma) = dX/(1+\sigma)$, the gross domestic product and its growth rate can be written as:

$$dY = D_K I + D_L dL + \left[\frac{\sigma}{1+\sigma} + D_X\right] dX,$$

$$\frac{dY}{Y} = D_K \frac{K}{Y}\frac{I}{K} + D_L \frac{L}{Y}\frac{dL}{L} + \left[\frac{\sigma}{1+\sigma} + D_X\right] \frac{X}{Y}\frac{dX}{X},$$

where $I = I_D + I_X$ is total investment and $d_L = dL_D + dL_X$ stands for the total increase of employment. $\sigma/(1+\sigma) + D_X$ represents the total effect of the export sector's lead in productivity and its positive external effect on the non-export sector. Finally the growth rate is a result of the factor accumulation and of the gain from shifting factors of

production from the relatively unproductive domestic sector to the relatively productive export sector.

A possible specification for the external effect D_X would be the assumption of a constant elasticity $\theta = D_X X/D$, which would imply for the growth rate:

$$\frac{dY}{Y} = D_K \frac{K}{Y}\frac{I}{K} + D_L \frac{L}{Y}\frac{dL}{L} + \left[\frac{\sigma}{1+\sigma} + \frac{\theta D}{X}\right]\frac{X}{Y}\frac{dX}{X},$$

$$\frac{dY}{Y} = D_K \frac{K}{Y}\frac{I}{K} + D_L \frac{L}{Y}\frac{dL}{L} + \left[\frac{\sigma}{1+\sigma} - \theta\right]\frac{X}{Y}\frac{dX}{X} + \theta\frac{dX}{X},$$

Setting $\sigma/(1+\sigma) = \theta$, reduces the result to:

$$\frac{dY}{Y} = D_K \frac{K}{Y}\frac{I}{K} + D_L \frac{L}{Y}\frac{dL}{L} + \theta\frac{dX}{X},$$

Assuming constant elasticities of production for labour and capital, $\alpha = D_L L/Y$ and $\beta = D_K K/Y$, the growth rate becomes a linear combination of the growth rates of factor supplies and of exports. Adding a constant for Hicks neutral technological progress leads to the above formulation:

$$\frac{dY}{Y} = \frac{dA}{A} + \alpha\frac{dL}{L} + \beta\frac{dK}{K} + \theta\frac{dX}{X}.$$

III. Methodology and empirical results for less developed and industrialized countries

First attempts to test the export-led growth hypothesis applied simple cross country correlations between exports on the one side and gross domestic product, productivity or the GDP growth rate on the other side [Michaely 1977, pp. 49-53]. But this procedure is not very informative since nothing can be said about the direction of the investigated causality.

Even the specification of a production function, in which, besides labour and capital, an indicator for the export performance is used as input in order to assess the validity of the assumed model from the significance of the export coefficient, does not solve the problem completely, since in that way just one of two possible directions of a causal relationship is regarded: Just like the development of exports may be driving the increase of productivity and economic growth, it is not unplausible to assume that the development of exports itself is determined by the development of output [Jung et al. 1985, p. 4].

In recent discussions it has become popular to represent this simultaneity by vector autoregressions[1]. In that context the question after the causal relation between exports and economic growth leads to a test for Granger causality.
The idea is to use the ability of a variable X to improve the prediction of a variable Y as an operational meaningful interpretation of the statement that X causes Y. Finally this causality test ends up in examining whether all coefficients of the variable X in the equation for the variable Y are insignificant or not:

$$X_t = \sum_{i=1}^{p} a_i X_{t-i} + \sum_{i=1}^{p} b_i Y_{t-i} ,$$

$$Y_t = \sum_{i=1}^{p} c_i X_{t-i} + \sum_{i=1}^{p} d_i Y_{t-i} .$$

1) For the theoretical background see Judge et al. [1988, pp. 751-780] and Engel and Granger [1987, pp. 251-276].

The assumption of a causal effect of X on Y is confirmed, if the null hypothesis, that all coefficients c_i are zero, can be rejected. On the other side, a causal relation from Y to X is assumed, if the null hypothesis, that all b_i are equal to zero, can be rejected. A bidirectional causative process is called a feedback system.

Although the export-led growth hypothesis has originally been formulated for developed industrialized countries [see Beckerman 1962, pp. 912-925], the majority of already existing empirical studies is referring to developing countries.

The results are not homogeneous, however. While early analyses applying cross-country correlations or cross-country regressions were supporting the hypothesis [Michaely 1977, Balassa 1978, Tyler 1981, Feder 1982, Kavoussi 1984], more recent studies based on vector autoregressions and tests for Granger or Sims causality offered quite heterogeneous outcomes: Positive results [Chow 1987, Bahmani-Oskooee et al. 1991] are confronted with negative results [Jung et al. 1985]. Recently some studies about industrialized countries applying vector autoregression were presented [Kunst and Marin 1987, Marin 1992 and Serletis 1992]. Their results are not homogeneous either.

IV. Problems concerning the data base

A considerable restriction on the outcomes of our work comes from the poor quality of the available data[2]. First of all there are only 20 to 30 observations and only annual data available.

Further should be mentioned that the Eastern European concept of the "net material product" differs from the welfare indicator "gross domestic product". Based on the Marxian theory of value the net material product just includes the so-called "productive" sectors of the economy, like agriculture, industry, construction, transport of commodities and communication and trade. The so-called "unproductive" sectors include branches like transport of persons, research and development, building administration, education, finance and public administration. In addition to that, the net material product does not include depreciations.

Comparisons with western data for the gross domestic product therefore turn out to be quite difficult: "Experience shows that the GDP may be as much as 10-50 % higher than the corresponding NMP - the difference being greater in countries with higher EDL[3] (and a more developed service sector). It is also growing over time and may vary depending on the rules for establishing the depreciation charges. The different coverage of both indicators has, of course, an impact not only on absolute levels but on growth rates as well" [Havlik 1986, pp. 3-5].

The available trade data are restricted to those productive branches, too. Therefore any analysis based on those data is automatically limited to the "productive" branches and does not necessarily represent the whole economy.

Apart from this methodological difference to western national income accounting systems, it is well known that the official data of centrally planned economies are not of first quality. According to Havlik [1986] it can be assumed that, due to political reasons, a tendency existed to overestimate welfare indicators. Therefore the official data should be treated with some caution.

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2) The data source is the COMECON Data Bank of the Viennese Institute for International Economic Comparisons.

3) "EDL" stands for Economic Development Level.

One problem that appears in the context with trade data is the specific foreign exchange policy of the former CMEA countries. After the Second World War official exchange rates were fixed artificially and had soon lost any substance; domestic currencies were clearly overvalued against convertible currencies. Transactions with western countries took place in convertible currencies, and the conversion of foreign currencies and foreign trade data into units of national currency with official exchange rates resulted in values in so-called "foreign exchange national currency units" or "valuta currencies" - valuta Crowns, valuta Forint or valuta Zloty - which were not identical with domestic currencies. The main consequence of the overvaluation of the CMEA currencies is that the role of foreign trade was strongly underestimated.

Hence the introduction of commercial exchange rates led to abrupt increases of exports and imports. For instance, in Hungary the export quota, the ratio of nominal exports to the nominal net material product, rose in 1976, the year of the exchange rate reform, from 13,2 % to 47,4 %, in Romania in 1981 from 9,9 % to 32,7 %, in Poland in 1982 from 2,1 % to 20 % and in Czechoslovakia in 1989 from 21,9 % to 35,2 %. Equivalent breaks appear for the import shares.

The main reason for those significant breaks simply lies in the shift from the former administrated exchange rates to commercial exchange rates [Havlik 1990]. The breaks imply a strong devaluation of any analysis that has to use this data source. In our analysis we therefore used dummy variables for the respective years to reflect that shift.

V. Empirical Results

In the following the empirical results of our paper are presented. We have pursued two different ways: Chapter 1 shows estimations that were done in the framework of production functions; using a linear regression the growth rate of the real net material product is explained by a constant, the growth rate of the factor supplies and the growth rate of real exports. The significance of the export coefficient is then used to assess the validity of the export-led growth hypothesis.

Chapter 2 is based on bivariate vector autoregressions of productivity - real net material product per employment - and real exports per employment. In case of a rejection of the null hypothesis, that all export coefficients in the productivity equation are zero, one can speak of export-led growth, at least in the sense of Granger-causality. Accordingly the causal effect of productivity on exports can be tested.

1. Estimations in a production function-type framework

In the theoretical framework of a production function the growth rate of the net material product is regressed on a rate of Hicks neutral technological progress, the growth rates of factor supplies and the growth rate of real exports; the significance of the export coefficient can be interpreted as a confirmation of the export-led growth hypothesis.

For most of the countries data are available from 1960 to 1990, for Hungary from 1965 to 1988 and for the GDR from 1960 to 1989. Because of considerable breaks at the end of the period we estimated the regressions only to 1989 or 1988; for Hungary, Poland and Romania we had to use dummy variables for the years of the exchange rate reforms, 1976, 1982 and 1981, respectively (D_H, D_P, D_R).

Tables 1-7 show the results, comparing "conventional" estimations of growth rates with "export-led growth models" using growth rates of real exports as an additional regressor:

$$\frac{dY}{Y} = \frac{dA}{A} + \alpha\frac{dL}{L} + \beta\frac{dK}{K} ,$$

$$\frac{dY}{Y} = \frac{dA}{A} + \alpha\frac{dL}{L} + \beta\frac{dK}{K} + \theta\frac{dX}{X} .$$

Y be the real net material product, L and K the supplies of labour and capital and X real exports. The tables show the R^2, the Durbin-Watson-statistic, the p-value of the Q-statistic ("marginal significance level", p_Q) and in brackets the t-statistics of the coefficients.

Table 1

Bulgaria (1961-1989)

Variable (Coefficient)	"conventional" model	"export-led growth" model
Constant	0,03	0,03
	(5,55)	(4,06)
dL/L (α)	0,5	0,44
	(4,8)	(3,97)
dK/K (β)	0,15	0,12
	(2,28)	(1,85)
dX/X (θ)		0,09
		(1,46)
R^2	0,6	0,63
Durbin-Watson	1,58	1,67
p_Q	0,72	0,84

Table 2

Czechoslovakia (1961-1988)

Variable (Coefficient)	"conventional" model	"export-led growth" model
Constant	0,01	0,01
	(0,7)	(0,46)
dL/L (α)	4,18	4,24
	(6,33)	(6,23)
dK/K (β)	-0,08	0,04
	(-0,21)	(0,09)
dX/X (θ)		-0,04
		(-0,52)
R^2	0,62	0,62
Durbin-Watson	1,76	1,83
p_Q	0,87	0,85

Table 3

GDR (1961-1988)

Variable (Coefficient)	"conventional" model	"export-led growth" model
Constant	0,05	0,05
	(2,69)	(2,54)
dL/L (α)	0,3	0,38
	(0,44)	(0,56)
dK/K (β)	-0,17	-0,18
	(-0,47)	(-0,51)
dX/X (θ)		0,91
		(1,45)
R^2	0,27	0,32
Durbin-Watson	1,95	1,83
p_Q	0,99	0,98

Table 4

Hungary (1966-1988)

Variable (Coefficient)	"conventional" model	"export-led growth" model
Constant	-0,01	-0,01
	(-0,45)	(-0,52)
dL/L (α)	0,86	0,58
	(1,54)	(0,98)
dK/K (β)	0,99	0,78
	(2,1)	(1,57)
dX/X (θ)		0,19
		(1,44)
D_H		-0,58
		(-1,47)
R^2	0,42	0,49
Durbin-Watson	2,11	1,88
p_Q	0,92	0,99

Table 5

Poland (1961-1989)

Variable (Coefficient)	"conventional" model	"export-led growth" model
Constant	0,02	0,01
	(0,92)	(0,47)
dL/L (α)	0,11	0,07
	(0,23)	(0,18)
dK/K (β)	0,36	0,18
	(2,13)	(1,03)
dX/X (θ)		0,37
		(4,26)
D_P		-7,27
		(-4,26)
R^2	0,58	0,75
Durbin-Watson	1,88	2,23
p_Q	0,88	0,15

Table 6

Romania (1961-1989)

Variable (Coefficient)	"conventional" model	"export-led growth" model
Constant	-0,05	-0,03
	(-1,9)	(-1,62)
dL/L (α)	-5,52	-5,02
	(-3,73)	(-3,86)
dK/K (β)	1,31	1,07
	(5,48)	(5,12)
dX/X (θ)		0,17
		(2,24)
D_R		-0,47
		(-2,72)
R^2	0,67	0,81
Durbin-Watson	1,37	1,38
p_Q	0,91	0,57

Table 7

Soviet Union (1961-1989)

Variable (Coefficient)	"conventional" model	"export-led growth" model
Constant	0,02	0,01
	(0,76)	(0,45)
dL/L (α)	0,70	0,42
	(1,71)	(1,02)
dK/K (β)	0,23	0,30
	(0,57)	(0,77)
dX/X (θ)		0,15
		(1,88)
R^2	0,43	0,50
Durbin-Watson	2,04	2,09
p_Q	0,85	0,82

Many estimates for the elasticities of production do not seem meaningful from a theoretical viewpoint, in particular the very high Czechoslovakian labour elasticity (4,18 or 4,24, respectively), and a significant negative labour elasticity for Romania (-5,52 or -5,02, respectively).

For Poland and the GDR, the OLS estimations show comparatively high first order autocorrelation; so we computed regressions with correction for first order auto-correlation.

The results indicate that the export-led growth hypothesis is rejected for Czechoslovakia; the export coefficient is not significant. For Bulgaria, the GDR and Hungary it is significant at the 20 % level, for the Soviet Union at the 10 % level, for Romania at the 5 % level and for Poland even at the 1 % level.

All in all, those results seem to support the export-led growth hypothesis for Eastern Europe. In addition to that, we treated all the production functions as seemingly unrelated regressions with the restriction that all the export coefficients are equal. Table 8 shows the results: The export coefficient is positive and highly significant.

Table 8

Variable (Coefficient)	Bulgaria	Czechoslovakia	GDR	Hungary	Poland	Romania	Soviet Union
Constant	0,04	0,06	0,04	0,00	0,03	-0,05	0,00
	(7,35)	(2,52)	(3,27)	(-0,15)	(1,85)	(-2,91)	(-0,07)
dL/L (α)	0,41	3,1	0,2	0,23	0,07	-2,04	0,96
	(5,31)	(4,39)	(0,31)	(0,59)	(0,18)	(-1,9)	(2,24)
dK/K (β)	-0,02	-0,83	-0,03	0,59	0,18	1,16	0,32
	(-0,44)	(-2,13)	-0,14	(1,69)	(1,18)	(6,73)	(0,86)
dX/X (θ)	0,18	0,18	0,18	0,18	0,18	0,18	0,18
	(6,89)	(6,89)	(6,89)	(6,89)	(6,89)	(6,89)	(6,89)
R^2	0,66	0,44	0,11	0,44	0,28	0,78	0,55
Durbin-Watson	2,42	1,34	1,62	1,39	0,76	1,99	2,43
p_Q	0,81	0,78	0,28	0,99	0,07	0,97	0,18

2. Estimations with vector autoregression

The estimations by vector autoregression include two variables, the logarithms of productivity *(Y)* - real net material product per employment - and real exports per employment *(X)* (figures 1-7).

Table 9 shows the results of the unit-root tests[4]; we applied the Dickey-Fuller test (DF) and the Augmented Dickey-Fuller test (ADF) with drift. At a significance level of 10 %, all the variables except productivity and exports of the GDR and productivity of Romania appear to have a unit root. The differences are all stationary (table 10). The length of the lag which appeared to be appropriate concerning the absence of autocorrelation of the residuals is given in parenthesis (1 stands for the Dickey-Fuller test, a value bigger than 1 for the Augmented Dickey-Fuller test).

Table 11 shows the results of the co-integration tests. The statistics indicate that the null hypotheses of no co-integration can be rejected for all the countries except Czechoslovakia at the 10 % level.

The statistics are based on co-integrating regressions of productivity on exports; the reversed regressions do not change the outcomes significantly.

The implications of the unit-root tests and co-integration tests for the estimation of the vector autoregressions are the following: First, all but three variables - productivity and exports of the GDR and exports of Romania - appear to have a unit root; the appropriate way to use them is to take first differences. Second, exports and productivity of Czechoslovakia are co-integrated; so an error-correction term (e_t) has to be included in that case. For Czechoslovakia, co-integration between exports and productivity already means at least some long-term relationship between those two variables.

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4) The indices used in tables 9 and 10 denote the first letter of the respective countries.

Table 9

Unit root tests for the levels

Variable	DF, ADF
Y_B	0,4 (1)
X_B	-1,99 (2)
Y_C	-1,86 (2)
X_C	-0,37 (2)
Y_G	-2,93 (1)
X_G	-5,1 (1)
Y_H	-2,13 (1)
X_H	-1,13 (1)
Y_P	-1,65 (2)
X_P	-0,4 (1)
Y_R	-2,85 (2)
X_R	-1,01 (1)
Y_S	-2,16 (1)
X_S	-1,05 (1)

Table 10

Unit root tests for the differences

Variable	DF, ADF
DY_B	-4,17 (1)
DX_B	-4,01 (1)
DY_C	-3,77 (1)
DX_C	-2,82 (2)
DY_H	-4,5 (1)
DX_H	-4,5 (1)
DY_P	-2,65 (2)
DX_P	-5,59 (1)
DX_R	-5,74 (1)
DY_S	-5,66 (1)
DX_S	-5,67 (1)

Table 11

Tests for co-integration

Variable	DF, ADF
Bulgaria	0,06 (1)
Czechoslovakia	-4,62 (2)
Hungary	-2,76 (1)
Poland	-1,68 (1)
Soviet Union	-2,57 (1)

We used the Schwartz criterion (SC)[5] for determining the length of the lags. As an upper bound we used a lag of 3 periods. It follows a lag length of 1 period for Bulgaria, the GDR, Hungary, Poland and the Soviet Union, and a lag of 2 periods for Romania. For Czechoslovakia, the optimal lag length is 2 for the pure VAR and 1 for the error-correction model. We used the same time range as for the estimations of the production functions.

In the context of a vector autoregression, however, the breaks in the export series of Hungary, Poland, and Romania in 1976, 1982, and 1981 require a particularly careful treatment. The distorted export values do not only affect the estimation of the export equation in the respective year, but also (according to the number of lags of the process) *both* the export and the productivity equations in the *following* years.

There are several methods to deal with the distorted export values: First, dummy variables might be used not only in the years of the exchange rate reforms, but, according to the order of the process, also in the following (one or two) years. Second, the distortions can be neutralized by an iterative procedure of recalculating the vector autoregression. The recalculation can be done either with the estimated export values substituted for the distorted values or with the distorted values corrected for the distortions estimated via dummy variables in the export equation. Both iterations converge to the same results. Third, instead of the iterative substitution of the distorted export

5) In the context of a VAR the Schwartz criterion is defined as follows: $SC = \ln \det\Sigma + K(\ln T)/T$, where Σ is the variance-covariance matrix of the residuals, K the number of the estimated parameters and T the number of observations. The lag length is selected by minimizing this criterion.

values by OLS estimates, the export values might be replaced by a single-step robust estimation. We applied least absolute deviation estimates [Donninger et al. 1984].

The results of the three methods did not differ significantly. We therefore just present the estimations with LAD corrected outliers.

Tables 12-18 show the results. They list the R^2, the p-value ("marginal significance level") of the Q-statistic and in brackets the t-values of the coefficients.

Table 19 presents the outcomes of the Granger causality tests. It lists the p-values for the null hypotheses that the coefficients of the other variable are all zero. $X \rightarrow Y$ stands for the effect of exports on productivity, $Y \rightarrow X$ for the effect of productivity on exports.

Table 12

Bulgaria

Variable	$\Delta Y_t = f(\Delta Y_{t-i}, \Delta X_{t-i})$	$\Delta X_t = f(\Delta Y_{t-i}, \Delta X_{t-i})$
Constant	0,03 (3,08)	0,05 (2,86)
ΔY_{t-1}	0,06 (0,31)	-0,43 (-0,97)
ΔX_{t-1}	0,03 (0,35)	0,34 (1,62)
R^2	0,01	0,10
p_Q	0,28	0,24

Table 13A

Czechoslovakia,
pure VAR

Variable	$\Delta Y_t = f(\Delta Y_{t-i}, \Delta X_{t-i})$	$\Delta X_t = f(\Delta Y_{t-i}, \Delta X_{t-i})$
Constant	0,02	0,01
	(2,11)	(0,58)
ΔY_{t-1}	0,85	-1,11
	(4,84)	(-2,68)
ΔY_{t-2}	-0,30	1,48
	(-1,70)	(3,62)
ΔX_{t-1}	0,01	0,72
	(0,13)	(4,31)
ΔX_{t-2}	-0,02	-0,19
	(-0,31)	(-1,12)
R^2	0,55	0,60
p_Q	0,65	0,84

Table 13B

Czechoslovakia,
error correction model

Variable	$\Delta Y_t = f(\Delta Y_{t-i}, \Delta X_{t-i}, e_{t-1})$	$\Delta X_t = f(\Delta Y_{t-i}, \Delta X_{t-i}, e_{t-1})$
constant	0,01	0,06
	(1,26)	(4,11)
ΔY_{t-1}	0,63	-1,07
	(3,30)	(-3,26)
ΔX_{t-1}	0,00	0,49
	(0,02)	(4,08)
R^2	0,36	0,67
p_Q	0,71	0,91

Table 14

GDR

Variable	$\Delta Y_t = f(\Delta Y_{t-i}, \Delta X_{t-i})$	$\Delta X_t = f(\Delta Y_{t-i}, \Delta X_{t-i})$
Constant	0,42	1,01
	(3,51)	(3,00)
ΔY_{t-1}	0,84	-0,40
	(15,90)	(-2,69)
ΔX_{t-1}	0,10	1,22
	(3,04)	(13,06)
R^2	1,00	1,00
p_Q	0,01	0,92

Table 15

Hungary

Variable	$\Delta Y_t = f(\Delta Y_{t-i}, \Delta X_{t-i})$	$\Delta X_t = f(\Delta Y_{t-i}, \Delta X_{t-i}, \Delta_H)$
Constant	0,03	0,05
	(2,47)	(2,57)
ΔY_{t-1}	0,21	0,38
	(0,87)	(0,93)
ΔX_{t-1}	-0,01	-0,05
	(-0,08)	(-0,18)
R^2	0,04	0,04
p_Q	0,70	0,93

Table 16

Poland

Variable	$\Delta Y_t = f(\Delta Y_{t-i}, \Delta X_{t-i})$	$\Delta X_t = f(\Delta Y_{t-i}, \Delta X_{t-i}, \Delta P)$
Constant	0,01	0,04
	(1,47)	(2,60)
ΔY_{t-1}	0,82	1,06
	(3,27)	(2,81)
ΔX_{t-1}	-0,18	-0,35
	(-0,97)	(-1,28)
R^2	0,42	0,29
p_Q	0,92	0,57

Table 17

Romania

Variable	$\Delta Y_t = f(\Delta Y_{t-i}, \Delta X_{t-i})$	$\Delta X_t = f(\Delta Y_{t-i}, \Delta X_{t-i}, \Delta R)$
Constant	0,11	0,24
	(2,14)	(2,49)
ΔY_{t-1}	1,85	0,86
	(9,49)	(2,39)
ΔY_{t-2}	-0,88	-0,92
	(-4,58)	(-2,61)
ΔX_{t-1}	-0,19	-0,08
	(-1,76)	(-0,41)
ΔX_{t-2}	0,10	-0,18
	(1,00)	(-0,98)
R^2	1,00	0,58
p_Q	0,83	0,55

Table 18

Soviet Union

Variable	$\Delta Y_t = f(\Delta Y_{t-i}, \Delta X_{t-i})$	$\Delta X_t = f(\Delta Y_{t-i}, \Delta X_{t-i})$
Constant	0,03	0,04
	(4,74)	(2,35)
ΔY_{t-1}	-0,08	-0,05
	(-0,37)	(-0,10)
ΔX_{t-1}	0,03	-0,04
	(0,29)	(-0,18)
R^2	0,01	0,00
p_Q	0,69	0,99

Table 19

Causality tests: p-values

Country	$X \rightarrow Y$	$Y \rightarrow X$
Bulgaria	72,78 %	33,98 %
Czechoslovakia		
Pure VAR	95,18 %	0,53 %
Error correction model	98,62 %	0,35 %
GDR	0,55 %	1,25 %
Hungary	93,98 %	36,41 %
Poland	34,27 %	0,96 %
Romania	17,45 %	0,11 %
Soviet Union	53,07 %	2,08 %

Summing up, it can be said that for all countries except the GDR there is no significant positive effect of exports on productivity. Only in the case of Romania, the null hypothesis for the export coefficients in the productivity equation is rejected at the 20 % level; the sum of the two coefficients is negative, however. Hence the export-led growth hypothesis is rejected by the concept of Granger causality for all those countries, although there exists co-integration between exports and productivity in the case of Czechoslovakia.

The estimation for the *GDR* turns out to be a problem; although levels appear to be stationary, the p-value of the Q-statistic indicates strong autocorrelation for the productivity equation. So the outstanding p-value for the export coefficient should not be taken too seriously.

Figure 1

Productivity and Exports in Czechoslovakia, Differences

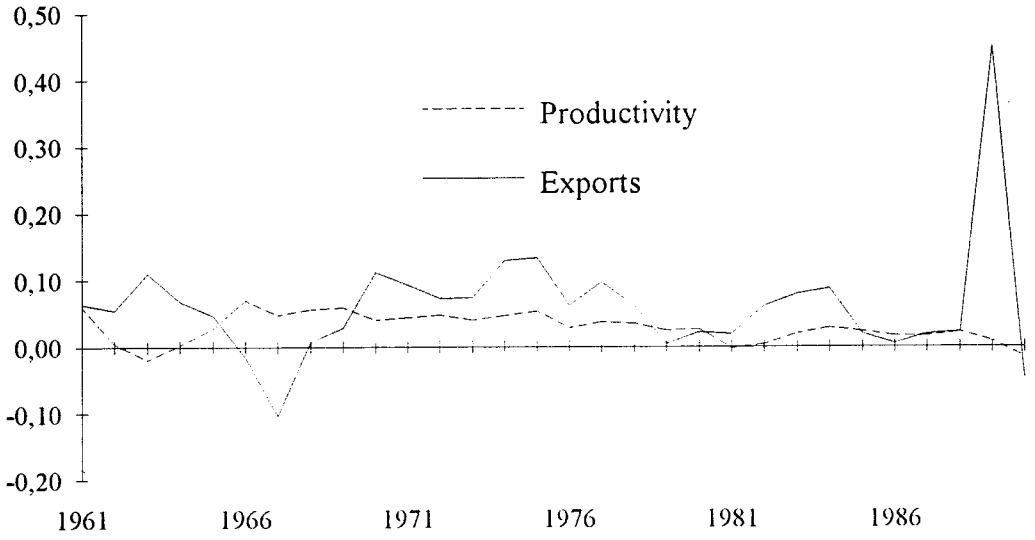


Figure 2

Productivity and Exports of Hungary, Differences

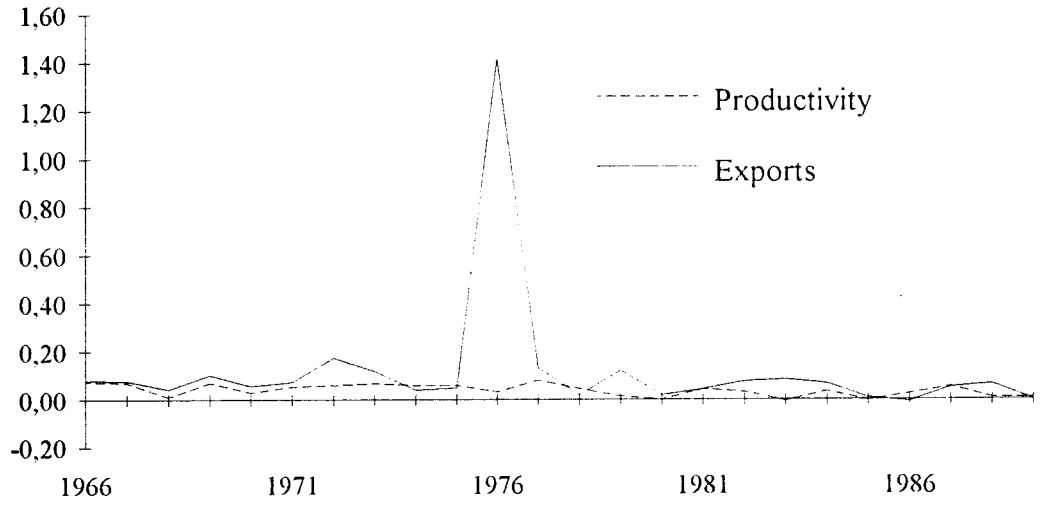


Figure 3

Productivity and Exports of Poland, Differences

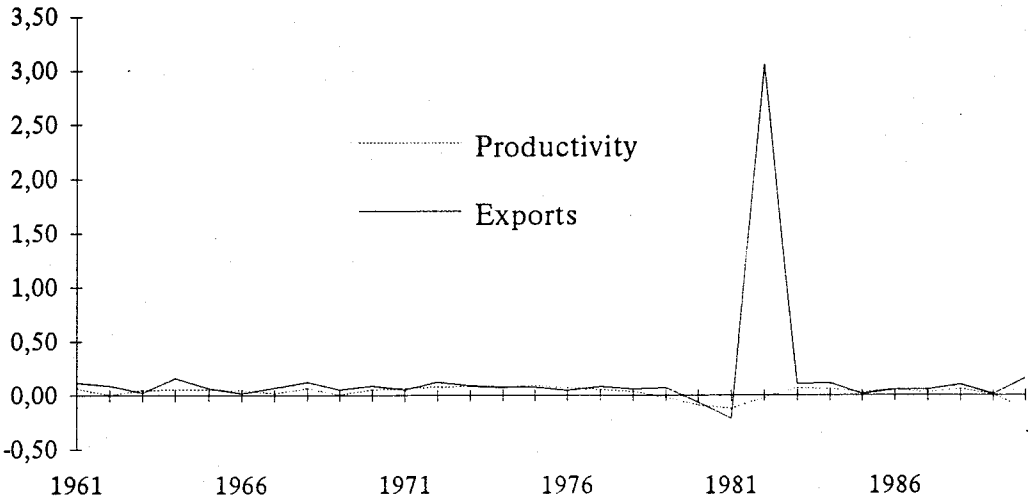


Figure 4

Productivity and Exports of Bulgaria, Differences

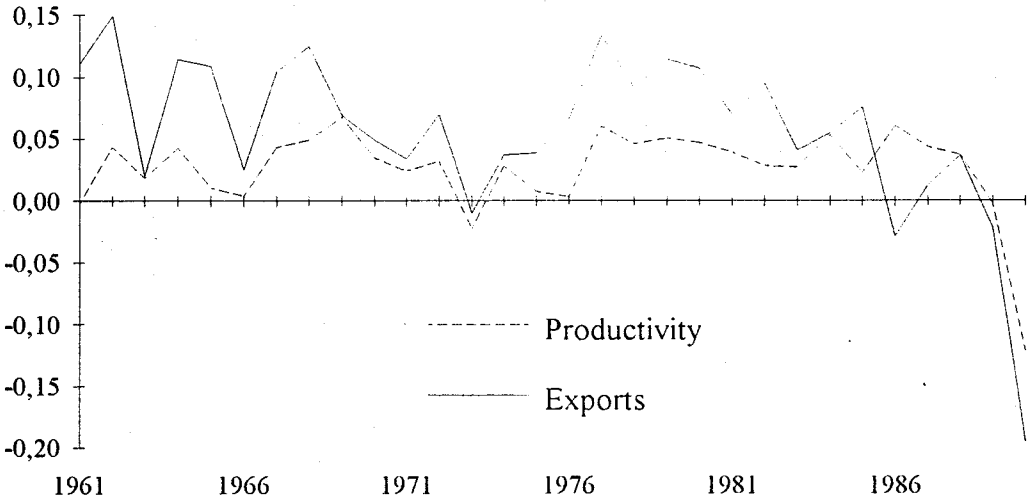


Figure 5

Productivity and Exports of GDR,
Levels

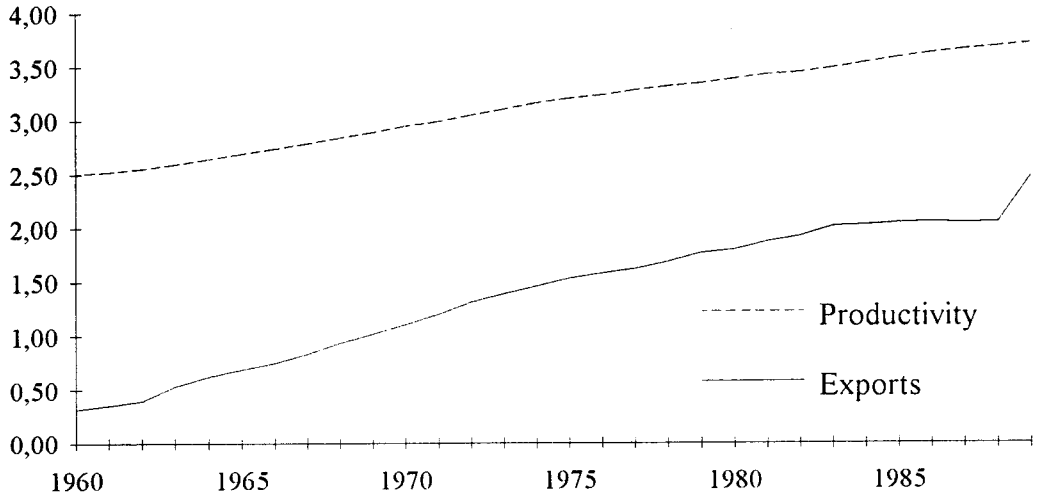


Figure 6

Productivity (levels) and Exports (differences) of Romania

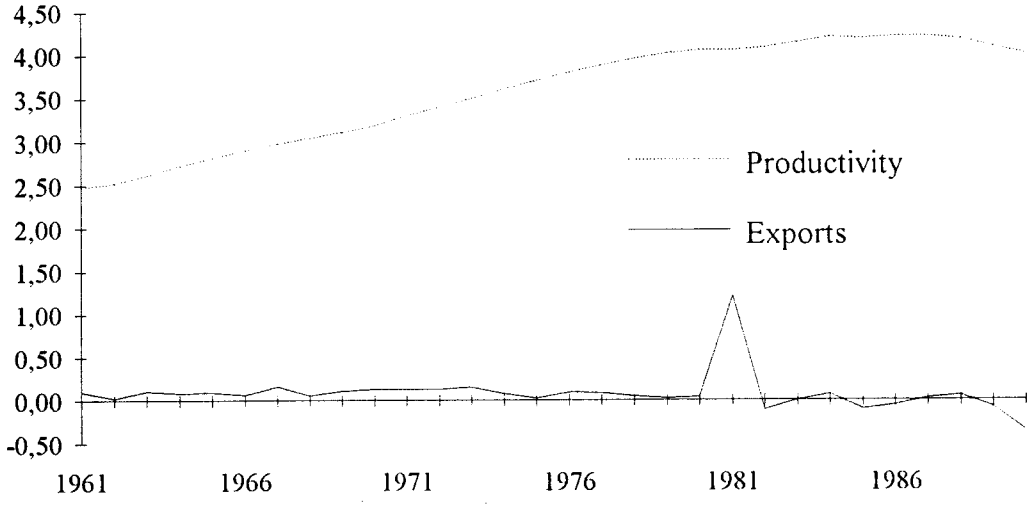
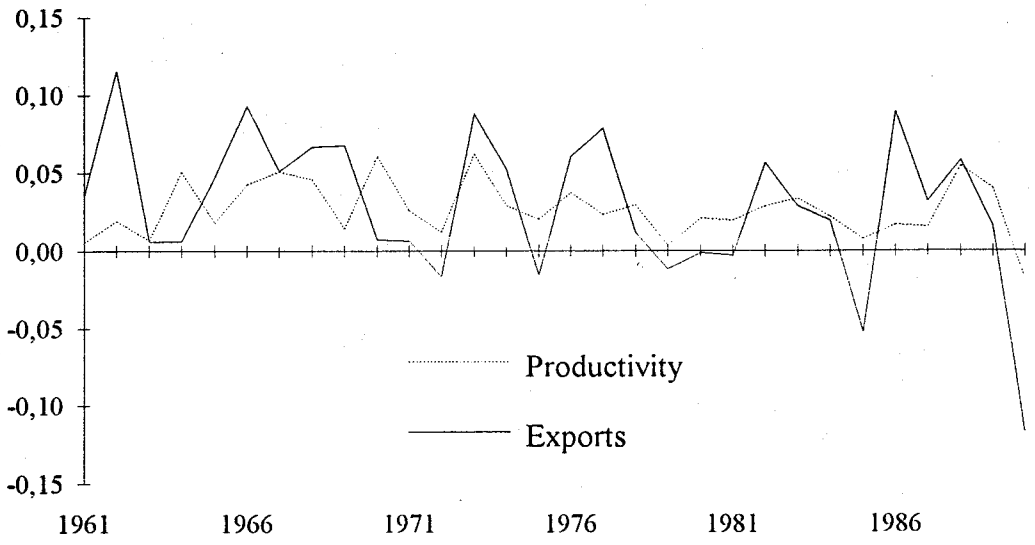


Figure 7

Productivity and Exports of the Soviet Union, Differences



VI. Summary of the empirical analysis

The results of our empirical analysis are not really homogeneous. The estimations in a production function-type framework seem to indicate that, except for Czechoslovakia, there is some evidence for the export-led growth hypothesis. In the context of a vector autoregression, however, Granger causality tests yield quite different results: The export-led growth hypothesis is rejected. It is interesting that the differing results of those two methods have some tradition in the literature.

The ambiguity of the results is striking from the theoretical point of view: Following the conventional idea of trade within the rigid political framework of centrally planned economies, a clear rejection of the export-led growth hypothesis should be expected.

References

Bahmani-Oskooee, Mohsen; Mohtadi, Hamid; Shabsigh, Ghiath, "Exports, growth and causality in LDCs, A re-examination", *Journal of Development Economics* 1991, pp. 405-415.

Balassa, Bela, "Exports and Economic Growth. Further evidence", *Journal of Development Economics* 1978, pp. 181-189.

Balassa, Bela, "Exports, Policy Choices, and Economic Growth in Developing Countries After the 1973 Oil Shock", *Journal of Development Economics* 1985, pp. 23-35.

Chow, Peter C. Y., "Causality Between Export Growth and In-dustrial Development. Empirical Evidence from the NICs", *Journal of Development Economics* 1987, pp. 55-63.

Donninger, Christian; Signor, Camillo; Wasilewski, Zbigniew, Theorie and Praxis von LAD-Schätzern. Institute for Advanced Studies, Vienna, *Research Memorandum No. 201*, June 1984.

Esfahani, Hadi Salehi, "Exports, imports, and economic growth in semi-industrialized countries", *Journal of Development Economics* 1991, pp. 93-116.

Feder, Gershon, "On Exports and Economic Growth", *Journal of Development Economics* 1982, pp. 59-73.

Havlik, Peter, *Comparison of Real Products in East and West 1970-1983*, WIIW Forschungsberichte, Nr. 115, Wien, April 1986.

Havlik, Peter, *Die Wechselkurspolitik der RGW-Länder und Probleme der Konvertibilität*, WIIW Forschungsberichte, Nr. 162, Wien, März 1990.

Heller, Peter S.; Porter, Richard C., "Exports and Growth. An empirical re-investigation", *Journal of Development Economics* 1978, pp. 191-193.

Helpman, Elhanan, "Growth, Technological Progress, and Trade", *Empirica* 1988, pp. 5-25.

Judge, George G.; Hill, R. Carter; Griffiths, William E.; Lütkepohl, Helmut; Lee, Tsoung-Chao, *Introduction to the Theory and Practice of Econometrics*, New York, Chichester, Brisbane, Toronto, Singapore 1988.

Jung, Woo S.; Marshall, Peyton J., "Exports, Growth and Causality in Developing Countries", *Journal of Development Economics* 1985, pp. 1-12.

Heitger, Bernhard, "Import Protection and Export Performance - Their Impact on Economic Growth", *Weltwirtschaftliches Archiv* 1987, Volume 123, pp. 249-61.

Kavoussi, Rostam M., "Export Expansion and Economic Growth. Further Empirical Evidence", *Journal of Development Economics* 1984, pp. 241-250.

Kugler Peter, "Growth, Exports and Cointegration: An Empirical Investigation", *Weltwirtschaftliches Archiv* 1991, Volume 127, pp. 73-82.

Kunst Robert M.; Marin, Dalia, "On Exports and Productivity: A Causal Analysis", *Review of Economics and Statistics* 1989, pp. 699-703.

Kunst Robert M.; Marin, Dalia, "The Export-Productivity Relationship: A Time Series Representation for Austria", *Empirica* 1987, pp. 55-75.

Lubitz, Raymond, "Export-Led Growth in Industrial Economies", *Kyklos* 1973, pp. 307-321.

Marin, Dalia, "Is the Export-Led Growth Hypothesis Valid for Industrialized Countries?", *Review of Economics and Statistics* 1992, pp. 678-88.

Michaely, Michael, "Exports and Growth. An Empirical Investigation", *Journal of Development Economics* 1977, pp. 49-53.

Michaely, Michael, "Exports and Growth. A Reply", *Journal of Development Economics* 1979, pp. 141-143.

Ram, Rati, "Exports and Economic Growth: Some Additional Evidence", *Economic Development and Cultural Change* 1973, Volume 33, pp. 415-425.

Rothschild, Kurt W., "Military Expenditure, Exports and Growth", *Kyklos* 1973, pp. 804-814.

Rothschild, Kurt W., "Exports, Growth and Catching-up: Some Remarks and Crude Calculations", *Weltwirtschaftliches Archiv* 1985, Vol. 121, pp. 304-314.

Serletis, Apostolos, "Export growth and Canadian economic development", *Journal of Development Economics* 1992, pp. 133-145.

Stock, James H.; Watson, Mark W., "Variable Trends in Economic Time Series", *Journal of Economic Perspectives* 1988, pp. 147-174.

Tyler, William G., "Growth and Export Expansion in Developing Countries. Some Empirical Evidence", *Journal of Development Economics* 1981, pp. 121-130.