

Pöyhönen, Pentti; Sullström, Risto

Working Paper

The EES and Trade in Manufactured Goods

ETLA Discussion Papers, No. 340

Provided in Cooperation with:

The Research Institute of the Finnish Economy (ETLA), Helsinki

Suggested Citation: Pöyhönen, Pentti; Sullström, Risto (1990) : The EES and Trade in Manufactured Goods, ETLA Discussion Papers, No. 340, The Research Institute of the Finnish Economy (ETLA), Helsinki

This Version is available at:

<https://hdl.handle.net/10419/187048>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

ETLA

ELINKEINOELÄMÄN TUTKIMUSLAITOS
THE RESEARCH INSTITUTE OF THE FINNISH ECONOMY
Lönnrotinkatu 4 B 00120 Helsinki Finland Tel. 601322 Telefax 601753

Keskusteluaiheita - Discussion papers

No. 340

Pentti Pöyhönen - Risto Sullström

THE EES AND TRADE IN MANUFACTURED GOODS

This series consists of papers with limited circulation intended to stimulate discussion. The papers must not be referred to or quoted without the authors' permission.

PÖYHÖNEN, Pentti - SULLSTRÖM, Risto, THE EES AND TRADE IN MANUFACTURED GOODS. Helsinki : ETLA, Elinkeinoelämän Tutkimuslaitos, The Research Institute of the Finnish Economy, 1990. 14 p. (Keskusteluaiheita, Discussion Papers, ISSN 0781-6847; no. 340).

ABSTRACT: The objective of the present paper is to estimate general effects of the EC internal markets up to the year 1992. Especially, we are interested in the manufacturing trade. The study covers foreign trade data from all OECD countries, the Soviet Union and the other European CMEA countries as aggregate over the period 1970-86. The data is disaggregated into three manufacturing groups, skill-intensive, labour-intensive and capital-intensive products. Using estimates from the estimation period and predicted values of GDP, number of population and R&D of different countries from 1987-92, we calculate and compare two alternative situations: the bloc structure of 1986 remains, and that the EFTA would have joined into the EC (the case of the EES). All the estimated models are gravitation models. The results show that the extended Pöyhönen's model seems to be the most promising. According to the results EFTA high-tech products are growing more rapidly outside the EES, but less than in the EES itself. Labour-intensive products will grow even faster than high-tech goods in the EES, but more slowly in EFTA. Growth in capital-intensive products will be much less than in the other two groups. Compared with the original EFTA the prospects for the EES are favourable. The separate estimate for all groups shows better growth for the EES.

KEY WORDS: integration, EES, gravitation model

THE EES AND TRADE IN MANUFACTURED GOODS¹⁾

by

Pentti Pöyhönen, Emeritus Prof. of Economics, University of Helsinki and

Risto Sullström, Pol.lic., University of Helsinki

Last year there was an item of news in the December issue of Scientific American concerning a group of twenty natural and economic scientists who had held a meeting near Santa Fe, New Mexico. The objective of their tending conference was to discuss common methodological problems in the hunt for new theories of economic activity through the application of insights from other scientific disciplines.

Some economists have proposed a radical departure from economic dogma. It seems that now is the time to make the break, which was initiated by the banker and chairman of Citycorp, John S. Reed. He urged them to "Come up with a new model to explain how the global economy works".

"The occasional forays by physical scientists into economics have usually, but not always, been trivial", says Kenneth J. Arrow. The Santa Fe group has not yet produced a model to help Reed make his next decision, but Citycorp is patient.

Although the mathematical tools employed by economists have become more sophisticated, the models still seem to stray from reality. In an equilibrium framework, economists are hard-pressed to account for persistent irregular fluctuations in the economy - such as the most recent stock market crash. Confounding the theories, technology has often widened rather than narrowed the chasm between rich and poor nations. Moreover, although economists can mathematically prove a state of equilibrium exists, calculating the specific point is often impossible.

The investigators cautiously suggest that any physical model must be extensively reworked before it can accurately describe economic activity. However, Santa Fe could break new ground, says Arrow, both by simulating interdisciplinary projects and by shifting economics away from the stiff mechanism of equilibrium towards a "groping" system more akin to the evolution of the ecological system.

1) The article is a part of the EFFECT Project financed by the Finnish Ministry of Trade and Industry. We are grateful to Mr Kimmo Pöyhönen for the assistance of data collection and Mrs Joan Nordlund for checking the English.

1. The background of the EFFECT project

Pöyhönen formulated a model offering an econometric explanation of practically all possible trade flows between countries in 1959. His article was awaiting publication in the *Weltwirtschaftliches Archiv* for nearly two years, during which time Jan Tinbergen published a very similar model in the appendix of his book "Shaping the World Economy" (1962). This is now known as the **gravity model of international trade flows** and is widely recognized and applied in econometric writing. It has also been considered the best explanatory trade model. E. Linne-mann, a pupil of Tinbergen, explained its association with pure economic theory in his dissertation (1966). Pöyhönen's article covered a limited number of countries (as did Tinbergen's), and soon afterwards the present author, together with his pupil K. Pulliainen, drew up a model using data from 62 countries covering over 90% of total world trade (Pulliainen, 1963).

In 1968, when Finland seemed likely to make a free trade agreement with the EEC, Pöyhönen and Pulliainen planned ERGI (= **Econometric Research Group on Integration**), an extensive econometric future simulation project. It was financed by the Academy of Finland from 1968 to 1972 and involved up to twenty researchers in the Department of Economics at the University of Helsinki. Project reports were published in the Economic Research series of the Department between 1970 and 1973.

The ERGI project was presented at the Econometric World Congress, Cambridge 1970. It was clear that the well-known **LINK Project of prof. Klein** had very similar goals so, in order to avoid further clashes, the ERGI goals became less global and more national (ERGI, 1970). A multi-equation macromodel was used to explain Finnish macroeconomy and trade before and after the EFTA agreement and to describe the various options with or without the EEC.

When the EC made new plans to develop the free market system by 1992, it seemed an ideal opportunity to continue the research in the Department of Economics. The present author and a colleague, Risto Sullström, already a member of the ERGI group, planned a new project, EFFECT (= EFTA, Finland and EC Trade). The Finnish Ministry of Trade and Industry provided a planning and research grant for the period 1 June, 1988 - 28 February, 1990.

2. The goals of the EFFECT Project

The major goals of the project were:

- 1) to estimate the effects of integration on trade flows using the gravity model.
- 2) to assess the economic situation of the countries involved up to 1992.
- 3) using as up-to-date data as possible, and beginning with the 1970s, to project data to 1992.

Some major alterations were made to the model itself:

a) The distance function, so far expressed in nautical miles in gravity model calculations, became the cost function incorporating several new variables. In Pöyhönen's first version (1963), the distance function was already in the form $(a_0 + bD_{ij})^{-d}$, and this was expanded to the cost function, which included all possible non-tariff barriers. The constant a_0 includes effects such as loading, unloading, storage, insurance, language barriers and, in particular, bloc policies. Parameter b explains the distance effect and parameter d the total cost effect in the model. D_{ij} is the distance variable.

b) When the cost function was estimated for different years, the impact of liberalization on the various parameters became apparent. With an a_0 parameter value of a' , it is possible to simulate the free trade situation. Tinbergen claimed that the gravity model describes a free trade situation when $a' = 0$.

c) It was considered unacceptable to use both gross national product (GDP) and population in the same model, as Tinbergen, Bikker (1988) and others did. Gross national product includes the population. There might be some point if GDP/capita yielded relevant information, but it seemed not to do so in this case.

d) Bikker (1988, 1989) used the substitution term in his EGM-model because of the bilateral origin of the gravity model. In the present study, **multilateral effects** were achieved by including **bloc-variables** in the model. These were constructed as follows. If *i* and *j* belonged to the same bloc then the GDPs of both countries were subtracted from the bloc GDP. If *i* and *j* belonged to different blocs, then the GDP of the destination country *j* was subtracted from the bloc GDP of country *j*. This did not involve the calculation of individual bloc parameters, as put forward by Bikker and others, but rather an estimation of those effects on the basis of the model itself. Dummy variables were used in the linear model for the bloc and country effects.

The blocs and countries included in the estimations were the EC (Belgium+Luxembourg, Denmark, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, Spain, United Kingdom), EFTA (Austria, Finland, Iceland, Norway, Sweden, Switzerland), CMEA (Soviet Union, Bulgaria, Czechoslovakia, GDR, Hungary, Poland, Romania) and ROW (Australia, Canada, Japan, New-Zealand, Turkey, USA, Yugoslavia). The number of bloc variables was 15, because trade flows inside the CMEA bloc were excluded.

Thurow (1989) predicted in Davos that the EC liberalization process would reduce world trade. It is an interesting prospect. The best way of giving a multilateral dimension to the model would to be to take all trade flows into account by comparing them for all the countries involved, but this is not statistically possible without losing all the degrees of freedom. It is, however, feasible to simulate global processes using the **electro analog computer** constructed by Pöyhönen in 1964 (Pöyhönen and Pulliainen 1970), which gives exact solutions and vastly ex-

tends the reliability of multilateral models, but it is too simple in construction to produce a good enough simulation model here. The electro-analog model did supply the impetus to move forward in gravity modelling in the EFFECT Project. The first goal was to obtain global-, bloc- and country-level estimates in the changing world in order to promote understanding of the meaning of multilateral economic dependence in the EES.

3. The models in the EFFECT Project

Three types of logarithmic model were examined: **linear, non-linear and system**. Trade flows were estimated separately for high-tech, labour-intensive and capital intensive products (see Haaland & Norman 1987). The linear models were lnlinear (natural log) in parameter. They included a general constant term, dummy-variables, the GDPs of both trading countries, bloc-GDPs and a research and development variable (R&D) as a quotient to measure the relative proportion of used human resources and the distance between partners. The formula is as follows:

$$(1) x_{ij} = c_j Y_i^a Y_j^b \prod B_{kh}^{gk} (R\&D_i/R\&D_j)^m D_{ij}^{-d} u_{ij}$$

Here, trade flow x_{ij} from country i to country j is explained by the GDPs Y_i and Y_j of country i and country j , by the bloc GDPs B_{kh} of country $i \in k$ and $j \in h$, the quotient of R&D, the distance between countries D_{ij} and dummy variables c_j . u_{ij} is the error term.

The non-linear model was constructed by combining the bloc and distance variables into the cost function. The model was:

$$(2) x_{ij} = c_j Y_i^a Y_j^b (R\&D_i/R\&D_j)^m (\sum a_h B_h + b D_{ij})^{-d} u_{ij}$$

which differed from the lnlinear model in the last term, as explained earlier. Here, the coefficient a_0 is decomposed into the bloc coefficients, corresponding to $a_1 = EC$, $a_2 = EFTA$ and $a_3 = ROW$ in the estimated models.

Other variables were also used, such as the number of telephones to measure the telecommunicative effect, border dummies, different bloc dummies, per capita GDPs to measure the effectiveness of integration, blocked distance variables to measure the effect of distance on the trade augmenting power of a customs union etc. Not all the results were included in the report.

4. Results

The most interesting estimates produced by the linear model used in this study were those for the latest year 1986 (Table 1). There were some significant effects, such as GDP, distance and R&D. Others, such as most bloc effects, were not significant. The country constants were plausible but frequently not significant. The total explanation was high measured with the coefficient of determination.

The country effects, measured by GDP were weaker for the exporting country i than the importing country j , which affected all trade groups over the whole period 1970-86. The picture changed when only the most recent data was considered. In group 1, the exporting country and the importing country were estimates approximately equal. They were also similar in the group 2, but in group 3 the importing country effect was as strong as for the whole period. Separate calculations of group totals gave more weight to the importing country's GDP in 1986.

The distance parameter d yielded different values for different groups, in numerical order: -1.17, -0.92, -0.66 and for the total -0.79. Against expectations, high-tech products were most sensitive to distance and, what was less of a surprise, capital-intensive products were least sensitive.

The R&D effect was strongest in group 1 and weakest in group 2 over the whole estimation period.

Table 1. Linear model estimates for 1986 *)

Variable	Group 1 High-tech products	Group 2 Labour-intens. products	Group 3 Capital-intens. products
GDP(i)	0.998 (16.7)	0.707 (11.3)	0.351 (5.92)
GDP(j)	1.114 (5.48)	0.728 (3.44)	1.219 (6.06)
D(ij)	-1.166 (14.9)	-0.921 (11.3)	-0.655 (8.44)
R&D	1.035 (9.37)	0.139 (1.21)	0.926 (8.46)
ECEC	0.121 (0.26)	-0.526 (1.10)	-0.301 (0.66)
ECEFTA	0.351 (0.58)	-0.455 (0.73)	-0.141 (0.24)
ECCMEA	0.013 (0.03)	-0.714 (1.38)	-0.457 (0.93)
ECROW	0.043 (0.10)	-0.586 (1.35)	-0.374 (0.90)
EFTAEC	0.037 (0.08)	-0.569 (1.20)	-0.366 (0.81)
EFTAFTA	0.358 (0.57)	-0.445 (0.68)	-0.124 (0.20)
EFTACMEA	0.010 (0.02)	-0.797 (1.53)	-0.467 (0.95)
EFTAROW	-0.002 (0.01)	-0.656 (1.50)	-0.436 (1.05)
CMEAEC	-0.621 (1.38)	-1.068 (2.27)	-0.724 (1.62)
CMEAFTA	-0.301 (0.50)	-0.880 (1.41)	-0.408 (0.69)
CMEAROW	-0.661 (1.59)	-0.997 (2.31)	-0.799 (1.94)
ROWEC	0.007 (0.02)	-0.609 (1.29)	-0.428 (0.95)
ROWEFTA	0.148 (0.25)	-0.732 (1.17)	-0.320 (0.54)
ROWCMEA	-0.027 (0.05)	-0.740 (1.43)	-0.395 (0.80)
ROWROW	-0.034 (0.08)	-0.641 (1.44)	-0.373 (0.88)
Can	0.882 (1.74)	1.555 (2.94)	0.418 (0.83)
USA	1.340 (1.31)	1.149 (1.08)	0.111 (0.11)
Jpn	0.497 (0.61)	0.552 (0.64)	0.013 (0.02)
Aus	2.512 (7.81)	2.101 (6.27)	1.092 (3.43)
Aut	-1.265 (1.72)	-1.642 (2.15)	-1.773 (2.44)
Fin	-0.552 (0.80)	-1.194 (1.67)	-1.265 (1.86)
Nor	-0.212 (0.31)	-0.607 (0.85)	-1.317 (1.94)
Swe	0.234 (0.29)	-0.612 (0.73)	-0.452 (0.57)
Swi	0.256 (0.32)	-0.480 (0.57)	-0.351 (0.44)
Bel	1.125 (2.33)	0.973 (1.93)	1.599 (3.34)
Dnk	0.489 (1.11)	0.652 (1.42)	0.596 (1.37)
Fra	0.411 (0.54)	0.455 (0.57)	0.528 (0.70)
Ger	1.004 (1.24)	1.123 (1.33)	0.912 (1.14)
Grc	-0.465 (1.24)	0.659 (1.68)	0.568 (1.52)
Ire	0.327 (0.87)	0.555 (1.41)	0.582 (1.56)
Ita	-0.146 (0.20)	0.491 (0.65)	0.295 (0.41)
Nld	1.350 (2.48)	1.086 (1.92)	1.912 (3.55)
Sp	-0.732 (1.31)	-0.317 (0.55)	-0.521 (0.94)
Uk	1.120 (1.56)	1.306 (1.74)	1.231 (1.73)
USSR	-0.641 (0.98)	-1.238 (1.82)	-0.853 (1.32)
Constant	-4.853 (1.24)	1.118 (0.28)	-3.098 (0.80)
R2	0.817	0.817	0.725

*) t-values in brackets, bloc-variables such as ECEF were calculated on the basis of the bloc GDPs of both areas and show the trade effect from EC to EFTA.

Exports between certain blocs were significant for the whole period: the effects for both ECCMEA and EFTACMEA were positive for trade from the EC and EFTA and negative to for trade to them. In group 1, negative estimates were obtained for ROWEFTA and ROWROW and this also applied to the overall results, even for ECROW, EFTAEC, and EFTAROW. Practically all the bloc estimates were insignificant for the latest year in the sample.

Again, the main variables were very significant (significant at the 1% level) in the non-linear model, as was the parameter d of the cost function. The bloc parameters a_1 for the EC and a_2 for EFTA were also very significant, unlike a_3 for ROW in table 2, where the type of cost function used was $d \cdot \ln(a_1 \cdot EC + a_2 \cdot EFTA + a_3 \cdot ROW + b \cdot \text{Dist})$. This was true for every group.

These estimates are more credible than those from the linear model. The totals give even better results. It seems that the non-linear model is better than any other gravity model so far. For group 1, the GDP estimates for the latest year were more weighted towards the exporting country i than the importing country j . The same was also true for group 2, but for group 3 the opposite was the case. R&D was positive for groups 1 and 3, but negative for group 2. All the above results are very significant. Distance was most effective for group 1 and least effective for group 3.

The bloc parameters were negative and very significant for the EC and EFTA, but not for ROW, for which they were positive. The same was true for all groups.

The distance unit cost was lowest in group 3 and high in both other groups.

Table 2 Non-linear model estimates for 1986

Parameter	Group 1 High-tech products	Group 2 Labour-intens. products	Group 3 Capital-intens. products
d	1.291 (15.4)	1.077 (14.5)	0.819 (12.0)
a1	-0.083 (2.79)	-0.092 (3.12)	-0.077 (5.28)
a2	-2.107 (2.68)	-2.671 (5.76)	-1.983 (4.81)
a3	0.309 (0.74)	0.206 (0.55)	0.036 (0.18)
b	2.465 (14.9)	2.474 (14.5)	1.805 (16.7)

Variable			
GDP(i)	0.868 (12.6)	0.659 (10.8)	0.345 (5.81)
GDP(j)	0.653 (6.52)	0.216 (2.46)	0.718 (8.45)
R&D	0.383 (3.25)	-0.338 (3.15)	0.447 (4.41)
Can	1.026 (1.89)	1.888 (3.46)	0.663 (1.65)
USA	2.128 (2.59)	2.945 (3.44)	1.597 (2.73)
Jpn	0.951 (1.51)	1.630 (2.86)	0.931 (1.71)
Aus	2.124 (5.89)	1.782 (5.82)	0.722 (2.62)
Aut	-0.165 (0.31)	-0.046 (0.10)	-0.065 (0.11)
Fin	0.268 (0.30)	0.084 (0.10)	0.167 (0.19)
Nor	0.502 (0.56)	0.585 (0.73)	0.027 (0.03)
Swe	0.865 (1.17)	0.717 (1.14)	0.979 (1.54)
Sch	0.988 (2.26)	0.997 (2.55)	1.187 (3.33)
Bel	0.750 (1.01)	1.033 (1.40)	1.379 (1.91)
Dnk	0.203 (0.23)	0.740 (0.88)	0.414 (0.48)
Fra	0.678 (0.82)	1.451 (1.74)	1.192 (1.41)
Ger	1.281 (1.53)	2.208 (2.85)	1.646 (2.00)
Grc	-0.096 (0.14)	1.120 (1.98)	0.770 (1.45)
Ire	-0.189 (0.26)	0.262 (0.36)	0.036 (0.06)
Ita	0.512 (0.57)	1.736 (2.04)	1.217 (1.37)
Nld	0.951 (1.14)	1.214 (1.52)	1.752 (2.30)
Sp	0.052 (0.07)	0.786 (1.19)	0.296 (0.48)
UK	1.222 (1.34)	2.096 (2.82)	1.706 (2.02)
USSR	-0.444 (0.83)	-0.092 (0.19)	0.182 (0.39)
Constant	0.324 (0.35)	0.794 (0.98)	-2.087 (2.89)

R2	0.605	0.548	0.606

5. Simulating effects and alternatives

The only alternative calculated for was if the EFTA bloc were a member of the EC. The effect would be the difference between the estimates for the two blocs and the one greater bloc, according to previous calculations.

The estimates from alternatives (1) and (2) were calculated as if the EC and EFTA were different blocs and from (3) as if they operated as one common bloc, the EES. Alternative (1) corresponded to the situation in 1986. Alternative (2) assumed that no changes would happen in the bloc structure compared with 1986 and alternative (3) assumed that EFTA would join the EC.

These estimates were based on bloc variable forecasts for GDP, R&D and distance. According to trade elasticity norms the formation of the EES will result in major trade expansion.

There was a noticeable difference in the distance estimates for the different groups. These will increase in the EES bloc when EFTA countries join. The distance effect is smallest for capital-intensive products and greatest for high-tech products.

Table 3 The bloc effects of integration 1987-1992, if the whole EFTA bloc joins the EC, expressed as bloc elasticities in the nonlinear model *).

Products	Alternatives	Total effect			Distance
		EC	EFTA	ROW	
High-tech products	(1)	0.036	0.026	-0.009	-1.34
	(2)	0.054	-0.013	-0.014	-1.32
	(3)	0.185	..	-0.014	-1.46
Labour-int. products	(1)	0.036	0.043	-0.005	-1.15
	(2)	0.060	0.326	-0.008	-1.45
	(3)	0.228	..	-0.008	-1.30
Capital-int. products	(1)	0.040	0.035	-0.001	-0.89
	(2)	0.080	-0.063	-0.002	-0.83
	(3)	0.087	..	-0.002	-0.90
All manuf. products	(1)	0.038	0.036	-0.002	-0.97
	(2)	0.069	0.254	-0.003	-1.22
	(3)	0.380	..	-0.003	-1.27

*) (1) = The situation in 1986, (2) = The situation in 1992, if nothing happens, (3) = The situation in 1992 if EFTA is a part of the EC.

Separate estimates were made for all groups of products and for total trade.

6. The outcome of the EFFECT Project

a) EES and ROW. The effect of the EES on trade in the outside world is not very significant. Manufactured products will decrease very little up to 1992. Trade outside the EES is growing faster than inside, but the balance is changing. There is no support for Thurow's argument of an EES-produced decrease in world trade.

b) The EC and the costs of trade. Lower border tariffs have been in evidence since 1985. That was built into the cost function of the non-linear model. What was surprising was that the drop was greater in EFTA trade than in trade between EC-countries. It was not possible to set $a'=0$ to obtain a free trade situation because the constant in the cost function includes other factors such as language and cultural barriers, which are virtually impossible to eliminate.

c) The manufacturing trade. Trade patterns in different groups of products are changing: EFTA high-tech products are growing more rapidly outside the EES, but less than in the EES itself and there is a possible decline from 1986 levels. Labour-intensive products will grow even faster than high-tech goods in the EES, but more slowly in EFTA. The difference is considerable. Growth in capital-intensive products will be much less than in the other two groups. Compared with the original EFTA, where trade will decrease, the prospects for the EES are very favourable. The separate estimate for all groups also shows better growth for the EES, too. ROW turns out negative in all groups. The biggest decrease is in labour-intensive products, but this is still less than 1 %.

It is interesting to note that the distance effect (in the non-linear model) varies in the EES. The estimate for d shows an increase from -1.32 to -1.46 for group 1, a decrease from -1.45 to -1.30 for group 2

and an increase from -0.83 to -0.90 for group 3. The tendency is similar for all groups and suggests a greater mean distance in the EES compared with the EC. Thus, the EES has less of an impact in the EES-bloc than in the EC-bloc.

d) Differences between countries in the manufacturing trade. Both the linear and non-linear gravity models showed uniform differences between country constants. Not all of them deviated significantly from the model average. In some cases, the length of the distance does not explain the differences which, as far as Europe is concerned, however, are understandable and describe the real situation.

e) Growth and the EES. In gravity models, growth depends on the post-1986 forecasts of the model variables. All forecasts were made using Holt-Winters' Additive Forecast-method (Abraham&Ledolter 1983) for the years 1989-1992. These are not very reliable because the data reveals only limited effects of all possible EC transformations after 1985. Because of these limitations, the forecasts were used only for trade diversion and trade creation calculations.

7. The limitations and other restrictions of the EFFECT Project.

Lacking as it does macrovariables such as employment, balance of payments and finance, the model is only effective for describing the integration effect on trade and its components. Its limitations also extend to cultural and language questions. Pollution was excluded from the project, although it will be included among the key variables in the future.

Cultural and language variables have not been included in gravity model calculations so far, but they could well be new key variables in further research, when international relations are at issue. There are problems of measurement and of language in cross-border communication. Time constraints prevented consideration of these factors in this project, but the authors feel that they will play a significant role in

gravity models in the future.

There is a lot of scope for analysis on the subject of pollution in the whole area and in different countries. The aim here was to assess some of its effects on the economic future, but this would have taken more time than was available. In the opinion of the authors, the gravity model could be particularly suitable for this purpose, incorporating as it does geographical factors such as distance and cost functions.

There were other time restrictions too. Detailed international data is published very late. The calculations were based on 1986 data and some aggregate information was from 1988. The effects of 1992 will not be fully documented until 1994. Meanwhile, the only way of assessing them is by forecasting.

R E F E R E N C E S

- Abraham, B. and Ledolter, J. (1983). *Statistical Methods for Forecasting*, Wiley
- Aitken, N.D. (1973). "The Effect of the EEC and EFTA on European trade: A temporal Cross-Section Analysis", *American Economic Review* Vol.63, No.1, 881-892.
- Bikker, J.A. (1987). "An International Trade Flow Model with Substitution: An Extension of the Gravity Model", *Kyklos*, Vol.40, 315-337.
- Bikker, J.A. (1988). "Internal and External Trade Liberalization in the EEC. An Econometric Analysis of International Trade Flows", *De Nederlandsche Bank N.V.*, March.
- ERGI (1972). "EEC ja Suomen vaihtoehto", *Helsingin yliopiston Kansantaloustieteen laitoksen tutkimuksia* Nr. 18.
- Haaland, I.J. and Norman, V.D. (1987). "Modelling Trade and Trade Policy", *The Scandinavian Journal of Economics* 89(3), 217-226.
- IATA/IAL (1979), *Air Distance Manual*, 6th ed.
- Linnemann, H. (1966). *An Econometric Analysis of International Trade Flows*, Amsterdam, North-Holland Publishing Company.
- OECD (1982). *GERD 1969-82*, Paris.
- OECD (1985). "The OECD Compatible Trade and Production Data Base by D.Blades and W.Simpson", *OECD Working Papers* No 18.
- OECD (1988). *National Accounts, Detailed Tables 1974-1986*, Paris.
- OECD (1989). *National Accounts 1960-1987*, Paris.
- OECD (1989). *Foreign Trade by Commodities, Vol III*, Paris.
- OECD (1989). *Main Science and Technology Indicators 1982-88*.
- OECD (1989). *Science and Technology Indicators No 3*, Paris.
- OECD (1989). *Monthly Statistics of Foreign Trade*, Paris.
- Pullainen, K. (1963). "A World Trade Study: An Econometric Model of the Pattern of Commodity Flows of International Trade in 1948-60".

Ekonomiska Samfundets Tidskrift, Vol.16, 78-91.

Pöyhönen, P. (1963). "A Tentative Model for the Volume of Trade Between Countries", *Weltwirtschaftliches Archiv, Band 90*, 93-100.

Pöyhönen, P. (1963b). "Toward a General Theory of International Trade", *Ekonomiska Samfundets Tidskrift, Vol.16*, 69-77.

Pöyhönen, P. and Pulliainen, K.-(1970). "World trade structure", the Second World Congress of the Econometric Society, Cambridge. 8th-14th September (Mimeo).

Thurow, L.C. (1989) "Can we sustain Economic Growth in '89, and avoid any Recession in '90s?", *World Economic Forum*.

Tinbergen, J. (1962). *Shaping the World Economy*, New York, 20th Century Fund.

UN Monthly Bulletin (1986). *Comecon Foreign Trade Data*, N.Y.

UN Statistical Year Book (diff. years), N.Y.

UNESCO Statistical Yearbook (diff. years), Paris.

UNESCO (1988). *Statistics and Technology*, Paris.

APPENDIX

The Data. Data from the OECD, sc. COMTAP, 1970-1986 was used in the project. Uniform trade and production data was available for 13 OECD countries. Production data is not used in trade flow analysis. The countries involved included all OECD countries, plus the Soviet Union and small European CMEA-countries together. Following Haaland & Norman (1987), products were classified in three groups 1, 2 and 3, and total manufactured goods in group 4. GDP, population and rates of exchange were taken from the OECD National Accounts, Main Aggregates Vol. I (1988). The shortest air distances quoted in the IATA/IAL Air distance manual were used for the distance variable.

R&D-variables were taken from the OECD Science and Technology Indicator Basic Statistical Series Volume B, Gross National Expenditure on R&D, GERD 1969-1982 (1985), Main Science and Technology Indicators 1982-88 (1989) and from OECD Science and Technology Indicators, Report n:o 3.

The level of information transfer was measured by the number of telephones. The data was taken from the UN and Finnish Statistical Year Books.

The trade data applied to a total of 31 countries (not all were included the estimation; CMEA was aggregated), including about 3/4 of world manufacturing trade.

ELINKEINOELÄMÄN TUTKIMUSLAITOS (ETLA)
THE RESEARCH INSTITUTE OF THE FINNISH ECONOMY
LÖNNROTINKATU 4 B, SF-00120 HELSINKI

Puh./Tel. (90) 601 322
Int. 358-0-601 322

Telefax (90) 601 753
Int. 358-0-601 753

KESKUSTELUAIHEITA - DISCUSSION PAPERS ISSN 0781-6847

- No 313 JUSSI RAUMOLIN, The Transfer and Creation of Technology in the World Economy with Special Reference to the Mining and Forest Sectors. 23.02.1990. 34 p.
- No 314 TOM BERGLUND - LAURA VAJANNE, Korkeopävarmuus valuuttaoptioiden hinnoittelussa. 06.03.1990. 21 s.
- No 315 TOM BERGLUND - EVA LILJEBLOM, The Impact of Trading Volume on Stock Return Distributions: An Empirical Analysis. 15.03.1990. 27 p.
- No 316 PIRKKO KASANEN, Energian säästön määrittely. 06.04.1990. 52 s.
- No 317 PENTTI VARTIA, New Technologies and Structural Changes in a Small Country. 17.04.1990. 15 p.
- No 318 TIMO MYLLYNTAUS, Channels and Mechanisms of Technology Transfer: Societal Aspects from a Recipients Viewpoint. 17.04.1990. 21 p.
- No 319 TOM BERGLUND, Earnings Versus Stock Market Returns; How Betas Computed on These Variables Differ. 24.04.1990. 12 p.
- No 320 VESA KANNIAINEN, Intangible Investments in a Dynamic Theory of a Firm. 27.04.1990. 30 p.
- No 321 ROBERT HAGFORS, Välillisen verotuksen muutosten hyvinvointivaikutukset - Näkökohtia arviointimenetelmistä. 11.05.1990. 23 s.
- No 322 VESA KANNIAINEN, Dividends, Growth and Management Preferences. 23.05.1990. 23 p.
- No 323 PEKKA ILMAKUNNAS, Do Macroeconomic Forecasts Influence Firms' Expectations? 28.05.1990. 26 p.
- No 324 PEKKA ILMAKUNNAS, Forecast Pretesting and Correction. 28.05.1990. 22 p.
- No 325 TOM BERGLUND - EVA LILJEBLOM, Trading Volume and International Trading in Stocks - Their Impact on Stock Price Volatility. 04.06.1990. 23 p.

- No 326 JEAN MALSOT, Rapport du printemps 1990 - Perspectives à moyen terme pour l'économie européenne (Euroopan keskipitkän aikavälin näkymät). 08.06.1990. 31 p.
- No 327 HILKKA TAIMIO, Naisten kotityö ja taloudellinen kasvu Suomessa vuosina 1860-1987, uudelleenarvio. 20.06.1990. 56 s.
- No 328 TOM BERGLUND - STAFFAN RINGBOM - LAURA VAJANNE, Pricing Options on a Constrained Currency Index: Some Simulation Results. 28.06.1990. 43 p.
- No 329 PIRKKO KASANEN, Energian säästö ympäristöhaittojen vähentämiskeinona, päätöksentekokehikko energian ympäristöhaittojen vähentämiskeinojen vertailuun. 01.07.1990. 41 s.
- No 330 TOM BERGLUND - KAJ HEDVALL - EVA LILJEBLOM, Predicting Volatility of Stock Indexes for Option Pricing on a Small Security Market. 01.07.1990. 20 p.
- No 331 GEORGE F. RAY, More on Finnish Patenting Activity. 30.07.1990. 9 p.
- No 332 KARI ALHO, Odotetun EES-ratkaisun ja Suomen linjan taloudelliset perustelut. 01.08.1990. 10 s.
- No 333 TIMO MYLLYNTAUS, The Role of Industry in the Electrification of Finland. 14.08.1990. 35 p.
- No 334 RISTO MURTO, The Term Structure and Interest Rates in the Finnish Money Markets - The First Three Years. 17.08.1990. 27 p.
- No 335 VEIJO KAITALA - MATTI POHJOLA - OLLI TAHVONEN, An Economic Analysis of Transboundary Air Pollution between Finland and the Soviet Union. 01.10.1990. 23 p.
- No 336 TIMO MYLLYNTAUS, Ympäristöhistorian tutkimus Suomessa. 08.10.1990. 35 p.
- No 337 KÅRE P. HAGEN - VESA KANNIAINEN, The R&D Effort and Taxation of Capital Income. 15.10.1990. 34 p.
- No 338 PEKKA YLÄ-ANTTILA - RAIMO LOVIO, Flexible Production, Industrial Networks and Company Structure - Some Scandinavian Evidence. 25.10.1990. 19 p.
- No 339 VESA KANNIAINEN, Destroying the Market for Drugs: An Economic Analysis. 01.11.1990. 32 p.
- No 340 PENTTI PÖYHÖNEN - RISTO SULLSTRÖM, The EES and Trade in Manufactured Goods. 09.11.1990. 14 p.

Elinkeinoelämän Tutkimuslaitoksen julkaisemat "Keskusteluaiheet" ovat raportteja alustavista tutkimustuloksista ja väliraportteja tekeillä olevista tutkimuksista. Tässä sarjassa julkaistuja monisteita on rajoitetusti saatavissa ETLAn kirjastosta tai ao. tutkijalta. Papers in this series are reports on preliminary research results and on studies in progress; they can be obtained, on request, by the author's permission.

E:\sekai\DPjulk.chp/09.11.1990