LINKED INPUT-OUTPUT MODELS FOR
FRANCE, GERMANY AND BELGIUM

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ABSTRACT

This paper presents a provisional method for the linking
of national input-output models. The national models of
Belgium, France and the Federal Republic of Germany are linked
through export equations in which domestic demands of the buying
countries are used to derive the export projections by sector
of each country.

Two national scenarios are presented for comparison with a
"basic case" scenario to illustrate the process. Alternative
growth rates of exports by sector for 1980-87 are compared.

An iterative method of solutions is used: the models are
solved in succession. Convergence was found to take place in
two iterations; a third iteration resulted in virtually no
change.

The method has the drawback that consistency between imports
and exports is not strictly ahdered to. It has the virtues
that new countries can easily be added to the existing set. An
expansion of a set of countries to include the U.S., Canada and
the U.K. is now planned.

Linked Input-Output Models for
France, Germany, and Belgium

In the course of the last two years, there has been rapid development of an international consortium of input-output models and their builders. The consortium now counts models or model-building groups for the United Kingdom, Portugal, France, Belgium, the Netherlands, Federal Republic of Germany, Norway, Sweden, Finland, Austria, Hungary, Bulgaria, India, South Korea, Japan, Canada, and the USA. All of these countries except the Netherlands, Canada, and Japan are presently represented by one or more active groups. There are strong signs of interest in Mexico and Italy.

These models are built with a package of programs designed to take the drudgery out of input-output modelling. The programs provide for behavioral equations for household consumption, exports, imports, investment, inventory change, input-output coefficient change, wage, profit, and price determination. From an initial input-output table, a model can be made in an hour or so. It will have very flexible, easy-to-use facilities for imposing scenarios, making pretty tables, and drawing graphs. But its behavioral equations will be totally naive. That is where the national partner groups come in. They develop the behavioral equations, and much originality, ingenuity, and judgment is hoped for from them. The programs impose no constraints on the behavioral functions, save those inherent in the accounting system.

One of the principal attractions of this family of models to groups interested in building models of their own countries has

been the possibility of linking the models through international trade. In many of the countries modeled, exports are a major source of income. For them, it makes little sense to develop an elaborate model of the domestic economy and then to take exports as exogenous. Within this consortium, this linking is facilitated by the fact that all of the models are built upon the same "skeleton" program "fleshed out" by the national model builders. The common skeleton means that all of the models have not only essentially the same operating manual -- so that one person can operate them all -- but also the same format for their output files. Both of these features simplify the task of linking.

Most of the resources available at IIASA over the last two years for work on this project have gone into helping national partners to get started. Linking will be largely a task to be taken on by Economics Research International, a nonprofit Belgian institution organized for the purpose of furthering this cooperation. The short-cut linking reported in the present paper, however, has been done at IIASA. The full linking task, however, remains a major challenge.

A linking mechanism has long been planned, and equations for it were estimated several years ago (Nyhus,75). This mechanism involves considerable sensitivity to prices, both in determining the share of imports in total domestic use of a product by a nation and in determining the share of each source country in the nation's imports. A full bilateral trade flow model was envisaged for each commodity. The problem with this approach arises from the fact that the price forecasts are usually developed only after the "real," constant-price part of the model

has been working for some time. But export projections are needed from the very outset. We have therefore sought a short-cut method in which prices are not used. Instead, the exports of a particular product by one country in real terms are related directly to the domestic consumption of that product in other countries. In this paper, we report on the first efforts to use this short-cut method.

The full-blown linking mechanism will work in two steps. In the first step, exports, by commodity, of one country will be related to imports, by commodity, of its customer countries. In the second step, imports of a commodity by a country are related to that country's use of the commodity and to relative foreign and domestic prices for that commodity. A full description of the linking mechanism is found in Nyhus(75) and a description of the operation of the whole linked system is found in Nyhus(80).

In the short-cut link, to be used where forecast prices are not available, we have skipped the first step and half of the second and related the exports of one country directly to the domestic demands in the customer countries for the product. Imports are still related to domestic demands and relative international prices, but now the distinction between imports and domestic production in domestic demand is not used in forecasting the exports of other countries. More precisely, we estimate the equation

$$(1) \quad X(t) - (a + b \sum_k w_k D_k(t)/D_k(0)) \ (d/f)^n$$

where X is one country's exports of a particular commodity; w_k is

the fraction of these exports which went to country k in the base year; D_k is the domestic demand for this product in country k; f and d are moving averages of domestic and foreign prices; and n is the price elasticity. Domestic demand is defined statistically as domestic output plus imports minus exports. In the foreign price index, f, foreign domestic prices of the customer countries are combined with weights proportional to the share of each country in the exports of the given country. Of course, not all countries are covered in these indexes, but we have indexes for the major countries industrial market economies. By taking moving averages of prices, we allow for delay in the response of exports to change in relative prices. The estimation of the weights in these moving averages is taken from Nyhus(75). Of course, products seldom have the same definition in the input-output table of different countries, so the D_k do not, in fact, match X perfectly in definition. In some cases, several sectors in a customer country will be combined to give a single D_k; in other cases, a single input-output sector domestic demand in the buying country has to serve as the D_k for several sectors in the exporting country's table.

As a matter of historical fact, we estimated (1) using production in country k in place of D_k, simply because at that time we did not have the consistent series on output, exports, and imports necessary to create the domestic demand series. When we get the necessary data on more countries, we will reestimate (1) with domestic demand data. Further, for the forecasts, projections of the historical d/f ratio were made with extrapolations of past trends.

One might think -- as we once thought -- that if (1) had been estimated with gross outputs in place of D, then it should also be simulated with gross outputs in place of D. But that procedure leads to error magnification. Suppose that from an equilibrium position we add a positive "error" or "perturbation" to French automobile exports. Then French automobile production will increase. German auto exports, since they are affected by French production, will also rise. Then French exports, affected by German production will rise further. Such a positive feedback is obviously dangerous in a linked system. When we use domestic demand, this particular positive feedback, or error magnification does not occur. We have therefore used indexes of domestic demand for linking the models. (Because D_k enters (1) in index form, the units do not change when we change from production to domestic demand.)

The results of fitting (1) have been described in (Lee,78) for France and in (Almon,Nyhus,77) for Belgium. Appendices 1-3 show the relevant demand(point) and price elasticities of the estimated export equations.

The three models linked so far are those for France, the Federal Republic of Germany (FRG) and Belgium. They have 78,49,and 51 sectors, respectively. The D_k values for other countries in (1) are exogenous and remain fixed in the experiment about be described.

In order to see the linking mechanism at work we needed a base case and a variation. The base case was a fairly conservative estimate of potential growth. of Growth rates GNP (or simi-

lar measure) between 1980 and 1987 were: France 2.6; Belgium 2.2;
FRG 2.2 . Growth rates of exports of individual industry exports
are shown in the accompanying tables in the column labeled
"base." The variation was to add one percent per year to the
growth rate of the French personal consumption expenditure
throughout the period from 1980 to 1987. This is clearly a
fairly large variation. First the French model was run with this
variation and then the German and Belgian models were run to get
their reaction to the French good fortune. German exports
stepped up their overall growth rate from 1.75 percent per year
to 1.85 per year, while Belgian exports accelerated from 2.64
percent per year to 3.00 percent per year. These are growth
rates for all exports, not just exports to France. Table 1 shows
in the column labeled "1st" and "full" the impacts of this varia-
tion on individual industries in the FRG. The greatest impact is
in consumer goods, despite the fact that the French model
includes investment functions which translate the accelerated
growth of output into demands for capital goods. Columns 4 and
5, labeled "2-1" and "3-1", respectively, show the changes in the
rates of growth for the exports of various industries. For the
FRG, the largest change was for Clothing (sector 30) with .48
percent per year, Textiles (29) with .34 and Meat (33) with .30 .

The first-round effects do not include any effects of the
French prosperity on stimulating other economies. As a second
round, we reran the French model with the higher output levels in
Germany and Belgium. We have not allowed any Keynesian multi-
plier, however. Because the Belgian and German models were
already considered to be running at or near the potential of the
economy, we assumed, in effect, that the income stimulus provided

Table 1.

Growth rates(80-87) of German exports   French expansion alternative

	sector	base	1st	full	2-1	3-1
1	landwirtschaft	2.47	2.54	2.55	0.07	0.08
2	elektrizitaet	2.95	3.27	3.29	0.32	0.34
3	gasverteilung	-4.34	-4.34	-4.34	0.00	0.00
4	wasser	-5.77	-5.77	-5.77	0.00	0.00
5	kohlenbergbau	1.30	1.35	1.36	0.05	0.06
6	uebriger bergbau	1.10	1.11	1.11	0.01	0.01
7	erdoel	5.17	5.17	5.17	0.00	0.00
8	chemie	5.85	5.91	5.92	0.06	0.07
9	mineraloel	1.52	1.61	1.61	0.09	0.09
10	kunststoffe	2.84	3.00	3.01	0.16	0.17
11	steine und erden	0.21	0.32	0.32	0.11	0.11
12	glas	0.24	0.33	0.34	0.09	0.10
13	stahl und eisen	2.19	2.28	2.28	0.09	0.09
14	nicht-eisen metall	-0.03	0.06	0.07	0.09	0.10
15	giessereien	-2.73	-2.63	-2.63	0.10	0.10
16	stahlbau	-1.85	-1.74	-1.73	0.11	0.12
17	nicht-str. fahrzg.	1.40	1.43	1.44	0.03	0.04
18	maschinenbau	0.49	0.59	0.59	0.10	0.10
19	strassenfahrzeuge	-0.37	-0.24	-0.21	0.13	0.16
20	reparaturen	-3.21	-3.19	-3.19	0.02	0.02
21	datenverarbeitung	4.31	4.55	4.56	0.24	0.25
22	elektrotechnik	-0.72	-0.58	-0.57	0.14	0.15
23	feinmechanik	-2.52	-2.42	-2.40	0.10	0.12
24	ebm-waren	-1.91	-1.83	-1.82	0.08	0.09
25	holz	-0.60	-0.36	-0.35	0.24	0.25
26	papier und pappe	-0.83	-0.59	-0.56	0.24	0.27
27	druckereien	2.36	2.56	2.57	0.20	0.21
28	leder	-5.90	-5.66	-5.66	0.24	0.24
29	textilien	1.99	2.31	2.33	0.32	0.34
30	bekleidung	0.50	0.97	0.98	0.47	0.48
31	nahrungsmittel	1.54	1.67	1.69	0.13	0.15
32	milch	2.30	2.36	2.36	0.06	0.06
33	fleisch	2.84	3.14	3.14	0.30	0.30
34	getraenke	3.41	3.52	3.52	0.11·	0.11
35	tabak	0.16	0.35	0.35	0.19	0.19
36	bauten	1.16	1.24	1.25	0.08	0.09
37	grosshandel	1.76	1.87	1.88	0.11	0.12
39	eisenbahn	0.15	0.18	0.18	0.03	0.03
40	schiffahrt	0.81	0.87	0.87	0.06	0.06
41	uebriger verkehr	2.27	2.39	2.40	0.12	0.13
42	bundespost	2.45	2.59	2.60	0.14	0.15
43	banken und b.-geb.	2.39	2.52	2.53	0.13	0.14
44	versicherungen	3.09	3.25	3.26	0.16	0.17
46	verlage	1.80	1.91	1.92	0.11	0.12
47	sonstige dienstl.	1.50	1.59	1.60	0.09	0.10
100	insgesamt	1.74	1.85	1.86	0.11	0.12

by the increased exports would be neutralized either by inflation or tax policy. Consequently real personal consumption expenditure in real terms does not change in any of the countries as we go from round 1 to round 2; only the increase in intermediate consumption makes round 2 differ from round 1. The difference between the two rounds was small; but we ran a third round which differed only microscopically from the second. The growth rates of exports in this third round are shown in the column labeled "full" in the accompanying tables. They are virtually identical to the first round growth rates. Table 2 contains the results for France. There are, of course, no first- round effects. The indirect effects show up in the column labeled "full."

Far from being a disappointment, this virtual congruence of the first and third round is reassuring -- reassuring because one of our concerns had been how much computing would be necessary to get the system to converge. The answer appears to be, as far as the present linking method is concerned, not more than two rounds, and the first round shows nearly everything.

A second variation, a kind of reverse of the first was tried. Personal consumption expenditures were increased in the German model by one percent per year throughout the period. The impact on France is shown in Table 3 and the FRG in Table 4. The total impact on French exports is only slightly higher than the reverse impact for Germany. As was true for Germany under the French consumption increase, the largest sectoral changes in French exports because of the German good fortune were found in consumer goods industries: Clothing (56) at .58 percent increase per year, Semi-manufactured wood products (61) at .50, Electri-

Table 2.
   Growth rates(80-87) of French exports   French expansion alternative

	sector	base	1st	full	2-1	3-1
1	agriculture et sylvi	1.22	1.22	1.23	0.00	0.01
2	peche et produits	-0.11	-0.11	-0.11	0.00	0.00
3	viandes	-0.44	-0.44	-0.44	0.00	0.00
4	prod. cereales	1.27	1.27	1.27	0.00	0.00
5	prod. laitiers	2.34	2.34	2.34	0.00	0.00
6	sucres	2.67	2.67	2.67	0.00	0.00
7	aliments pour animau	1.19	1.19	1.19	0.00	0.00
8	prod. alimen. divers	3.23	3.23	3.23	0.00	0.00
9	boissons et alcools	-0.03	-0.03	-0.03	0.00	0.00
10	corps gras	-0.04	-0.04	-0.04	0.00	0.00
14	cokefaction	0.09	0.09	0.09	0.00	0.00
16	electricite	1.91	1.91	1.92	0.00	0.01
20	petrole raffine	1.49	1.49	1.49	0.00	0.00
21	mat de constru et ce	2.45	2.45	2.46	0.00	0.01
22	verre	1.22	1.22	1.23	0.00	0.01
23	minerai de fer	-5.39	-5.39	-5.39	0.00	0.00
24	ferraille	8.10	8.10	8.10	0.00	0.00
25	siderugie	1.40	1.40	1.41	0.00	0.01
26	min non ferreux	2.11	2.11	2.13	0.00	0.02
27	metaux non-ferreux(d	-2.66	-2.66	-2.65	0.00	0.01
28	metaux non ferreux	6.22	6.22	6.24	0.00	0.02
29	demi-prod non-ferreu	2.70	2.70	2.72	0.00	0.02
30	prem transfor. de l'	0.83	0.83	0.84	0.00	0.01
31	fonderies	-0.06	-0.06	-0.06	0.00	0.00
32	travail des metaux	-0.49	-0.49	-0.49	0.00	0.00
33	materiel d'equipemen	4.60	4.60	4.60	0.00	0.00
34	mecanique de precis	3.18	3.18	3.19	0.00	0.01
37	mat electrique indus	0.69	0.69	0.70	0.00	0.01
38	materiel eletronique	8.01	8.01	8.01	0.00	0.00
39	appareilles electro	12.78	12.78	12.78	0.00	0.00
40	auto, motocycles e c	1.32	1.32	1.33	0.00	0.01
41	construction navale	5.24	5.24	5.24	0.00	0.00
42	constrution aeronaut	5.49	5.49	5.50	0.00	0.01
43	armement et munition	0.91	0.91	0.91	0.00	0.00
44	mineraux divers	-0.88	-0.88	-0.88	0.00	0.00
45	chimie minerale	-1.06	-1.06	-1.06	0.00	0.00
46	chimie organiques	9.91	9.91	9.92	0.00	0.01
47	parachimie	5.62	5.62	5.63	0.00	0.01
48	pharmacie	1.29	1.29	0.00	0.00	-1.29
49	caoutchouc brut	1.88	1.88	1.90	0.00	0.02
50	ouvrages en caotchou	0.58	0.58	0.59	0.00	0.01
51	mat. premieres texti	4.58	4.58	4.59	0.00	0.01
52	fils artificiels et	7.55	7.55	7.56	0.00	0.01
53	fils et files	0.93	0.93	0.94	0.00	0.01
54	ouvrages en files	0.76	0.76	0.78	0.00	0.02
55	produits de la bonne	1.96	1.96	1.99	0.00	0.03
56	habillement	2.25	2.25	2.25	0.00	0.00
57	cuirs, peaux et pell	0.72	0.72	0.72	0.00	0.00
58	cuirs, peaux et pell	-0.73	-0.73	-0.73	0.00	0.00
59	chaussures et articl	0.26	0.26	0.27	0.00	0.01
60	bois bruts et scies	0.25	0.25	0.25	0.00	0.00
61	demi-produits en boi	-1.21	-1.21	-1.21	0.00	0.00
62	meubles et literie	2.10	2.10	2.10	0.00	0.00
63	pates a papier, vieu	0.21	0.21	0.22	0.00	0.01
64	papiers et cartons	1.59	1.59	1.61	0.00	0.02
65	presse et edition	0.56	0.56	0.56	0.00	0.00
66	transformation des p	7.40	7.40	7.42	0.00	0.02
67	industries diverses	-0.10	-0.10	-0.09	0.00	0.01
100	total	3.16	3.16	3.17	0.00	0.01

Table 3.
    Growth rates(80-87) of French exports   German expansion alternative

	sector	base	1st	full	2-1	3-1
1	agriculture et sylvi	1.22	1.40	1.41	0.18	0.19
2	peche et produits	-0.11	-0.07	-0.07	0.04	0.04
3	viandes	-0.44	-0.30	-0.30	0.14	0.14
4	prod. cereales	1.27	1.48	1.48	0.21	0.21
5	prod. laitiers	2.34	2.50	2.50	0.16	0.16
6	sucres	2.67	2.77	2.77	0.10	0.10
7	aliments pour animau	1.19	1.27	1.27	0.08	0.08
8	prod. alimen. divers	3.23	3.42	3.42	0.19	0.19
9	boissons et alcools	-0.03	0.27	0.26	0.30	0.29
10	corps gras	-0.04	0.01	0.01	0.05	0.05
14	cokefaction	0.09	0.18	0.18	0.09	0.09
16	electricite	1.91	2.33	2.34	0.42	0.43
20	petrole raffine	1.49	1.64	1.64	0.15	0.15
21	mat de constru et ce	2.45	2.89	2.89	0.44	0.44
22	verre	1.22	1.35	1.35	0.13	0.13
23	minerai de fer	-5.39	-5.39	-5.39	0.00	0.00
24	ferraille	8.10	8.12	8.12	0.02	0.02
25	siderugie	1.40	1.45	1.45	0.05	0.05
26	min non ferreux	2.11	2.19	2.19	0.08	0.08
27	metaux non-ferreux(d	-2.66	-2.57	-2.57	0.09	0.09
28	metaux non ferreux	6.22	6.34	6.34	0.12	0.12
29	demi-prod non-ferreu	2.70	2.80	2.80	0.10	0.10
30	prem transfor. de l'	0.83	0.89	0.89	0.06	0.06
31	fonderies	-0.06	0.10	0.10	0.16	0.16
32	travail des metaux	-0.49	-0.31	-0.31	0.18	0.18
33	materiel d'equipemen	4.60	4.72	4.72	0.12	0.12
34	mecanique de precis	3.18	3.43	3.43	0.25	0.25
37	mat electrique indus	0.69	0.90	0.90	0.21	0.21
38	materiel eletronique	8.01	8.22	8.22	0.21	0.21
39	appareilles electro	12.78	12.93	12.94	0.15	0.16
40	auto, motocycles e c	1.32	1.57	1.57	0.25	0.25
41	construction navale	5.24	5.30	5.30	0.06	0.06
42	constrution aeronaut	5.49	5.65	5.65	0.16	0.16
43	armement et munition	0.91	0.95	0.95	0.04	0.04
44	mineraux divers	-0.88	-0.88	-0.88	0.00	0.00
45	chimie minerale	-1.06	-1.00	-0.99	0.06	0.07
46	chimie organiques	9.91	10.00	10,00	0.09	0.09
47	parachimie	5.62	5.69	5.69	0.07	0.07
48	pharmacie	1.29	1.34	1.34	0.05	0.05
49	caoutchouc brut	1.88	2.07	2.07	0.19	0.19
50	ouvrages en caotchou	0.58	0.73	0.73	0.15	0.15
51	mat. premieres texti	4.58	4.62	4.63	0.04	0.05
52	fils artificiels et	7.55	7.68	7.68	0.13	0.13
53	fils et files	0.93	1.03	1.03	0.10	0.10
54	ouvrages en files	0.76	0.91	0.92	0.15	0.16
55	produits de la bonne	1.96	2.23	2.24	0.27	0.28
56	habillement	2.25	2.83	2.83	0.58	0.58
57	cuirs, peaux et pell	0.72	1.06	1.06	0.34	0.34
58	cuirs, peaux et pell	-0.73	-0.43	-0.43	0.30	0.30
59	chaussures et articl	0.26	0.66	0.67	0.40	0.41
60	bois bruts et scies	0.25	0.32	0.32	0.07	0.07
61	demi-produits en boi	-1.21	-0.71	-0.71	0.50	0.50
62	meubles et literie	2.10	2.29	2.29	0.19	0.19
63	pates a papier, vieu	0.21	0.40	0.40	0.19.	0.19
64	papiers et cartons	1.59	1.83	1.83	0.24	0.24
65	presse et edition	0.56	0.69	0.69	0.13	0.13
66	transformation des p	7.40	7.60	7.60	0.20	0.20
67	industries diverses	-0.10	0.06	0.07	0.16	0.17
100	total	3.16	3.32	3.32	0.16	0.16

Table 4.
   Growth rates(80-87) of German exports   German expansion alternative

	sector	base	1st	full	2-1	3-1
1	landwirtschaft	2.47	2.47	2.48	0.00	0.01
2	elektrizitaet	2.95	2.95	2.98	0.00	0.03
3	gasverteilung	-4.34	-4.34	-4.34	0.00	0.00
4	wasser	-5.77	-5.77	-5.77	0.00	0.00
5	kohlenbergbau	1.30	1.30	1.32	0.00	0.02
6	uebriger bergbau	1.10	1.10	1.10	0.00	0.00
7	erdoel	5.17	5.17	5.17	0.00	0.00
8	chemie	5.85	5.85	5.87	0.00	0.02
9	mineraloel	1.52	1.52	.1.53	0.00	0.01
10	kunststoffe	2.84	2.84	2.87	0.00	0.03
11	steine und erden	0.21	0.21	0.22	0.00	0.01
12	glas	0.24	0.24	0.26	0.00	0.02
13	stahl und eisen	2.19	2.19	2.20	0.00	0.01
14	nicht-eisen metall	-0.03	-0.03	-0.01	0.00	0.02
15	giessereien	-2.73	-2.73	-2.72	.0.00	0.01
16	stahlbau	-1.85	-1.85	-1.83	0.00	0.02
17	nicht-str. fahrzg.	1.40	1.40	1.41	0.00	0.01
18	maschinenbau	0.49	0.49	0.50	0.00	0.01
19	strassenfahrzeuge	-0.37	-0.37	-0.33	0.00	0.04
20	reparaturen	-3.21	-3.21	-3.21	0.00	.0.00
21	datenverarbeitung	4.31	4.31	4.33	0.00	0.02
22	elektrotechnik	-0.72	-0.72	-0.70	0.00	0.02
23	feinmechanik	-2.52	-2.52	-2.50	0.00	0.02
24	ebm-waren	-1.91	-1.91	-1.90	0.00	0.01
25	holz	-0.60	-0.60	-0.59	0.00	0.01
26	papier und pappe	-0.83	-0.83	-0.79	0.00	0.04
27	druckereien	2.36	2.36	2.38	0.00	0.02
28	leder	-5.90	-5.90	-5.88	0.00	0.02
29	textilien	1.99	1.99	2.02	0.00	0.03
30	bekleidung	0.50	0.50	0.51	0.00	0.01
31	nahrungsmittel	1.54	1.54	1.56	0.00	0.02
32	milch	2.30	2.30	2.31	0.00	0.01
33	fleisch	2.84	2.84	2.84	0.00	0.00
34	getraenke	3.41	3.41	3.41	0.00	0.00
35	tabak	0.16	0.16	0.16	0.00	0.00
36	bauten	1.16	1.16	1.18	0.00	0.02
37	grosshandel	1.76	1.76	1.78	0.00	0.02
39	eisenbahn	0.15	0.15	0.16	0.00	0.01
40	schiffahrt	0.81	0.81	0.82	0.00	0.01
41	uebriger verkehr	2.27	2.27	2.29	0.00	0.02
42	bundespost	2.45	2.45	2.48	0.00	0.03
43	banken und b.-geb.	2.39	2.39	2.41	0.00	0.02
44	versicherungen	3.09	3.09	3.11	0.00	0.02
46	verlage	1.80	1.80	1.82	0.00	0.02
47	sonstige dienstl.	1.50	1.50	1.51	0.00	0.01
100	insgesamt	1.74	1.74	1.75	0.00	0.01

city (16) at .43 and Shoes (59) at .41 . Figure 1 compares, for selected goods, the impact of the French prosperity on Germany with the impact of the German prosperity on France.

A comparison of the two alternatives is presented in Table 5 for the third country, Belgium, that is linked. The first column shows the base case growth rates; the second, the first round effects with the French alternative; the third, the first round effects of the German good fortune; the fourth and fifth, the full French and German effects; the sixth and seventh, the increments to the growth rates under the French alternative; columns eight and nine, the increments for the German alternative; the last column, the difference between the fourth and fifth columns. Our main attention here will be on columns seven, nine, and ten.

Comparing column seven with that of column five of Tables 1 and 3, we see that Belgium is far more affected by its partners than Germany or France. The five sectors showing the largest increase are Meat (21) .77 increase in percent per year, Clothing (26) .76, Fishery (2) .59, Printing (31) .56, and Beverages (24) .53 . Figure 2 shows some of the largest impacts on Belgium of faster growth in France and West Germany.

Column nine, showing the full German good fortune impact on Belgium, can be compared to column five of Tables 2 and 4. The five largest impacts were for Meat (21) .95, Clothing (26) .81, Shoes (28) .77, Automobiles (19) .41, and Wood and Furniture (29) .36 .

Column ten shows the differences by sector in the growth

Table 5. Growth rates(80-87) of Belgian exports French and German alternative expansions

sector	base	1fup	1gup	full-fup	full-gup	2-1	4-1	3-1	5-1	5-4
1 landbouwprodukten	0.90	1.26	1.13	1.26	1.14	0.36	0.36	0.23	0.24	-0.12
2 visserijprodukten	2.31	2.89	2.39	2.90	2.39	0.58	0.59	0.08	0.08	-0.51
3 steenkool,bruinkool	2.59	2.59	2.59	2.59	2.59	0.00	0.00	0.00	0.00	0.00
4 cokes	4.11	4.11	4.11	4.11	4.11	0.00	0.00	0.00	0.00	0.00
5 aardolie. en petrole	2.14	2.17	2.31	2.17	2.31	0.03	0.03	0.17	0.17	0.14
6 elektrische energie	1.44	1.64	1.63	1.64	1.64	0.20	0.20	0.19	0.20	0.00
7 gas gedistribueerd	-5.51	-5.51	-5.51	-5.51	-5.51	0.00	0.00	0.00	0.00	0.00
9 ijzerertsen en ferro	2.72	2.76	2.75	2.76	2.75	0.04	0.04	0.03	0.03	-0.01
10 non-ferrometalen	1.11	1.26	1.20	1.28	1.23	0.15	0.17	0.09	0.12	-0.05
11 glas	2.55	2.71	2.64	2.72	2.65	0.16	0.17	0.09	0.10	-0.07
12 cement,kalk,gips	0.93	1.12	0.96	1.12	0.97	0.19	0.19	0.03	0.04	-0.15
13 andere niet-metaal.	0.68	0.80	0.76	0.80	0.77	0.12	0.12	0.08	0.09	-0.03
14 chemische produkten	1.50	1.64	1.61	1.65	1.62	0.14	0.15	0.11	0.12	-0.03
15 produkten uit metaal	2.30	2.49	2.47	2.49	2.49	0.19	0.19	0.17	0.19	0.00
16 machines	0.68	0.92	0.82	0.92	0.84	0.24	0.24	0.14	0.16	-0.08
17 bureaumachines, prec	4.81	5.03	5.09	5.03	5.10	0.22	0.22	0.28	0.29	0.07
18 elektrotechnische in	0.02	0.16	0.31	0.17	0.32	0.14	0.15	0.29	0.30	0.15
19 automobielen en moto	3.71	3.98	4.11	3.99	4.12	0.27	0.28	0.40	0.41	0.13
20 andere transportmidd	-0.55	-0.50	-0.49	-0.50	-0.49	0.05	0.05	0.06	0.06	0.01
21 vlees	3.64	4.41	4.59	4.41	4.59	0.77	0.77	0.95	0.95	0.18
22 melk	1.63	1.72	1.79	1.73	1.79	0.09	0.10	0.16	0.16	0.06
23 andere voedingsmidde	0.96	1.19	1.14	1.19	1.15	0.23	0.23	0.18	0.19	-0.04
24 dranken	2.28	2.81	2.40	2.81	2.41	0.53	0.53	0.12	0.13	-0.40
25 tabaksprodukten	2.86	3.18	2.88	3.18	2.88	0.32	0.32	0.02	0.02	-0.30
26 breigoed en kleding	3.18	3.94	3.99	3.94	3.99	0.76	0.76	0.81	0.81	0.05
27 overige textielprodu	3.62	3.87	3.84	3.89	3.86	0.25	0.27	0.22	0.24	-0.03
28 leder,huiden, schoei	-1.17	-0.70	-0.42	-0.69	-0.40	0.47	0.48	0.75	0.77	0.29
29 hout en houten meube	4.82	5.31	5.17	5.31	5.18	0.49	0.49	0.35	0.36	-0.13
30 papier, papierwaren	1.08	1.50	1.27	1.51	1.29	0.42	0.43	0.19	0.21	-0.22
31 drukwerk	0.69	1.25	0.75	1.25	0.77	0.56	0.56	0.06	0.08	-0.48
32 rubberartikelen	2.53	2.67	2.77	2.68	2.78	0.14	0.15	0.24	0.25	0.10
33 plastic produkten	4.77	5.00	4.96	5.01	4.97	0.23	0.24	0.19	0.20	-0.04
34 over. industrie(diam	5.08	5.40	5.23	5.40	5.23	0.32	0.32	0.15	0.15	-0.17
35 gebouwen, wegen-,wat	2.39	2.64	2.63	2.64	2.64	0.25	0.25	0.24	0.25	0.00
37 recuper. en andere r	2.39	2.64	2.63	2.64	2.64	0.25	0.25	0.24	0.25	0.00
38 handel	2.39	2.64	2.63	2.64	2.64	0.25	0.25	0.24	0.25	0.00
39 hotels, restaurants	2.39	2.64	2.63	2.64	2.64	0.25	0.25	0.24	0.25	0.00
40 spoorwegen, trams	2.39	2.64	2.63	2.64	2.64	0.25	0.25	0.24	0.25	0.00
41 vervoer over de weg	2.39	2.64	2.63	2.64	2.64	0.25	0.25	0.24	0.25	0.00
42 binnenscheepvaart	2.39	2.64	2.63	2.64	2.64	0.25	0.25	0.24	0.25	0.00
43 zee- en kustvervoer	2.39	2.64	2.63	2.64	2.64	0.25	0.25	0.24	0.25	0.00
44 luchtvervoer	2.39	2.64	2.63	2.64	2.64	0.25	0.25	0.24	0.25	0.00
45 opslag en overslag	2.39	2.64	2.63	2.64	2.64	0.25	0.25	0.24	0.25	0.00
46 communicatie	2.39	2.64	2.63	2.64	2.64	0.25	0.25	0.24	0.25	0.00
47 kredietinstellingen	2.39	2.64	2.63	2.64	2.64	0.25	0.25	0.24	0.25	0.00
48 diensten aan bedrijv	2.39	2.64	2.63	2.64	2.64	0.25	0.25	0.24	0.25	0.00
100 totaal	2.40	2.64	2.63	2.65	2.64	0.24	0.25	0.23	0.24	-0.01

rates generated by the two alternatives. Positive numbers indicate that the German alternative had more effect and negative numbers show that the French alternative was larger. One result, shown on the bottom line, is that the total effect is virtually the same. Another result is that although the total effect is similar, the sectoral breakdowns are very different. The French effect exceeded the German effect by more than .30 in four sectors: -.51 in Fishery (2), -.48 in Printing (31), -.40 in Beverages (24) and -.30 for Tobacco (25). The largest differences where German influence was higher were in Shoes (28) .29, Meat (21) .18, Electrical goods (18) .15, and Automobiles (19) .13 . alternative affected some relatively small export sectors more than the German For seventeen sectors the French expansion had more affect; in ten, the German; and in eighteen the effects were approximately the same.

The present linking mechanism will be used to get the initial system of "real side" models to work together. When one model gets a price side, we can incorporate those results into the d/f ratio of equation (1). Equations of this type are currently used in the US model.

The present system of linking, using the d/f ratio may prove adequate until we want to study bilateral trade flows; then we will have to use the more complicated mechanism originally planned. Also the present system lacks consistency checks; it cannot tell whether France's agricultural exports are consistent with the agricultural imports of France's trading partners. This simple mechanism, however, has the decided advantage that it expands easily as more models are added. Instead of using exo-

genous values for a D_k in (1), we can simply substitute the values produced by the model when country k's model joins the system.

The short-cut method is in some ways akin to our method of developing the national models themselves. That method is to start with a very simple model (needing only an input-output table for one year) and add the various submodules to it as they are developed. At each stage we have a working model. This process may seem pedestrian; but experience is a powerful teacher. We feel that a working model, even with deficiencies, is often of more use than an elaborate theoretical model that cannot be implemented.

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APPENDIX 1.

Elasticities of French Export Equations

	sector	demand elasticity	price elasticity
1	agriculture et sylvi	1.94	-0.50
2	peche et produits	0.55	-0.50
3	viandes	0.58	-0.50
4	prod. cereales	1.69	-0.50
5	prod. laitiers	1.76	-0.50
6	sucres	1.44	-0.50
7	aliments pour animau	2.13	-0.50
8	prod. alimen. divers	1.67	-0.50
9	boissons et alcools	1.70	-1.00
10	corps gras	1.31	-1.00
11	tabac et allumettes	2.36	-1.00
14	cokefaction	1.66	-0.50
16	electricite	1.66	-0.50
18	petrole brut	1.44	-0.50
19	gaz naturel	2.04	-0.50
20	petrole raffine	0.66	-1.00
21	mat de constru et ce	4.78	-2.00
22	verre	1.44	-2.00
24	ferraille	0.18	-1.60
25	siderugie	0.78	-0.60
26	min non ferreux	0.94	-0.20
27	metaux non-ferreux(d	1.80	-1.40
28	metaux non ferreux	1.54	-2.00
29	demi-prod non-ferreu	1.60	-1.80
30	prem transfor. de l'	1.04	-0.20
31	fonderies	1.47	-2.00
32	travail des metaux	1.75	-2.00
33	materiel d'equipemen	1.18	-3.00
34	mecanique de precis	1.42	-3.00
35	appareils menagers e	0.38	-0.20
37	mat electrique indus	1.52	-3.00
38	materiel eletronique	1.49	-3.00
39	appareilles electro	1.06	-3.00
40	auto, motocycles e c	1.56	-3.00
41	construction navale	1.39	-3.00
42	constrution aeronaut	1.11	-3.00
43	armement et munition	1.15	-3.00
45	chimie minerale	1.24	-2.00
46	chimie organiques	1.08	-2.00
47	parachimie	0.72	-2.00
48	pharmacie	0.93	-2.00
49	caoutchouc brut	2.20	-2.00
50	ouvrages en cadtchou	1.63	-2.00
51	mat. premieres texti	0.33	-2.00
52	fils artificiels et	0.96	-2.00
53	fils et files	1.21	0.00
54	ouvrages en files	1.10	0.00
55	produits de la bonne	2.60	-2.00
56	habillement	2.51	-1.50
57	cuirs, peaux et pell	1.26	0.00
58	cuirs, peaux et pell	1.76	-0.30
59	chaussures et articl	2.10	-1.40
60	bois bruts et scies	0.26	0.00
61	demi-produits en boi	1.07	-1.00
62	meubles et literie	1.42	-1.50
63	pates a papier, vieu	1.51	-1.00
64	papiers et cartons	1.60	-1.20
65	presse et edition	1.10	-0.40
66	transformation des p	1.23	-3.00
67	industries diverses	1.36	-3.00

APPENDIX 2.

Elasticities of German Export Equations

sector	demand elasticity	price elasticity
1 landwirtschaft	2.48	-0.50
2 elektrizitaet	1.02	-0.75
5 kohlenbergbau	0.76	0.00
6 uebriger bergbau	0.39	-0.50
7 erdoel	3.18	-0.50
8 chemie	1.35	-2.00
9 mineraloel	0.69	-1.00
10 kunststoffe	2.03	0.00
11 steine und erden	1.25	-1.00
12 glas	1.05	-1.00
13 stahl und eisen	0.72	-1.80
14 nicht-eisen metall	1.46	-0.40
15 giessereien	1.42	-1.40
16 stahlbau	0.98	-1.60
17 nicht-str. fahrzg.	1.05	0.00
18 maschinenbau	0.98	-0.40
19 strassenfahrzeuge	1.33	-2.50
20 reparaturen	0.28	-0.60
21 datenverarbeitung	2.08	-2.00
22 elektrotechnik	1.48	-2.00
23 feinmechanik	1.04	-1.20
24 ebm-waren	1.24	-2.00
25 holz	1.65	-1.00
26 papier und pappe	1.96	-1.50
27 druckereien	1.50	-1.50
28 leder	2.55	-0.70
29 textilien	3.72	-1.00
30 bekleidung	2.95	-1.00
31 nahrungsmittel	3.23	-0.50
32 milch	3.11	-0.50
33 fleisch	3.06	-0.50
34 getraenke	1.56	-0.50
35 tabak	1.70	-0.50

APPENDIX 3.

Elasticities of Belgian Export Equations

sector	demand elasticity	price elasticity
1 landbouwprodukten	2.08	-0.50
2 visserijprodukten	1.57	-0.80
5 aardolie. en petrole	1.24	-1.75
9 ijzerertsen en ferro	0.92	-1.80
10 non-ferrometalen	1.22	-1.40
11 glas	1.20	-0.60
12 cement,kalk,gips	1.00	-1.80
13 andere niet-metaal.	1.59	-1.80
14 chemische produkten	1.41	-2.00
15 produkten uit metaal	1.52	-2.50
16 machines	1.50	-0.80
17 bureaumachines, prec	2.17	0.00
18 elektrotechnische in	1.55	-0.80
19 automobielen en moto	2.15	-3.00
20 andere transportmidd	0.47	-0.40
21 vlees	3.06	-1.40
22 melk	2.81	-1.50
23 andere voedingsmidde	2.42	-0.30
24 dranken	2.04	-1.00
25 tabaksprodukten	1.70	-1.50
26 breigoed en kleding	4.35	-1.50
27 overige textielprodu	1.85	-1.70
28 leder,huiden, schoei	2.93	0.00
29 hout en houten meube	2.24	-3.00
30 papier, papierwaren	2.28	-3.00
31 drukwerk	1.34	-1.40
32 rubberartikelen	1.63	-1.00
33 plastic produkten	1.43	-2.00
34 over. industrie(diam	1.29	-1.80
35 gebouwen, wegen-,wat	1.61	-2.00
6 elektrische energie	1.59	-1.75