MARYLAND INTERINDUSTRY FORECASTING PROJECT

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AN ESTIMATE OF THE STEEL-OUTPUT COEFFICIENTS BY I-O SECTORS

by

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This paper presents projections of coefficient change in the steel row of the input-output (I-O) table. In addition, it ascertains and forecasts coefficients for eleven major steel products: structural shapes, plates, hot-rolled bars, reinforcing bars, standard pipe, line pipe, drawn wire, electrolytic tin plate, hot-rolled sheets, cold-rolled sheets, and galvanized sheet and strip.

These coefficients are defined as

$$a_{ij} = X_{ij}/X_j ,$$

where

X_{ij} = shipments of the ith steel product, in thousands of net tons, to the jth market

X_j = output of the jth industry, in millions of 1958 dollars.

From the publication AIS 16 of the American Iron and Steel Institute (AISI) we obtained the X_{ij} for 11 years, 1957-67. Unfortunately, the market classification of the AISI does not agree exactly with our I-O sectors or even with the SIC numbers, and one of the main problems was to match the AISI markets with the I-O sectors. We ended up with 19 aggregate sectors, plus 46 subsectors, all of which are shown on the very left column of the attached Table 1. The SIC description of the series we used for outputs (X_j) is shown in the column headed "SIC".

For each steel product purchased by an industry, we estimated the steel I-O coefficient with a regression equation of the following form:

$$\ln a_{ijt} = b_0 + b_1 t + b_2 I_t + b_3 \ln(P_S/P_{NF}) + u_t$$

where

t = time

I = steel inventories

P_S = prices of steel

P_{NF} = prices of non-ferrous metals

u = disturbance term

The inventory variable includes steel held by the steel industry plus steel held by the steel users. Inventories are included among the explanatory variables because X_{ij}, the numerator of the a_{ij} coefficient, is the amount of the steel product <u>shipped</u> to the jth industry, and not the amount <u>consumed</u> by the industry to produce its output. The difference becomes change in inventories. Unfortunately, there are no data on steel inventory by uses, only on the total held by all users. We were not, therefore, able to correct the X_{ij}. We are able only to include the total steel inventory as an explanatory variable.

An increase in the price of steel relative to the price of non-ferrous metals should lead to a substitution of non-ferrous metals for steel. In fact, elasticities of steel use with respect to the price ratio are likely to be quite small, for non-ferrous metals use is small relative to steel consumption. Copper and aluminum use are only about 2 and 10 percent, respectively, of steel use. Therefore, even if the elasticity of demand for aluminum is 1.0 with respect to the price of steel, the elasticity of demand for steel with respect to the price of aluminum will be only 0.1. Consequently, the price variable seldom proved significant. The inventory coefficient was more frequently significant statistically, but not of much importance relative to the time variable. This variable, t, is used to represent all factors for which we could find no better measure. They include

technological progress, changes in manufacturing processes, changes
in product mix, substitution of plastics for steel, and, if the prices
of non-ferrous metals proves insignificant, the substitution of them
for steel also. Because the other coefficients variables were of
slight importance, only the values of b_1, the time trends are
reported here.

Table 1 shows the time trends in steel use in the major sectors
and in the 46 subsectors which correspond approximately to input-
output industries. The first column gives the trend in the total
tonnage of eleven principal products; the second column gives the
trend in the value of these same eleven products. The values were
calculated at 1963 prices. It was anticipated that a shift towards
higher-priced products might lead to slower declines in value than
in tonnage. That, however, proved not to be the case. The third
column, which shows the trends in the coefficients for total tonnage
of all products (not just the eleven largest), could therefore
be accepted as representing also trends in total value coefficients,
in constant dollars. It is these coefficient change rates which have
gone into the Maryland Interindustry Forecasting Model.

Table 2 shows the time trends for each of the eleven steel
products to the 19 aggregate sectors.

We can see that the time trend for all steel, as expected, gave
a negative sign in 15 out of the 19 industries. The trend ranged
from -.015 for Bolts, nuts, rivets and screws to -.126 for Shipbuilding
and marine equipment. For one sector, Mining, quarrying and lumbering,
the time trend was positive, .027. For Contractors' products,
Aircraft, and Electrical machinery, the fixed coefficient assumption

holds. The time trends for the sum of the eleven products, in
general, agree, as they should, with the time trends for all steel
products. The one exception is Rail transportation; the trouble is
simply that rails are not included among the eleven products.

When we tried to get trends of coefficients by type of steel
by subsector, we found erratic results which could certainly not
be extrapolated. Even at the aggregate sector level, we feel that
the trend for the total should be used as a control total on the growth
of the parts.

Table 1

Time Trends of Steel Coefficients

			SIC	$\sum_{i=1}^{11} x_i$ (Tons)	$\sum_{i=1}^{11} p_i x_i$ (Value)	Total (Tons)
1		Steel for converting & processing	331	−.0344	−.0409	−.0860
	010	Wire & wire products	3312	−.0985		−.1001
	020	Hot & cold rolled sheets & strip	3312	0		0
	030	Pipe & tube	3317	0		0
	040	Cold finished bars	3316	−.0566*		−.0566*
	060	Resale shipments	3312	0		.0710
2		Forgings	3391	.0112	.0113	−.0281
3		Bolts, nuts, rivets, screws	345	−.0131	−.0217	−.0152
4		Steel service centers & distrib.		−.0504	−.0508	−.0487
5		Construction		−.0520	−.0619	−.0488
	170	Construction − residential		0		.1352
	190	Construction − non-residential		−.0975*		−.0951*
	200	Public construction − highways		0		0
	210	Public construction − all other		.1266*		0
	230	Oil & gas − process distrib.		−.0830		.0405
	240	Public utilities − exc. gas		0		0
	250	Steel ind. − construc. m & r		.1563*		.0557
	260	Unidentified construction		0		0
6		Contractors' products		0	.0092	0
	270	Air conditioning & ventilating eq.	3585	−.0417		.0404*
	280	Builders' hardware	3429	−.0350*		−.0333*
	290	Culverts & concrete pipe	3272	0		0
	300	Plumbing & heating equip.	343	−.0444		−.0426
	320	All other contractors' products		.0487		.0690
7		Automotive		−.0290	−.0285	−.0305
	330	Vehicles − trailers	371	−.0079		−.0074
	350	Parts & accessories − ind. supplies		−.0332		−.0326
8		Rail transportation	374	.0932	.0932	−.0317
	390	Rail− exc. locomotive	3742	.1480		.1461*
	430	Locomotives	3741	.0937*		.0938*
9		Shipbuilding & marine eq.	373	−.1257	−.1262	−.1256
10		Aircraft	372	0	0	0
11		Oil & gas drilling	13	−.0532	−.0575	−.0607
12		Mining, quarrying, lumbering	10-12,14	.0318	.0349	.0270

Table 1

(continued)

	SIC	$\sum_{i=1}^{11} x_i$ (Tons)	$\sum_{i=1}^{11} p_i x_i$ (Value)	Total (Tons)
13 Agriculture		−.0179	−.0204	−.0196
14 Machinery, indl. equip., tools	35	−.0248	−.0275	−.0238
550 General purpose indl. eq.	356	.0466		−.0469
580 Construc & related eq.	353	.0894*		.0898*
610 Metal working eq.	354	0		−.0189
640 Oth. special indl eq.	355	−.0234		−.0252
660 Tractors	3537	−.0136		−.0141
670 Hand tools	3423	.0768*		.0765*
15 Electrical mach. & eq.	36	−.0354	.0329	0
16 Appliance, utensils, cuttery		−.0281	−.0287	−.0322
720 Cooking & space heating stoves	3631	−.0218		−.0220
730 Refrig. - air conditioners	3632	0		0
740 Household laundry eq.: dishwashers	3633	.0328*		.0354
750 Oth. household appliances	3634,9	−.0500		−.0537
770 Utensils & galvanized ware	3461	−.0410		−.0487
780 Cutlery & table flatware	3421	−.1829*		−.2357*
17 Other domestic & commercial eq.		−.0872	−.0934	−.0930
790 Domestic furniture & oth eq.	251	−.1207		−.1308
800 Office furniture, supplies, mach.		−.0443*		−.0431*
810 Oth. commercial eq.		−.0178		−.0125
830 Sporting goods - toys	394	−.0308		−.0329
18 Containers, packaging, shipping matl.		−.0279	−.0279	−.0370
870 Cans - sanitary & general line	3411	−.0370*		−.0370*
890 Crowns, caps, closures	3461	−.0785*		−.0805*
910 Steel barrels - heavy	3491	.0481		−.0459
920 Steel barrels - light	3491	.0454*		.0453
930 Shippings pairs	3491	−.0308		−.0303
940 Compressed gas cylinders	3443	−.0856		−.0860
960 All other sector 18		.0343		.0120
20 Export (merchandise)		−.1239	−.1265	−.1011

* Value of b_1 when inventory and price variables are significant

Table 2

Time Trends on Coefficients for 11 Steel Products

	SIC	Structural shapes (X_1)	Plates (X_2)	Bars-Hot Rolled (X_3)	Bars-Rein-forcing (X_4)	Standard Pipe (X_5)	Line Pipe (X_6)
1 Steel for converting	331	-.3538	-.2893	0	-.2133	-.2480	-.7123
2 Forgings	3391	-	-.0351	.0129	-	-	-
3 Bolts, nuts, rivets, screws	345	-	.2723	-.0135	-	-	-
4 Steel service center		-.0882	.0399	-.0579	-.0367	-.1120	.0240
5 Construction		-.0594	0	-.0449	.0555	-.0742	-.1281
6 Contractors' products		-.1766	0	-.0259	-.1078	-.1948	-.1274
7 Automotive	371	.0525	0	-.0325	-	-.2810	.1732
8 Rail transportation	374	.1711	.0965	.0868	-	.0934	-.0914
9 Shipbuilding	373	-.1282	-.1223	-.1031	-	-.0932	-.4563
10 Aircraft	372	-.3490	-.2229	.0477	-	-	-
11 Oil & gas drilling	13	-.1843	-.0275	-.0175	-	-.1710	.2898
12 Mining, lumbering	10-12,14	-.0397	.0769	.0381	-	0	.1661
13 Agriculture		-.0108	.0190	-.0322	-	-.0606	.0630
14 Machinery, non-el.	35	-.0504	0	.0409	-	-.0571	-.1092
15 Electrical mach.	36	-.1094	-.0299	-.0355	-	.0458	-.2876
16 Appliances, utensils		-.2574	-.0631	-.0751	-	-.1170	-.3338
17 Oth. domestic & commercial eq.		-.0384	-.0495	-.1356	-	-.1347	-.1440
18 Containers		0	-.1330	-.0702	-	-	-
20 Export		0	-.1373	-.2324	0	-.6580	-.0563

Table 2

(continued)

	SIC	Wire Drawing (X_7)	Tin Plate Electrolytic (X_8)	Sheets – Hot-Rolled (X_9)	Sheets – Cold-Rolled (X_{10})	Sheets & Strip Galvanized (X_{11})
1 Steel for converting	331	-.0740	.1550	-.0304	.0566	.2839
2 Forgings	3391	–	–	–	–	–
3 Bolts, nuts, rivets, screws	345	.0212	–	.0464	.1365	.1741
4 Steel service center		-.1683	.0397	.0628	.0652	.0206
5 Construction		.1211	.0727	-.0596	-.0447	.0571
6 Contractors' products		.2213	.1387	-.0464	-.0293	.0363
7 Automotive	371	-.0554	.0649	-.0287	-.0399	.2318
8 Rail transportation	374	0	.3406	.1560	.1091	.1213
9 Shipbuilding	373	0	–	-.1592	.0382	-.2034
10 Aircraft	372	-.4188	–	-.2136	-.0581	-.5716
11 Oil & gas drilling	13	-.0378	–	-.1742	-.7030	-.0770
12 Mining, lumbering	10-12 ,14	.1832	–	0	.0858	.0726
13 Agriculture		-.1016	.0329	0	-.0433	-.0215
14 Machinery, non-el.	35	-.0773	-.1196	-.0378	.0566	.0640
15 Electrical mach.	36	-.0939	.0214	0	.0931	.0171
16 Appliances, utensils		-.0347	-.0160	-.0264	-.0302	.1093
17 Oth. domestic & commercial eq.		-.1885	-.1120	-.0596	-.0592	-.0371
18 Containers		-.1089	-.0257	-.0439	-.0259	-.0280
20 Export		-.1280	-.1528	-.2188	.0483	-.1239