DISAGGREGATED ARMINGTON ELASTICITIES

FOR THE MINING AND MANUFACTURING SECTORS OF THE UNITED STATES [*]

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1. Introduction

Most neoclassical trade models specify continuous substitution possibilities between imported and domestic goods in comparable product categories. A common form of this in practical work is based on a constant elasticity of substitution (CES) specification due to Armington (1969). Although the Armington model has been widely adopted, little direct econometric estimation of CES elasticities has been undertaken, leaving modelers to rely on judgemental values and sensitivity analysis.[1] In this paper, we provide Armington estimates for detailed mining and manufacturing sectors of the United States.

Using data from a number of government sources, we have developed time series on prices and quantities of imported and domestic goods (in domestic use) for 163 sectors. For most of these, we were able to specify an estimating equation which yielded statistically significant CES elasticities. In the next section, the CES specification of import demand is reviewed. Section three discusses the database which was assembled for the estimates presented in section four. Section five presents some concluding remarks.

2. Modeling Import Behavior with the CES Functional Form

Trade theory usually views import behavior from the perspective of the economy as a whole. This is equivalent to considering an aggregate agent who views imported and domestic goods in similar product categories as substitutes

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[1] Three exceptions are estimates for Australia by Alaouze, Marsden, and Zeitsch (1977), for Portugal by Corado and de Melo (1986), and for Ecuador by Roland-Holst and Sadoulet (1989).

in consumption. If this representative consumer has a well-behaved utility function, then its consumption decision is amenable to neoclassical utility maximization or, in a dual formulation, expenditure minimization.

The hypothetical representative consumer obtains utility from a composite (Q) of imported (M) and domestic (D) goods, and we assume there are continuous substitution possibilities between the latter. The decision problem is then to choose a mix of M and D which minimizes expenditure, given respective prices p_M and p_D and the desired level of Q. In the Armington specification, a CES functional form is chosen for Q as:

$$Q \;=\; \alpha[\beta M^{(\sigma-1)/\sigma} + (1-\beta)D^{(\sigma-1)/\sigma}]^{\sigma/(\sigma-1)} \tag{1}$$

where α and β are calibrated parameters and σ is the (constant) elasticity of substitution between imports and domestic goods. The solution to the consumer's optimization problem will then be to choose imports and domestic goods whose ratio satisfies the first-order condition:

$$M/D \;=\; [(\beta/(1-\beta))(p_D/p_M)]^{\sigma}$$

$$\tag{2}$$

which is the familiar equivalence between rates of substitution and relative prices.[2] The parameter σ also can be interpreted as the compensated price elasticity of import demand.

Assuming utility in composite consumption is weakly separable, Armington

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[2] de Melo and Robinson (1989) give a more extended treatment of CES import behavior in a general equilbrium model.

elasticities can be estimated for disaggregated commodity categories.[3] These

can then used to determine import demand elasticities in multisectoral

simulation models.[4]

3. Data on U.S. Prices and Demand for Imported and Domestic Goods

Applied multisectoral trade models increasingly rely on social-accounting

matrices (SAMs) as their basic information structure.[5] Since the data source

of the inter-industry component of U.S. SAMs is the input-output table of the

U.S. Bureau of Economic Analysis (BEA), our estimates of Armington elasticities

are based on a set of 163 sectors which is directly conformable to BEA

sectors.[6]

The estimation of Armington elasticities requires data on both import

prices and real-valued imports. To generate these series, quarterly import

data for the years 1980-1988 were extracted from U.S. Department of Commerce

data tapes by 7-digit TSUSA item. These data then were concorded to the 163

sectors. Laspeyres price indices were computed for each sector as:

$$P_M(t) = \varphi_i \, (P(t)/P(0)) \tag{3}$$

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[3] See Section 2 of Winters (1984) for a discussion of separability assumptions.

[4] See e.g., Dervis, de Melo, and Robinson (1982).

[5] The U.S. International Trade Commission, for example, is currently constructing a highly-disaggregated SAM to calibrate a computable general equilibrium model for trade-policy analysis. See Reinert and Roland-Holst (1990).

[6] A table detailing the concordance between the 163 estimating sectors and the corresponding BEA and SIC sectors is available from the authors.

where φ_i is the base-period import share of TSUSA item i, $P(t)$ is the unit value of TSUSA item i in quarter t, and $P(0)$ is the unit value of TSUSA item i in the base period. The base period was chosen as the second quarter of 1987 for mining sectors and the second quarter of 1986 for manufacturing sectors. These import price indices were used to deflate imports to obtain real import series.

The Armington estimation also requires data on prices of the corresponding domestic goods and real values of domestic sales of domestic goods. Producer price indices (PPI) were used as a proxy for the prices of the domestic goods. These were obtained from U.S. Department of Labor data tapes on a four-digit SIC basis and were concorded to the 163 estimating sectors. In cases where more than one producer price series concorded with a sector, the series were aggregated using domestic output weights (1986 for manufacturing, 1987 for mining). Domestic output for these base periods was obtained from U.S. Department of Commerce data tapes for manufacturing sectors and the Census of Mining for mining sectors. The PPI are monthly data, and an average of the PPI over the three months of each quarter was used.

The core data for the development of a domestic output series are the Federal Reserve Bank's Indices of Industrial Production (IIP).[7] The IIP classification was concorded to the 163 sectors. In cases where more than one IIP concorded with a sector, the series were aggregated using IIP series weights. The IIP series are monthly, and a three-month average was taken as the quarterly value.

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[7] These indices are described in Board of Governors of the Federal Reserve System (1986) and in Hosley and Kennedy (1985).

The IIP data provide series for domestic production. However, to estimate the Armington functions, we require data on domestic sales of domestic goods, that is, domestic production less exports. To do this, we first rescaled the IIP series so that they express domestic production as a proportion of the base-year average quarterly production. Again, the base years are 1987 for mining and 1986 for manufacturing. Next, we applied base year output to these series to generate series of real output. Finally, we subtracted real export series to obtain series of real domestic sales. To generate the real export series, quarterly export data for the years 1980-1988 were extracted from U.S. Department of Commerce data tapes by 7-digit Schedule B item. These data then were concorded to the 163 estimating sectors. In order to deflate the exports, Laspeyres price indices were computed in a manner equivalent to Equation 3.

4. Empirical Estimates of Armington Elasticities

To estimate the CES elasticities of substitution between imports and domestic goods, we take a logarithmic form of the first-order conditions of expression (2) above, i.e.

$$\log[M/D] = \sigma \log[\beta/(1-\beta)] + \sigma \log[p_D/p_M] \tag{4}$$

and supplement this with quarterly dummy variables (d_i) to specify the estimating equation:

$$y = b_0 + b_1 x + b_2 d_2 + b_3 d_3 + b_4 d_4 \tag{5}$$

where $x = \log(p_D/p_M)$ and $b_1 = \sigma$ is the Armington elasticity.

We compared this relatively parsimonious model with more complex specifications, including trends, lagged dependent variables, and gamma distributed lag models, and found that expression (5) performed best. Shiells (1985) in particular has proposed a model with both distributed lag adjustments and simulataneous equations to determine domestic supply and demand.[8] While it might be of independent interest to elucidate the dynamic adjustment process, elaborate lag specifications did not improve our estimates which, in any case, are intended primarily for use in comparative static simulation work. It also may be of independent interest to study empirical linkages between domestic supply, demand, and import behavior, but for this purpose we encourage reliance upon a fully specified CGE simulation rather than a two equation, partial equilbrium specification.

Equation (5) was estimated with OLS and an iterative Cochrane-Orcutt scheme to correct for autocorrelation. The results are summarized in Table 1. Of the 163 sectors estimated, 104 had positive Armington estimates which were significant at the 5 percent level. In addition to these, 14 had significant residual serial correlation, 15 had insufficient data, and the remainder of the estimated coeficients were insignificant. The residually autocorrelated sectors are indicated with an asterisk next to their respective Durbin-Watson statistics in Table 1, and the sectors with insufficient data, as well as those with negative coefficients, are omitted from the table.

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[8] See also Shiells et al. (1986).

Table 1.

Estimated Armington Elasticities [a]

Sect	Elast	t	R^2	DW	DOF	Description
1	1.22	1.63	.64	1.93	10	Iron and ferroalloy ores mining
4	0.16	0.23	.21	2.12	30	Coal mining
5	0.31	2.30*	.50	2.13	24	Crude petroleum and natural gas
6	0.97	17.84*	.96	1.83	10	Stone, sand, and gravel
8	1.13	1.78	.40	1.87	10	Chemical and fertilizer mineral mining
9	1.68	3.30*	.28	1.06*	30	Meat packing plants and prepared meats
11	1.00	33.92*	.99	2.23	12	Creamery butter
12	1.99	6.74*	.88	1.80	30	Cheese, natural and processed
15	0.67	3.10*	.79	1.75	18	Fluid milk
17	1.16	2.84*	.32	2.32	30	Flour and other grain mill products
18	0.35	8.04*	.70	1.19	30	Cereals and flour
19	1.88	7.90*	.90	1.30	6	Dog, cat, and other pet food
20	1.26	6.24*	.56	1.29	30	Prepared feeds, n.e.c.
21	0.59	1.67	.56	1.41	8	Wet corn milling
22	1.11	7.68*	.76	1.51	28	Bread, cake, cookies, and crackers
24	0.13	6.57*	.56	1.29	30	Chocolate and other confectionary products
25	0.02	0.80	.72	2.22	30	Malt and malt beverages
26	3.49	6.95*	.75	2.08	14	Wine, brandy, and brandy spirits
27	0.15	8.46*	.86	2.76	30	Distilled liquor, except brandy
28	1.49	4.75*	.65	0.95*	24	Soft drinks, flavorings, and syrups
29	0.93	2.82*	.40	2.51	30	Vegetable oil mills
30	0.06	0.14	.05	2.77	30	Animinal and marine fats and oils
32	1.85	4.12*	.45	2.70	22	Shortening and cooking oils
33	0.27	5.16*	.47	1.74	30	Sea foods, ice, and pasta
34	0.69	1.52	.45	1.97	26	Cigarettes
35	0.15	3.28*	.57	2.23	30	Cigars
36	0.99	6.21*	.54	1.62	30	Tobacco
37	0.54	3.96*	.54	1.89	30	Yarn, thread, and broadwoven fabric mills
38	0.82	7.41*	.88	1.22	12	Narrow fabric mills
39	1.21	2.55*	.77	1.32	8	Floor coverings
40	0.57	1.91	.44	1.43	6	Felt, lace and other textile goods
41	2.53	9.80*	.75	1.12*	30	Hosiery
43	0.45	3.55*	.38	1.80	30	Apparel made from purchased materials
44	2.18	3.74*	.74	1.19	6	Housefurnish., textile bags, canvas
45	0.64	2.60*	.55	1.47	22	Logging camps and logging contractors
46	0.58	0.64	.13	2.92	26	Sawmills
47	1.73	8.53*	.84	0.83	12	Hardwood dimension and flooring mills
48	0.06	2.10*	.22	2.01	30	Millwork, wood kitchens and cabinets
50	1.02	20.13*	.96	2.14	30	Wood pallets, skids, and containers
52	0.49	9.92*	.77	1.45	30	Wood preserving and particleboard
53	0.05	0.91	.15	1.71	30	Household furniture
56	0.97	16.60*	.86	2.65	30	Paper mills, except building papers
57	1.50	6.92*	.62	1.50	30	Paperboard mills
59	1.42	8.19*	.68	2.27	30	Sanitary paper products
60	0.97	1.00	.39	1.30	6	Building paper and board mills
61	1.68	10.15*	.84	1.43	18	Paper coating and glazing

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62  1.48   4.57*   .64  3.44   10   Paperboard containers and boxes
63  0.98   9.26*   .80  3.00   30   Newspapers
64  1.00  43.12*   .79  1.19   30   Periodicals, books, and greeting cards
65  0.80  11.48*   .85  1.98   20   Printing
66  0.48   4.17*   .50  1.39   18   Industrial inorganic and organic chemicals
67  0.31   3.62*   .43  1.39   30   Agricultural chemicals
68  0.96  18.73*   .94  0.86    8   Chemical preparations
69  1.71  11.55*   .82  1.36   30   Plastics materials and resins
70  0.87   4.47*   .52  2.81   30   Synthetic rubber
71  0.66   2.31*   .29  2.17   30   Organic fibers
72  1.09   6.49*   .91  2.50   10   Drugs
73  0.58   1.44    .35  1.77   10   Soap, detergents, and sanitation goods
76  0.40   1.53    .88  1.15   10   Paving mixtures,blocks, asphalt felts
77  0.02   0.34    .27  1.66   30   Tires and inner tubes
78  0.29   4.32*   .56  2.42   26   Rubber and plastics footwear
79  0.01   0.14    .68  2.39   22   Other rubber products
80  1.46   1.71*   .10  0.94*  30   Miscellaneous plastics products
81  1.07   1.89*   .31  2.90   30   Leather tanning and finishing
83  1.27  14.85*   .98  1.68   10   Other leather goods
84  0.36  11.95*   .80  1.14*  30   Glass and glass products, exc. containers
85  0.23   1.13    .06  0.76*  30   Glass containers
86  1.09  12.73*   .86  0.67*  30   Cement, hydraulic
87  1.04  28.48*   .97  1.89   30   Brick and structural clay tile
88  0.88  24.13*   .46  2.12   30   Ceramic wall and floor tile
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Table 1 (Cont.)

Sect	Elast	t	R^2	DW	DOF	Description
90	0.84	8.94*	.74	1.03*	30	Ceramic plumbing and electrical supplies
91	1.45	7.38*	.77	2.12	30	China and earthenware products
93	0.82	16.13*	.88	2.13	30	Stone and nonmetalic mineral products
94	0.76	7.75*	.87	1.71	10	Primary steel
95	3.08	4.06*	.70	2.35	10	Iron and steel foundries
96	0.69	2.17*	.53	1.08	8	Metal heat treating and primary metal
97	0.91	0.98	.12	1.46	28	Primary copper
103	0.16	1.30	.29	2.68	20	Other nonfer. rolling, drawing, insulating
106	1.03	2.76*	.57	1.16	16	Metal barrels, drums and pails
107	0.45	1.47	.45	1.71	10	Metal plumbing fixtures, heating equipment
108	0.74	6.26*	.75	0.91*	30	Fabricated metal work
109	1.07	2.34*	.25	1.57	29	Fabricated plate work (boiler shops)
110	0.22	2.34*	.63	1.86	10	Screw machine products and bolts, etc.
111	1.17	23.65*	.98	1.79	10	Forgings and stampings
112	0.20	0.48	.53	2.23	14	Cutlery
113	0.22	8.87*	.71	1.77	30	Hand tools
115	0.24	2.75*	.22	0.75*	30	Other fabricated metal products
116	0.30	1.25	.29	2.10	30	Pipe, valves, and pipe fittings
117	0.99	21.77*	.96	2.37	20	Turbines and turbine generator sets
118	0.30	17.75*	.91	2.04	30	Internal combustion engines, n.e.c.
119	1.06	11.08*	.96	1.52	10	Farm and garden machinery and equipment
120	0.97	7.60*	.65	1.42	30	Construction, mining, oil field machinery
121	0.94	10.79*	.79	2.37	30	Elevators, conveyors, cranes
122	0.79	8.01*	.91	2.17	8	Machine tools and power driven hand tools
123	0.69	7.05*	.53	0.91*	30	Special industry machinery
124	0.26	2.77*	.39	2.72	24	Pumps, compressors, blowers, fans, furnaces
125	0.83	10.89*	.86	1.02*	30	Ball and roller bearings transmiss. equip.
127	0.85	5.60*	.49	1.07*	30	Electrical computing equipment
128	1.22	9.67*	.90	1.84	10	Service industry machines
129	0.20	2.13*	.16	2.23	30	Transformers, switchgear and switchboard
130	0.72	3.30*	.58	1.28	8	Electrical industrial apparatus
131	2.69	2.60*	.18	2.10	30	Household cooking equipment
132	1.13	5.91*	.64	1.45	30	Household refrigerator and freezers
133	1.01	19.66*	.93	2.08	30	Household laundry equipment
134	1.97	11.77*	.86	1.75	18	Electric housewares and fans
135	1.99	3.92*	.72	1.13	4	Household vacuum cleaners
136	0.09	1.12	.30	2.16	30	Sewing machines, household appliances
137	0.82	3.59*	.67	2.63	10	Electric lamps, lighting, wiring devices
138	1.41	3.52*	.63	1.33	10	Radio, TV, phonograph records and tapes
139	0.63	4.18*	.75	0.47	6	Telephone and telegraph apparatus
140	1.42	16.54*	.97	1.47	6	Radio and TV communication equipment
141	0.62	9.80*	.75	2.48	30	Electron tubes
143	2.65	11.60*	.92	1.82	10	Storage batteries
144	0.36	5.99*	.59	1.47	26	Electrical equipment and supplies
145	1.16	12.02*	.92	1.39	10	Motor vehicles parts and accessories
146	0.76	3.30*	.68	1.09	6	Aircraft
147	0.62	3.24*	.55	1.60	8	Aircraft and missile equipment, n.e.c.

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149   0.30    2.47*   .26    1.64    22    Boat building and repairing
150   0.92    5.07*   .67    0.98    12    Railroad equipment
151   1.73    6.30*   .91    1.98    10    Motorcycles, bicycles, and parts
153   0.65    2.31*   .93    1.17     8    Transportation equipment, n.e.c.
155   0.89    1.64    .45    1.65     6    Ordnance and accessories
157   0.89   22.52*   .98    1.95     6    Engineering, scientific, optical equipment
158   1.05   18.18*   .96    1.48    10    Measuring devices, environmental controls
159   0.66    2.61*   .86    0.65    10    Surgical, medical and dental equipment
160   0.28    2.26*   .43    2.80    16    Watches, clocks, and ophthalmic goods
162   0.14    4.13*   .40    1.14*   30    Jewelry, musical instruments, toys
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[a] "Elast" to the estimated Armington elasticity of substitution. "t" is the t statistic, and
an asterisk next to this number indicates the estimated elasticity is statistically significant
at the 5 percent level. "R^2" is the R-squared value, and "DW" is the Durbin-Watson statistic.
An asterisk next to the latter value indicates significant residual serial correlation. Finally,
"DOF" refers to the degrees of freedom for the estimation.

5. Concluding Remarks

This paper matched the Armington specification of substitution between imports and domestic goods with U.S. trade data to obtain econometric estimates of the Armington elasticities for 163 mining and manufacturing sectors. In about two-thirds of the cases, positive and statistically significant estimates were obtained. Individually or in weighted aggregations, these estimates can be used to sharpen the behavioral specification of applied trade models.

Our general results indicate that substitution possibilities between U.S. domestic goods and importables are indeed limited, with significant elasticities ranging between a low of 0.14 and a high of 3.49. This implies, among other things, that commodities at this level of aggregation are far from perfect substitutes, and there is ample scope for price differences and distortions without complete specialization in trade. Imperfect substitutability calls into question a variety of effective protection and welfare measures which impose the law of one price on domestic and imported commodities.

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Table A-1

Description of Estimated Sectors [a]

ES	BEA	Description	SIC
1	050000	Iron and ferroalloy ores mining	101, 106
2**	060100	Copper and ore mining	102
3*	060200	Nonfer. metal ores mining, exc. copper	103, 104, 105, 108, 109
4	070000	Coal mining	1221, 1222, 1231, 1241[b]
5	080000	Crude petroleum and natural gas	131, 132
6	090001	Dimension, crushed and broken stone	141, 142, 144
	090002	Sand and gravel mining	
7*	090003	Clay, ceramic, and refr. minerals mining	145, 148, 149
	090004	Nonmet. mineral serv. and misc. minerals	
8	100000	Chemical and fertilizer mineral mining	147
9	140101	Meat packing plants	2011, 2013
	140102	Sausages and other prepared meats	
10**	140103	Poultry dressing plants	2016, 2017
	140104	Poultry and egg processing	
11	140200	Creamery butter	2021
12	140300	Cheese, natural and processed	2022
13*	140400	Condensed and evaporated milk	2023
14**	140500	Ice cream and frozen deserts	2024
15	140600	Fluid milk	2026
16*	140800	Canned specialties	2032, 2033, 2034, 2035, 2037, 2038
	140900	Canned fruits and vegetables	
	141000	Dehydrated food products	
	141100	Pickles, sauces, and salad dressings	
	141301	Frozen fruits, juices and vegetables	
	141302	Frozen specialties	
17	141401	Flour and other grain mill products	2041
18	141402	Cereal breakfast foods	2043, 2044, 2045

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        141403  Blended and prepared flour
        141600  Rice milling


19      141501  Dog, cat, and other pet food        2047


20      141502  Prepared feeds, n.e.c.              2048


21      141700  Wet corn milling                    2046


22      141801  Bread, cake, and related products   2051, 2052
        141802  Cookies and crackers


23*     141900  Sugar                               2061, 2062, 2063


24      142001  Confectionary products              2065, 2066, 2067
        142002  Chocolate and cocoa products
        142003  Chewing gum


25      142101  Malt beverages                      2082, 2083
        142102  Malt


26      142103  Wine, brandy, and brandy spirits    2084


27      142104  Distilled liquor, except brandy     2085
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ES	BEA	Description	SIC
28	142200	Bottled and canned soft drinks	2086, 2087
	142300	Flavoring extracts and syrups, n.e.c.	
29	142400	Cottonseed oil mills	2074, 2075, 2076
	142500	Soybean oil mills	
	142600	Vegetable oil mills, n.e.c.	
30	142700	Animinal and marine fats and oils	2077
31*	142800	Roasted coffee	2095
32	142900	Shortening and cooking oils	2079
33	140700	Canned and cured sea foods	2091, 2092, 2097, 2098, 2099
	141200	Fresh or frozen packaged fish	
	143000	Manufactured ice	
	143100	Macaroni and spaghetti	
	143200	Food preparations, n.e.c.	
34	150101	Cigarettes	211
35	150102	Cigars	212
36	150103	Chewing and smoking tobacco	213, 214
	150200	Tobacco stemming and redrying	
37	160100	Broadwoven fabric mills and finishing	221, 222, 223, 2261, 2262, 2269,
	160300	Yarn mills and finish. of textiles, n.e.c.	2281, 2282, 2283, 2284
	160400	Thread mills	
38	160200	Narrow fabric mills	224
39	170100	Floor coverings	227
40	170200	Felt goods, n.e.c.	229
	170300	Lace goods	
	170400	Padding and upholstery filling	
	170500	Processed textile waste	
	170600	Coated fabrics, not rubberized	
	170700	Tire cord and fabric	
	170900	Cordage and twine	
	171001	Nonwoven fabrics	
	171002	Textile goods, n.e.c.	
41	180101	Women's hosiery, except socks	2251, 2252
	180102	Hosiery, n.e.c.	

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42*   180201  Knit outerwear mills                    2253, 2254, 2259, 2257, 2258

      180202  Knit underwear mills

      180203  Knitting mills, n.e.c.

      180300  Knit fabric mills


43    180400  Apparel made from purchased materials   231, 232, 233, 234, 235, 236, 237, 238


44    190100  Curtains and draperies                  239

      190200  Housefurnishings, n.e.c.

      190301  Textile bags

      190302  Canvas and related products

      190303  Pleating and stitching

      190304  Automotive and apparel trimmings

      190305  Schiffli machine embroideries

      190306  Fabricated textile products, n.e.c.


45    200100  Logging camps and logging contractors   2411


46    200200  Sawmills and planing mills, general     2421, 2429

      200400  Special product sawmills, n.e.c.


47    200300  Hardwood dimension and flooring mills   2426


48    200501  Millwork                                2431, 2434, 2439

      200502  Wood kitchens and cabinets

      200701  Structural wood members, n.e.c.
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ES	BEA	Description	SIC
49*	200600	Veneer and plywood	2435, 2436
50	200901	Wood pallets and skids	2441, 2448, 2449
	210000	Wood containers	
51**	200702	Prefabricated wood buildings	2451, 2452
	610602	Mobile homes	
52	200800	Wood preserving	2491, 2492, 2499
	200902	Particleboard	
	200903	Wood products, n.e.c.	
53	220101	Wood household furniture	2511, 2519, 2517, 2512, 2514, 2515
	220102	Household furniture, n.e.c.	
	220103	Wooden TV and radio cabinets	
	220200	Upholstered household furniture	
	220300	Metal household furniture	
	220400	Mattresses and bedsprings	
54**	230100	Wood office furniture	252, 2531, 254, 259
	230200	Metal office furniture	
	230300	Public building furniture	
	230400	Wood partitions and fixtures	
	230500	Metal partitions and fixtures	
	230600	Drapery hardware and blinds and shades	
	230700	Furniture and fixtures, n.e.c.	
55*	240100	Pulp mills	261
56	240200	Paper mills, except building papers	262
57	240300	Paperboard mills	263
58*	240400	Envelopes	2642, 2643, 2645, 2646, 2648, 2649
	240702	Bags, except textile	
	240703	Die-cut paper and board	
	240704	Pressed and molded pulp goods	
	240705	Stationary products	
	240706	Converted paper products, n.e.c.	
59	240500	Sanitary paper products	2647
60	240602	Building paper and board mills	266
61	240701	Paper coating and glazing	2641
62	250000	Paperboard containers and boxes	265

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63    260100  Newspapers                                271

64    260200  Periodicals                               272, 273, 277
      260301  Book publishing
      260302  Book printing
      260700  Greeting card publishing

65    260400  Miscellaneous publishing                  274, 276, 2782, 2753, 2751, 2752,
      260501  Commercial printing                          2754, 2789, 2795, 2793, 2794,
      260502  Lithographic platemaking and services        2791
      260601  Manifold business forms
      260602  Blankbooks and looseleaf blinders
      260801  Engraving and plate printing
      260802  Bookbinding and related work
      260803  Typesetting
      260804  Photoengraving
      260805  Electrotyping and stereotyping

66    270100  Industrial inorganic and organic chemicals  281, 2865, 2869, 2861
      270401  Gum and wood chemicals

67    270201  Nitrogenous and phosphatic fertilizers    2873, 2874, 2875, 2879
      270202  Fertilizers, mixing only
      270300  Agricultural chemicals, n.e.c.
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ES	BEA	Description	SIC
68	270402	Adhesives and sealants	289
	270403	Explosives	
	270404	Printing ink	
	270405	Carbon black	
	270406	Chemical preparations, n.e.c.	
69	280100	Plastics materials and resins	2821
70	280200	Synthetic rubber	2822
71	280300	Cellulosic man-made fibers	2823, 2824
	280400	Organic fibers, noncellulosic	
72	290100	Drugs	283
73	290201	Soap and other detergents	284
	290202	Polishes and sanitation goods	
	290203	Surface active agens	
	290300	Toilet preparations	
74*	300000	Paints and allied products	285
75*	310101	Petroleum refining	291, 299
	310102	Lubricating oils and greases	
	310103	Products of petroleum and coal, n.e.c.	
76	310200	Paving mixtures and blocks	295
	310300	Asphalt felts and coatings	
77	320100	Tires and inner tubes	301
78	320200	Rubber and plastics footwear	302
79	320301	Reclaimed rubber	303, 304, 306
	320302	Fabricated rubber products, n.e.c.	
	320500	Rubber and plastics hose and belting	
80	320400	Miscellaneous plastics products	307
81	330001	Leather tanning and finishing	311
82*	340201	Shoes, except rubber	314
	340202	House slippers	
83	340100	Boot and shoe cut stock and findings	313, 315, 316, 317, 319
	340301	Leather gloves and mittens	
	340302	Luggage	

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      340303  Women's handbags and purses
      340304  Personal leather goods
      340305  Leather goods, n.e.c.


84    350100  Glass and glass products, exc. containers    3211, 3229, 323


85    350200  Glass containers                             3221


86    360100  Cement, hydraulic                            324


87    360200  Brick and structural clay tile               3251


88    360300  Ceramic wall and floor tile                  3253, 3255
      360400  Clay refractories


89**  360500  Structural clay products, n.e.c.             3259


90    360600  Vitreous plumbing fixtures                   3261, 3264
      360800  Porcelain electrical supplies


91    360701  Vitreous china food utensils                 3262, 3263, 3269
      360702  Fine earthenware food utensils
      360900  Pottery products, n.e.c.
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ES	BEA	Description	SIC
92*	361000	Concrete block and brick	3271, 3272, 3273, 3274, 3275
	361100	Concrete products, n.e.c.	
	361200	Ready-mixed concrete	
	361300	Lime	
	361400	Gypsum products	
93	361500	Cut stone and stone products	328, 3291, 3292, 3293, 3295, 3296,
	361600	Abrasive products	3297, 3299
	361700	Asbestos products	
	361800	Gaskets, packing and sealing devices	
	361900	Mineral, ground or treated	
	362000	Mineral wool	
	362100	Nonclay refractories	
	362200	Nonmetalic mineral products, n.e.c.	
94	370101	Blast furnaces and steel mills	331
	370102	Electrometallurgical products	
	370103	Steel wire and related products	
	370104	Cold finishing of steel shapes	
	370105	Steel pipe and tubes	
95	370200	Iron and steel foundries	332
96	370401	Metal heat treating	339
	370402	Primary metal products, n.e.c.	
97	380100	Primary copper	3331
98*	380200	Primary lead	3332, 3333, 3339
	380300	Primary zinc	
	380500	Primary nonferrous metals, n.e.c.	
99*	380400	Primary aluminum	3334
100**	380600	Secondary nonferrous metals	334
101*	380700	Copper rolling and drawing	3351
102*	380800	Aluminum rolling and drawing	3353, 3354, 3355
103	380900	Nonferrous rolling and drawing, n.e.c.	3356, 3357
	381000	Nonferrous wire drawing and insulating	
104**	381100	Aluminum castings	336
	381200	Brass, bronze, and copper castings	
	381300	Nonferrous castings, n.e.c.	

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105**   390100   Metal cans                                  3411

106     390200   Metal barrels, drums and pails              3412

107     400100   Metal sanitary ware                         343
        400200   Plumbing fixture fittings and trim
        400300   Heating equipment, except electric

108     400400   Fabricated structural metal                 3441, 3442, 3444, 3446, 3448, 3449
        400500   Metal doors, sash, anr trim
        400700   Sheet metal work
        400800   Architectural metal work
        400901   Fabricated metal buildings
        400902   Miscellaneous metal work

109     400600   Fabricated plate work (boiler shops)        3443

110     410100   Screw machine products and bolts, etc.      345

111     370300   Iron ans steel forgings                     346
        381400   Nonferrous forgings
        410201   Automotive stampings
        410202   Crowns and closures
        410203   Metal stampings, n.e.c.

112     420100   Cutlery                                     3421
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ES	BEA	Description	SIC
113	420201	Hand and edge tools, n.e.c.	3423, 3425, 3429
	420202	Hand saws and saw blades	
	420300	Hardware, n.e.c.	
114**	420401	Plating and polishing	347
	420402	Metal coating and allied services	
115	420500	Miscellaneous fabricated wire products	3495, 3496, 3493, 3497, 3499
	420700	Steel springs, except wire	
	421000	Metal foil and leaf	
	421100	Fabricated metal products, n.e.c.	
116	420800	Pipe, valves, and pipe fittings	3494, 3498
117	430100	Turbines and turbine generator sets	3511
118	430200	Internal combustion engines, n.e.c.	3519
119	440001	Farm machinery and equipment	352
	440002	Lawn and garden equipment	
120	450100	Construction machinery and equipment	3531, 3532, 3533
	450200	Mining machinery, except oil field	
	450300	Oil field machinery	
121	460100	Elevators and moving stairways	3534, 3535, 3536, 3537
	460200	Conveyors and conveying equipment	
	460300	Hoists, cranes, and monorails	
	460400	Industrial trucks and tractors	
122	470100	Machine tools, metal cutting types	354
	470200	Machine tools, metal forming types	
	470300	Special dies, tools and mach. tool access.	
	470401	Power driven hand tools	
	470402	Rolling mill machinery	
	470403	Metalworking machinery, n.e.c.	
123	480100	Food products machinery	3551, 3552, 3553, 3554, 3555, 3559
	480200	Textile machinery	
	480300	Wordworking machinery	
	480400	Paper industries machinery	
	480500	Printing trades machinery	
	480600	Special industry machinery, n.e.c.	
124	490100	Pumps and compressors	3561, 3563, 3564, 3565, 3567, 3569
	490300	Blowers and fans	
	490400	Industrial patterns	

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        490600  Industrial furnaces and ovens
        490700  General industrial machinery, n.e.c.


125     490200  Ball and roller bearings              3562, 3566, 3568
        490500  Power transmission equipment


126**   500001  Carburetors, pistons, rings, valves   3592, 3599
        500002  Machinery, except electrical, n.e.c.


127     510101  Electrical computing equipment        357
        510102  Calculating and accounting machines
        510300  Scales and balances
        510400  Typewriters and office machines, n.e.c.


128     520100  Automatic merchandising machines      358
        520200  Commercial laundry equipment
        520300  Refrigeration and heating equipment
        520400  Measuring and dispensing pumps
        520500  Service industry machines, n.e.c.


129     530200  Transformers                          3612, 3613
        530300  Switchgear and swithboard apparatus
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ES	BEA	Description	SIC
130	530400	Motors and generators	362
	530500	Industrial controls	
	530600	Welding apparatus, electric	
	530700	Carbon and graphite products	
	530800	Electrical industrial apparatus, n.e.c.	
131	540100	Household cooking equipment	3631
132	540200	Household refrigerator and freezers	3632
133	540300	Household laundry equipment	3633
134	540400	Electric housewares and fans	3634
135	540500	Household vacuum cleaners	3635
136	540600	Sewing machines	3636, 3639
	540700	Household appliances, n.e.c.	
137	550100	Electric lamps	364
	550200	Lighting fixtures and equipment	
	550300	Wiring devices	
138	560100	Radio and TV receiving sets	365
	560200	Phonograph records and tapes	
139	560300	Telephone and telegraph apparatus	3661
140	560400	Radio and TV communication equipment	3662
141	570100	Electron tubes	3671
142*	570200	Semiconductors and related devices	3674, 3675, 3676, 3677, 3678, 3679
	570300	Other electronic components	
143	580100	Storage batteries	3691
144	580200	Primary batteries, dry and wet	3692, 3693, 3694, 3699
	580300	X-ray apparatus and tubes	
	580400	Engine electrical equipment	
	580500	Electrical equipment and supplies, n.e.c.	
145	590100	Truck and bus bodies	371
	590200	Truck trailers	
	590301	Motor vehicles and car bodies	
	590302	Motor vehiicles parts and accessories	
	610603	Motor homes	

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146    600100  Aircraft                                   3721

147    600200  Aircraft and missile engines and parts    3724, 3728, 3764, 3769
       600400  Aircraft and missile equuipment, n.e.c.

148**  610100  Ship building and repairing               3731

149    610200  Boat building and repairing               3732

150    610300  Railroad equipment                        374

151    610500  Motorcycles, bicycles, and parts          375

152**  610601  Travel trailers and campers               3792

153    610700  Transportation equipment, n.e.c.          3799

154**  130100  Guided missiles and space vehicles        3761

155    130200  Ammunition, except for small arms, n.e.c.  348
       130500  Small arms
       130600  Small arms ammunition
       130700  Other ordnance and accessories

156**  130300  Tank and tank components                  3795
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ES	BEA	Description	SIC
157	620100	Engineering and scientific equipment	3811, 383
	630100	Optical instruments and lenses	
158	530100	Instruments to measure electricity	382
	620200	Mechanical measuring devices	
	620300	Environmental controls	
159	620400	Surgical and medical instruments	384
	620500	Surgical appliances and supplies	
	620600	Dental equipment and supplies	
160	620700	Watches, clocks, and parts	387, 385
	630200	Ophthalmic goods	
161*	630300	Photographic equipment and supplies	386
162	640101	Jewelry, precious metal	391, 396, 394, 393
	640102	Jewelers' materials and lapidary work	
	640104	Silverware and plated ware	
	640105	Costume jewelry	
	640200	Musical instruments	
	640301	Games, toys, and children's vehicles	
	640302	Dolls	
	640400	Sporting and athletic goods, n.e.c.	
	640600	Artificial trees and flowers	
	640701	Buttons	
	640702	Needles, pins, and fasteners	
163*	640501	Pens and mechanical pencils	395, 399
	640502	Lead pencils and art goods	
	640503	Marking devices	
	640504	Carbon paper and inked ribbons	
	640800	Brooms and brushes	
	640900	Hard surface floor coverings	
	641000	Burial caskets and vaults	
	641100	Signs and advertising displays	
	641200	Manufacturing industries, n.e.c.	

[a] A single asterisk indicates a negative Armington estimate, and a double asterisk indicates insufficient data for estimation. These sectors are not included in Table 1.

[b] The PPI uses the older SIC classification sectors 1111, 1211, 1213.