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Dissecting Trade: Firms, Industries, and Export Destinations

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ABSTRACT

We examine entry across 113 national markets in 16 different industries using a comprehensive data set of French manufacturing firms. The data are unique in indicating how much each firm exports to each destination. Looking across all manufacturers: (1) Firms differ substantially in export participation, with most selling only at home; (2) The number of firms selling to multiple markets falls off with the number of destinations with an elasticity of -2.5 ; (3) Decomposing French exports to each destination into the size of the market and French share, variation in market share translates nearly completely into firm entry while about 60 percent of the variation in market size is reflected in firm entry. Looking within each of 16 industries we find little variation in these patterns. We propose that any successful model of trade and market structure must confront these facts.

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We examine the entry behavior of producers in different industries in different export markets using a comprehensive data set of French firms. These data reveal enormous heterogeneity, primarily within industries, in the nature of market penetration. Nonetheless, some striking regularities appear both across and within industries.

The French data add a new dimension to an emerging empirical literature examining international trade at the level of individual producers. James Tybout (2003) provides a survey. This work has shown that: (i) exporters are in the minority; (ii) they tend to be more productive and larger; (iii) yet they usually export only a small fraction of their output.

The findings that most firms do not export while those that do sell most of what they make at home suggest substantial barriers to exporting. Theories of producer export behavior have suggested either standard “iceberg” costs, e.g., Andrew Bernard et al. (2003), or fixed costs, e.g., Mark Roberts and Tybout (1997) and Marc Melitz (2003), as explanations.

Up to now our knowledge of the export behavior of individual producers has been limited to knowing whether or not they export and how much they sell abroad if they do. Without data on where producers sell it’s hard to untangle the nature of trade costs or whether they apply simply to exporting at all or to entering individual foreign markets.

The French data, in indicating where French firms export, are particularly enlightening on these issues. They suggest a world in which national markets are highly fragmented, and in which both fixed and unit costs of export play a role in separating them. Rather than pursuing a particular explanation of firm export penetration, our purpose here is to establish some key features of the data that any successful model of trade and market structure must confront.

1 The French Data

Pierre Biscourp and Kramarz (2002) describe how the French firm-level data are constructed by merging customs and tax administration data sets. French customs record exports of French firms to each of over 200 destinations. Our analysis here is based on data for 1986. Table 1 presents our industry classification and compares features of the French firm data with U.S. plant-level data taken from Bernard and J. Bradford Jensen (1995). Since the U.S. data exclude the smallest plants, while the French data are virtually exhaustive, there are more French producers, especially in light industries such as food and tobacco products. But there are strong underlying similarities between the two countries not only in overall export participation but also in the pattern across industries.

2 Dissection 1: Markets per Firm

Having seen the similarity between the French and U.S. data in terms of overall export activity, we now look at the dimension unique to the French data: where individual firms sell. Table 2 presents for each of our 16 industries the fraction of exporting firms shipping to exactly 1 destination, to 10 or more, and to 50 or more. In each case, we report the fraction of total exports that such firms represent. To summarize, across industries, the modal exporter ships to only one foreign destination (most often Belgium), whereas exports by the small fraction of firms that ship widely constitute a substantial share of total exports.

Looking at all of manufacturing (excluding petroleum refining), Figure 1A plots the frequency with which firms serve different numbers of markets, including France itself (so that nonexporters appear as having one market). The frequency with which more markets are served declines smoothly and monotonically to the point where at most a single firm

serves a very large number. Overall, the elasticity of the number of firms with respect to the number of markets is roughly -2.5.

The qualitative pattern is very much replicated industry by industry, although there are distinct differences in the extent to which the frequency declines with number of markets. Figures 1B reports patterns for four industries that reflect the gamut: food and tobacco, lumber and furniture, chemicals, and electronic and electrical equipment. (To make the plots more comparable across industries, frequency here is in terms of the fraction of firms in the industry rather than firm count, with the fractions grouped by intervals of 10 markets for market numbers exceeding 40.) Across all 16 industries, the decline is most precipitous in light industries such as lumber and furniture, paper, and textiles and apparel and least so in heavy industries such as chemicals and in high-tech industries such as machinery and computer equipment. (Appendix Figure A1 displays results for all 16 industries.)

3 Dissection 2: Firms per Market

Having looked at the number of destinations across firms, we now examine the number of firms across destinations. In order to match the French firm data to a measure of a destination's market size, we aggregate to 113 countries, including France. Our measure of market n 's size is its absorption, X_n , defined as gross production plus imports minus exports (in US\$billions).¹

A standard approach to modeling bilateral trade volumes is the gravity equation, which relates exports from i to n , X_{ni} , to the market sizes of n and i and measures of the geographic barriers between them, such as distance d_{ni} , e.g.:

$$X_{ni} = \kappa \frac{X_i X_n}{d_{ni}}$$

(where κ is a constant reflecting units of measurement). In our situation the source is always France (so $i = F$), while we can summarize the role of geographic barriers with France's market share, λ_{nF} , giving us the identity:

$$X_{nF} \equiv \lambda_{nF} X_n.$$

With our firm data we obtain an additional identity relating X_{nF} to firm behavior:

$$X_{nF} \equiv N_{nF} \bar{x}_{nF}$$

where N_{nF} is the number of French firms selling in destination n , and \bar{x}_{nF} average sales per firm there.²

Figure 2 depicts a striking relationship among three elements of these two decompositions. On the horizontal axis is the market size measure X_n . On the vertical axis is the number of French exporters divided by French market share (N_{nF}/λ_{nF}).³ When normalized by French market share, the number of French firms selling increases systematically with market size, but with an elasticity less than one.

Another way to present this relationship is in terms of a regression of $\ln N_{nF}$ on $\ln \lambda_{nF}$ and $\ln X_n$, yielding the coefficients (with robust standard errors):

$$\ln N_{nF} = 9.088 + .875 \ln \lambda_{nF} + .617 \ln X_n.$$

(.150)
(.030)
(.021)

The R^2 is .903.⁴ The implication is that, given market size, a higher French market share in a destination typically reflects 88 percent more firms selling there and 12 percent more sales per firm. Given market share, sales to a larger market reflect 62 percent more firms and 38 percent more sales per firm.

To what extent does this pattern of entry differ for individual industries? We pursued this question in a number of directions, all of which gave the same answer: not much. For

example, we decomposed France’s exports to destination n in industry s , X_{nF}^s into: (i) French market share λ_{nF} , (ii) absorption X_n , (both at the level of total manufacturing) and (iii) the “industry bias” of French exports to market n , $B_{nF}^s = X_{nF}^s/X_n$, as well as into the number of French firms in industry s selling in market n , N_{nF}^s , and their average sales there, \bar{x}_{nF}^s yielding:

$$\lambda_{nF} X_n B_{nF}^s \equiv X_{nF}^s \equiv N_{nF}^s \bar{x}_{nF}^s.$$

Extending our procedure above, we regressed $\ln N_{nF}^s$ on $\ln \lambda_{nF}$, $\ln X_n$, and $\ln B_{nF}^s$ for each industry. While the differences in coefficients are statistically significant, the magnitudes of the differences are small with no clear economic significance. Hence we report a pooled regression (with robust standard errors in parentheses, allowing for clustering by industry):⁵

$$\begin{aligned} \ln N_{nF}^s = & 7.442 + .826 \ln \lambda_{nF} + .585 \ln X_n + .418 \ln B_{nF}^s. \\ & (.258) \quad (.023) \quad (.019) \quad (.051) \end{aligned}$$

The R^2 is .837. Adding industry indicators has virtually no effect on these coefficients and raises the R^2 to only .894. More importantly, to show that industry is not the essential element explaining entry, the R^2 of the regression with only industry indicators is .150, whereas a regression that only includes country indicators has an R^2 of .744. Our account of entry, which includes only three variables, is therefore both powerful and parsimonious.⁶

4 Conclusion

We have reviewed initial evidence on the nature of market penetration by individual firms in different industries across national markets. At the level of overall manufacturing, several features stand out: (1) There is enormous heterogeneity across firms in the extent of their export participation, with most selling only at home. (2) The number of firms selling

to multiple markets falls off with the number of destinations with an elasticity of -2.5. (3) Variation in French exports across destinations represents differences in the number of French firms selling there much more than the amount that each one sells. (4) Decomposing French exports to each destination into the size of the market and French share, we find that the variation in market share translates nearly completely into firm entry, while about 60 percent of the variation in market size is reflected in firm entry.

Qualitatively, these features are very much replicated within two-digit industries, suggesting that differences across industries have surprisingly little to do with them. Across industries, larger markets are served by more firms. Presumably, consumers benefit from more variety or more competition. A policy implication is that a potentially important welfare gain from market integration is the entry of firms.

Eaton et al. (2003) develop a Ricardian model with imperfect competition, transport costs, and destination-specific fixed costs of market entry to explain these qualitative features of the data. They pursue a structural estimation of the model at the level of overall manufacturing, finding that it can pick up aggregate patterns quite well. Our examination of the industry-level data suggests that the qualitative implications of the model survive looking within industries, in particular, the enormous heterogeneity across individual firms and the fragmentation of the world market.

Notes

¹The data for constructing absorption cover manufacturing (excluding petroleum refining) in 113 destination countries as of 1986. Total exports and imports are from Robert Feenstra (2000). Gross production is from UNIDO (2001), available for 86 countries. For the remainder, we use value added in manufacturing from the World Bank (2001). We divide these value added numbers by 0.418, the average ratio of World Bank value added in manufacturing to UNIDO gross production in manufacturing across 59 countries for which both are available. Appendix Table A1 reports the list of 113 destination countries, along with each destination's total manufacturing absorption, French market share, number of French exporters, and average sales per French firm.

²For a foreign destination n , X_{nF} is the sum across firms of exports there. When n is France it is the sum across firms of domestic sales. All measures are translated into US\$billions.

³If French firms sell on average the same amount as other firms to destination n , then N_{nF}/λ_{nF} indicates the total number of firms selling there.

⁴Of course, because of the identity connecting the variables, a regression of $\ln \bar{x}_{nF}$ on $\ln \lambda_{nF}$ and $\ln X_n$ yields coefficients of exactly 1 minus the ones reported above.

⁵With 16 sectors and 113 destinations we have 1808 observations. For 38 both X_{nF}^s and N_{nF}^s are zero. We dropped these observations.

⁶Appendix Figure A2 displays a relationship that is essentially the industry analog of Figure 2. The horizontal axis is absorption at the industry level while the vertical axis is the number of French firms exporting to a destination in a given industry divided by overall French market share in that destination. Because of the need to construct absorption by industry we had to drop the 27 countries for which UNIDO gross production data was not available. In addition 270 industry-country pairs had to be dropped due to incomplete coverage in the UNIDO data. Note that in Figure A2 each industry displays much the same pattern as for the aggregate, albeit noisier.

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TABLE 1: Producer Export Participation, France vs. USA

SIC	Industry	Number of Producers		Percentage that Export		Percentage Exported	
		France	USA	France	USA	France	USA
20, 21	Food and Tobacco Products	59637	11887	5.5	13.1	11.9	5.8
22, 23	Textiles and Apparel	24952	17456	24.1	6.2	22.0	4.6
24, 25	Lumber and Furniture	29196	22518	12.1	6.7	9.9	8.8
26	Paper and Allied Products	1757	4512	45.3	18.0	18.4	8.7
27	Printing and Publishing	18879	27842	15.1	2.9	4.3	3.2
28	Chemicals, etc.	3901	7312	55.4	30.3	27.4	12.0
30	Rubber and Plastics	4722	8758	44.3	22.2	24.3	6.5
31	Leather and Leather Products	4491	1052	26.3	17.0	19.3	11.6
32	Stone, Clay, Glass, and Concrete	9952	10292	16.3	9.0	16.7	7.0
33	Primary Metal Industries	1425	4626	52.8	22.1	27.7	4.0
34	Fabricated Metal Products	25923	21940	16.8	15.2	13.1	7.5
35	Machinery and Computer Eqpt	17164	27003	26.8	19.6	27.7	13.9
36	Electronic and Electrical Eqpt	9382	9525	30.2	34.6	21.6	11.5
37	Transportation Equipment	3786	5439	32.9	23.5	28.7	12.9
38	Instruments, etc.	7567	4232	13.3	43.1	32.7	15.5
39	Miscellaneous Manufacturing	11566	7254	21.0	13.0	22.4	7.3
	Manufacturing (ex. Petroleum Ref.)	234300	191648	17.4	14.6	21.6	10.3

Notes: US figures are for 1987, derived from Bernard and Jensen (1995). French figures are for 1986, based on Customs and BRN-SUSE data sources. Percentage exported is exports of the industry as a percentage of exporting producers' sales.

TABLE 2: Penetration of Export Markets by French Firms

SIC	Industry	Firms Exporting to Exactly 1 Market		Firms Exporting to 10 or More Markets		Firms Exporting to 50 or More Markets	
		% exporters	% exports	% exporters	% exports	% exporters	% exports
20, 21	Food and Tobacco Products	36.2	1.8	18.4	78.5	1.6	35.9
22, 23	Textiles and Apparel	26.8	1.4	24.9	83.8	0.4	19.9
24, 25	Lumber and Furniture	50.6	5.4	4.8	45.4	0.0	0.0
26	Paper and Allied Products	25.4	0.2	24.6	89.9	1.0	30.2
27	Printing and Publishing	46.8	2.8	9.1	61.1	0.6	23.4
28	Chemicals, etc.	19.6	0.1	38.4	96.9	6.2	69.1
30	Rubber and Plastics	30.9	1.1	18.1	91.4	0.9	54.9
31	Leather and Leather Products	29.5	1.2	21.3	83.5	0.8	30.8
32	Stone, Clay, Glass, and Concrete	47.4	2.2	12.6	89.3	1.3	57.1
33	Primary Metal Industries	23.0	0.1	25.1	81.1	2.4	40.3
34	Fabricated Metal Products	41.9	3.0	13.1	71.7	0.5	19.3
35	Machinery and Computer Eqpt	30.6	0.5	26.1	93.5	2.5	58.8
36	Electronic and Electrical Eqpt	29.7	0.3	23.3	94.1	2.8	58.9
37	Transportation Equipment	28.9	0.1	24.2	96.0	2.3	65.1
38	Instruments, etc.	27.3	1.1	30.0	90.9	2.7	42.5
39	Miscellaneous Manufacturing	34.8	1.9	17.5	82.5	0.8	24.2
	Manufacturing (ex. Petroleum Ref.)	34.5	0.7	19.7	89.6	1.5	51.6

Notes: French figures are for 1986, based on Customs and BRN-SUSE data sources.

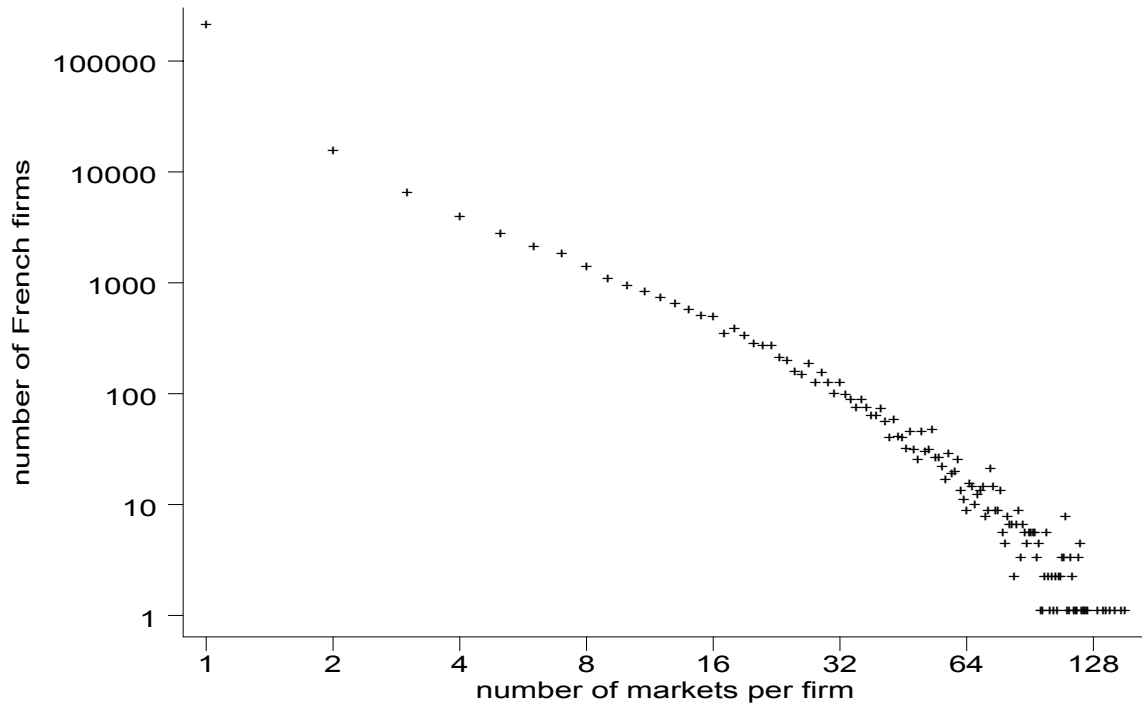


Figure 1A: Entry of French Firms

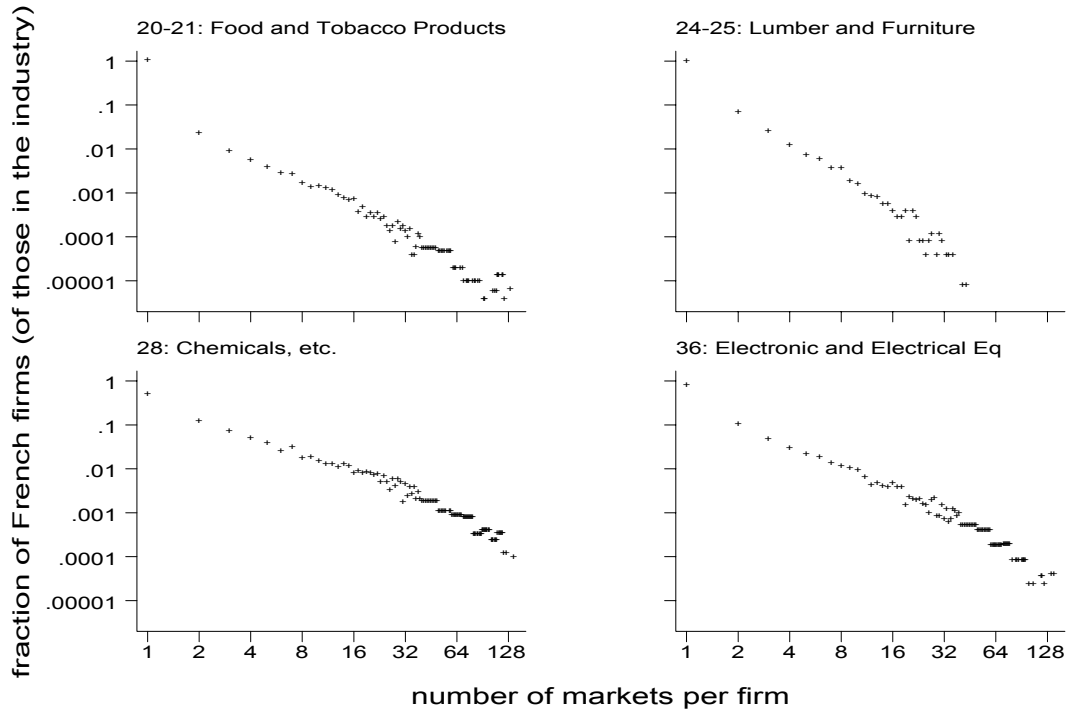


Figure 1B: Entry of French Firms in Four Industries

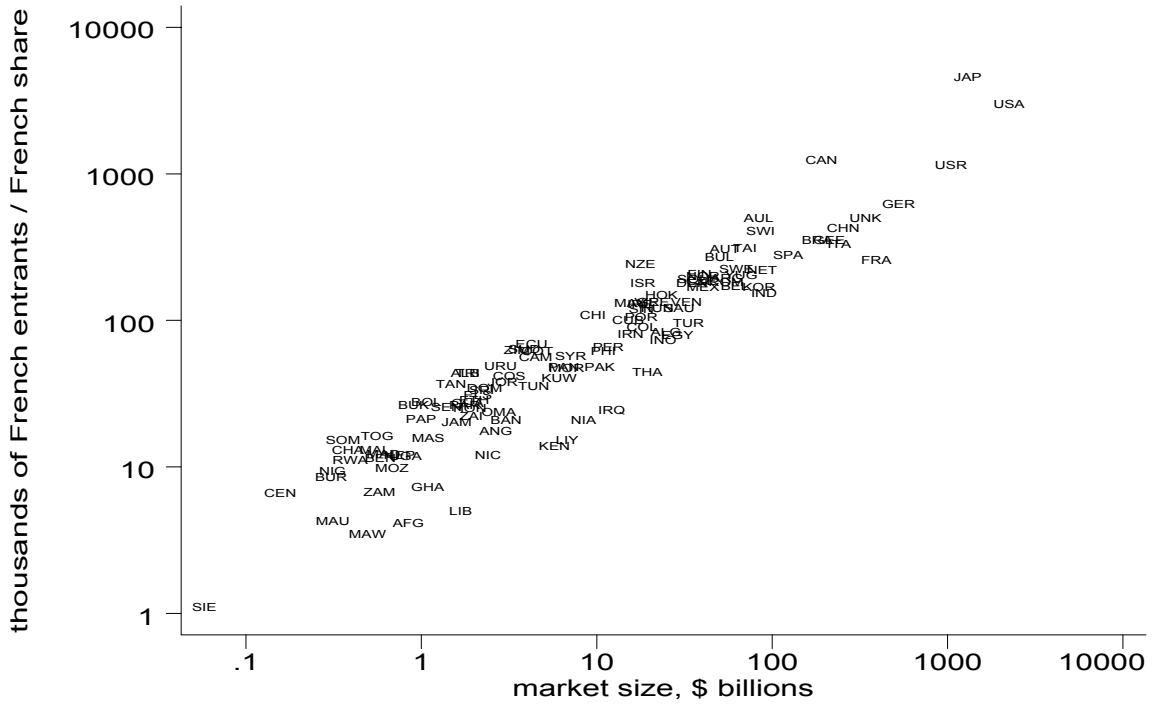


Figure 2: Entry and Market Size

TABLE A1: Market Penetration of French Firms, by Destination (first of three tables)

#	Country	Country Code	UNIDO Data (yes=1)	Market Size (\$billions)	French Share (%)	French Exporters (#)	French Sales per Firm (\$thousands)
1	AFGHANISTAN	AFG	1	0.84	1.44	56	215.75
2	ALBANIA	ALB	1	1.77	0.17	70	42.69
3	ALGERIA	ALG	1	24.76	5.05	3986	313.57
4	ANGOLA	ANG	0	2.65	2.97	494	159.72
5	ARGENTINA	ARG	1	55.16	0.49	897	298.32
6	AUSTRALIA	AUL	1	83.83	0.54	2510	178.81
7	AUSTRIA	AUT	1	53.78	1.60	4640	184.98
8	BANGLADESH	BAN	1	3.05	0.83	163	155.08
9	BELGIUM-LUXEMBOURG	BEL	1	61.33	12.25	19864	378.13
10	BENIN	BEN	0	0.58	12.17	1319	53.84
11	BOLIVIA	BOL	1	1.07	0.38	99	40.60
12	BRAZIL	BRA	0	181.18	0.31	1050	543.43
13	BULGARIA	BUL	1	50.11	0.19	496	196.71
14	BURKINA FASO	BUK	0	0.90	5.16	1286	36.22
15	BURUNDI	BUR	1	0.31	3.73	299	38.12
16	CAMEROON	CAM	0	4.48	8.24	4404	83.78
17	CANADA	CAN	1	191.06	0.42	4994	161.47
18	CENTRAL AFRICAN REPUBLIC	CEN	1	0.16	18.14	1131	25.15
19	CHAD	CHA	0	0.38	4.33	533	30.83
20	CHILE	CHI	1	9.49	0.77	798	91.84
21	CHINA	CHN	1	254.17	0.16	637	630.07
22	COLOMBIA	COL	1	18.12	0.68	577	213.66
23	COSTA RICA	COS	1	3.16	0.49	192	79.88
24	COTE D'IVOIRE	COT	0	4.57	7.19	4189	78.38
25	CUBA	CUB	1	15.11	0.25	240	158.83
26	CZECHOSLOVAKIA(FORMER)	CZE	1	39.52	0.36	633	226.20
27	DENMARK	DEN	1	34.99	2.49	4212	206.83
28	DOMINICAN REPUBLIC	DOM	0	2.29	0.67	217	70.30
29	ECUADOR	ECU	1	4.25	0.50	321	65.56
30	EGYPT	EGY	1	28.85	2.00	1490	386.94
31	EL SALVADOR	ELS	0	2.10	0.38	113	71.27
32	ETHIOPIA	ETH	1	2.00	0.82	223	73.44
33	FINLAND	FIN	1	38.54	1.48	2879	198.10
34	FRANCE	FRA	1	392.24	95.79	234300	1603.54
35	GERMANY(EAST)	GEE	1	211.23	0.11	369	637.15
36	GERMANY(WEST)	GER	1	525.79	2.79	16503	888.99
37	GHANA	GHA	1	1.09	2.05	140	158.60
38	GREECE	GRE	1	20.91	2.72	3408	167.02
39	GUATEMALA	GUA	1	1.83	0.62	161	71.02
40	HONDURAS	HON	1	1.89	0.51	121	79.49

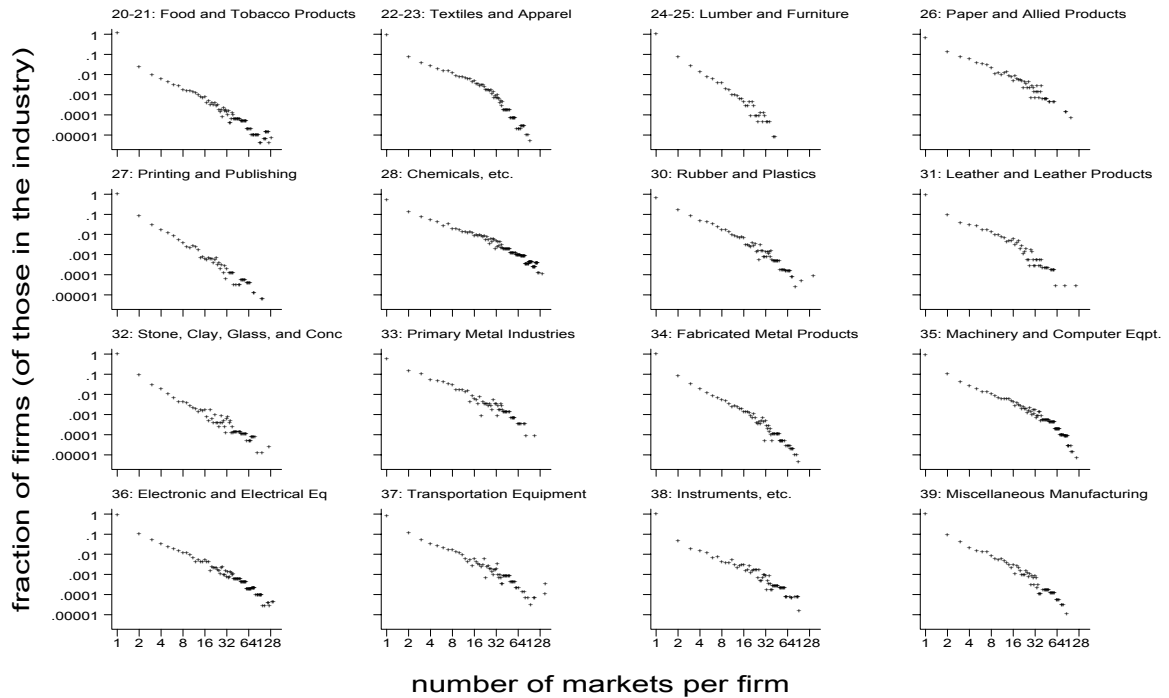
TABLE A1: Market Penetration of French Firms, by Destination (second of three tables)

#	Country	Country Code	UNIDO Data (yes=1)	Market Size (\$billions)	French Share (%)	French Exporters (#)	French Sales per Firm (\$thousands)
41	HONG KONG	HOK	1	23.39	1.73	2422	167.17
42	HUNGARY	HUN	1	22.09	0.76	864	194.16
43	INDIA	IND	1	90.00	0.84	1219	617.88
44	INDONESIA	INO	1	23.88	0.89	619	342.79
45	IRAN	IRN	1	15.58	0.45	339	204.88
46	IRAQ	IRQ	1	12.16	2.76	643	522.91
47	IRELAND	IRE	1	17.62	1.79	2194	143.92
48	ISRAEL	ISR	1	18.29	1.58	2680	107.71
49	ITALY	ITA	1	241.60	3.87	12084	773.23
50	JAMAICA	JAM	1	1.59	0.59	112	83.58
51	JAPAN	JAP	1	1305.65	0.08	3646	303.62
52	JORDAN	JOR	1	2.90	2.45	877	81.00
53	KENYA	KEN	1	5.74	3.11	408	437.79
54	KOREA(SOUTH)	KOR	1	83.98	0.66	1053	528.41
55	KUWAIT	KUW	1	6.10	3.71	1423	159.03
56	LIBERIA	LIB	0	1.67	3.39	160	354.48
57	LIBYA	LIY	0	6.77	2.04	296	466.52
58	MADAGASCAR	MAD	1	0.61	9.43	1084	52.78
59	MALAWI	MAW	1	0.49	1.89	62	149.54
60	MALAYSIA	MAY	1	15.60	0.59	741	124.79
61	MALI	MAL	0	0.54	8.79	1082	44.11
62	MAURITANIA	MAU	0	0.31	18.53	749	77.23
63	MAURITIUS	MAS	1	1.09	6.37	944	73.66
64	MEXICO	MEX	1	40.32	0.50	809	250.93
65	MOROCCO	MOR	1	6.72	9.89	4433	149.89
66	MOZAMBIQUE	MOZ	1	0.68	1.85	171	73.25
67	NEPAL	NEP	1	0.75	0.43	49	65.21
68	NETHERLANDS	NET	1	87.39	4.52	9367	421.27
69	NEW ZEALAND	NZE	1	17.73	0.41	944	77.19
70	NICARAGUA	NIC	0	2.40	0.94	108	208.79
71	NIGER	NIG	0	0.31	13.09	1155	35.29
72	NIGERIA	NIA	0	8.41	3.30	649	428.21
73	NORWAY	NOR	1	40.33	1.70	3208	214.22
74	OMAN	OMA	0	2.76	2.46	551	123.34
75	PAKISTAN	PAK	1	10.40	1.47	664	230.36
76	PANAMA	PAN	1	6.49	0.92	417	143.08
77	PAPUA NEW GUINEA	PAP	1	1.00	0.38	76	49.64
78	PARAGUAY	PAR	0	1.77	0.95	236	71.24
79	PERU	PER	1	11.63	0.73	456	186.22
80	PHILIPPINES	PHI	1	10.92	0.72	424	186.04

TABLE A1: Market Penetration of French Firms, by Destination (third of three tables)

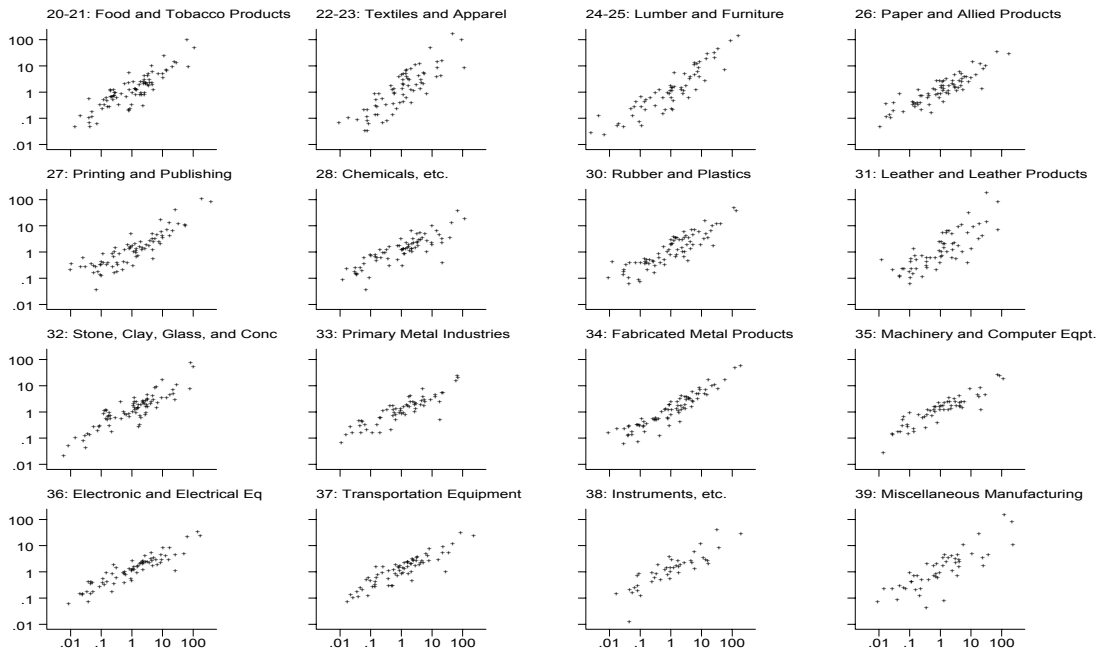
#	Country	Country Code	UNIDO Data (yes=1)	Market Size (\$billions)	French Share (%)	French Exporters (#)	French Sales per Firm (\$thousands)
81	PORTUGAL	POR	1	17.91	4.25	4228	179.94
82	ROMANIA	ROM	1	54.56	0.22	379	314.44
83	RWANDA	RWA	1	0.39	3.35	350	37.47
84	SAUDI ARABIA	SAU	0	29.43	2.47	2823	256.97
85	SENEGAL	SEN	0	1.39	12.74	3069	57.72
86	SIERRA LEONE	SIE	1	0.06	9.23	96	55.57
87	SINGAPORE	SIN	1	17.99	1.67	1869	160.68
88	SOMALIA	SOM	1	0.36	0.50	73	24.60
89	SOUTH AFRICA	SOU	1	35.69	1.01	1816	197.79
90	SPAIN	SPA	1	123.43	3.12	8170	471.13
91	SRI LANKA	SRI	1	2.20	0.81	256	69.61
92	SUDAN	SUD	0	3.86	0.43	257	64.20
93	SWEDEN	SWE	1	62.48	2.19	4664	293.58
94	SWITZERLAND	SWI	1	85.94	4.13	15900	223.25
95	SYRIAN ARAB REPUBLIC	SYR	1	7.10	1.37	736	132.37
96	TAIWAN	TAI	1	70.00	0.36	1073	237.85
97	TANZANIA	TAN	1	1.47	0.37	131	42.06
98	THAILAND	THA	1	19.39	1.96	819	465.18
99	TOGO	TOG	0	0.56	11.70	1780	36.72
100	TRINIDAD AND TOBAGO	TRI	1	1.83	0.40	163	44.59
101	TUNISIA	TUN	0	4.36	10.33	3466	130.01
102	TURKEY	TUR	1	33.26	1.37	1237	369.63
103	UGANDA	UGA	0	0.81	0.51	57	72.38
104	UNITED KINGDOM	UNK	1	340.59	2.35	11066	722.38
105	UNITED STATES	USA	1	2244.07	0.31	8597	799.47
106	URUGUAY	URU	1	2.82	1.00	461	61.01
107	USSR(FORMER)	USR	1	1045.35	0.06	644	962.83
108	VENEZUELA	VEN	1	32.46	0.65	826	255.99
109	VIETNAM	VIE	0	19.30	0.09	112	152.89
110	YUGOSLAVIA(FORMER)	YUG	1	66.54	0.63	1217	343.08
111	ZAIRE	ZAI	0	1.92	4.85	1027	90.68
112	ZAMBIA	ZAM	0	0.58	1.92	123	89.99
113	ZIMBABWE	ZIM	1	3.50	0.36	212	58.78

Notes: Data cover the manufacturing sector (excluding Petroleum refining) in 1986. Market size is total absorption of manufactures. French share is the total exports of all French manufacturing firms to a destination as a percentage of absorption.



number of markets per firm
Figure A1: Entry of French Firms, All Industries

French entrants / French market share (scaled)



market size (scaled)

Figure A2: Entry and Market Size, All Industries