Dissecting Trade: Firms, Industries, and Export Destinations

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January 2004

We examine the entry behavior of producers in different industries in different export markets using a comprehensive dataset of French firms. These data reveal enormous heterogeneity, primarily within industries, in the nature of entry into different markets. 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. Andrew Bernard and J. Bradford Jensen (1995, 1999), Sofronis Clerides et al. (1998), and Bee Yan Aw et al. (2000), among others, have shown that: (i) exporters are typically 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., Bernard et al. (2003) or fixed costs, e.g., Mark Roberts and James 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 is hard to know 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

We merge data from two French administrative sources. The BRN-SUSE source is a collection of records of the universe of firms subject to the "normal" tax system. After additions and controls made at INSEE under the SUSE system, the data include all balance-sheet variables, employment, industry affiliation, and a firm identifier (the Siren identifier). The version we use classifies firms into just under 100 industries, which, for matters of comparison with aggregate data, we collapse into 16. French Customs compile all sales of French firms (also indicating their Siren identifier) in over 200 destinations. Pierre Biscourp and Kramarz (2002) provide a thorough description of the two sources. After merging, our resulting file is a cross section of 234,300 manufacturing firms in 1986.[1]

Table 1 presents our industry classification and compares features of the French firm

data with U.S. plant-level data taken from Bernard and 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. The correlation of the total number of producers across industries is .501; the correlation of the percentage who export is .371; the correlation in the fraction of sales abroad (among producers who do export) is .586.

2 Dissection 1: Markets per Firm

Having seen the similarity between the French and U.S. data in terms of overall export activity (where they can be compared) 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 finally 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 only to one destination (most often Belgium) whereas exports by the small fraction of firms that ship widely constitute a huge share of total exports.

Looking at all of manufacturing, Figure 1A plots the frequency with which firms serve different numbers of markets, including France itself. The frequency with which more markets are served declines smoothly and monotonically to the point where only a single firm serves a very large number. Figure 1B shows the extent to which this pattern is replicated within individual industries. (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.)

Again, 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. The decline is most precipitous in light industries such as lumber and furniture, paper, and textiles and apparel. It is least so in heavy industries such as chemicals and in high-tech industries such as machinery and computer equipment.

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 French export data to measures of market size in destinations we aggregate destinations into 113 countries. Our market size measure is absorption, defined as gross production plus imports minus exports.[2]

A standard approach to modeling the aggregate volume of exports from source i to destination n, X_{ni}, is to relate them to the market sizes of i and n, X_n and X_i, respectively, 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 can obtain an additional identity relating X_{nF} to firm behavior:

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

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

Figure 2A depicts a striking relationship among three of the 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}). The relationship suggests a very systematic and robust relationship: 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 $\ln X_n$ and $\ln \lambda_{nF}$, .yielding the coefficients (with robust standard errors):

$$\begin{array}{rcccccc} \ln N_{nF} & = & -5.061 & + & .875 \ \ln \lambda_{nF} & + & .617 \ \ln X_n \\ & & (.069) & & (.030) & & (.021) \end{array}$$

The R^2 is .903.[3] The implication is that 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, larger sales to a larger market typically reflect 62 percent more firms and 38 percent more sales per firm.

Figure 2B depicts a similar relationship for each of the 16 SIC categories for the 86 countries for which we have UNIDO industry-level data.[4] Industry-level absorption X_n^s is on the horizontal axis. The vertical axis gives the number of French firms in that sector selling there, N_{nF}^s, divided by overall French market share there, λ_{nF}.

A formal econometric test rejects the hypothesis that these relationships have the same slope across industry, but our sense of the Figure is much more one of cross-industry sameness. No industry jumps out appearing to have a notably different mode of market entry: Forcing the number of firms in an industry to vary with overall French market

share does not do a lot of violence, while the number of entrants rises quite smoothly with industry market size.

We pursued these impressions more systematically by further decomposing imports at the industry level. We did so in a number of directions but one that was particularly robust (and allowed us to use the full sample of destinations) emerged from decomposing 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, $B_{nF}^s = X_{nF}^s/X_{nF}$, as well as into the number of French firms in industry s selling in market n, N_{nF}^s, and their average sales there, $\overline{x}_{nF}^s$. That is:

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

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 coefficients differ in statistical significance the magnitude of the differences is small with no clear economic significance. Hence we report a pooled regression (with robust standard errors in parenthesis, allowing for clustering by industry):[5]

$$\begin{array}{rcccccccc} \ln N_{nF}^s & = & -.639 & + & .826 & \ln \lambda_{nF} & + & .585 & \ln X_n \\ & & (.352) & & (.023) & & & (.019) & \end{array} \quad + \quad \begin{array}{cc} .418 & \ln B_{nF}^s \\ (.051) & \end{array}$$

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 or serving only a handful of national markets. (2) 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. (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.

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 Cournot competition and fixed costs of market entry to explain these qualitative features of the data. They pursue a structural estimation of a 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.

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Notes

[1]What individual producers report exporting is less than what is reported at the aggregate level. In the French data missing exports arise because manufacturing firms sell to nonmanufacturing intermediaries who report the foreign sales, and the connection between producer and destination is lost. Across all destinations, the firm data fail to account for about 20 per cent of total manufacturing exports. The figure is remarkably uniform across destinations. Across industries underreporting is more variable, and is greatest in lumber and furniture.

[2]Total exports and imports are from Robert Feenstra et. al. (1997). Gross production is from UNIDO (1999), available at the industry level for 86 countries. For the remainder we use value added in manufacturing from the World Bank (1995), translating it to gross production as in Bernard et al. (2003). A table appearing on the American Economic Review web site (http://www.aeaweb.org/aer/contents/) reports the destinations, along with each destination's total manufacturing absorption, French market share, number of French exporters, and average sales per French firm.

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

[4]Because of zeros at the industry level and incomplete data from UNIDO, we lose 270 observations.

[5]With 16 sectors and 113 destinations we have 1808 observations. For 38 both X^s_{nF} and N^s_{nF} are zero. We dropped these observations.

[6]In our sample of 86 countries for which we have an industry-level measure of absoption, we further decomposed our measure of the industry bias of French exports $B^s_{nF} = X^s_{nF}/X_{nF}$ into a "destination absorption bias" (X^s_n/X_n) and a "French share bias" $(\lambda^s_{nF}/\lambda_{nF})$. The margins of entry for each were very similar to each other and to that for the overall industry bias of French exports B^s_{nF}.

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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.

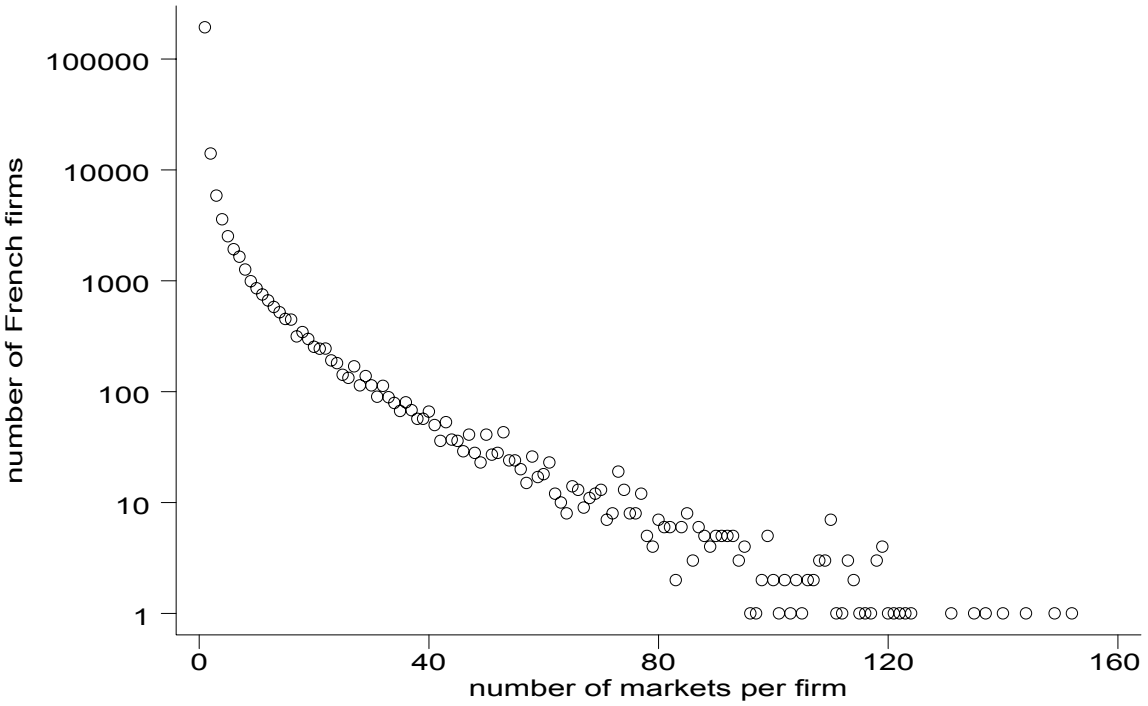

Figure 1A: Entry of French Firms

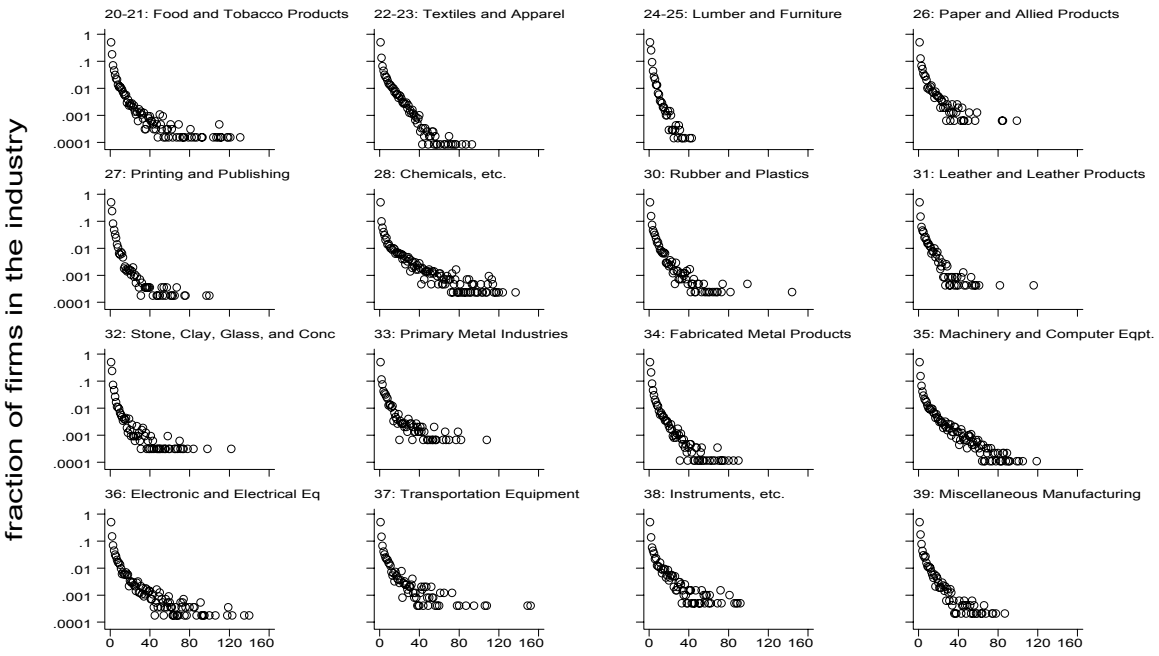

Figure 1B: Entry of French Firms by Industry

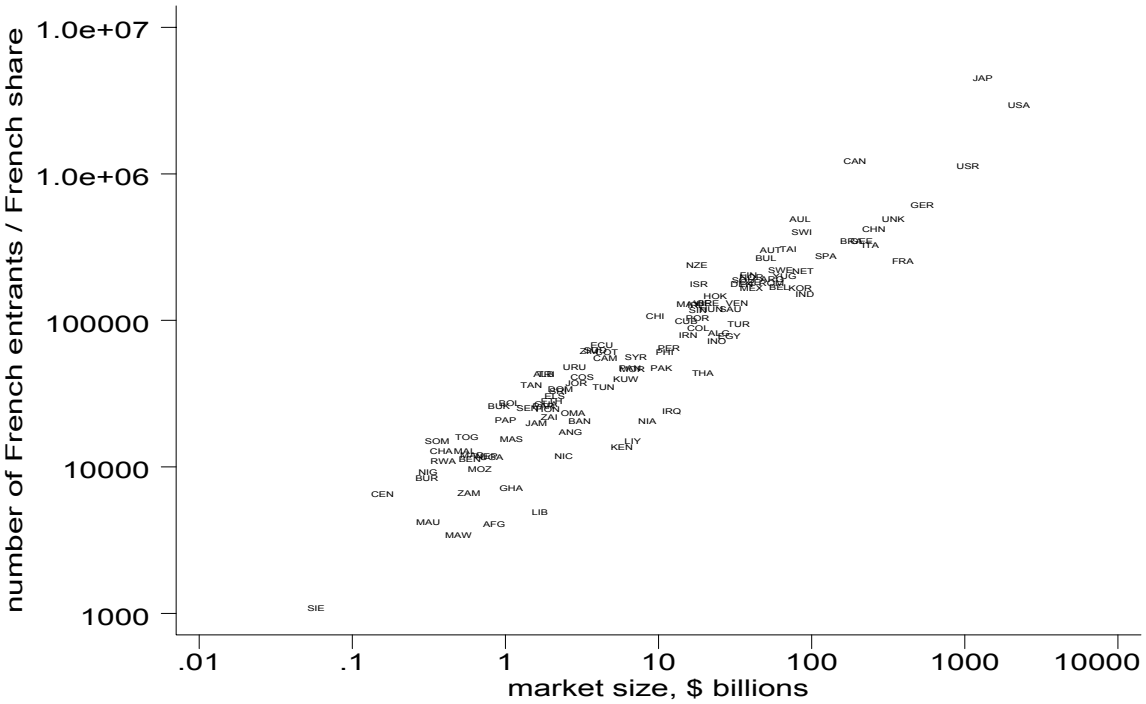

Figure 2A: Entry and Market Size

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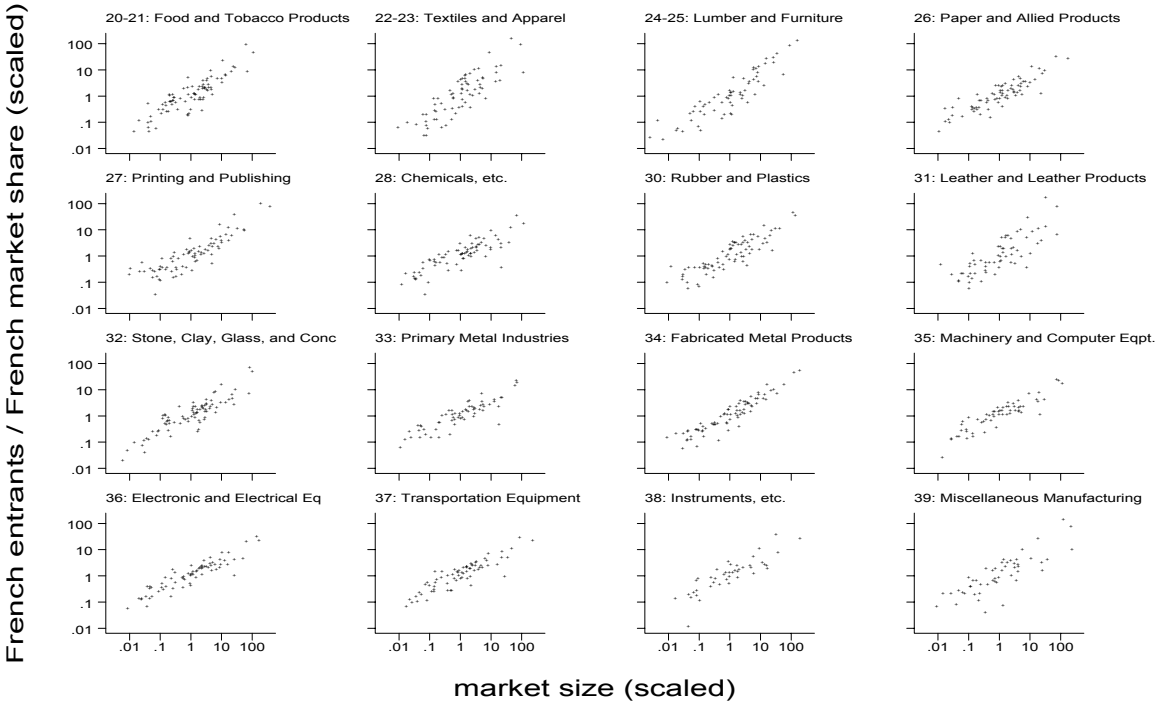

Figure 2B: Entry and Market Size by Industry