

The Impact of International Competition on Small-Firm Exit in U.S. Manufacturing

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This econometric study uses Statistics of U.S. Businesses (SUSB) data to examine the impact of trade on small manufacturers. As global trade increases and currency exchange rates fluctuate, concerns about their impact on small U.S. manufacturers increase. Small manufacturers, by the nature of their scale of operations, are less able to insulate themselves from foreign competition than large manufacturers. Although not without costs, large manufacturers have greater leeway in managing the effects of international competition: they can move production offshore, sign long-term commodity contracts in foreign currencies, or use other tactics to weather global shifts.

Overall Findings

Increased international pressures in the form of currency exchange rates lead to increased exit rates among very small manufacturers (those with fewer than 20 employees). Slightly bigger manufacturers (20-499 employees) are less sensitive to changing conditions in the international marketplace. High-tech industries are more insulated from international pressures than low-tech industries are.

Highlights

- At the national level, exit rates among overall small manufacturers showed little fluctuation between 1990 and 2004. They had large variations across firm sizes and industries, however. Exit rates of firms with fewer than 10 employees hovered around 14 percent from 1990 to 2004, around 7 percent for firms with 10-19 employees, and around

5 percent for firms with 20-99 employees and 100-499 employees. Apparel firms with fewer than 10 employees had the highest exit rate, at 22.3 percent; while the exit rate was lowest for firms in the beverage/tobacco industry with 100-499 employees, at 2.9 percent.

- The determinants of exit generally differed by firm size category between 1990 and 2004, but there were some consistent factors. Mirroring conventional wisdom, growth in the overall economy reduced exit, while increases in labor costs increased firm exits.
 - Consumer goods industries had higher rates of exit among small manufacturers.
 - In low-tech industries where import penetration is significant, a strong dollar leads to an increased likelihood of exit for small manufacturing firms with fewer than 20 employees.
 - For the smallest size class of manufacturers studied (firms with 1-9 employees), the impact of exchange rate effects were greater in the 1990s than in the 2000s.
 - Changes in an industry's import share were not statistically significant for firms with 20-499 employees; it was negative but not consistently statistically significant for firms with 1-19 employees across the two time periods of analysis, the 1990s and 2000s.
 - With the results showing some differences between the decades of the 1990s and 2000s, effects of international competition seem to be changing over time. More disaggregated data would be necessary to evaluate this properly, however.

Scope and Methodology

This study determines international competition impacts from 1990 to 2004 on the survival of small manufacturers by industry using econometric models. Firm size categories of 1-9, 10-19, 20-99, and 100-499 employees were evaluated. Establishment exits (or business location exits) by employment size of firm were used as a proxy for firm exits (which includes all business locations). This is very accurate for small size categories (which are largely one-location firms), but breaks down as the firm size increases.¹

Dependent variables included exchange rates, imports as a share of an industry's goods, research and development intensity by industry, large firm expansions, wage growth (to proxy input cost trends), and a dummy variable on whether the industry sells primarily consumer goods or durable goods. Some dependent variables were lagged one year to indicate causation of exit rates instead of correlation with them. The U.S. Census Bureau's Statistics of U.S. Businesses (SUSB), which is partially funded by the Office of Advocacy, was a primary source. In addition, sources included the New York Federal Reserve Board and the National Science Foundation. SUSB switched industry codes from SIC to NAICS in 1998, forcing an analysis of two separate time periods.

This report was peer reviewed consistent with the Office of Advocacy's data quality guidelines. More information on this process can be obtained by contacting the director of economic research at *advocacy@sba.gov* or (202) 205-6533.

¹ Almost all (99.9 percent) of establishment exits in manufacturing firms with fewer than 10 employees are firm exits. (Essentially, these are one-establishment firms.) This figure was 98.3 percent for firms with 10-19 employees, 85.3 percent for firms with 20-99 employees and 29.8 percent for firms with 100-499 employees.

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I. Introduction

The important role of new entry in promoting employment and growth in the U.S. economy is by now well established. Less carefully studied is the staying power of new entrepreneurs, in particular the causes of exit by small firms. The previous empirical literature on determinants of exit or firm survival has mostly involved cross-industry studies (with relatively few degrees of freedom available for econometric work and no ability to explore the considerable intertemporal variation in entry within industries) or hazard rates of individual firms. Little research has considered differential determinants of rates of exit of different size categories of small firms.

Acs and Audretsch (1989) explained differential *entry* rates by size but only in one cross section (representing the 1978-80 period). Dunne et al. (1988) looked at panels of firms at 5-year intervals from 1963-1982, and at patterns of differing types of entry and exit, but not differentials by size; furthermore, the focus was on description, rather than on explaining entry or exit. Neither study examines data since the early 1980s and, for this reason little emphasis was given to the increasingly important role of foreign competition. In particular, it might be expected that small domestic firms may bear the brunt of any displacement of U.S. firms caused by foreign competition, however it is possible that small niche firms may be able to take advantage of foreign sources of supply in competing with larger rivals.

This report analyzes both the time-varying and cross-sectional determinants of small firm exit rates in U.S. manufacturing over the 1989-2004 period, especially the reaction of domestic firms to the nature of foreign competition as proxied by industry-specific real exchange rate movements (interacted with import penetration by industry). Exit rates for several size categories of small firms will be explained, and explanatory variables will include lagged industry data and macroeconomic variables.

Data were obtained from the Statistics of U.S. Businesses, available from the U.S. Small Business Administration (in collaboration with the U.S. Census Bureau). Data classification for the period spanned the conversion from Standard Industrial Classification (SIC) system to the North American Industrial Classification System (NAICS) system. Hence data from 1989-1998 were obtained for 140 3-digit SIC manufacturing industries; annual data for 1998-2004 were obtained for 86 4-digit

NAICS industries. The study will explain small firm exit rates in several employment size categories—under 10 employees, 10-19 employees, 20-99 employees, and 100-499 employees—using industry data and international and macroeconomic determinants as explanatory variables, with data sources including the Census of Manufactures, Annual Survey of Manufactures, Bureau of Labor Statistics, and National Science Foundation. Employment cost and demand proxies will be included as will variables measuring capital intensity and R&D activity. After discussing the relevant previous academic literature on the topic and descriptive statistics on the key variables of interest, this report will present statistical findings and discuss their economic significance.

II. Literature Review and Theoretical Motivation

While there have been a large number of empirical studies investigating the determinants of entry, far fewer have examined determinants of survival or exit of firms. I discuss just a few of the more recent studies here. In terms of theory, Ghemawat and Nalebuff (1985) derive results showing—somewhat counter-intuitively—that small firms are better able to survive demand downturns than large firms when they have comparable costs; however, where scale economies are important (as may be true in many manufacturing industries) the pattern reverses with small firms the first to exit. Turning to empirical evidence, Khemani and Shapiro (1987) analyze entry and exit equations to examine whether their determinants are symmetric. They find that high market concentration acts as a deterrent to entry, and (surprisingly) that high profit industries experience more exits; the latter effect is explained as high profits attracting more entrants who then displace some incumbents. “In general, both entry and exit are deterred in industries where the minimum efficient plant size and its associated capital requirements are high and where multi-plant firms are prevalent” (p. 25).

Dunne et al. (1988) look at the period 1963-1982, describing and explaining patterns of entry, exit, and growth in U.S. manufacturing. They focus on “the relative importance of different types of entrants, the correlation of entry and exit patterns across industries and over time, and the entrants’ post-entry size and exit patterns” (p. 513). They find small, relatively new firms to have the highest exit rates, though survival probabilities seem to depend on how firms originally entered the market—most successful are firms diversifying from other manufacturing industries through new-plant construction. Phillips and Kirchoff (1989) provide evidence that survival rates of new firms is higher than previously thought, with almost half of all new manufacturing firms surviving at least

6 years; furthermore, they report that survival chances are still higher for those new firms showing growth in the early years.

Audretsch (1994) examined data obtained from the U.S. Small Business Administration on more than 12,000 U.S. manufacturing plants established in 1976; he finds that establishments larger on entry had a lower chance of exit over the next 10 years, as did newly formed independent establishments (relative to newly created affiliates of multiplant firms); innovative activity by new firms had somewhat ambiguous impacts on subsequent exit, though it raised survival probabilities over the long-run. Wagner (1994), in a similar study of German establishments, observes no clear link between start-up size and exit rates; he does, however, find the result noted by Phillips and Kirchoff (1989) for the United States, namely that surviving firms are more likely to have experienced high rates of growth in their early years. Audretsch and Mahmood (1995) involved a further look into the SBA dataset utilized in Audretsch (1994), with similar findings. They do note that improved macroeconomic conditions (proxied by the unemployment rate) lead to reduced exit rates, though no investigation of the role of international factors (as studied in the current project) is undertaken.

Kleijweg and Lever (1996) study entry and exit in Dutch manufacturing industries during the 1980s, and (of relevance to the current project) they find that R&D-intensive industries experience reduced rates of exit. The paper which comes closest to the focus of the current study is that by DeBacker and Sleuwagen (2003). They analyze data on Belgian manufacturing industries to determine the impact of foreign competition (both through imports and inbound foreign direct investment) on entry and exit rates of domestic entrepreneurs. While they find that this international competition does increase domestic exit rates, their results suggest that firms may undertake strategies to respond to foreign direct investment which lessen the impact of competition.

As seen above, little work has examined international effects on survival and exit rates, the focus of this study. Much of my past research has investigated the impact of foreign competition on domestic firms (though I have not previously examined the exit decision). For example, Feinberg (1989a) found the passthrough of exchange rate movements into domestic U.S. prices to be quite incomplete and to vary by industry factors. Feinberg (1989b) used a simple simulation model to consider the role that an unexpected surge in imports would have on the nature of competition in a

domestic industry. Feinberg (2007) identified a pro-competitive effect of foreign competition on pricing behavior by U.S. firms.

Based on the literature above, it seems reasonable to expect that international pressures will affect domestic firm survival or exit rates, and that small firms may be particularly at risk. Demand growth (and perceptions of future growth) should also impact firm exit behavior. As noted above, some authors have found the nature of technology in the industry to affect survival; therefore R&D intensity in the industry as well as its interaction with international pressures, will also be included as explanatory variables.

In explaining small firm exit rates by industry, two caveats must be kept in mind. The first is that the level of aggregation employed here (3-digit SIC or 4-digit NAICS categories) may be too great to capture motivations of heterogeneous firms—i.e, small businesses in niche categories of broader industry groupings may be little affected by aggregate conditions. Perhaps more importantly, the work of Headd (2003) reminds us that business closure (exit) may not always reflect failure; he found that about a third of closed businesses regarded themselves as successful at closure. This suggests that to fully explain the exit decision by small firms, one would ideally like to go beyond the industry, macroeconomic, and international influences considered in this report—and consider more idiosyncratic individual explanations for why firms choose to shut down. At the level of industry detail this is not possible, but we should not be surprised if expected patterns explaining small firm *failure* do not seem to well predict *closure*.

III. Descriptive Statistics

The SUSB data on exit by industry actually provide information on establishment exits. While this can be a firm exit, it also may mean a plant closing by a firm that remains in operation. While the distinction is not made at the level of industry detail used in this study, a look at the more aggregate data for all manufacturing is illuminating. Table 1 presents establishment exits in manufacturing in the four size categories studied here and the extent to which these represent firm exit (for the 2003-2004 period).

Table 1. Firm Exits and Establishment Exits, All Manufacturing, 2003-2004

	Firm Size (number of employees)			
	1-9	10-19	20-99	100-499
Firm Exits	18,735	2,541	2,439	348
Establishment Exits	18,780	2,546	2,858	1,166
Percentage Firm Exits	99.8%	98.3%	85.3%	29.8%

Source: Statistics of U.S. Businesses (SUSB). U.S. Department of Commerce, Bureau of the Census, partially funded by the Office of Advocacy, U.S. Small Business Administration.

Clearly, the exit of establishments in firms of under 20 employees can be safely assumed to represent firm exit. The overwhelming bulk of such exits in firms of 20-99 employees can also be seen as exit. However, for firms in the 100-499 employee range, establishment exits are more likely to represent firm restructuring or capacity reduction. While this study will examine determinants of establishment exit in this size range, it would not be surprising to find differences among firms as compared to the smaller size ranges in which firm exit is more accurately measured.

We now turn to measures of exit over time and by industry sector for the four size categories considered here. In Table 2 we see relatively little variation in exit rates over the 15-year time frame: 13.3-15.9 percent for the smallest firm size; 5.6-7.9 percent for 10-19 employee firms; 3.6-5.8 percent for the 20-99 employee firms; and 4.4-6.7 percent for the 100-499 employee firms.¹

There does seem to be somewhat greater variation across industry sectors, however (Table 3). Exit rates for 1-9 employee firms vary from as low as 11.4 percent (chemicals, in the 1999-2004 period) to 22.3 percent (apparel, also during 1999-2004). For 10-19 employee firms, exit rates vary from 4.4 percent (primary metals, 1999-2004) to 15.7 percent (apparel, 1999-2004); for 20-99 employee firms, exit rates vary from 3.4 percent (again, primary metals, 1999-2004) to 11.5 percent (again, apparel, 1999-2004). For the largest size category considered here, exit rates vary from 2.9 percent (beverage/tobacco, 1999-2004) to 9.2 percent (again, apparel, 1999-2004). Apparel also is the

¹ Exit rates seem have a post-9/11 spike. In 2002 exit rates jumped for the very smallest and largest of these size categories.

sector with the highest rate of exit in the 1990-1998 period. Clearly there is much cross-industry variation in exit rates to explain in the statistical analysis.

Table 2. Mean Values of Exit Measures by Year
(Percent of all exits in size class)

	Firm Size (number of employees)			
	1-9	10-19	20-99	100-499
1990	14.6	7.1	5.5	5.1
1991	15.9	7.0	5.4	5.5
1992	15.1	6.8	5.7	4.7
1993	13.7	7.5	5.8	5.2
1994	13.7	5.8	5.6	6.1
1995	14.4	5.6	3.6	4.4
1996	13.6	6.3	5.4	4.9
1997	14.2	7.9	5.3	4.4
1998	14.2	6.8	5.0	5.3
1999	14.3	6.7	5.0	5.0
2000	14.2	6.5	5.0	4.9
2001	14.3	6.6	5.3	4.4
2002	15.7	6.8	5.7	6.7
2003	13.9	6.6	5.2	5.8
2004	13.3	6.0	5.0	5.0

Source: Statistics of U.S. Businesses (SUSB). U.S. Department of Commerce, Bureau of the Census, partially funded by the Office of Advocacy, U.S. Small Business Administration.

Table 3. Mean Values of Exit Measures by Industry Sector
(Percent of all exits in size class)

	Firm Size (number of employees)			
	1-9	10-19	20-99	100-499
<i>SIC-basis: 1990-1998</i>				
Food and Beverage	13.61	6.61	4.75	4.33
Tobacco	20.57	8.97	7.94	8.70
Textile	15.58	8.88	6.43	4.82
Apparel	20.57	12.57	9.31	8.45
Lumber	15.47	6.78	5.24	5.14
Furniture	15.46	7.92	6.11	5.69
Paper	14.97	9.81	6.22	3.52
Printing	13.34	5.65	4.58	4.76
Chemicals	12.08	5.07	4.12	4.92
Petroleum Refining	13.80	7.76	5.54	4.47
Rubber and Plastics	12.13	6.01	4.82	4.66
Leather	15.85	8.24	6.21	6.25
Mineral Products	13.14	5.26	4.50	4.02
Primary Metals	13.08	5.73	4.16	3.69
Fabricated Metals	12.04	4.88	3.63	4.43
Machinery and Computers	12.32	4.75	3.71	4.73
Electronics and Electrical	14.00	5.57	4.63	4.87
Transportation Equipment	15.32	6.31	5.64	5.43
Measurement and Control Devices	13.10	5.29	4.74	6.09
Miscellaneous Manufacturing	13.63	5.46	4.74	4.46
<i>NAICS-basis: 1999-2004</i>				
Food	13.84	6.34	5.03	4.70
Beverage and Tobacco	17.31	7.97	9.77	2.88
Textiles	15.19	7.90	5.96	6.77
Apparel	22.33	15.72	11.53	9.16
Leather	15.65	8.82	7.76	8.03
Wood products	14.30	6.22	3.98	4.28
Paper	16.05	8.82	4.86	6.32
Printing	11.52	4.92	4.50	5.71
Chemicals	11.38	5.54	4.79	3.71
Petroleum and Coal Products	13.07	5.55	4.72	4.40
Rubber and Plastics	12.97	5.36	4.45	4.44
Furniture	13.58	5.98	4.41	4.41
Mineral Products	14.99	6.54	4.81	4.95
Primary Metals	11.73	4.41	3.42	4.08
Fabricated Metals	12.46	4.87	3.85	4.97
Machinery	16.26	7.79	6.76	7.26
Computer and Electronics	14.21	5.91	4.42	5.41
Transportation Equipment	16.13	6.58	5.21	5.86
Electrical Equipment, Components	12.69	5.77	4.90	4.62
Miscellaneous Manufacturing	11.64	4.43	4.14	5.02

Source: Statistics of U.S. Businesses (SUSB). U.S. Department of Commerce, Bureau of the Census, partially funded by the Office of Advocacy, U.S. Small Business Administration.

Tables 4 and 5 present descriptive statistics for the variables to be used in the statistical analysis to follow, looking at the full SIC and NAICS samples. Over all industries and years, average exit rates are quite similar in the two samples, about 14 percent for 1-9 employee firms, 7 percent for 10-19 employee firms, and 5 percent for both 20-99 and 100-499 employee firms, confirming the commonly held belief that larger firms are less likely to fail. Also similar is the rate of growth in new establishments by large (over 500 employee) firms, about 3 percent in both samples; this variable is taken to be a proxy for the perceived growth in industry demand (from the perspective of the smaller firms analyzed in this study).

The main explanatory variables include the following:

- (1) a real exchange rate index defined at the broader 2-digit SIC level (normalized at 100 for 1990) for the earlier time period and at the broader 3-digit NAICS level (normalized at 100 for 2000) for the later period. This variable is interacted both with import penetration for that broader industry sector to capture the industry's vulnerability to international pressures, as well as with industry R&D intensity to see whether small firms in knowledge intensive industries can better survive in the face of foreign competition.
- (2) real GDP growth; this is included in lieu of industry level growth, which may be endogenous with respect to company behavior.
- (3) growth in aggregate labor compensation; this is included to account for effects on exit rates due to cost trends.
- (4) growth rates in the number of establishments in firms over 500 employees; this variable can be interpreted as a proxy for growth potential perceived by smaller firms (though it may also reflect the extent to which small firms feel threatened by large firm expansion).
- (5) cross-industry measures of import penetration and capital intensity (capital-labor ratios); these variables will proxy the role of barriers to *successful* entry which make failure of small firms more likely.
- (6) the (log of the) number of establishments in a particular size category within an industry in a given year (to control for large variations in exit rates caused by one or a small number of exits in an industry/size category cell with only few firms).
- (7) product characteristics—whether the industry sells primarily *consumer* goods, *durable* goods, or both.

Reflecting the steady growth in import penetration in U.S. manufacturing in recent years, we find the import share averaging 17 percent for 1992 and a little over 18 percent for 1998. While the sample averages suggest a decline over time in R&D intensity and an increase in capital intensity, this may simply be due to changes in industry definitions rather than any real economy-wide changes. (The NAICS definitions are broader—with 86 industries at the 4-digit level—than the SIC definitions, for which there are 140 industries at the roughly comparable 3-digit level.)

Table 4. Descriptive Statistics for SIC-based Study, 1990-1998

<u>Variable</u>	<u>Observations</u>	<u>Mean</u>	<u>Standard Deviation</u>	<u>Minimum</u>	<u>Maximum</u>
Exit Rate (<10)	1257	14.37	6.39	0	100
Exit Rate (10-19)	1245	6.74	6.67	0	100
Exit Rate (20-99)	1260	5.26	5.14	0	100
Exit Rate (100-499)	1244	5.08	5.34	0	100
Large Firm Expansion	1251	3.36	3.62	0	60
Broad Sector Import Share	1251	16.98	14.93	1.16	56.97
M-Wt Real XR Change	1251	1.85	4.82	-9.76	18.4
R&D Intensity	1260	1.78	2.17	0.06	5.86
Capital Intensity	1260	0.17	0.17	0.01	1.37
Consumer Good	1260	0.37	0.48	0	1
Durable Good	1260	0.26	0.44	0	1

Variable Definitions:

Exit Rate (by Size) = establishment deaths in size category as percentage of previous year establishments by category (Source: U.S. Small Business Administration)

Large Firm Expansion = establishment births in firms over 500 employees as percentage of previous year establishments of that size (Source: U.S. Small Business Administration)

Broad Sector Import Share = value of imports as percentage of “apparent domestic consumption” (domestic shipments + imports—exports), for 1992 at 2-digit SIC level (Source: U.S. Department of Commerce, Bureau of the Census)

M-Wt Real XR Change = annual percentage change in import-weighted real exchange rate index (varying by 2-digit SIC, 1st quarter to 1st quarter changes) (Source: New York Federal Reserve Board, Database on Industry-Specific Exchange Rates, <http://www.ny.frb.org/research/economists/goldberg/papers.html>)

R&D Intensity = total company funds for R&D as percentage of value of shipments, for 1992, at broader 2-digit SIC level (Source: National Science Foundation, Annual Survey of Manufactures)

Capital Intensity = total capital expenditures per dollar of labor costs at the 3 digit SIC level, for 1992 (Source: Annual Survey of Manufactures)

Consumer Good, Durable Good—classifications based on Ornstein (1977), modified as necessary by author.

Table 5. Descriptive Statistics for NAICS-based Study, 1999-2004

<u>Variable</u>	<u>Observations</u>	<u>Mean</u>	<u>Standard Deviation</u>	<u>Minimum</u>	<u>Maximum</u>
Exit Rate (<10)	516	14.29	3.81	6.45	38.46
Exit Rate (10-19)	516	6.53	3.43	0	21.43
Exit Rate (20-99)	516	5.2	2.85	0	33.33
Exit Rate (100-499)	516	5.31	3.07	0	23.08
Large Firm Expansion	430	3.44	2.42	0	24.32
Broad Sector Import Share	516	18.21	14.28	3.47	67.48
M-Wt Real XR Change	516	3.19	5.46	-11.81	18.37
R&D Intensity	516	1.05	0.87	0.06	3.71
Capital Intensity	516	0.21	0.13	0.05	0.7
Consumer Good	516	0.36	0.48	0	1
Durable Good	516	0.33	0.47	0	1

Variable Definitions:

Exit Rate (by Size) = establishment deaths in size category as percentage of previous year establishments by category (Source: U.S. Small Business Administration)

Large Firm Expansion = establishment births in firms over 500 employees as percentage of previous year establishments of that size (Source: U.S. Small Business Administration)

Broad Sector Import Share = value of imports as percentage of “apparent domestic consumption” (domestic shipments + imports—exports), for 1998 at 3-digit NAICS level (Source: U.S. Department of Commerce, Bureau of the Census)

M-Wt Real XR Change = annual percentage change in import-weighted real exchange rate index (varying by 3-digit NAICS, 1st quarter to 1st quarter changes) (Source: New York Federal Reserve Board, Database on Industry-Specific Exchange Rates, <http://www.ny.frb.org/research/economists/goldberg/papers.html>)

R&D Intensity = total company funds for R&D as percentage of value of shipments, for 1998, at broader 3-digit NAICS level (Source: National Science Foundation, Annual Survey of Manufactures)

Capital Intensity = total capital expenditures per dollar of labor costs at the 4-digit NAICS level, for 1998 (Source: Annual Survey of Manufactures)

Consumer Good, Durable Good—classifications based on Ornstein (1977), modified as necessary by author.

IV. Statistical Results

Given problems of comparability between SIC and NAICS codes, two separate statistical studies (pooled cross-section time series regression analyses) will be conducted to explain exit rates by firms in the 1-9, 10-19, 20-99, and 100-499 employee size categories, however with the same model specification. Using SIC industries for 1989-1998 will yield more than 1,100 observations, while the use of NAICS industries for 1998-2004 will allow estimation on more than 400 observations.

Timing issues are of course important to consider. The SUSB exit data are for the year ending in March, while the demand and cost proxies, real GDP and the employment cost index, are changes in annual averages—therefore these will be lagged one year. Similarly, exchange rate changes are first-quarter annual changes; as exit decisions should be based on current and expected future competitive pressures, we examine contemporaneous exchange rate impacts on exit rates.

As industries are likely to differ in the variability of exit rates, statistical techniques need to account for this problem. Therefore, estimates will be obtained via feasible generalized least squares controlling for heteroscedasticity (using the *xtgls* command in STATA), with random industry effects.²

The basic model is:

Exit_{it} (separately by employment size category) =
f(lagged growth in real GDP, lagged growth in large firms within industry, capital intensity, import penetration, lagged aggregate employment cost changes, real exchange rate index value [interacted with both import shares and R&D intensity], consumer/durable goods dummies, number of category establishments, random industry effects)

To start, Table 6 presents results explaining exit rates within the four small-firm size categories in most of the 140 SIC industries during the 1990s. To better judge the role of demand and cost pressures, these effects are held constant across industries (and so the estimated coefficients for these variables may be regarded as rough average effects of these macroeconomic factors). Several

² As the dependent variable, exit rate, is a “limited dependent variable” which by definition cannot fall below zero. An alternative estimation approach was also attempted—a Tobit estimation with random industry effects using the *xttobit* routine in STATA. These results were quite similar to what is reported below in Tables 6 and 7. Allowing for within-industry autocorrelation was also tested, with results again similar to those reported here.

results stand out and are remarkably consistent across all four size categories of small firm exit (especially the under-100 employee categories in which *establishment* exit most likely corresponds to *firm* exit):

- (1) aggregate demand growth in the economy reduces exit, while cost pressures increase exit rates;
- (2) consumer goods industries have consistently higher rates of exit;
- (3) for the 10-19 and 20-99 employee categories, capital intensity seems to make exit more likely, perhaps by increasing the amount of financing required not just to enter but to continue operations;
- (4) a stronger dollar makes very small firm exit (19 or fewer employees) *more likely in industries where import penetration is significant*. This strong effect is moderated in R&D-intensive industries, the latter result suggestive of high-tech niches that can allow small firms to thrive despite exchange rate pressure (and perhaps these niche categories may rely on lower-cost imported components as the dollar strengthens).

In addition, the number of establishments in each size/industry category is a useful control for exit rates, with smaller groups implying higher exit rates *ceteris paribus*. Other effects are more spotty: larger import shares (independent of the role of exchange rates) seem, surprisingly, to reduce exit rates, but only with a statistically significant impact in the 10-19 employee size category; and durable goods industries have a higher exit rate for the under-100 employee size categories, though not statistically significant for all of these. The previous year's growth rate in large firm establishments (over 500 employees) seems to imply higher rates of exit but the magnitude of this impact is quite small (and only statistically significant for the very largest and very smallest firms in the sample).

Table 7 examines the same issues for the first part of the current decade, using the NAICS-based sample. As noted earlier, the rate of exit rose in all four size classes in 2002, and substantially in the 1-9 and 100-499 employee size classes. This may have been a response to the uncertainties created in the aftermath of 9/11. To account for this, a dummy variable for 2002 is included in the regression equations (a dummy for 2001 was not statistically significant). This variable has the predicted positive impact for all size classes, both statistically significant and of substantial magnitude for all but the 20-99 employee size category, with exit rates in 2002 between 0.3 and 1.6

percentage points higher *ceteris paribus* (the latter, for example, representing about 10 percent of the mean 2002 rate of exit in the 1-9 employee category).

More so than in the earlier period, the determinants of exit seem to vary considerably by size category. Only for the largest size category does establishment exit respond as expected to economy-wide demand growth (though to the extent that large-firm expansion is viewed as a proxy for expected industry-specific demand growth, we see a significant effect for the 20-99 employee size category as well). Capital intensity no longer has any statistically significant effect on small firm exit. However, of particular interest for this study, international pressures—through exchange rate movements—continue to lead to greater exit (when accompanied by high import shares) for both of the under-20 employee firm size categories. For all size categories, R&D intensity reduces the sensitivity of exit rates to dollar appreciation (statistically significant for all but the largest—100-499 employee—grouping).

Table 6. Feasible Generalized Least Squares Results Explaining Small-Firm Exit Rates by Firm Size, Heteroscedasticity Across Industries, Random Industry Effects – SIC-based study, 1990-1998

	Firm Size (number of employees)			
	1-9	10-19	20-99	100-499
GDP growth	-0.16*** (0.05)	-0.12*** (0.04)	-0.17*** (0.04)	-0.10** (0.05)
Aggregate wage growth	0.73*** (0.14)	0.60*** (0.11)	0.28*** (0.10)	0.32** (0.14)
<i>ln</i> (No. of establishments)	-0.48*** (0.05)	-0.25*** (0.05)	-0.26*** (0.04)	-0.15** (0.07)
Import share	-0.06 (0.05)	-0.14*** (0.04)	-0.02 (0.04)	0.06 (0.05)
Mshr*RXR	0.0011** (0.0005)	0.0017*** (0.0004)	0.0003 (0.0004)	-0.0005 (0.0005)
Large Firm Expansion	0.05* (0.02)	0.02 (0.02)	0.02 (0.02)	0.07** (0.03)
R&D intensity*RXR	-0.0036*** (0.0004)	-0.0037*** (0.0003)	-0.0019*** (0.0003)	0.0008** (0.0003)
Capital intensity	-0.04 (0.90)	2.17*** (0.67)	1.59*** (0.58)	-0.69 (0.67)
Consumer good	1.78*** (0.15)	0.88*** (0.14)	0.92*** (0.11)	0.57*** (0.14)
Durable good	0.45** (0.20)	0.11 (0.17)	0.26* (0.13)	-0.45** (0.20)
N	1104	1079	1104	1103
Wald Chi-squared	617.9***	525.5***	350.6***	65.2***

Note: standard errors in parentheses below estimated coefficients.

*Significant at 10%

**Significant at 5%

***Significant at 1%

Table 7. Feasible Generalized Least Squares Results Explaining Small Firm Exit Rates by Firm Size, Allowing for Heteroscedasticity Across Industries – NAICS-based study, 2000-2004 (86 industries x 5 years)

	Firm Size (number of employees)			
	1-9	10-19	20-99	100-499
GDP growth	0.15* (0.09)	0.07 (0.08)	-0.07 (0.07)	-0.27*** (0.10)
Aggregate wage growth	0.14 (0.22)	-0.07 (0.20)	0.29* (0.17)	-0.55** (0.28)
<i>ln</i> (No. of establishments)	-0.67*** (0.10)	-0.27*** (0.10)	-0.13* (0.08)	0.19* (0.11)
Import share	-0.24** (0.12)	-0.09 (0.11)	0.01 (0.08)	-0.04 (0.13)
Mshr*RXR	0.0033*** (0.0012)	0.0017* (0.0016)	0.0005 (0.0008)	0.0011 (0.0013)
Large Firm Expansion	0.08** (0.03)	0.01 (0.03)	-0.07*** (0.03)	0.07* (0.04)
R&D intensity*RXR	-0.0116*** (0.0016)	-0.0097*** (0.013)	-0.0048*** (0.0010)	-0.0002 (0.0013)
Capital intensity	-1.07 (1.24)	-0.39 (1.04)	0.73 (0.68)	-0.86 (0.71)
Consumer good	0.34 (0.24)	0.69*** (0.22)	0.88*** (0.15)	0.45** (0.19)
Durable good	-0.18 (0.20)	-0.86*** (0.21)	-0.50*** (0.15)	-0.24 (0.20)
Year 2002	1.57*** (0.22)	0.41** (0.19)	0.26 (0.17)	0.64** (0.30)
N	430	430	430	430
Wald Chi-squared	328.4***	159.7***	184.9***	169.3***

Note: standard errors in parentheses below estimated coefficients.

*Significant at 10%

**Significant at 5%

***Significant at 1%

One result which is consistent across size categories is the pattern that was also observed for the earlier time period, namely that consumer goods industries have higher rates of exit. A finding which differs from the period of the 1990s, however, is that durable goods industries have lower rates of exit. Given the differing industry definitions in the two samples (and the more aggregate nature of the more recent analysis), it is difficult to know the extent to which the changed determinants are entirely the result of the time periods or whether the degree of aggregation is a factor. Analysis at the level of the establishment (using the underlying confidential Census data) would be required to sort these issues out.

While the data suggest that the appreciation of the dollar is a cause of exit generally for import-competing small firms, the effects are clearly largest (and statistically significant) for those with under 20 employees. To get a sense of the magnitudes involved, consider the annual rate of exit for a firm with between 10 and 19 employees. In an industry well-sheltered from imports (say, a 5 percent import share) a 10 percent appreciation of the dollar would lead to less than an 0.1 percentage point increase in the exit rate (around a mean value of 6.65 for the two time periods combined); in contrast, for firms facing strong import competition (say, a 30 percent import share), that same 10 percent dollar appreciation would lead to the exit rate increasing by more than half a percentage point (from 6.65 percent to 7.16 percent). For the very smallest firms (the 1-9 employee category) the exchange rate effects were smaller in the decade of the 1990s but stronger in the more recent period.

The technology base seems to matter in terms of how small firms respond to these international pressures, especially in the most recent period. Consider a firm with between 10 and 19 employees in an industry with the mean import penetration (combining the two time periods, using 17.5 percent of the mean import share). A 10 percent dollar appreciation raises the exit rate for firms in relatively “low-tech” industries (with the mean company R&D expenditures just 0.5 percent of value of shipments) by 0.28 percentage points during the 1990s; and by 0.25 percentage points in the 2000-2004 period. Relatively high-tech firms (those in industries with a mean R&D intensity of 3.0 percent) are much less affected by international pressures. Their exit rate increased by 0.19 percentage points during the 1990s and barely at all (just 0.01 percentage points) since 2000. The patterns for the very smallest (1-9 employee) firms are similar.

V. Conclusions

While results are not as consistent across time periods as one would hope, there are certain findings which seem reasonably robust. One is that international pressures, in the form of import-share weighted exchange rate appreciation, seem to lead to increased rates of exit among the *smallest manufacturing firms*, though the magnitudes of these effects are smaller than sometimes discussed. Conversely, one would expect the current period of dollar depreciation to decrease small firm exit rates. Very importantly, though, there is the strong suggestion that high-tech industries may have been able to avoid much of this impact during the appreciation of the dollar (though they may also not gain much from depreciation). The exact cause of this relationship cannot be pinpointed, but patents and a reputation for innovation may shield a small firm somewhat from lower-priced foreign competitors.

Another result of interest is that consumer goods industries have higher rates of small-firm exit than durable goods industries (perhaps due to the cost and risk associated with establishing and maintaining brand loyalty). Other results seem to vary by both time period and size category, perhaps suggesting that the exit decision needs to be analyzed at a more disaggregated level to account for the complexities involved. Related to this is the important notion that in examining small firm exit, one must keep in mind the idiosyncratic motivations for exit which may not correspond to economic notions of “failure” (as discussed in Headd, 2003). These can play a role in small-firm dynamics, and their impact cannot be discerned in industry-level data of the sort examined here.

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