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ABSTRACT

Producers entering a market can differ widely in their prior production experience, ranging from none to extensive experience in related geographic or product markets. In this paper, we quantify the nature of prior plant and firm experience for entrants into a market and measure its effect on the plant's decision to exit the market. Using plant-level data for seven regional manufacturing industries in the U.S., we find that a producer's experience at the time it enters a market plays an important role in the subsequent exit decision, affecting both the overall probability of exit and the method of exit. After controlling for observable plant and market profit determinants, there remain systematic differences in failure patterns across three groups of plants distinguished by their prior experience: de novo entrants, experienced plants that enter by diversifying their product mix, and new plants owned by experienced firms. The results indicate that the exit decision cannot be treated as determined solely by current and future plant, firm, and market conditions, but that the plant's history plays an important independent role in conditioning the likelihood of survival.

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1. Introduction

In their study of firm entry and exit patterns in U.S. manufacturing industries, Dunne, Roberts, and Samuelson (1988) identify three distinct types or methods of firm entry into product markets and show that long-term differences in failure rates and relative firm size exist across the three categories of entrants. Their observations indicate that characteristics of a firm at the time it enters an industry are related to the ultimate success of the firm even ten or 15 years after entry.

One explanation is that the method of entry, opening a new plant, for example, or diversifying the product mix of an existing plant, is simply a proxy for the firm's underlying productivity and profitability in the market in future periods.[1] In this view, variables that affect the firm's current and future profits, and not initial conditions themselves, are the determinant of firm failure. A large empirical literature demonstrates clearly that many observable characteristics of a plant or firm in year t, including size, age, productivity, capital intensity, wage rates, and diversity of product offerings among other things, are correlated with the decision of the plant or firm to continue in operation in year $t+1$.[2] Several important theoretical models, including Hopenhayn (1992) and Ericson and Pakes (1996), are also predicated on the assumption that the determinants of firm profits follow a Markov process so that, once we control for current characteristics, the exit decision is not affected by the firm's past history.

An alternative explanation is that initial characteristics exert a long-term influence on the firm's exit decision, even after other determinants of current and future profits are controlled for. A theoretical model that is consistent with this explanation is Jovanovic's (1982) model in which a firm learns about its unknown, time-invariant productivity parameter through its production experience. Pakes and Ericson (1998) show that an implication of this model is that a firm's size in year t will depend on the whole past

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[1] Entry method and profitability could be correlated if different entry methods were characterized by different sunk entry costs. A firm that chose a high sunk cost entry method, such as building a new plant, would require higher expected future profits in order to induce entry than a firm choosing a low entry cost method, such as altering its product line in an existing plant. Bernard, Redding, and Schott (2003) develop a theoretical model of heterogeneous firms choosing among alternate product markets that generates a positive correlation between firm productivity and the fixed costs of the products.

[2] This empirical literature is reviewed in Caves (1998).

history of the firm's size including its size at the time of entry. They find empirical evidence of this pattern in data on firms in the retail sector. Other empirical evidence of a role for a producer's initial size is provided by Dunne, Roberts and Samuelson (1989), Audretsch (1995), and Mata, Portugal, and Guimaraes (1995). These studies show that the initial size of a manufacturing plant is correlated with its failure probability and growth rate even after controlling for the current size and age of the plant. In his study of the early history of the U.S. auto, tire, television, and pharmaceutical industries, Klepper (2002) shows that the experience of a firm in related industries prior to entry is an important determinant of firm survival in these four products. He develops a theoretical model in which initial entry conditions, specifically, prior experience and time of entry affect the subsequent survival pattern of a firm.

In this paper we develop an empirical model of exit that allows both initial conditions and current firm and plant characteristics to affect the producers's decision to exit a market. To proxy differences in initial conditions we develop a set of variables that measure the degree of production experience possessed by a firm at the time it enters a product market. By focusing on a group of manufactured products that are sold in relatively small geographic markets we are able to distinguish firms that have prior experience manufacturing the product in other geographic markets from firms with no prior experience with the product. By exploiting data on the full set of products manufactured in each plant we are able, like Dunne, Roberts, and Samuelson (1988), to distinguish firms that enter a product market using a plant with which they have operating experience from firms that enter with a new production facility. Thus we are able to measure both firm and plant dimensions of an entrant's prior experience.

In addition, we focus on the exit decision of a producer within a narrowly-defined market. Exploiting our geographic market data, we examine the exit decision for seven different manufactured products in 181 geographic markets in the U.S. over the 1963-1997 period. This gives us a very rich set of demand and cost conditions. In contrast, most previous studies of exit ignore detailed market demand and cost variables, controlling for them with industry or time dummies, and instead examine the correlation between the decision to close a plant and observable plant characteristics.

Our first set of empirical results, based on a probit model of exit, clearly demonstrate that the prior experience of the firm and plant have an important effect on the likelihood of exit, even after controlling for current plant and firm characteristics and market conditions. Our set of six experience variables can be simplified into three categories for which exit probabilities differ. Denovo entrants who have no prior firm or plant experience, new plants owned by firms with some prior experience in the product or geographic market, and experienced plants that are diversifying their product mix have distinctly different exit probabilities for all of the products we examine. For six of the seven products we study, product mix entrants have higher failure probabilities than de novo entrants and experienced firms opening new plants have the lowest failure probabilities.

Plant characteristics, including productivity, absolute size, relative size in the market, and degree of specialization, are all correlated with exit in the expected way. Firm-level characteristics, including firm size and the distance to other plants owned by the firm, are also important determinants of exit for several products. Finally, high current demand levels per producer and high rates of future demand growth both act to depress exit. One additional finding is a remarkable degree of consistency in the magnitude of the effects across products, particularly for the plant-level characteristics and market-level variables.

In a second empirical model we distinguish plants by the method of exit they use, closing the plant or diversifying out of the product market, using a multinomial logit model. Here we find that the type of prior experience again has a large impact on the probability of each type of exit. The most experienced group of plants, those with both firm and plant operating history, were the most likely to exit a product market by shifting their product line but keeping the facility in operation. This is consistent with the argument that these plants have the most favorable set of options in other product markets. Overall, we find that initial entry conditions play an important role in both the plant's decision to exit a product market and the choice of exit method, even after controlling for current profit determinants. The exit decision is not one that can be fully captured by looking at a plant's characteristics at a point in time, but rather history matters in a significant way.

In the next section of this paper we develop an empirical model of plant exit and relate it to the existing theoretical models and empirical studies. Section 3 describes the data for our geographic markets and discusses the construction of the plant and firm experience variables. Section 4 provides the results from a probit model of plant exit while section 5 reports the findings from a multinomial logit analysis that distinguishes two different methods of exit. The final section summarizes the results.

2. The Decision of a Plant to Exit a Market

We begin by specifying the current profit of a plant that produces output in a specific market. We view a market as a combination of industry and geographic area and recognize that a plant often produces and sells output in several industries. Like Dunne, Roberts, Samuelson (1988), we are interested in the decision of a producer to exit a market and this is distinct from the decision to close the plant entirely.

Let $B_{igt}(z_0, x_t, m_{igt})$ be the maximum profits earned by a plant that produces output in industry i in geographic area g in year t. Plant profits are a function of a set of plant-specific characteristics at the time the plant enters the market z_0, plant characteristics that vary over time x_t, and market conditions m_{igt}. The z_0 represent a set of initial conditions at the time the plant enters the market and, thus, remain fixed over time. Both x_t and m_{igt} are state variables that evolve over time, either exogenously to the plant or endogenously as a result of plant decisions. An example of a variable that evolves exogenously is population in the geographic market, a determinant of market demand. An example of a variable that could evolve endogenously is the plant's capital stock, which changes with the plant's investment decision. The plant characteristics z_0 and x_t can include factors that are specific to the plant, such as the plant's productivity, or factors that arise at the firm level, such as the amount of managerial input or R&D activity of the firm, that could affect the profitability of all plants owned by the firm. That is, z_0 and x_t can include firm characteristics that affect a plant's profits.

We view the plant as making a decision to continue operating in a market at the start of each year prior to observing (or choosing) the values of x and m for that year. Specifically, the plant decides to produce in year $t+1$ by comparing the expected discounted sum of profits from operating , EV_{igt+1} , with the scrap value it earns by exiting, F. Expected future profits are calculated from knowledge of the profit function B_{igt+1} , the observed state variables for year t, (z_0, x_t, m_{igt}), and knowledge of the transition process for the time-varying state variables. If EV_{igt+1} $F, the plant will continue in the market and we will observe the discrete variable F_{igt+1} =0. If expected profits are less than the scrap value the plant exits the market and we observe F_{igt+1} =1. Our empirical model will express the discrete exit variable in year $t+1$ as a function of the initial conditions and state variables in year t: $F_{igt+1} (z_0, x_t, m_{igt})$

Overall, the goal of the empirical model is to identify groups of variables - initial entry conditions, time-varying plant and firm variables, and market-level variables - that may matter to the exit decision. While the model outlined in the last paragraph is the basis for many of the empirical exit studies in the literature, our application will vary from these others in several ways. First, the primary focus in the literature has been on the set of plant characteristics in x_t that can account for differences in profitability across producers. These variables commonly include size, usually measured by employment, age, productivity, capital stock, type of technology, whether it is owned by a single or multi-plant firm, and possibly some information on the size or product market diversity of the owning firm.[3] A common finding is that the exit process does reflect underlying differences in productivity or efficiency. Like these other studies, we will control for an important set of plant and firm-level characteristics that are correlated with differences in profits and survival, but we will also exploit some aspects of our data that let us measure differences in the experience of the plant operators at the time of entry. Specifically, we construct a set of variables that distinguish completely inexperienced producers, de novo entrants, from producers that had prior experience in the geographic area and/or product market.

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[3] A comprehensive summary of this literature is provided in Caves (1998). A recent extension, which incorporates the role of import competition in the plant shutdown decision, is Bernard and Jensen (2002).

Second, our empirical model will focus on the decision of a manufacturing plant to stop producing output for industry *i* in geographic market *g*. Thus the focus is *not* on the decision to close a plant and we are *not* studying the death process for plants. Rather, many plants produce multiple products and a plant can exit an industry without closing by altering its product mix. This is what Dunne, Roberts, and Samuelson (1988) and Bernard, Redding, and Schott (2003) have identified in their studies. It is the exit of the plant from production in the industry that we believe is the most relevant measure of exit for industrial organization economists to understand because it directly affects the number and relative size of competitors in the market which in turn determines pricing and markup patterns.

Third, we will also estimate a model that recognizes the way in which the plant exits. Our first model treats the plant as making the binary exit/continuation decision as described above. Our second model recognizes that the plant has three choices, continue in operation or exit the market in one of two ways, close the plant or diversify out of the product. We can distinguish these two exit methods in our data and will estimate a multinomial logit model that quantifies the effect of plant, firm, and market characteristics on the probability of exit by each method.

Fourth, we will study exit in the context of a specific product market. The profits of a plant depend on the level of demand, cost conditions, and market structure in the market in which it operates and failure to control for differences in market conditions omits an important set of variables. In studies that use time series data for a single industry which operates in a national market, such as Olley and Pakes' (1996) study of telecommunications equipment, Deily's (1988) study of the steel industry, Das' (1991) study of cement kilns, Bresnahan and Raff's (1991) study of automobile assembly plants, Lieberman's (1990) analysis of the chemical industry or Klepper and Simon's (2000) study of the tire industry, market conditions are identical for all producers at each point in time and it is not necessary to control for them in empirical models, except to recognize that the market conditions may change over time. Other studies of exit pool data across a large number of industries and then it does become important to control for differences in market conditions. Generally this is done by including industry and time dummy variables in the exit regression. In order to isolate the role of market-level variables in the exit process we will study seven industries that operate in small geographic markets We will have multiple observations on each market over time and a 35-year time period in which there are large changes in demand and cost conditions for most markets.

3. Data

The data consists of observations on manufacturing plants collected in the U.S. Census of Manufactures which is taken at five-year intervals over the period 1963-1997. We have eight annual observations over this 35-year period. We estimate separate exit models for the seven four-digit regional manufacturing industries listed in Table 1. We include three food industries (milk, baked goods, and soft-drink bottling) and four industries that manufacture construction-related products (asphalt and three concrete-product industries). These industries were chosen because plants in these industries sell their output in relatively small geographic areas and this will give us a large number of markets with different demand and cost conditions to exploit in the estimation. Table 1 provides data from the 1977 Commodity Transportation Survey on shipping distances for the industries included in this study. The construction related industries (SICs 2951, 3271, 3272, 3273) appear to have the smallest local markets. Over 90% of the products shipped in these industries are shipped less than 100 miles. The food industries (SICs 2026, 2051 and 2086) have somewhat larger geographic markets. Between 61% and 83% of shipments in these industries are shipped less than 100 miles, while the vast majority of shipments in these industries are shipped less than 200 miles.

These industries have undergone very different patterns of expansion and/or contraction over the 35-year period of our data. Both long-term shifts in demand due to population growth and the development of substitute products and long-term changes in technology have had a substantial impact on the market structure in each industry. For example, the fluid milk industry has undergone significant changes in the distribution systems utilized in the industry. In 1963, there were 5713 plants while in 1997 there were only 837 plants. The shrinkage in the number of plants in fluid milk is due changes in technology (improvements in refrigeration) and changes in delivery mode (supermarkets vs. milkmen). Alternatively, the number of ready-mix concrete plants has stayed relatively stable over time though firm structure has changed substantially over the period. At the beginning of our sample, single-plant producers accounted for 75.8 percent of plants, while at the end of the study they accounted for only 44.5 percent. Given the industry-specific forces affecting these markets, we will estimate our exit models separately for each industry.

Market Definition

To identify the plants that produce in each of the seven four-digit SIC industries we use information on the entire set of products manufactured in each plant. In the data set for industry *i,* we include all plants that manufacture product *i* even if it is not the primary output of the plant. We then assign each plant to a local geographic market *g*. As geographic markets we use the 181 distinct regional markets identified by the Bureau of Economic Analysis (BEA) as economic areas.[4] Each of these geographic markets is an aggregate of a group of counties. A plant exit is defined as a plant that was producing in the geographic market-industry pair in the current census year *(t)*, but is not producing in the geographic market-industry pair in the next census year *(t+5)*. Since we recognize that plants can produce multiple products, this definition recognizes that plants can exit a market by changing the product lines they produce or by shutting down the operation completely.

Variable Definitions

As discussed in section 2, the exit model focuses on the importance of four broad groups of variables: plant/firm experience, plant characteristics, firm characteristics, and market conditions. We

4 These are defined by the BEA as "*Each economic area consists of one or more economic nodes metropolitan areas or similar areas that serve as centers of economic activity and the surrounding counties are economically related to the nodes.*" See Johnson (1995) for a detailed discussion of BEA economic areas.

discuss each group in turn and appendix Table A1 provides detailed definitions for all the variables used in the empirical exit models.

Plant and Firm Experience: Our empirical specification includes information about the history of the plant in the market, z_0. An important and unique element of our data is that we can observe plants at the time they first enter a market and can quantify the type of prior production experience they possess.

First, for each entrant we measure the prior production experience of that plant. In the first year we observe the plant in industry *i* market *g,* we classify the plant into one of two categories based on experience: the first category is "no experience" and contains all new plants. We will refer to these as new-plant entrants. The second category contains all previously-existing plants. These plants are ones that were not producing output in industry *i* in the prior census but were producing output in some other industry. We will refer to these plants as product-mix entrants. The operators of these plants have some prior experience with the plant's workforce, suppliers, transportation providers and, possibly, buyers and thus may be more knowledgeable than the operator of a new plant. It is also likely that the cost of entering industry *i* will be different for product mix and new plant entrants. The former do not have to incur the cost of setting up production facilities while the latter do. In Table 2, the two types of plant experience are represented by the two columns.

Second, we also classify the plant in its first year of production in industry *i* market *g* into several categories based on the prior experience of the *firm* that owns it. First, the firm may already have some experience manufacturing product *i* in market *g* with a different plant. A firm with this type of industry/geography-specific experience should have a better understanding of the technology, type of customers, and demand characteristics of the buyers of the product. To the extent that this type of expertise can be transmitted within the firm and applied to new plants in this geographic location, these firms should have better prior information than counterparts that have not operated in this industry and/or geographic market. Second, the firm may have prior experience producing in industry *i* in a different geographic market. This type of plant would benefit from the firm's experience with the technology even though it does not have any direct experience with the buyers in market *g*. Third, the firm may have no prior experience in industry *i*, but still be an ongoing entity with manufacturing experience in some other, possibly related, industry. While these firms will not have industry-specific experience with product *i*, they do have prior manufacturing experience which may give them advantages in dealing with labor markets, accounting, distribution, R&D, or product development.

Focusing on the new plant entrants, column 1 in Table 2, the four categories of firm experience are identified. First, the firm may be new and have no prior production experience. New plants owned by these firms (de novo entrants) are denoted as type 1 in the table. Plants owned by firms with prior experience in both the industry and geographic market are denoted as type 2. Plants owned by firms with prior experience in the industry but not in the geographic market are denoted as type 3. Plants owned by firms with manufacturing experience outside of industry *i* are denoted as type 4.[5] For product-mix entrants, column 2 in the table, only two of the categories of firm experience are possible. Since the plant already exists, the firm must have some prior experience, either within the industry (type 5) or in some other industry (type 6).

Together these six categories distinguish the type of experience that each plant possesses when it begins production in industry *i* market *g*. In the exit model we include dummy variables to distinguish these six categories of firm/plant experience. We also test a number of models that restrict the six categories to a smaller set in which, for example, only prior plant experience matters or only prior firm experience matters. These tests help identify if a particular source of prior experience has a long-lived effect on the plant's participation decision.

Table 3 provides data on the distribution of plant experience categories in the first year the plant is observed in the market. The percentages are averaged over the six census years in which we observe

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[5] We do not distinguish whether this prior manufacturing experience occurs in geographic market *g* or in some other market because there were few plants in these subcategories.

entry. The most common form of entry is denovo entry (type 1). These are new firms entering with new plants. These inexperienced plants account for more than one-half of the new producers in a census year in four of the seven industries. The second most numerous group of entrants are type 6, existing plants in which the owning firm has no prior experience in industry *i* in the preceding census. These are producers that have entered industry *i* by changing the product mix of an existing plant.

There are some interesting similarities across industries. Both the milk (2026) and soft drink bottling (2086) industries have a very similar distribution of prior experience. Denovo entry, type 1, is less important than in the other industries and product mix entry from existing plants, types 5 and 6, is more common. This represents an ability of existing producers to shift production among alternative products. For example, milk producers move in and out of other dairy product industries and soft drink bottlers move in and out of other beverages. Another interesting similarity exists between the asphalt (2951) and ready-mix concrete (3273) industries. Many of the new plants in these industries are owned by firms that already have a plant in the geographic market, type 2. This most likely reflects the fact that shipping distances are very short for these products, so that firms expand capacity by adding more plants in the geographic market, as opposed to increasing plant size.

Market Conditions: The second broad class of profit determinants are market conditions m_{gt}. We control for differences in the profitability of different geographic markets by including a set of demand and cost shifters and a set of geographic market dummies. The demand and cost shifters account for differences in profitability over time across markets. For the asphalt and concrete industries, we measure demand by the level of activity in construction, specifically, the level of real earnings in the construction industries.[6] For the food industries, we use population as the measure of demand. We express the demand variables in year *t* on a per-producer basis by dividing by the number of plants in the market in year *t*. The growth in demand is measured as the growth in the demand variable from year *t* to *t+5,* divided by the number of

[6] The Bureau of Economic Analysis (BEA) constructs annual earnings data for each sector of the economy at the county level. We aggregate the BEA earnings data at the county level to the BEA economic area level.

plants in year *t*. We expect that high per-producer demand and high growth both indicate higher profits and, thus, less exit.

To measure differences in costs across geographic markets, we use the average wage paid and the average price of electricity for all plants operating in a geographic market as well as the changes in these variables from *t* to *t+5*. We also measure the local price of the key raw material used in each industry. The raw material we include is specific to each industry. In the baking industry (SIC 2051) we include the price of wheat flour, in the milk industry (2026) whole milk is the key input, in soft-drink bottling (SIC 2086) it is flavoring syrups, in asphalt the key ingredient is asphalt, and in the 3 concrete-related industries (3271, 3272, and 3273) portland cement is the main material component.[7] All exit models also include time period dummies to control for aggregate shocks to the industry.

Plant-level Characteristics: The third set of control variables are plant-level variables (x_{it}) that act as profit determinants including measures of the plant's production efficiency. These are proxied by both the absolute size of the plant and its position relative to other producers in the same market in year *t*. We measure plant size using the log of total employment. We measure its relative position in the market by both its relative labor productivity and its output market share. Relative labor productivity is defined as the log of the plant's value of shipments per worker relative to the average labor productivity over all plants in the market. The market share is measured as the plant's share of production in a geographic market. We also measure the relative importance of the product in terms of the share of production in the plant. We distinguish between primary producers (50% or more of a plant's output is in the product) and secondary producers (less than 50% of the plant's output is in the product). Differences in specialization could produce differences in profitability if there are economies or diseconomies of scope in production. Differences in scrap values could also arise if secondary product producers have better alternative uses for

[7] We cannot include changes in this material price variable because in 1997 the material coding changed significantly so that it was not possible to construct similar price indices for the materials variables in 1997.

the plant than producers with highly-specialized production. The costs of exit in this case may be quite different in comparison to a firm that is a primary producer of a product. Finally, as in other studies of exit, we control for plant age. Plant age is measured with a set of dummy variables distinguishing four age classes: 1-5 years, 6-10 years, 11-15 years, and more than 15 years old.[8]

Firm Characteristics: A plant's profits or scrap value may also be determined by characteristics of the firm that owns it and we include a set of firm-level variables in the empirical model to account for this source of variation in plant profits. The firm variables are firm size and several measures of the geographic distribution of production by the firm. In the latter case, we want to control for the fact that multi-plant producers may face different exit costs and a fundamentally different exit decision than single-plant producers. For a single-plant producer, the decision to close is the decision to exit a market and perhaps close down the firm. For the multi-plant producers, it may simply represent an alternative method of capacity adjustment.[9] In order to control for such differences in firm structure across producers, we measure the proximity of other plants owned by the firm and information on the overall number of geographic markets the firm operates in.

4. Empirical Results - Determinants of the Exit Decision

In this section we report coefficient estimates for probit models of plant exit. The models are estimated separately for each industry and include both fixed effects for the geographic markets and years.[10] Before reporting the coefficients for individual variables, we examine the statistical significance

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[8] For the group of plants that are in operation in the first year of our data set, 1963, we cannot measure the age or entry experience variables. For these we included a separate set of year dummies that control for the age and time related patterns in their failure rates. Therefore, both the age and experience coefficients in the exit models are estimated only from information on the group of plants that enter in census years after 1967.

[9] Papers by Whinston (1988), Baden-Fuller (1989), and Lieberman (1990) emphasize the multiplant shutdown decision.

[10] In addition to the coefficients reported in this section, we performed some sensitivity checks to the definitions of our geographic markets. In the eastern U.S., the geographic markets we use tend to be much smaller than in the western U.S. and they share many borders in common. This may allow the plants we study to more easily serve

of 6 broad groups of variables. Table 4 presents the log-likelihood ratio test statistics. The first column reports the test statistic for the hypothesis that there are no geographic market effects and, in all industries, we reject the hypothesis. Columns two and three present test statistics that the market demand and cost variables are jointly equal to zero. In six of the seven industries we reject the hypothesis that market demand variables do not matter. In four of the seven industries, we reject the null hypothesis that the market cost variables do not matter. The final three columns show that plant, firm, and plant age effects are important in almost all industries. This is particularly the case with the four plant variables (size, market share, specialization, and productivity). The tests statistics for the plant variables (column 5) are all very large indicating that, within markets, plant heterogeneity plays a very important role in determining the plant exit patterns. Overall, we need to control for market, plant, and firm characteristics in the exit models. Next, we turn attention to the importance of the plant experience variables.

Plant and Firm Experience

The first set of variables we examine distinguish the six categories of prior experience. We initially test four hypotheses about whether the set of experience variables can be simplified and the P^2 test statistics are reported in Table 5. First, we test the hypothesis that all six experience variables are jointly equal to zero. This is equivalent to specifying that there is no difference in failure probabilities between the original plants present in the 1963 cohort and the later plant entrants. The hypothesis is rejected for all seven industries. Failure probabilities are significantly different for plants that enter over the sample period.

The second hypothesis we test allows entrants to differ from the initial 1963 cohort but restricts all the firm and plant experience coefficients to be equal. This is equivalent to imposing that the type of prior experience, whether firm or plant or within the industry or not, has no effect on failure probabilities. This

adjoining markets so that market-level demand, cost and relative size variables are less accurate for them. We have estimated the model omitting the densely populated eastern geographic areas and the results we report are robust to this change in the sample.

hypothesis is rejected in 6 of the 7 industries. The hypothesis is not rejected in soft drink bottling (2086). In the other 6 products, the source of the plant's experience at the time of entry is going to have an effect on its failure probability.

The third hypothesis recognizes the difference in plant experience between new entrants and product mix entrants but restricts all sources of firm experience to be unimportant. That is, it does matter if the firm has no prior experience, experience in the industry, or experience elsewhere in manufacturing. This hypothesis is rejected in only 1 of the 7 industries – ready-mix concrete. An alternative way of expressing this result is that, for the six industries, once we distinguish new plants (type 1,2,3, and 4) from old plants (type 5 and 6), there is no significant difference within each group based on the source of firm experience.

The final hypothesis we test allows three distinct categories of experience. Plants are distinguished based on whether they are new or product mix entrants, and the firm is distinguished by whether it has some prior experience or not. All other sources of firm experience are restricted to be equal. This leaves three distinct categories - new plants owned by new firms (type 1), new plants owned by firms with some type of experience (type 2, 3, and 4), and experienced plants (type 5 and 6). This hypothesis cannot be rejected in any of the industries. This implies that, in terms of the effect on failure probabilities, there are three groups of plants distinguished by their experience at the time of entry. There are plants with no prior experience of any type, plants that are new but that are owned by firms with some production history, but the source of the history, whether or not it is in the same industry or same geographic area, does not matter, and plants that are ongoing operations but are diversifying their product mix in order to enter. Plants that fall into these different categories will have different probabilities of failure even many years after entry and even after we control for other time varying characteristics.

Since we cannot reject the last hypothesis in any of the industries, we simplify our discussion of the remaining results by treating the model with three experience categories as the unrestricted model and reporting coefficients for this specification. Coefficients for the three experience categories are reported in

Table 6. Rather than report probit coefficients directly, we report the change in the probability of exit for a discrete change in the value of a dummy variable. All coefficients measure the difference from the exit probability of the 1963 incumbent firms (the omitted group). The first column in the table reports the difference in exit probabilities for the de novo entrants. The second column reports the effect for experienced firms opening new plants and the final column for experienced plants (product mix entrants). Every statistically significant difference is positive, indicating that these entrants have higher exit probabilities than the base group. The interesting differences appear when we compare across experience categories. In six of the seven industries, product mix entrants have the highest exit probabilities followed by de novo entrants and lastly by experienced entrants. The higher exit probability for product mix entrants is significant for all products but the difference between de novo and experienced new plant entrants is often not significant. Overall, it is clear that the exit probabilities of plants are determined by characteristics, in this case the type of experience, at the time of entry. We reject the hypothesis that exit of a plant at time *t* is only determined by characteristics of the plant at time *t*, in favor of an alternative explanation that also relies on a role for initial entry conditions.[11]

Market Characteristics

The results for the remaining variables are reported in Table 7. The estimates reported measure the change in the probability of exit for an infinitesimal change in the value of a continuous variable and the change in the probability of exit for a discrete change in the value of a dummy variable, evaluated at the means of all the independent variables. The first panel of Table 7 reports the results for the demand variables. Across all industries increases in demand lower the probability of exit from the industry. The

[11] The results for the experience coefficients in Table 6 indicate a significant role for initial plant conditions in the subsequent exit patterns, they do not allow the experience effects to diminish as the plant ages. We check if the role of entry experience diminishes as the plant ages in the market by a set of interaction terms between plant age and the prior production experience variables. The plant age-firm experience interactions are generally not significant and we do not observe a different aging patten on the probability of exit for firms that entered with differing prior experience. In six of the seven industries we could not reject the hypothesis that the effect of experience was constant as the plant aged. This lends further support to the argument that prior experience has a long-lived effect on plant participation.

general pattern is that, for the food industries, a higher initial level of demand as measured by the log of population per producer leads to lower subsequent exit. For the construction industries, both the initial demand and the growth in demand are negatively correlated with the probability of producer exit. The five parameters associated with the market-level cost variables are not reported since there are no strong patterns in the cost parameters across industries and in most cases, the individual cost variables were not statistically significant at the 5% level.

Plant characteristics

The second panel of Table 7 reports the results for the four plant characteristic variables. As expected, an increase in plant size (log of total plant employment) has a negative and statistically significant impact on the probability of exit in all industries. For example, in the food industries, an increase in the plant size by 10 employees, which represents a 23 to 33 percent increase in average plant size, decreases the probability of exit by .035 to .048 across the food industries. This is a substantial effect as the average probability of exit varies between .38 and .41 across these industries. The negative relationship between size and exit agrees with most other studies of exit that find larger plants have significantly lower failure probabilities than smaller plants (for example, Evans (1987), Dunne, Roberts and Samuelson (1989), Levinsohn and Petropoulos (2000), and Bernard and Jensen (2002)). The next two columns report the results for variables that measure the relative performance of a producer in the geographic market -- market share and relative labor productivity. In almost all industries, greater market share and higher relative productivity lead to lower exit probabilities. The only exception is SIC 3273 where the market share effect is positive though not statistically significant. The effect of an increase in the market share by 10 percentage points would be to lower the probability of exit by .01 to .035 across the six industries where the market share is statistically significant. In the case of the relative labor productivity, a producer that is twice as productive as the average producer in the geographic market has a .06 to .14 lower probability of exit than the average producer.

The last column under the plant characteristics panel reports the results from our variable that measures whether the product is a secondary or primary product in the plant. Across all industries, secondary product producers have a much higher probability of exit from the industry. The difference in the probability of exit of a secondary producer compared to a primary producer ranges from a low of .104 in ready-mix concrete (3273) to a high of .274 in bottled and canned soft drinks (2086).

In addition to the variables that measure size, relative performance and secondary product status, we also include controls for plant age in the probit model. The pattern is quite consistent across industries. In all industries for all years the coefficients are negative indicating that older plants fail less frequently than new plants (the omitted group). For all but two industries (2951 and 3273), the probability of exit declines monotonically through the first two age groups (6-10 years old and 11-15 years old). For the oldest plants (greater than 16 years of age), the pattern is mixed. For many industries, there is little difference between the second oldest and oldest groups, although for some industries the exit probability rises slightly for the oldest group of plants. In general these aging patterns agree with the prior studies that have found that the probability of exit generally declines with age (see the papers reviewed in Caves (1998)).

Firm Characteristics

The next set of variables we examine are firm characteristics, including variables that measure the proximity of other facilities owned by the firm, firm size, and the number of geographic markets each firm operates in. The first column of the fourth panel reports the results for firm size, which is measured as the log of total firm employment in manufacturing. The results indicate that plants owned by large firms generally have a higher probability of exiting a market than plants owned by smaller firms. The marginal change in probability is positive in six of seven industries and statistically significant in three of the seven industries.[12] The next column shows that the number of geographic markets that a firm operates in has

[12] This is similar to the findings of Lieberman (1990) for the chemical products industry. Controlling for plant size he finds that large firms had a higher probability of closing a plant.

little systematic effect on the probability of exit across industries. The last two firm characteristics measure the proximity of nearby facilities. The first variable is a dummy indicating whether a firm has another facility producing in the same industry within 100 miles of the plant. The second variable is a dummy variable that indicates that while a firm does not have a plant within 100 miles it has a plant producing in the industry between 100 and 250 miles away from the plant. These variables control for the fact that multi-plant producers face a different exit problem than single-plant producers. Presumably, a nearby plant could service the customers in a geographic market in the face of closure of an individual facility. The results differ across the two industry groups. In the food industries, the effect of nearby plants on exit is positive though often not statistically significant. This is consistent with the firm consolidating nearby plants. In contrast, the most robust pattern is that for the construction industries: having a nearby facility generally lowers the probability of exit for a plant. Overall, while firm characteristics are often statistically significant in the exit regressions, the effects are less robust than the plant characteristics, age, and experience variables.

5. Empirical Results - Plant Shutdown versus Product-Line Exit

Up to this point, our analysis has focused on examining producer exit from an industry in a geographic market -- a zero-one choice. However, this exit decision actually encompasses two distinct decisions for the plant. A plant can exit the industry by completely shutting down its operation, or alternatively, the plant can remain open but shift its production toward other products. We will refer to the first method of exit as plant shutdown and the second method as reflecting a shift in the plant's product line. While both of these cases result in the plant exiting the industry in market *g*, they are likely to reflect different opportunity costs for the plant. In the case where the plant shuts down entirely, the decision is likely to be affected by the characteristics and quality of the plant's capital stock or workforce. In contrast, a plant that is relatively efficient in production may exit an industry because the inputs can be more profitably allocated to other types of output. In this case, declines in demand for the industry output or increases in the demand for alternative products the plant can produce could lead the plant to shift its product line toward other goods.

We can extend the empirical model developed in section 2 to reflect these distinct types of exit by being more explicit about the range of alternatives available to the plant. Specifically, a plant that is contemplating complete shutdown will compare the profits from continued operation with the scrap value that it could earn by liquidating all of the plant's physical assets. A plant that is contemplating a shift in its product line will compare the profits from continued operation with the profits that it could make by reallocating its capital and labor inputs to producing for other product markets. This alternative is likely to be more attractive for a multi-product plant that is already selling some of its output in a different product market, since they are likely to have already established distribution or sales networks or contacts. Similarly, on the supply side, plants that have more flexible technologies may find it less costly to shift production lines toward alternative products and thus be more likely to remain in operation, even if we observe them exiting a specific industry.

An extension of our empirical model of exit views the plant as choosing among three alternatives: remain in operation in the industry, remain in operation but shift production toward other industries (product line exit), or completely shut down the plant. As above, let EV_{igt+1} be the expected profits if plant i continues to produce in the industry. Let EV^{k}_{igt+1} be the expected profits if plant i shifts its production capacity to its most profitable alternative product k and let F_i be the scrap value earned if the plant closes. The plant chooses the alternative that gives them the highest expected firm value. They will shift product line if $EV^{k}_{igt+1} > F_i$ and $EV^{k}_{igt+1} > EV_{igt+1}$ and will close the plant entirely if $F_i > EV^{k}_{igt+1}$ and $F_i > EV_{igt+1}$. By comparing plants that choose one of the exit options we are learning about the relative magnitudes of F_i and EV^{k}_{igt+1}. Plants that have more or better opportunities in other product markets will be more likely to choose to keep the plant open and thus exit the industry by shifting their product line. Alternatively, plants that have limited options in other industries, because, for example, they have low overall productivity or have physical assets that are highly specialized in the production of one product, will be more likely to exit through plant closure. We will model the plant's choice using a multinomial logit model with three outcomes: remain in operation in the industry, remain in operation but shift production out of the industry, and shut down the plant. We will estimate this model using the same data and the same set of independent variables as the probit model in section IV.

Before estimating the model we examine the incidence of each choice. The amount of exit resulting from product-line shifts in ongoing plants averages 21% of all exit across our seven industries, while plant closure accounts for the remaining 79% of exit. The relative importance of product-line exit, however, varies significantly across industries. The frequency is relatively low in bakery products (SIC 2051) and ready mix concrete (SIC 3273), where product-line exit accounts for only approximately 10% of all exit, but is much higher in concrete block and brick (SIC 3271) and concrete products n.e.c. (SIC 3272) where it accounts for almost a third of exit.

The results of the multinomial logits are presented in Tables 8 and 9. For each industry, we present the base probability of exit by plant closure and by product-line exit in the first two columns.[13] In Table 8 these are constructed by taking the average predicted probability of exit by plant closure and product-line reallocation across all plants within each industry. The omitted choice is to continue in the industry. We then examine how a change in prior experience affects the probability of each choice. The table shows that product mix entrants are much more likely to utilize product-line exit than either the other entrants or plants in the 1963 cohort (the base group). A formal test of the hypothesis that the product mix entry variable has no effect on the odds ratio of plant closure to product-line exit is rejected in six of the seven industries. The only exception is the baking industry. Alternatively, we cannot reject the null hypothesis that the denovo entry or experienced new plant entry variables have no effect on the odds ratio

[13] The parameters from the multinomial logit models, and their corresponding standard errors, that are used to construct the probabilities are presented in appendix Tables A2 and A3.

of plant closure to product-line exit in six of the seven industries.[14]

Table 9 presents the multinomial results for a subset of the continuous variables: initial market demand, change in demand, plant size, relative productivity, and market share. The table reports the percentage change in the probability of both plant closure and product-line exit for a one standard deviation increase in the variable of interest. The results for the demand variables in Table 9 show that an increase in the level or growth rate of demand virtually always lowers the probability of both types of exit. One difference between the food and construction industries is that the former are less affected by an increase in the rate of demand growth. For the plant characteristics, two basic patterns emerge. First, an increase in plant size or relative productivity has a larger effect on the plant closing decision than the product-line exit decision. A one standard deviation increase in plant size decreases the probability of closing the plant, on average, by 40.9%. However, the impact of an increase in plant size on product-line exit is much smaller, the average decline is only 7.4%. This same general pattern holds when we evaluate a one standard deviation increase in relative productivity though the magnitudes of the effects are smaller. An increase in relative productivity significantly lowers the probability of closing a facility while the impact on product-line exit is much weaker. Thus, larger plants and more productive plants are more likely to utilize product-line exit as compared to plant closure as a mode of exit. Alternatively, the market share variable appears to have a larger and more consistent effect on the product-line exit decision, particularly for the construction industries. We believe that this reflects the fact that an increase in market share can reflect two factors: an increase in plant size relative to other producers in the geographic market and an increase in the plant's degree of specialization in the product of interest. If the coefficient generally reflects the second force, and it should since we have already controlled for overall plant size in the regressions, then market share increases reflect a larger commitment to the product market we study and

[14]The underlying likelihood ratio tests are performed at the 5% level and are available from the authors by request.

the plant is thus less likely to exit by shifting production away from the product.[15]

Using the results of this section, we can broadly characterize the type of plant that chooses each exit method. Initial conditions, in this case experience at the time of entry, are an important differentiating factor. Plants that had prior experience operating in other product markets at the time of entry have the largest difference in their choice of exit method. Exiting by shifting the product line, rather than closing the plant, is a much more commonly used option among this group of plants. This is consistent with the view that these plants have the best set of profit opportunities in other product markets, as evidenced by their history of operating in other product markets. We also find that plants that are larger and have higher productivity are more likely to use the product-line exit option and these are the plants that we would expect to have the best opportunities in other product markets.

6. Conclusions

This paper examines the role of entry experience and plant, firm, and market characteristics as determinants of the plant's decision to exit a market. The paper finds that the producer's experience at the time it enters the market plays an important role in the subsequent exit decision, affecting both the overall probability of failure and the mode of exit, specifically plant closure versus a shift in product line. In the seven manufacturing industries we study, many new suppliers in a market begin with significant prior operating experience, but the nature of that experience, whether it is in the same industry or geographic area or with the same plant, can differ. We find that three combinations of plant and firm experience lead to distinct exit patterns. After controlling for observable profit determinants of the plant, experienced plants that enter by diversifying their product mix have the highest exit rates, followed by de novo entrants, and then new plants owned by experienced firms. The plants that entered through changes in

[15] The results from the multinomial logit for the secondary product status are also striking but to conserve on space we did not present the results in our main tables. In short, we are much more likely to observe secondary product plants exit the industry through product line changes than are primary product producers. See appendix Tables A2 and A3 for the parameters from the multinomial logit models for the secondary product variable.

product mix are also more likely to use shifts in product lines to exit an industry than are the other types of entrants. Overall, we find that the characteristics of the plant at time *t* are not sufficient to explain the decision to exit a market, but that initial conditions of the plant, in this case the type of experience it possessed at entry, also lead to long term differences in the probability of exit.

In addition to the measures of prior experience, we find that current and future market demand levels are also important. An increase in current demand per producer and an increase in the growth rate of future demand generally lowers exit rates across our regional manufacturing industries. In contrast, differences in market level cost conditions across locations do not play an important role in the exit process, probably because many of the important cost differences exist at the plant, not market, level. We also control for a large set of plant and firm-level characteristics that can account for profit differences across plants. We generally confirm the findings of other empirical studies that stress the important role of producer heterogeneity in the exit process. We find that plants that are larger, both in absolute size and market share, are older, have higher labor productivity, and are more specialized are less likely to exit the market. Our controls for firm characteristics, the number of other plants owned by the firm, whether or not they are geographically close, and firm size, have a much weaker and less systematic effect on exit than the plant characteristics. Finally, we estimate our exit models separately for seven regional manufacturing industries. The patterns of coefficients and corresponding significance level are quite consistent across these industries, indicating that the process that drives exit has similar components across industries.

Our empirical findings on the important role of entry characteristics in the exit decision reinforce the findings of Dunne, Roberts, and Samuelson (1989), Audretsch (1995), Mata, Portugal, and Guimaraes (1995), Pakes and Ericson (1998) for the retail sector, and Klepper (2002). They suggest that the exit decision cannot be treated as determined solely by current and future plant and market conditions, but that the plant's history plays an important, independent role in conditioning the likelihood of survival.

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Table 1. Number of Plants, Industry Size, and Product Distance Shipped in 1977.

Industry	Number of Plants	Total Employees (in thousands)	% product shipped less than 100 miles (a)	% product shipped less than 200 miles (a)
2026: Fluid Milk	1924	93.5	80.1	91.2
2051: Bakery Products -- Bread, Cake and Related Products	3062	178.0	61.6	82.7
2086: Bottled and Canned Soft Drinks	2192	114.1	83.0	94.8
2951: Paving Mixtures and Blocks	1022	12.8	94.4	97.1
3271: Concrete Block and Brick	1273	18.7	92.1	99.3
3272: Concrete Products, N.E.C.	3916	61.7	94.6	99.7
3273: Ready-Mix Concrete	5433	87.9	94.6	96.3

Source: (a) 1977 Census of Manufactures and 1977 Commodity Transportation Survey.

Table 2. Combinations of Firm and Plant Experience at the Time of Entry.

Prior Firm Experience	Prior Plant Experience	
	No (New Plant Entrant)	Yes (Product Mix Entrant)
None	(1)	Not Applicable
Experience in (i, g) pair	(2)	(5)
Experience in industry i	(3)	Not Applicable
Experience in a different industry	(4)	(6)

Table 3. Distribution of Plants by Plant and Firm Experience Categories.

Industry *(i)*	(1)	(2)	(3)	(4)	(5)	(6)
2026	49.4	8.2	7.8	2.5	12.1	19.9
2051	87.8	2.7	3.0	1.0	2.1	3.7
2086	45.9	7.7	9.2	1.9	12.9	22.3
2951	42.0	20.8	13.3	4.8	6.2	12.9
3271	53.4	7.7	3.9	4.3	7.7	23.0
3272	64.6	3.6	4.4	3.1	4.0	20.4
3273	63.1	22.0	4.8	1.2	2.9	6.0

Experience Categories:

(1) No Plant Experience, No Firm Experience (denovo entry).

(2) No Plant Experience, Firm Experience in industry i market g..

(3) No Plant Experience, Firm Experience in industry i, not in market g.

(4) No Plant Experience, Firm Experience in manufacturing but not in industry i.

(5) Plant Experience, Firm Experience industry i.

(6) Plant Experience, Firm Experience in manufacturing but not industry i.

Table 4. Hypothesis Tests for Groups of Variables.

	Hypothesis Tests					
Industry	No Geographic Market Effects	No Market Demand Variables	No Market Cost Variables	No Firm Variables	No Plant Variables	No Plant Age Variables
2026	277.6*	24.9*	6.2	21.0*	1212.8*	36.7*
2051	206.1*	8.7	51.4*	53.3*	895.5*	70.2*
2086	232.4*	15.6*	17.1*	34.9*	1386.7*	44.0*
2951	283.2*	12.8*	164.0*	79.9*	417.0*	29.9*
3271	276.4*	26.5*	6.11	8.9	667.2*	84.9*
3272	310.0*	33.5*	5.4	81.6*	1337.8*	202.3*
3273	397.5*	68.7*	16.4*	125.6*	1269.5*	159.5*
Critical Value "=.01	135.8	9.2	15.1	13.3	13.3	11.3

* Significant at the 1% level.

Table 5. Hypothesis Tests for Experience Coefficients.

	Entrants and incumbents are the same 1,2,3,4,5,6=0	Type of prior experience does not matter 1,2,3,4,5,6 are equal	Firm experience does not matter 1=2=3=4 and 5=6	Any firm experience is equivalent 1 and 2=3=4 and 5=6
2026	26.18*	20.83*	8.87	8.80
2051	45.33*	44.22*	10.58	1.33
2086	33.16*	4.62	3.19	1.97
2951	21.66*	21.47*	6.86	6.34
3271	29.83*	27.59*	3.08	1.32
3272	101.13*	47.39*	9.58	7.64
3273	67.89*	34.41*	20.07*	3.37
Critical Value "=.01	16.82	15.09	13.28	11.35

* Significant at the 1% level.

Table 6. The Effect of Plant Experience Categories on the Probability of Exit.

Industry (SIC)	Denovo Entrants	Experienced Entrants: New Plant	Experienced Entrants: Product Mix
2026	.040 (.027)	.046 (.032)	.115* (.031)
2051	.025 (.028)	-.050 (.032)	.176* (.039)
2086	.123* (.022)	.099* (.026)	.094* (.023)
2951	.014 (.041)	-.001 (.041)	.099* (.048)
3271	.029 (.032)	-.005 (.037)	.116* (.035)
3272	.152* (.023)	.129* (.027)	.229* (.024)
3273	.104* (.018)	.058* (.020)	.154* (.024)

*Significant at the 5% level.

Table 7. The Effect of Market, Plant, and Firm Characteristics on the Probability of Exit.

Industry	Demand		Plant Characteristics				Plant Age			Firm Characteristics			
	Initial Demand	Growth in Demand	Plant Size	Mkt. Share	Rel. Prod.	Sec. Prod.	6-10 Years	11-15 Years	> 16 Years	Firm Size	# of Geog	Plant w/i 100 mi.	Plant w/i 200 mi.
2026 n=14165 xr=.414	-.123* (.025)	-.110 (.211)	-.179* (.007)	-.236* (.053)	-.097* (.008)	.120* (.013)	-.078* (.022)	-.155* (.027)	-.133* (.029)	-.002 (.005)	-.000 (.001)	.076* (.020)	.053* (.023)
2051 n=12437 xr=.378	-.059* (.028)	-.435* (.212)	-.182* (.008)	-.222* (.049)	-.076* (.009)	.207* (.022)	-.117* (.019)	-.182* (.022)	-.136* (.025)	.030* (.007)	-.004* (.001)	.044* (.021)	.020 (.024)
2086 n=16030 xr=.390	-.094* (.025)	-.198 (.164)	-.170* (.007)	-.105* (.045)	-.103* (.008)	.274* (.012)	-.078* (.017)	-.122* (.021)	-.105* (.023)	.017* (.005)	-.003* (.001)	.026 (.017)	.025 (.020)
2951 n=5749 xr=.331	-.097* (.028)	-.089* (.034)	-.068* (.009)	-.318* (.072)	-.101* (.010)	.183* (.026)	-.096* (.018)	-.079* (.022)	-.070* (.024)	.007 (.004)	.002* (.001)	-.133* (.018)	-.181* (.022)
3271 n=8684 xr=.398	-.111* (.023)	-.126* (.027)	-.157* (.011)	-.356* (.064)	-.139* (.013)	.191* (.014)	-.131* (.018)	-.182* (.022)	-.145* (.024)	.014 (.008)	-.004 (.008)	-.042* (.022)	-.093* (.031)
3272 n=17105 xr=.418	-.096* (.017)	-.097* (.020)	-.162* (.007)	-.114* (.056)	-.059* (.008)	.267* (.011)	-.137* (.012)	-.170* (.015)	-.171* (.016)	.042* (.005)	-.009* (.001)	-.075* (.015)	-.104* (.018)
3273 n=25175 xr=.320	-.071* (.014)	-.119* (.014)	-.107* (.005)	.059 (.078)	-.094* (.006)	.104* (.013)	-.103* (.009)	-.099* (.011)	-.095* (.012)	.001 (.003)	.012* (.003)	-.041* (.009)	-.133* (.012)

Note: n is the number of observations and xr is the average industry exit rate between two census years.

* Significant at the 5% level.

Table 8. Multinomial Exit Results: Changes in Probability of Plant Closure and Product-Line Exit by Entrant Experience.

Industry	Base Probabilities		Probability of Exit for Denovo Entrants		Probability of Exit For Experienced New Plant Entrants		Probability of Exit for Product Mix Entrants	
	Plant Closure	Product Line Exit	Plant Closure	Product Line Exit	Plant Closure	Product Line Exit	Plant Closure	Product Line Exit
2026	.327	.073	.347	.073	.354	.087	.349	.121*
2051	.347	.025	.357	.045*	.311	.033	.377	.047*
2086	.295	.066	.365*	.094*	.341*	.090*	.284	.120*
2951	.267	.053	.274	.052	.251	.064	.241	.133*
3271	.278	.099	.268	.133	.224	.155*	.227	.221*
3272	.241	.096	.323*	.138*	.313*	.131*	.300*	.191*
3273	.255	.021	.322*	.045*	.286*	.035*	.279*	.098*

* Significantly different from base probability at the 5% level.

Table 9. Multinomial Exit Results: Changes in the Probability of Plant Closure and Product-Line Exit.

			Percentage Change in the Probability of Exit for a One Standard Deviation Increase in the Column Variable.									
Industry	Base Probabilities		Initial Demand		Growth in Demand		Plant Size		Relative Productivity		Market Share	
Exit Method	Plant Closure	Product Line Exit	Plant Closure	Product Line Exit	Plant Closure	Product Line Exit	Plant Closure	Product Line Exit	Plant Closure	Product Line Exit	Plant Closure	Product Line Exit
2026	.331	.083	-26.5	-25.8	-1.8	4.2	-46.4	-23.6	-15.5	-2.2	-6.6	-12.9
2051	.347	.031	-5.7	-26.8	-4.4	-4.3	-53.7	-3.6	-11.3	3.6	-9.5	13.0
2086	.303	.086	-12.0	-19.3	-0.5	-10.6	-48.1	-9.7	-18.3	-0.7	0.5	-15.1
2951	.258	.072	-26.0	-7.0	-9.0	-4.7	-28.3	11.5	-23.4	-9.5	-8.5	-39.5
3271	.261	.136	-27.7	-19.1	-8.8	-10.9	-36.8	-14.2	-17.4	-8.2	-8.1	-19.2
3272	.279	.139	-18.5	-14.4	-7.5	-4.2	-41.3	-12.7	-13.5	10.6	1.4	-10.6
3273	.284	.036	-19.5	3.5	-12.3	-2.0	-32.0	0.3	-14.7	-13.4	1.5	-6.5

Table A1. Variable Definitions.

Variable Name	Definition
Exit	An indicator variable that takes the value 1 if the plant exits the industry/geographic market between census year t and census year t+5.
Plant Size	Log of total plant employment in census year t.
Market Share in the Geographic Market	Ratio of a plant's value of production in a four-digit industry in a geographic market to the total production in the four-digit industry in the geographic market
Relative Productivity	Ratio of a plant's labor productivity, measured as value of shipments per employee, to the average plant-level productivity in the industry-geographic market.
Secondary Product Dummy	Indicator variable that takes the value 1 if the product represents less than 50% of the total value of shipments of the plant.
Plant Age	For plants that enter after 1963, they are grouped into four age categories: 0-5 years old, 6-10 years old, 11-15 years old, and 16 or more years old. we include dummy variables for the latter three categories. For plants in existence in 1963, we cannot measure their age and instead include a separate set of year dummy variables for plants in this cohort. The omitted time dummy for the 1963 cohort is 1967.
Firm Size	Log of a firm's total employment in the manufacturing sector in census year t.
Number of Geographies	A count of the number of different geographic markets in which the firm has a plant producing the product in.
Nearby Plant-1	An indicator variable that is set to 1 if a firm has another plant in the industry within 100 miles of the plant.
Nearby Plant-2	An indicator variable that is set to 1 if a firm does not have another plant in the industry within 100 miles of the plant but does have another plant in the industry between 100 miles and 250 miles of the plant.
Plant and Firm Experience Dummy Variables	A set of six dummy variables measuring the combination of plant/firm experience at the time of plant entry. See Table 2 for details on the classification scheme.
Initial Market Demand per Plant	We utilize two different measures of market demand depending upon the industry. For the manufacturing industries that service the construction sector (SIC 2951, 3271, 3272 and 3273), construction earnings in the geographic area are used. The source of this data is the Bureau of Economic Analysis. For the food industries (SIC 2026, 2051 and 2086), population in the geographic market is used. For initial demand, we use the log of demand (construction earnings or population) per plant in period t.
Growth in Demand	Change in the log of per plant demand from period t to t+5. The number of plants is measured in period t.
Initial Wage and Change in Wages	This measures the average hourly wage paid over all plants operating in the two-digit sector and geographic market measured in logs. We include both the initial level and changes.
Electricity Price and Change in Electricity Price	The average price per kilowatt-hour of electricity purchased by plants operating in the two-digit sector and geographic market measured in logs. We include both the initial level and changes.

Materials Price	The average price per given unit of raw material purchased by plants operating in the industry and geographic market. The raw material differs for each of the industries we study and is the most important raw material in terms of total expenditure by plants in the industry. We include only the levels because we are unable to construct the prices in 1997 because of changes in the material definitions collected by the census. Without the 1997 prices we cannot construct input price growth rates from 1992-1997.
BEA Effects	181 dummy variables for the BEA economic areas. Each area is a combination of US counties.
Time Effects	A time dummy for each census year is included in all estimating equations. The omitted time period is 1967.

Table A2. Multinomial Logit Results: Food Industries.

Industry	Exit Mode	Demand		Plant Characteristics				Plant Age			Entry Type		
		Initial Demand	Growth in Demand	Plant Size	Mkt. Share	Rel. Prod.	Sec. Prod.	6-10 Years	11-15 Years	> 16 Years	Exper.	Product Mix	Denovo
2026	Plant Closure	-.547* (.120)	-.666 (.985)	-.844* (.033)	-1.021* (.260)	-.467* (.035)	-.123 (.064)	-.297* (.114)	-.606* (.159)	-.545* (.170)	.191 (.147)	.245 (.141)	.153 (.120)
2026	Product Mix	-.549* (.210)	1.071 (1.821)	-.537* (.051)	-1.601* (.599)	-.219* (.057)	2.478* (.106)	-.411* (.153)	-.941* (.237)	-.721* (.250)	.306 (.241)	.793* (.200)	.331 (.200)
2051	Plant Closure	-.232 (.132)	-2.016* (.993)	-.867* (.038)	-1.036* (.248)	-.403* (.044)	.320* (.105)	-.506* (.107)	-.779* (.148)	-.510* (.150)	-.200 (.161)	.220 (.176)	.103 (.128)
2051	Product Mix	-.664* (.304)	-1.744 (2.478)	-.264* (.091)	.369 (.584)	-.073 (.104)	1.834* (.153)	-.325 (.204)	-. 873* (.310)	-.514 (.298)	.207 (.363)	.754* (.341)	.669* (.301)
2086	Plant Closure	-.375* (.118)	-.544 (.777)	-.885 (.034)	-.125 (.215)	-.550* (.037)	.674* (.058)	-.200* (.088)	-.349* (.116)	-.293* (.126)	.307* (.121)	.040 (.111)	.446* (.101)
2086	Product Mix	-.555* (.198)	-3.289* (1.323)	-.347* (.054)	-1.715* (.554)	-.185* (.061)	2.974* (.106)	-.616* (.124)	-.967* (.180)	-.835* (.198)	.506* (.206)	.818* (.151)	.625* (.176)

*Significant at the 5% level.

Table A3. Multinomial Logit Results: Construction Industries.

Industry	Exit Mode	Demand		Plant Characteristics				Plant Age			Entry Type		
		Initial Demand	Growth in Demand	Plant Size	Mkt. Share	Rel. Prod.	Sec. Prod.	6-10 Years	11-15 Years	> 16 Years	Exper.	Product Mix	Denovo
2951	Plant Closure	-.552* (.142)	-.499* (.175)	-.418* (.045)	-1.017* (.374)	-.525* (.052)	.150 (.130)	-.532* (.103)	-.330* (.127)	-.272* (.136)	-.076 (.209)	-.004 (.230)	.042 (.202)
2951	Product Mix	-.278 (.271)	-.376 (.313)	.029 (.080)	-4.094* (.864)	-.329* (.101)	1.837* (.174)	-.143 (.178)	-.734* (.282)	-.849* (.344)	.239 (.394)	1.285* (.387)	.010 (.385)
3271	Plant Closure	-.527* (.116)	-.517* (.137)	-.821* (.053)	-1.183* (.334)	-.677* (.061)	.074 (.074)	-.438* (.107)	-.800* (.144)	-.540* (.147)	-.248 (.193)	-.082 (.177)	.009 (.158)
3271	Product Mix	-.438* (.152)	-.646* (.178)	-.468* (.069)	-2.285* (.442)	-.460* (.081)	2.307* (.101)	-.807* (.134)	-.978* (.184)	-.898* (.199)	.548* (.247)	1.163* (.218)	.400 (.216)
3272	Plant Closure	-.407* (.082)	-.437* (.093)	-.792* (.031)	-.082 (.277)	-.385* (.038)	.298* (.058)	-.521* (.066)	-.645* (.087)	-.654* (.095)	.530* (.125)	.594* (.119)	.603* (.107)
3272	Product Mix	-.405* (.121)	-.370* (.133)	-.435* (.047)	-1.628* (.486)	.177* (.057)	2.513* (.075)	-.743* (.089)	-1.067* (.136)	-1.116* (.168)	.637* (.188)	1.278* (.160)	.753* (.159)
3273	Plant Closure	-.368* (.067)	-.609* (.072)	-.548* (.023)	.314 (.408)	-.451* (.030)	.016 (.065)	-.500* (.051)	-.477* (.064)	-.502* (.072)	.203* (.093)	.269* (.112)	.413* (.083)
3273	Product Mix	-.052 (.167)	-.237 (.172)	-.132* (.061)	-1.146 (1.020)	-.417* (.074)	1.772* (.094)	-.620* (.118)	-.660* (.158)	-.508* (.150)	.616* (.248)	1.814* (.225)	.941* (.209)

*Significant at the 5% level.