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SPECIFIC KNOWLEDGE AND DISECONOMIES OF SCOPE IN DIVERSIFIED FIRMS

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Abstract

This paper studies how diseconomies of scope arise from the knowledge characteristics of industries in which firms operate. When an industry is characterized by specific knowledge ? voluminous, fast-changing, and embedded in a local context ? we predict that the corporate costs of managing will rise sharply. We test this prediction at the industry and firm-level among U.S. manufacturing firms. We use geographic concentration of an industry to proxy for location-specific knowledge, since clusters of agglomerated firms have been found to have high levels locally-embedded practices, knowledge, and human capital. In analysis of industry-level data, we find that the distribution of industries in firms is consistent with this prediction: diversified firms are less likely to operate in industries that are more geographically concentrated. We also explore the behavior of diversified firms when geographic concentration rises in an industry. We find that firms are more likely to exit an industry after an increase in geographic concentration, either in their primary or secondary industry. The results suggest that specific knowledge shapes the boundaries of the firm independent of transaction risks. The findings also suggest that the monitoring role of the corporate office cannot be neatly separated from its entrepreneurial functions as has been proposed by strategy scholars.

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ABSTRACT

This paper studies how diseconomies of scope arise from the knowledge characteristics of industries in which firms operate. When an industry is characterized by specific knowledge — voluminous, fast-changing, and embedded in a local context – we predict that the corporate costs of managing will rise sharply. We test this prediction at the industry and firm-level among U.S. manufacturing firms. We use geographic concentration of an industry to proxy for location-specific knowledge, since clusters of agglomerated firms have been found to have high levels locally-embedded practices, knowledge, and human capital. In analysis of industry-level data, we find that the distribution of industries in firms is consistent with this prediction: diversified firms are less likely to operate in industries that are more geographically concentrated. We also explore the behavior of diversified firms when geographic concentration rises in an industry. We find that firms are more likely to exit an industry after an increase in geographic concentration, either in their primary or secondary industry. The results suggest that specific knowledge shapes the boundaries of the firm independent of transaction risks. The findings also suggest that the monitoring role of the corporate office cannot be neatly separated from its entrepreneurial functions as has been proposed by strategy scholars.

Keywords: diseconomies of scope, specific knowledge, corporate headquarters, managing the diversified firm

INTRODUCTION

Conflicts between distributed activities shape many organizational choices. Prominently in the area of corporate strategy, innovative companies developed the multidivisional form as they struggled to reduce the functional conflicts that arose as they entered new markets and became more diversified. These conflicts represent diseconomies of scope — misfits and coordination costs that rise as a firm's activities become more diverse and complex. In general, diseconomies of scope are a fundamental assumption in most studies of complex organizations, but research in strategy has focused on the management advantages that overcome these costs — related diversification, shared resources, a dominant logic — rather than examining what drives the diseconomies themselves.

So while we understand that management practices and strategic resources help firms compensate for the conflicts inherent in diversity, we know much less about how a firm's productive knowledge can directly influence these diseconomies. Studying how lines of business differ in their joint costs of coordination can enrich our theory of the firm as well as our understanding of productive knowledge. The role of knowledge in the boundaries of the firm has generated significant debate in the literature. While a number of theorists put knowledge development and transfer at the heart of a theory of the firm (Grant, 1996; Kogut & Zander, 1993), arguments based on efficiency in knowledge sharing have ultimately been inseparable from the transaction cost account of boundaries of the firm (Argyres, Felin, Foss, & Zenger, 2012). In this study, we turn this question on its head and explore instead how the boundary of diversified firms can be shaped by the rising cost of managing knowledge as conflicts arise between market settings.

We propose that industries characterized by more location-specific knowledge (Williams, 2007), that is, by sticky knowledge (G Szulanski, 1996) embedded in local geographic areas, will be combined less often in a single firm. The crux of our argument is that effective corporate

monitoring and management will be more difficult when market activities depend on location-specific knowledge. Misfits and ineffective coordination will rise when corporate units attempt to manage pairs of industries characterized by context-speecific knowledge. In other words, diseconomies of scope between pairs of industries will rise with specific knowledge. As a result, we expect to see firms avoid markets characterized by location-specific knowledge.

In data on U.S. manufacturing firms, we use geographic concentration as a proxy for location-specific knowledge, since concentrated, or agglomerated, industries are widely considered to depend on location-specific knowledge and activities. We study how diversified firms approach industries with more geographic concentration of activity, and the effects of geographic concentration both at the industry and firm-level among U.S. manufacturing firms. We find that diseconomies arising from location-specific knowledge – geographic concentration – help explain the distribution of markets among diversified firms at the industry level, as well as the exit of firms from industries with rising geographic concentration.

This approach to scope helps advance our understanding of productive knowledge and the boundaries of firms. By exploring diseconomies of scope arising from specific knowledge we begin to understand how firm boundaries are shaped by knowledge conflicts independent of transaction risks. Importantly for corporate strategy, the study raises new questions about the role of the corporate headquarters, since it suggests that the financial monitoring, or "loss-prevention", role of the corporate unit is linked to the entrepreneurial responsibilities of the unit — two areas that have traditionally been treated as separable activities for diversified firms (Foss, 1997).

THEORY

What does theory tell us about when and why conflicts arise from managing diverse activities in the firm? One of the earliest contributions to our understanding of this phenomenon was Alfred Chandler's history of diversification and divisionalization — *Strategy and Structure*

(1962). Chandler details the emergence of business divisions as a solution to functional conflicts as firms launched new products. As an early pioneer of diversification, Dupont found that its new products were underperforming industry competitors because functional commitments for core gunpowder markets were holding back sales and marketing in new lines of business, such as paint. After several organizational experiments, Dupont moved to decentralized product divisions with functions duplicated and managed within the division in order to enable appropriate adaptation of functional activities within each product market.

The multidivisional form has dominated our understanding of diseconomies of scope since Chandler's seminal work. The field of strategy assumes that any conflict between markets can be resolved through organizational structure: specifically, the multidivisional form. If a conflict exists between two markets, then it can be handled by duplicating functional activities and moving them into separate decentralized divisions. This argument is reprised for modern firms in a recent case study of the Columbian airline, LAN, which manages synergy and conflict between different business models by identifying areas where shared resources increase synergies while isolating areas where activities would conflict (Casadesus-Masanell and Tarzijan 2012).

Recent research, however, has begun to explore the edges of our understanding of diseconomies of scope. A study of manufacturing firms found diseconomies of scope between markets actually rose with common inputs to production (Zhou, 2011). Common inputs require that firms employ the resources jointly, and joint use leads to conflicting demands for coordination and adaptation. As a result, the study finds that firms are less likely to enter markets with shared inputs when existing lines of business are complex. A different study of taxi and limousine fleets (Rawley & Simcoe, 2010) suggests that incentive conflicts also rise when a firm enters a related market. When firms in the study faced potential resentment by taxi drivers over higher pay for limousine drivers, they were more likely to outsource taxi provision to drivers who owned the taxi.

Several studies have also found evidence suggesting that diversified firms are less closely adapted to individual markets. A study of fishing boats (Natividad, 2012) found evidence that joint routines for diversified firms are less efficient than specialized routines. When Peruvian boats that fished both mackerel and anchovy were barred from mackerel fisheries they became significantly less efficient in anchovy fishing. Similarly, a study of firms in US cellular communication services (Chen, Williams, & Agarwal, 2012) found that diversifying entrants to the market grow more slowly than similar specialized firms — they only exhibit advantages over focused firms when further change is required.

In sum, recent research on scope in firms suggests that misfits and maladaptations rise with complex and diverse activities in firms. In depth examination of diseconomies uncovers some surprising patterns: shared inputs can increase diseconomies rather than economies of scope; and, specific pairs of markets may lead to unique conflicts and a rise in outsourcing.

The M-form and Corporate Monitoring

Evidence of diseconomies of scope is important because it suggests limits to the separation between activities that firms can achieve through organizational practices. In the multidivisional (M-form) organization, division structure is designed to duplicate activities that conflict and monitor the performance of the units that carry them out. While separation of activities is one fundamental means of reducing conflict and misfit in the modern corporation, monitoring of activities is an essential and complementary practice for accomplishing this.

Theorists of the corporate office have variously called this role the "Administrative Function" (Chandler, 1991), "Loss Prevention" (Foss, 1997) and "Financial Parenting" (Goold & Campbell, 1987). The emphasis, however, is that these functions are cleanly separate from more entrepreneurial activities involved in supporting new business development or enabling joint value creation between lines of business. The general implication is that monitoring does not require deep understanding of lines of business in order to carry out effective loss

prevention. At the extreme, monitoring of financial (accounting) data generated by a division is considered the default corporate approach in conglomerate firms where lines of business have no meaningful relationship between them. In general, monitoring is treated as a quantitative exercise that can effectively be done at a distance.

There are limits, however, to the effectiveness of monitoring decentralized activities. To think about why, we need to examine what is involved in corporate parenting through financial monitoring. There are two key steps necessary for effective loss prevention through monitoring. The first is detecting a problem in time to address it without major losses and the second is to intervene appropriately once the problem has been detected. Both of these become substantially more difficult as the information gathered becomes more extensive and complex.

To detect a problem in a timely fashion, the corporate unit must understand industry dynamics. First of all, in fast-moving industries, accounting assessment will often arrive too late for the corporate parents to avert serious consequences and losses. Problems are often masked during an initial period by transferring resources from industry leadership to extraction through underinvestment. Observe the nature of collapse of recent mobile telephone companies Motorola, RIM, Nokia. The accounting profits remained for an extended period while industry observers warned of deepening competitive problems at the firm. Accounting profits can be maintained with existing customers while avoiding the competitive investments that would keep the firm at the front of the industry. Thus, accounting data often comes too late in industries that are marked by intense interactions and fast-paced change.

Even more than problem detection, appropriate intervention is really an extension of the business unit capabilities of the firm that relies on tacit, detailed understanding of the business setting. It is relatively clear that changing specific strategic decisions at a business unit requires deep understanding of the business, but even the more sweeping choice of replacing a top executive requires some assessment of the nature of the problem and the sorts of capabilities that the replacement should bring to address the situation. How is the customer mix of the firm

shifting? What are the appropriate features to offer in a product or service? Which emerging segment of customers will shape the future of the market? These are questions that must be answered for a corporate parent to intervene in a business unit. Rich understanding and complementary capabilities can be particularly hard to develop in the corporate office when knowledge related to the business is location specific.

Sticky Knowledge and Geographic Concentration

Knowledge is considered sticky when it is more difficult and costly to transfer to a new location. This arises when knowledge depends on local context (Williams, 2007). While it is widely accepted that knowledge is quite difficult to transfer between separate organizations (Grant, 1996; Kogut & Zander, 1993; Rivkin, 2001), scholars have also explored the internal challenges of knowledge transfer. Research has found that knowledge is especially difficult to transfer when cause effect relationships are difficult to understand and when the recipient lacks the ability to value, assimilate, and apply the new knowledge successfully (Szulanski, 2002). In particular, the information necessary for productive knowledge is difficult to transfer — or sticky — when it is tacit, or when the information is very extensive, and it is difficult to predict which subset of the information will be relevant for problem solving. This information stickiness helps explain the partitioning of innovative activities between actors and between locations in the organization (Tyre & Von Hippel, 1997; von Hippel, 1994, 1998).

Work on innovation suggests that, within organizations, knowledge becomes sticky when the information it relies on is voluminous, that is, so extensive that it is nearly impossible to transfer all of it to different locations in the firm. Of course, information flow in organizations is frequently huge, but firms manage by transferring only a few key parts of it that are needed in other locations or levels of the organization. As Stinchcombe says, "In analyzing an information processing system, then, one wants to know the four numbers that the best administrators of departments or projects have calculated for them, rather than what all is included in the twenty-page biweekly output that is stacked in a closet" (Stinchcombe, 1990, p. 10). But this synthesis

requires skills and tacit understanding, which tend to arise in a specialized domain with frequent interaction. They are more difficult to develop through distant and less frequent interaction.

These characteristics of sticky knowledge and information — voluminous, tacit, dependent on local environment — coincide closely with the reasons that have been found to drive geographic co-location in an industry. As Marshall put it in his groundbreaking observation, firms locate in specialized clusters because they and their workers benefit from "something in the air" (Marshall, 1920). Geographic clusters of industrially related firms are well known for the information and knowledge "spillovers" they generate between firms. The flow of information through informal contacts and the movement of people accelerates learning and innovation (Saxenian, 1996). The flow of information leads firms seeking knowledge to locate close to other firms that generate knowledge (Alcácer & Chung, 2007; Alcácer & Zhao, 2012) and can even lead firms with valuable knowledge to avoid the center of agglomeration (Myles Shaver & Flyer, 2000). Scholars have gone so far as to attribute general industrial success to the emergence of industrial clusters marked by advanced consumers, specialized suppliers, and advanced human capital in the experienced work force (Porter, 1993).

The flow of information between firms that makes it important (or sometimes risky) for firms to co—locate in an industry also makes it more difficult to transfer that information to other parts of the organization. Thus the information "in the air" of a cluster represents a mix of basic know—how for production, as well as deep understanding of the competitive trajectory of products and industry players. In such a setting, knowledge (prior understanding) and information are both required for a recipient of the information to make use of the information. In addition, since the information is changing through frequent interactions in the network, it is evolving quickly and can lose value very quickly. When firms, their suppliers, their customers, and their employees interact frequently, their understanding, emphasis, and focus evolves through these interactions. In geographically concentrated industries, then, the context necessary

for understanding evolving strategic ideas changes more quickly than in other industries. This can make corporate monitoring very difficult indeed.

Thus, we arrive at the central argument of this paper. When productive knowledge of a business is more situated, embedded in a local context, the cost of corporate parenting for diversified firms will rise due to diseconomies of scope.

Proposition: Diseconomies of scope rise when an industry is relies on more location-specific knowledge.

If more concentrated industries are more difficult to manage jointly with other lines of business, these diseconomies will be apparent in the frequency distribution of industries in diversified firms. When an industry is more geographically concentrated, the cost of managing that line of business together with another industry will rise. Thus we should see fewer diversified firms combining that industry with others.

Conveniently, strategy scholars David Bryce and Sidney Winter (2009) have developed a relatedness measure for industries that is based on the frequency with which diversified firms are active in two industries. Based on US census data, two industries are rated as more closely related when most firms active in one industry are not active in the other. Conversely, two industries are rated as less related when most firms active in one industry are not active in the other. This leads to the following hypothesis at the industry level.

Hypothesis 1: When industries have higher levels of (separate) geographic concentration they have lower levels of Bryce-Winter relatedness.

This hypothesis suggests that geographic concentration will shape the boundaries of the firm at the level of industry patterns. This is important because it can capture effects that might not be evident if we only look at firm-level choices. If diversified firms are avoiding industries that are difficult to monitor and manage because of location specific information we may not see diversified firms in these industries often enough to detect the pattern. That is, selection effects might lead us to miss or underestimate the size of this effect on firms.

On the other hand, because the hypothesized mechanism operates within firms and below the level of the industry, alternative might account for the predicted pattern of diversification. We would like to see that firms actually react to the challenges of sticky information by changing their behavior. If increasing stickiness of knowledge makes knowledge conflicts and monitoring costs higher for firms, then we predict diversified firms will be more likely to exit an industry after an increase in geographic concentration. This leads to our second hypothesis.

Hypothesis 2: When industry geographic concetration rises, diversified firms will be more likely to exit from the industry.

In summary, we propose that location-specific knowledge – knowledge that is rich, fast-changing, and embedded in specific geographic contexts – will increase the diseconomies of scope between pairs of industries. This stickiness is likely to be higher in industries that are more geographically concentrated because they produce and rely on information that is voluminous, specialized, and embedded in local relationships. This proposition leads us to expect lower levels of "induced" relatedness between industries when they are more geographically concentrated. In addition, we predict that diversified firms will be more likely to exit an industry when it becomes more concentrated.

EMPIRICAL CONTEXT AND METHODOLOGY

Diseconomies of scope are a characteristic of a pair of markets. When the cost of managing activities in two markets is higher then diseconomies are higher. As a result, our empirical analysis is built around market pairs as our fundamental unit of analyis. We study pairs of industries in the context of U.S. manufacturing industries defined by 4-digit SIC codes.

We explore whether the data is consistent with our proposition in two ways. First we study how the extent of geographic concentration of a pair of industries is associated with the degree of relatedness measure for pairs of manufacturing industries based on the census of actual

U.S. firms involved in both industries in 1987. For this study, we use data from the Bryce-Winter Relatedness Index that draws from the Longitudinal Research Database (LRD) at the Center of Economic Studies (CES) at the U.S. Census Bureau (Bryce & Winter, 2009). We also use data from the Bureau of Economic Analysis of the U.S. Census Bureau to obtain and construct our measures on agglomeration and coagglomeration.

Then, we move to the firm level to examine whether firm behavior is consistent with our proposition. We study exit from industries among diversified firms in US manufacturing sectors from 1986 to 1997 to test whether firms react to increases in agglomeration and reductions in coagglomeration by exiting secondary markets. We use data from the same sources as mentioned above, plus we draw from the Compustat Historical Segment database to obtain firm-level information. We obtained firms' primary industry from the 4-digit SIC listed in the Compustat database, from which we also obtain the firm-level financials.

Industry Level Analysis

The sample for industry analysis was constructed from pairs of US manufacturing industries in 1987. It includes four-digit pairs of SIC codes from the 2000 and 3000 of the U.S. Standard Industry Classification system. Since the outcome variable is a percentile ranking, we use a logistic pseudo-likelihood model for the regression analysis (Papke and Wooldridge 1996). Definitions, descriptive statistics, and correlations for the variables are presented in Tables 1, 2, and 3.

******* Tables 1, 2, & 3 About Here*******

Outcome Variable: We measure industry relatedness using the *Bryce-Winter Relatedness Index (BWRI)* for the manufacturing industries for the year 1987. This measure was created to capture the relatedness between two industries using census data for how commonly two industries appear together in a single firm (Bryce & Winter, 2009). It is an index based on the methodology of an earlier study of corporate coherence (Teece, Rumelt, Dosi, & Winter, 1994).

The measure is a percentile ranking of the distance between two manufacturing industries based on the relative incidence of those two industries occurring together in U.S. census data. That is, a pair of industries has a high value of relatedness if they very regularly are found together in the same firm. For instance, the production of refrigerators and freezers (SIC 3633) and household laundry equipment (SIC 3632) are among the pairs of industries that are most commonly found together in diversified firms. Similarly, meat packing (SIC 2011) and sausage production (SIC 2013) are frequently paired. On the other hand, porcelain electrical supplies (SIC 3264) and logging (SIC 2411) or schiffli machine embroideries(SIC 2397) and macaroni and spaghetti (SIC 2098), are among the businesses least likely to be combined in a single firm. The values of the index range from 0 to 1 in .01 increments.

Explanatory Variables: *Geographic concetration* is measured with a modified version of Ellison & Glaeser's agglomeration index for industries (Ellison, Glaeser, & Kerr, 2010; Ellison & Glaeser, 1999). Concentration is measured as the value:

$\gamma_i \equiv \frac{\sum_{m=1}^{M}(s_{mi}-x_m)^2}{1-\sum_m x_m^2}$, in which s_{mi} is the share of industry *i*'s employment in each geographic area, and x_m is a measure of area's share of population. This measure takes the relative geographic concentration of industry i in county m, compared to the county's relative share of the population. Compared to Ellison and Glaeser's original agglomeration measure, this measure does not include a standardization for the competitive concentration (Herfindahl index) of each industry. We include this measure for each industry in the pair, *Geographic Concentration of SIC1* and *Geographic Concentration of SIC2*.

Control Variables: We use several controls in our analysis. We include *Colocation, SIC1 & SIC2*, for the pair of industries, which measures the extent to which the two industries are located in the same counties (similar to the Ellison, Glaeser and Kerr (2010) measure without the standardization for competitive concentration). We control for competitive concentration (domination by a few firms) with the Census Bureau's 1987 Herfindhal-Hirschman Index for the

50 largest companies (*Herfindahl Index for SIC1* & *Herfindahl Index for SIC2*). In addition, we control for the shared human capital of the two industries with *Human Relatedness* (Coff, 2002). We also include trade between the pair of industries from the input output tables of the Bureau of Economic Analysis Benchmark Input-Output Data − Use of Commodities by Industries table (*Sales of SIC2 to SIC1* & *Sales of SIC1 to SIC2*). These measures are intended to account for trade between vertically related industries that could lead to vertical integration within a single firm. We include *Sales (Net) SIC1*and *Sales (Net) SIC2* to capture the effects of industry size. These are calculated by summing the segment sales in a specific industry across all U.S. firms in the Compustat database for 1986 and taking the natural logarithm of this value. Finally, we include 1-year sales growth for each industry (*Sales Growth SIC1* and *Sales Growth SIC2*). These are the percentage change in total sales between 1985 and 1986 based on Compustat data.

Firm Level Analysis

To conduct the firm-level analysis we constructed a panel to extend the industry data to the level of firms. The panel includes U.S. public, diversified firms with their primary SIC classification in a US manufacturing industry between 1986 and 1996. By design, the panel begins in 1987, the year of our cross-sectional industry analysis, and continues through 1996. The level of analysis is again a pair of markets - an observation is a market pair-firm-year combination, in which a market pair is a firm's primary market and a secondary market, with primary and secondary markets classified based on Compustat assignments. The analysis is designed to test whether a firm is more likely to exit an industry when it or the primary industry become more geographically concentrated.. For the core industry location variables the panel contains 78,855 observations corresponding to 6,793 firms, though the panel size falls to 42,936 observations (5,199 firms) and 17,130 observations (2,264 firms) as more controls are included. The data has the following time structure: the independent variables are from 1 year prior to the

dependent variable. So, for instance, in an observation with an outcome of exit in 1990 the industry growth will be measured between 1988 and 1989.

The regression specifies the likelihood of exit using a panel complementary loglog estimator with random effects to account for unobserved heterogeneity and additional fixed effects for each year of the panel. Definitions of the variables, descriptive statistics, and correlations are presented in Tables 4 and 5.

******* Tables 4 & 5 About Here *******

Outcome Variable: We measure *exit* from the secondary market in an observation with a variable coded 1 if the company stopped reporting operations in a secondary SIC code (4 digit) in which it was active the year before (Compustat data).

Explanatory Variables: For the firm-level analysis we want to understand if diversified firms are reacting to *changes* in concentration rather than levels, which were our focus in the industry cross-section. Our primary variables of interest, then, are changes in geographic concentration for the secondary and primary industries of a given market-firm-year observation. These change variables are based on the geographic concentration measures that were described in the data for the industry analysis. For the firm panel we calculated geographic concentration for the primary industry (*Geographic Concentration – Primary Industry*) and for the secondary industry (*Geographic Concentration – Secondary Industry*) for every year 1985-1996, both of which are included in the regression. The change variables − *Change in Concentration, Primary Industry* and *Change in Concentration, Secondary Industry* − were calculated as the difference between the concentration level at t-1 and concentration level at t-2 (for an observation of exit or no exit at time t).

Control Variables: The analysis also includes a panel version of the Colocation variable (*Colocation*), as well as a measure of year to year change in Colocation (*Change in Colocation*). There are variables for the logarithm of industry sales for the primary and secondary industries (Primary Industry Sales, logged & Secondary Industry Sales, logged), which are calculated by summing sales in each 4-digit SIC industry across all firms in Compustat for that year. The

growth rates for both industries are included, *Primary Industry Sales Growth* and *Secondary Industry Sales Growth*. *Primary Industry Ad Intensity* and *Secondary Industry Ad Intensity* are averages of the ratio of advertising expenditures/sales for all Compustat firms active in this industry. Similarly, *Primary Industry R&D Intensity* and *Secondary Industry R&D Intensity* are averages of R&D expenditures over sales for all firms in the industry in that year. *Financial Slack* is drawn from the firm's balance sheet, measuring the firm's cash and cash equivalents divided by the firm's current liabilities. *Firm ROA* is the return on assets for the firm one year earlier. *Prior Market Entries* is a count of markets entered by the firm in the prior period. *Assets* is the dollar value of the firm's Total Assets in Compustat. *Herfindahl Index* is the Herfindhal index for each industry estimated using market share data for each industry based on Compustat data for each year of the panel (Hou & Robinson, 2006). Finally, *Input* and *Output* are the value of sales between the industries from the BEA's Benchmark Industry data. These values are reported every five years by BEA, so the panel uses 1987 data for 1987-1991 and 1992 data for 1992-1995.

RESULTS

Table 6 shows the analysis of industry-level patterns of industry distance using the Bryce Winter Relatedness Index. Table 7 shows the analysis of firm-level patterns of exit. We discuss each in turn.

Industry Analysis

The models in Table 6 differ only in the variables that are included in the analysis and the sample size, which falls sharply in the final models because industry sales data are only computable for a subset of the 4-digit manufacturing industries.

******* Table 6 About Here *******

In the analysis, the variables for industry geographic concentration are each associated with significantly lower values of BWRI. The pattern is uniform across all models of the analysis:

both are negative and signicant. The parameters of these variables are larger than all other parameters in the model, though real economic effects have not yet been calculated. It is reasonable to conclude, however, that the concentration of an industry is associated with lower frequency of that industry combined with other industries in a single, diversified firm. This is consistent with hypothesis 1, suggesting that the information and knowledge characteristics of industries do in fact influence the diseconomies of scope in a firm.

Two control variables have substantial positive effects on BWRI. The colocation of the two industries is positively associated with the relatedness of the two industries. That is, industries that share a greater proportion of their county-level location have higher levels of combination in diversified firms. In addition, a measure of human capital relatedness between the two industries is positively associated with the values of BWRI. Together, these suggest that firms tend to combine industries when they are colocated and share human capital.

Industry growth paints a somewhat contradictory pattern. The growth of SIC1 has a modest negative association with BWRI, while the growth of SIC2 has a modest positive association. This pattern could arise if the two measures were highly correlated and one was picking up a residual effect not accounted for by the primary axis of varation, but this does not appear to be the case here since the two measures have a very low correlation of -0.007. The size of the industries have small but similarly opposing effects. *Sales (Net) of SIC1* has a small positive impact on BWRI, while *Sales (Net) of SIC2* has a small negative impact. Since sales and growth are positive on average across all industries, it is possible that these small opposite effects cancel out and leave no meaningful difference between the two industries in most of the sample. This possibility needs to be explored by studying the net real effect of the two parameters in the sample. Given the symmetric nature of the two industries in the construction of the BWRI measure, the opposing effects of the two remains a puzzle at least until these real effects are examined.

Finally, in most specifications of the model, the *Herfindahl Index* of the two industries has a small negative impact on BWRI. This suggests that diversified firms are somewhat less likely to combine two markets that are more oligopolistic, which is consistent with the literature on oligopolistic competition and barriers to entry.

To verify the robustness of the results we analyzed the industry data with a variety of alternative specifications. Both tobit maximum likelihood regression and ordinary least squares (OLS) regression returned identical patterns of comparative size and significance of the estimated paramenters. In addition, we used an alternative normalized version of the BWRI index, which varies from -7 to 3.5, and again OLS regression produced identical results in terms of relative size and significance of the parameters of interest.

Firm Analysis

The models in Table 7 present the effect on likelihood of exit of (1) the core explanatory variables for industry concentration and colocation; (2) a first set of control variables for industry and firm characteristics; and (3) a further set of industry controls. The variables differ in their availability for observations, so the panel size falls from 78,855 in model 1 to 42,936 in model 2 and, finally, 17,130 observations in model 3.

******* Table 7 About Here *******

In Table 7, the two primary variables of interest are *Change in Concentration – Primary Industry* and *Change in Concentration – Secondary Industry*. In all three models, these have a positive and significant impact on exit. Firms are significantly more likely to exit a secondary industry after the geographic concentration increases in that industry. This pattern is consistent with the idea that rising information stickiness makes it more difficult for diversified firms to operate in a market. Interestingly, there is also a cross-industry effect between the firm's primary industry and the secondary market – if concentration increases in the primary industry firms are also more likely to exit the secondary industry. This suggests that the demands of information stickiness in

a primary market also increases the diseconomies between businesses. In sum, at the firm-level the pattern of exit from industries is consistent with the argument that knowledge stickiness increases diseconomies of scope.

The analysis also includes the levels of geographic concentration in each industry. While change in concentration increases the likelihood of entry, the baseline level of concentration has the opposite effect. Firms are less likely to exit a secondary market when that market is more geographically concentrated, as well as when their primary industry is more concentrated. This might arise if firms build more valuable resources through the interactions in local clusters, leading them to remain in the industry longer.

The colocation of the two industries, has the opposite effect of concentration in all three models. The more two industries are colocated, the more likely a firm is to exit from the secondary industry. On the other hand, rising levels of colocation are associated with lower likelihood of exit. This pattern is a bit more of a puzzle since colocation ought to offer coordination economies that reduce the costs of joint operation of the two businesses. These coordination economies are likely to rest on the ease of communication and coordination between the two lines of business, but may not represent more profound synergies based on valuable competitive resources. If this were the case, colocation would be associated with exit because it is likely to have led to inefficient integration in the past.

Not surprisingly, the number of segments in which a firm competes is strongly associated with exit from markets in both model 2 and model 3. In model 3, the sample size falls dramatically because the Herfindahl Index and Input/Output data are available for fewer industries in the panel. In this reduced sample, a number of control variables lose their significance. Among the other controls, advertising intensity in the primary industry significantly reduces exit in model 2, though not in model 3. Similarly, R&D intensity in the primary industry is associated with higher levels of exit in model 2 but not model 3. Size of the primary and

secondary industries is negatively associated with exit in model 2, but not model 3. In fact, in model 3 the size of the primary industry has a small positive effect on exit.

One possibility is that these variables lose their significance because the new variables account for their effect in model 3. In model 3, the variables for trade between the two industries (*Input* and *Output*) have a significant impact on exit, but the size of the effects are tiny and in opposite directions. In addition, the variables for the Herfindahl concentration index in the primary and secondary industries have no effect on exit. Thus it seems unlikely that the new variables in model 3 have absorbed the effect of the other variables. It is more likely the effects change because the reduced sample is no longer representatitive of the population.

A final set of year categorical variables is included to represent different baseline rates of exit in each year of the panel. These are mostly not significant in the analysis, though some years later in the period have a small but significant positive intercept.

The specification of the regression as a complementary loglog function has some advantages, including that it may be interpreted as a proportional hazard model (similar to the class of Cox semi-parametric hazard models) that allows for unobserved heterogeneity among the multiple observations for a firm. In robustness analysis, we also specify the outcome with a conditional panel logit estimator with fixed effects. The results are identical for the primary variables of interest and largely the same for controls. In addition, we analyze the data with a "piecewise" exponential hazard function that allows shared frailty among the common observations for a firm and varying intercepts for each year of the panel. We find the results are largely the same.

CONCLUSION

In examining the market choices of U.S. manufacturing firms, we find evidence consistent with our core proposition: diseconomies of scope are higher when industries are more geographically concentrated. At the industry level, we find firms operate less often in pairs of

industries when those industries are highly concentrated. At the firm level, we find that firms are more likely to exit a secondary industry after it becomes more concentrated, as well as after the firm's primary industry becomes more concentrated.

Since the stickiness of productive knowledge rises as it is embedded in local clusters of specialized activity, firms find it more difficult to monitor and intervene appropriately in businesses as knowledge becomes more location specific. Corporate units find it more difficult to detect problems in a timely fashion as their monitoring is reduced to low bandwidth financial monitoring. Once problems are detected, the difficulty shifts to appropriate intervention. Inappropriate or heavy-handed reactions risk weakening the relationships between the corporate center and its businesses. On the other hand, inaction or weak responses can discourage initiative and problem solving across the firm.

For diversified firms location specific, or sticky, knowledge raises the cost of operating in a business because it increases misfit, conflict, and misappropriation of effort. As a result, we see that diversified firms reduce their involvement in businesses that are characterized by location-specific knowledge. The limits of financial monitoring for businesses with substantial specific knowledge are highlighted by the sequential, and rapid, collapse of a number of firms in mobile technology markets. Motorola, Nokia, and RIM soldiered on with reasonable profits but increasing alarms sounded by industry analysts. It was not impossible to detect problems, but they were not immediately apparent in the balance sheets of these firms. Once the problems were widely agreed upon appropriate responses have been even more difficult to define.

This study focuses on the contribution of geographic concentration to specific knowledge, but the aim of the study is to illustrate the diseconomies that can arise from specific knowledge rather than exhaustively measure all sources of specific knowledge. Knowledge becomes more specific as it becomes more embedded in a local context, of course, but it can also arise from specialized cultures or knowledge bases. For instance, pharmaceutical firms have struggled with the rise of biotechnology in part because it has been challenging for them to

absorb and react to the extensive differences in knowledge bases and cultures among biologists and chemists, who formed the traditional heart of pharmaceutical research and development. Similarly, established telecom companies struggled with the rise of the internet and the high tech startup cultures that emerged around data networking despite the close technological ties to their established businesses.

Whatever the source of specific knowledge, this study suggests that the boundaries of firms are shaped by the nature of their productive knowledge in addition to the extent of the joint (specific) investments that must be made between the two businesses. This can help us understand why so many relationships entailing specific investments are actually managed through quasi market relationships and relational contracts rather than full integration in a single firm (Oxley & Sampson, 2004; Shelanski & Klein, 1995). The costs of joint coordination can rise sharply in the presence of diseconomies from sticky knowledge.

In addition, the study highlights that we have much more to learn about the role of the corporate unit in diversified firms. Decades of theory and research have treated the entrepreneurial and monitoring roles of the corporate office as separable activities. But the nature of diseconomies of scope between different lines of business suggests that activities across different markets cannot be completely isolated. The corporate office must make substantial investments to tailor monitoring and management activities in markets with specific knowledge, and thus diseconomies arising from specific knowledge in separate markets spill over through the corporate office. Even in relatively decentralized firms, the monitoring role of the corporate unit is better understood as an extension of the firm's productive capabilities rather than a separate, and separable, activity.

Studies of firm location have tended to focus on the attempts of firms to manage the benefits and costs of knowledge flow between firms. However, this study suggests that the costs and benefits of managing the flow of knowledge from disparate locations within the firm are quite substantial, as well (Lahiri, 2010). A natural extension of this study would be to look at the

physical location of the business units and corporate office in relation to clusters of industry activity to examine the interaction of firm and industry location. It would be enlightening to explore if firms differ in their propensity to enter or exit industries that are concentrated near or far from the corporate office. A first order hypothesis would be that firms are less likely to exit concentrated industries that are close to their corporate office. Our finding that colocation of primary and secondary industries is more associated with exit, however, suggests that the picture might be more complicated.

While this paper was motivated, in part, on contrasting approaches to the theory of the firm in transaction cost economics and knowledge-based approaches, the findings have much in common with more recent work in institutional economics. More current work treats the firm as a nexus of specific investments (Rajan & Zingales, 1998), which must be managed through a network of relational contracts (Baker, Gibbons, & Murphy, 2002). Theory now points out that decentralized coordination both within the firm and in external networks of firms requires the development of relational contracts. Scholars have proposed that these relational contracts form the foundation of organizational capabilities in firms (Gibbons & Henderson, 2012). But as we have examined the relationship between these contracts and the enactment of capabilities in the firm, the emphasis has shifted from the role of transaction risk and incentives. As Gibbons and Henderson point out in a recent article, establishing clarity in expectations between different levels of the organization – between managers and workers, most explicitly – is probably the most difficult aspect of the relational contract (Gibbons & Henderson, 2012).

This study, then, contributes to our understanding of relational contracting for decentralized activities in firms. The relationship between the corporate office and business units is one of the classic forms of decentralized relationship in modern companies, and this study suggests that knowledge in each business will shape the nature – and feasibility – of decentralized relationships in the firm. Thus, while specific knowledge encourages more decentralized activity in the firm to avoid the costs of knowledge transfer, it also makes the conditions for supporting

that decentralization through relational contracts much more difficult. In order to achieve clarity in expectations between upper and lower levels of the firm, both sides must possess some understanding of the nature of the activities of the other party. Since specific knowledge makes it much more difficult to achieve this understanding, it represents an impediment to decentralization as well as a driver. By establishing that diseconomies arise from specific knowledge, then, this study also help us begin to describe and understand the supporting processes that are necessary for effective decentralization in firms.

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Table 1 Industry Analysis Variable List

Variable	Description
BWRI	Bryce Winter Relatedness Index is a percentile ranking of pairs of U.S. manufacturing industries based on frequency of firms active in both industries. 1 indicates the industries most frequently combined in a single firm, while 0 indicates the industries least frequently combined.
Geographic Concentration SIC1	The concentration of economic activity for the first industry (SIC 1) relative to the concentration of population.
Geographic Concentration SIC2	Tthe concentration of economic activity for the second industry (SIC 2) relative to the concentration of population.
Colocation, SIC1 & SIC2	A measure of the co-location of the two industries.
Herfindahl Index for SIC1	Herfindahl measure of sales concentration of the first industry (SIC 1) from US Census Bureau.
Herfindahl Index for SIC2	Herfindahl measure of sales concentration of the second industry (SIC 2) from US Census Bureau.
Human Relatedness	Measure of shared human capital characteristics between two industries.
Sales of SIC2 to SIC1	The value of goods from Industry 2 (SIC 2) that are purchased by Industry 1 (SIC 1) from BEA "Use" table for 1987.
Sales of SIC1 to SIC2	The value of goods from Industry 1 (SIC 1) that are purchased by Industry 2 (SIC 2) from BEA "Use" table for 1987.
Sales (Net) (MM$) Industry 1	Total sales of industry 1 (SIC 1) in 1986
Sales (Net) (MM$) Industry 2	Total sales of industry 2 (SIC 2) in 1986
Sales Growth 1 Year for Industry 1	Growth in sales of industry 1 (SIC 1) from 1985 to 1986
Sales Growth 1 Year for Industry 2	Growth in sales of industry 2 (SIC 2) from 1985 to 1986

Table 2 Industry Analysis Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max
BWRI	0.50	0.29	0.00	1.00
Geographic Concentration SIC1	0.04	0.04	0.01	0.31
Geographic Concentration SIC2	0.05	0.05	0.01	0.31
Colocation, SIC1 & SIC2	0.09	0.10	0.00	1.37
Herfindahl Index for SIC1	685	629	0	2894
Herfindahl Index for SIC2	694	628	0	2894
Human Relatedness	0.39	0.16	0.05	1.00
Sales of SIC2 to SIC1	8.05	110.16	0.00	9124.60
Sales of SIC1 to SIC2	13.52	450.57	0.00	24700.00
Sales (Net) (MM$) Industry 1	8.32	41.64	0.00	582.45
Sales (Net) (MM$) Industry 2	14.23	62.91	0.00	582.45
Sales Growth 1 Year for Industry 1	-0.79	0.25	-0.99	0.63
Sales Growth 1 Year for Industry 2	-0.78	0.23	-0.99	0.63

Table 3, Industry Analysis Correlations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) BWRI	1												
(2) Geographic Concentration SIC1	-0.1510	1											
(3) Geographic Concentration SIC2	-0.0762	0.0040	1										
(4) Colocation of SIC1 & SIC2	-0.0895	0.4561	0.6697	1									
(5) Herfindahl Index for SIC1	-0.1541	0.3058	-0.0002	0.1367	1								
(6) Herfindahl Index for SIC2	-0.0944	-0.0007	0.3229	0.1685	-0.0026	1							
(7) Human Relatedness	0.1759	0.0245	-0.0398	-0.0428	0.0027	0.0218	1						
(8) Sales of SIC2 to SIC1	0.0467	0.0111	-0.0010	-0.0010	0.0060	0.0106	0.0996	1					
(9) Sales of SIC1 to SIC2	0.0266	0.0163	-0.0020	0.0105	-0.0010	0.0080	0.1009	0.3758	1				
(10) Industry Sales SIC1	0.0501	-0.0690	0.0108	-0.0167	-0.0517	0.0038	0.0148	0.0349	0.0068	1			
(11) Industry Sales SIC2	0.0048	0.0009	-0.0246	-0.0092	-0.0012	-0.0415	0.0086	0.0984	-0.0017	-0.0022	1		
(12) Sales Growth SIC1	-0.0266	-0.0667	-0.0019	-0.0306	-0.1207	-0.0051	0.0458	-0.0162	-0.0060	-0.0434	-0.0015	1	
(13) Sales Growth SIC2	0.0656	0.0069	-0.0962	-0.0259	0.0046	-0.0532	0.0640	-0.0007	-0.0058	0.0051	-0.0483	-0.0071	1

Table 4 Firm Analysis Variable List

Variable	Description
Exit	Exit from a 4-digit SIC industry between t-1 and t (Compustat).
Geographic Concentration Primary Industry	The concentration of economic activity for the primary industry relative to the concentration of population.
Change in Concentration, Primary Industry	Change in geographic concentration in the primary industry between t-2 and t-1.
Geographic Concentration Secondary Industry	The concentration of economic activity for the second industry relative to the concentration of population.
Change in Concentration, Primary Industry	Change in geographic concentration in the primary industry between t-2 and t-1.
Colocation	A measure of the geographic co-location of primary & secondary industries.
Change in Colocation	Change in colocation between t-2 and t-1.
Primary Industry Sales	Logarithm of total sales of primary industry at t-1.
Secondary Industry Sales	Logarithm of total sales of secondary industry at t-1.
Primary Industry Sales Growth	Growth in sales of primary industry between t-2 and t-1.
Secondary Industry Sales Growth	Growth in sales of secondary industry between t-2 and t-1.
Primary Industry Advertising Intensity	Average advertising expenditures divided by total sales in the primary industry.
Secondary Industry Advertising Intensity	Average advertising expenditures divided by total sales in the secondary industry.
Primary Industry R&D Intensity	Average R&D expenditures divided by total sales in the primary industry.
Secondary Industry R&D Intensity	Average R&D expenditures divided by total sales in the secondary industry.
Financial Slack	Firm's cash and cash equivalents divided by total liabilities (t-1)
Firm Performance	Return on Assets (t-1)
Prior Market Entries	Count of entries into new 4-digit SIC industries at t-1.
Firm Assets	Total assets from Compustat at t-1
Firm Count of Secondary Industries	Count of secondary industry segments that the company reports as active in Compustat (t-1)
Herfindahl Index for SIC1	Herfindahl measure of sales concentration of the first industry (SIC 1) from US Census Bureau.
Herfindahl Index for SIC2	Herfindahl measure of sales concentration of the second industry (SIC 2) from US Census Bureau.
Input	Most recent value of goods from secondary industry that are purchased by primary industry from BEA "Use" tables for 1987 and 1992.
Output	Most recent value of goods from primary industry that are sold to secondary industry from BEA "Use" tables for 1987 and 1992.

Table 5, Firm Panel Correlation Matrix and Descriptive Statistics

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1)	Exit - 1 year window	1											
(2)	Raw Geographic Concentration - Primary Industry	0.01	1										
(3)	Change in raw concentration - Primary industry	0.00	-0.40	1									
(4)	Raw Geographic Concentration - Other Industry	0.01	0.72	-0.32	1								
(5)	Change in raw concentration - Secondary industry	0.00	-0.32	0.80	-0.37	1							
(6)	Colocation	0.20	0.27	-0.09	0.21	-0.03	1						
(7)	Change in colocation	-0.04	-0.16	0.37	-0.07	0.24	-0.26	1					
(8)	Primary industry sales - logged	0.00	0.12	0.03	0.11	0.03	0.01	0.01	1				
(9)	Secondary industry sales - logged	-0.03	0.12	0.02	0.10	0.03	-0.06	0.01	0.70	1			
(10)	Primary industry sales growth	0.01	0.05	-0.01	0.05	-0.01	0.00	0.00	0.07	0.07	1		
(11)	Secondary industry sales growth	-0.01	0.05	-0.01	0.05	-0.01	0.00	0.00	0.06	0.07	0.68	1	
(12)	Primary industry ad intensity	-0.02	-0.01	0.01	0.01	0.01	-0.03	0.01	-0.02	-0.04	-0.04	-0.03	1
(13)	Secondary industry ad intensity	-0.01	0.02	0.00	0.00	0.01	0.01	-0.01	-0.03	-0.02	-0.03	-0.04	0.83
(14)	Primary industry R&D intensity	-0.02	0.22	-0.02	0.17	-0.02	0.01	-0.02	0.26	0.22	0.07	0.06	-0.12
(15)	Secondary industry R&D intensity	-0.01	0.19	-0.03	0.21	-0.02	-0.01	-0.02	0.21	0.28	0.07	0.06	-0.11
(16)	Financial slack	-0.02	0.00	0.00	-0.01	0.00	-0.02	-0.01	0.03	0.02	0.01	0.01	-0.01
(17)	Firm prior performance	0.00	-0.01	0.00	-0.01	0.00	0.04	0.00	-0.01	-0.02	0.00	-0.01	0.00
(18)	Prior market entries	0.05	-0.01	0.02	-0.01	0.01	0.07	0.01	0.01	0.00	0.01	0.01	-0.03
(19)	Assets - Total	0.01	0.05	0.00	0.05	0.00	0.07	0.00	0.18	0.13	-0.02	-0.02	-0.01
(20)	Count of total secondary industries	0.12	-0.02	0.02	-0.02	0.01	0.26	0.00	0.00	-0.04	-0.03	-0.03	-0.08
(21)	Herfindahl Index - Primary Industry	0.02	0.03	0.04	0.04	0.03	0.08	0.01	-0.18	-0.13	-0.05	-0.03	0.14
(22)	Herfindahl Index - Other Industry	0.04	0.03	0.04	0.06	0.04	0.16	0.02	-0.12	-0.22	-0.04	-0.04	0.13
(23)	Input	-0.05	0.06	-0.02	0.07	-0.03	-0.16	0.01	0.28	0.29	0.00	0.00	-0.08
(24)	Output	-0.11	0.05	-0.02	0.07	-0.03	-0.32	0.02	0.44	0.47	-0.01	-0.01	-0.07
(25)	Year	-0.01	-0.04	0.09	-0.04	0.09	-0.05	0.06	0.21	0.20	0.08	0.07	-0.08
	Mean	0.03	0.03	0	0.03	0	0.01	0	8.91	8.82	0.14	0.14	0.01
	S.D.	0.17	0.03	0.03	0.03	0.03	0.03	0.02	1.48	1.52	0.34	0.34	0.02
	Min	0	0	-0.62	0	-0.62	0	-0.64	2.49	2.49	-0.97	-0.97	0
	Max	1	0.31	0.05	0.31	0.05	0.37	0.06	13.49	13.49	5.31	5.31	0.18

Table 5 (Continued), Firm Panel Correlation Matrix and Descriptive Statistics

		(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)
(13)	Secondary industry ad intensity	1												
(14)	Primary industry R&D intensity	-0.10	1											
(15)	Secondary industry R&D intensity	-0.10	0.82	1										
(16)	Financial slack	-0.02	0.09	0.10	1									
(17)	Firm prior performance	0.01	-0.06	-0.06	-0.05	1								
(18)	Prior market entries	-0.02	-0.05	-0.04	-0.03	0.00	1							
(19)	Assets - Total	0.00	-0.05	-0.06	-0.05	0.03	0.08	1						
(20)	Count of total secondary industries	-0.05	-0.19	-0.17	-0.10	0.06	0.32	0.30	1					
(21)	Herfindahl Index - Primary Industry	0.11	-0.23	-0.18	-0.04	0.01	0.03	0.10	0.08	1				
(22)	Herfindahl Index - Other Industry	0.15	-0.20	-0.25	-0.05	0.01	0.04	0.07	0.11	0.64	1			
(23)	Input	-0.09	-0.09	-0.07	-0.01	-0.01	-0.03	0.00	-0.09	-0.13	-0.12	1		
(24)	Output	-0.08	-0.05	-0.03	0.00	0.00	-0.04	0.13	-0.11	-0.13	-0.16	0.63	1	
(25)	Year	-0.08	0.13	0.12	0.05	-0.01	-0.03	0.00	-0.14	-0.07	-0.07	0.12	0.09	1
	Mean	0.01	0.04	0.04	1.09	-0.05	0.16	572.12	3.07	0.27	0.29	878.29	11171	1991.8
	S.D.	0.02	0.03	0.03	3.78	0.59	0.54	2458.1	1.95	0.18	0.2	1773	16158	2.85
	Min	0	0	0	-0.01	-35	0	0.01	2	0.05	0.05	0	0	1987
	Max	0.18	0.12	0.12	295.33	6.6	10	87422	18	1	1	40186	147890	1996

Table 6, Effect of Geographic Concentration on Industry Relatedness

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Geographic Concentration SIC1	-4.5288***	-5.5960***	-4.4341***	-4.7709***	-4.4334***	-9.4329***	-6.1350***
	(0.1161)	(0.1343)	(0.1339)	(0.1326)	(0.1457)	(0.3488)	(0.6103)
Geographic Concentration SIC2	-1.6966***	-2.9528***	-2.1486***	-2.1708***	-2.2255***	-6.6332***	-4.2764***
	(0.0796)	(0.1239)	(0.1252)	(0.1233)	(0.1357)	(0.3452)	(0.5402)
Colocation, SIC1 & SIC2		0.9740***	0.8296***	1.0166***	1.1023***	2.3528***	1.7821***
		(0.0715)	(0.0695)	(0.0681)	(0.0724)	(0.1308)	(0.1845)
Herfindahl Index for SIC1			-0.0002***	-0.0002***	-0.0003***	-0.0002***	-0.0000
			(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Herfindahl Index for SIC2			-0.0002***	-0.0002***	-0.0002***	-0.0001***	0.0001***
			(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Human Relatedness				1.5307***	1.5022***	1.5063***	1.4918***
				(0.0245)	(0.0285)	(0.0593)	(0.0872)
Sales of SIC2 to SIC1					0.0005***	0.0003***	0.0000
					(0.0001)	(0.0001)	(0.0001)
Sales of SIC1 to SIC2					-0.0000	-0.0000	0.0000
					(0.0000)	(0.0000)	(0.0000)
Sales (Net) (MM$) SIC1						0.0007**	-0.0000
						(0.0003)	(0.0004)
Sales (Net) (MM$) SIC2						-0.0004***	-0.0004**
						(0.0001)	(0.0002)
Sales Growth SIC1							-0.1424***
							(0.0509)
Sales Growth SIC2							0.5062***
							(0.0804)
Constant	0.2530***	0.2769***	0.4414***	-0.1599***	-0.1738***	0.0838***	0.2105**
	(0.0074)	(0.0075)	(0.0084)	(0.0126)	(0.0149)	(0.0310)	(0.0875)
Observations	89,700	89,700	89,700	89,700	71,022	18,360	6,006

*** p<0.01, ** p<0.05, * p<0.1 (Robust standard errors in parentheses)

Outcome Variable: Bryce-Winter relatedness between SIC 4-digit industries ([0,1] percentile-ranking; lower value means fewer businesses operate in both industries); GLM pseudo-likelihood regression using logistic link function and binomial distribution of dependent variable; Industry-level data on U.S. manufacturing industries 1985—1987

Table 7, Diversified Firm Industry Exit, 1987—1996

	(1)	(2)	(3)
Geographic Concentration - Primary Industry	-24.5671***	-35.0102***	-9.5503***
	(1.1578)	(2.1001)	(3.0132)
Change in Concentration - Primary Industry	9.9139***	19.4899***	15.5025**
	(3.2889)	(6.9705)	(7.6369)
Geographic Concentration - Secondary Industry	-29.2265***	-37.5029***	-10.1617***
	(1.0949)	(2.0078)	(2.9764)
Change in Concentration - Secondary industry	8.7543***	18.9178***	15.0402**
	(3.2618)	(6.9778)	(7.6497)
Colocation of Primary and Secondary Industries	32.1139***	42.0410***	21.4532***
	(1.0437)	(1.9528)	(2.8362)
Change in Colocation	-8.9852***	-18.8625***	-12.0096
	(3.1878)	(6.8108)	(7.3282)
Primary industry sales - logged		-0.0613***	0.0919**
		(0.0185)	(0.0421)
Secondary industry sales - logged		-0.0788***	0.0197
		(0.0140)	(0.0361)
Primary industry sales growth		0.0173	0.1450
		(0.0398)	(0.1258)
Secondary industry sales growth		0.0018	-0.2262
		(0.0023)	(0.1423)
Primary industry ad intensity		-3.3041**	-0.0775
		(1.6066)	(3.2195)
Secondary industry ad intensity		-0.4222	-3.0198
		(1.3113)	(2.8631)
Primary industry R&D intensity		1.2107**	-0.0210
		(0.5816)	(2.0722)
Secondary industry R&D intensity		0.5966	2.2927
		(0.3837)	(2.0104)
Financial slack		0.0020*	-0.0420
		(0.0011)	(0.0269)
Firm ROA		-0.0160*	-0.0339
		(0.0089)	(0.0876)
Prior market entries		-0.0216	-0.0105
		(0.0299)	(0.0629)
Assets - Total		0.0000	-0.0001*
		(0.0000)	(0.0000)
Count of total secondary industries		0.1574***	0.1239***
		(0.0135)	(0.0264)
Herfindahl Index - Primary Industry			0.3514
			(0.3047)
Herfindahl Index - Other Industry			-0.0605
			(0.2604)
Input			0.0001***
			(0.0000)
Output			-0.0002***
			(0.0000)
Observations	78,855	42,936	17,130
Number of firms	6,793	5,199	2,264

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1
Outcome variable: exit from firm's secondary industry between t-1 and t; a panel observation is a firm-industry pair observed during the period 1986-1997; complementary loglog panel regression with random effects for firm heterogeneity; year fixed effects are estimated but not displayed.