New-Firm Startups, Technology, and Macroeconomic Fluctuations

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ABSTRACT. New-firm startup activity is examined within a framework pooling a cross-section of 117 industries over six time periods between 1976 and 1986. A model is introduced relating startup activity both to elements of the business cycle, in particular the macroeconomic growth rate, the cost of capital, and the unemployment rate, and to industry-specific characteristics, especially the technological conditions underlying the industry. The pooled cross-section regression results suggest that macroeconomic fluctuations as well as industry-specific elements contribute to startup activity. While new-firm startups respond positively to macroeconomic growth, they are promoted by a low cost of capital and high unemployment rate. A somewhat surprising result is that new-firm startups are not apparently deterred in capital intensive industries and where R&D expenditures play an important role. The empirical results suggest that new firms may be able to overcome their inherent size and experience disadvantages in such markets through exploiting university research and pursuing innovative activity.

I. Introduction

An important finding of Mills and Schumann (1985) was that small firms account for a greater share of economic activity during economic expansions and a reduced share during contractions. Building upon the theories introduced by Stigler (1939) and Marschak and Nelson (1962), they concluded that small enterprises served an important economic function by infusing productive flexibility into an economy which serves to absorb macroeconomic fluctuations.

But where do these small firms come from? This matter was left unexplored by Mills and Schumann. One source is clearly the startup of new firms. Of course, a literature has recently blossemed consistently showing that entry into markets is impeded when confronted with certain characteristics of industry structure.[1] How can this be reconciled with the observation in the second section of this paper that the startup of new firms is a pervasive phenomenon throughout U.S. manufacturing? One answer is that not only have the bulk of entry studies focused on "net" entry, or the change in the number of firms within an industry over a specified period of time, rather than on gross entry, or the startup of new firms, but that, with only a handfull of exceptions, every study examining entry behavior has been restricted to a cross-section comparison across industries for a single time period. And, while Highfield and Smiley (1987) undertook one of the only studies examining new-firm startups over time, their data were aggregated to the macroeconomic level for the U.S., rendering it impossible to identify the industry-specific component influencing startups.

These constraints have made it virtually impossible to decompose the impact that both macroeconomic fluctuations and industry-specific characteristics exert on startup activity. The purpose of this paper is to provide the first study examining the startup of new firms within both a cross-section and time series context. This enables us not only to identify the extent to which startup activity responds to conditions in the labor market, the credit market, and the overall aggregate economy, but also the manner in which the startup of new firms responds to the technological conditions underlying the particular industry. In the second section of this paper the data source and method used to measure new-firm startups is introduced. The manner in which both industry-specific effects and macroeconomic fluctuations are expected to shape startup activity is explained

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in the third section. Based on the amount of startup activity in 117 four-digit standard industrial classification (SIC) industries observed in six different years, the pooled cross-section regression model is estimated and the empirical results reported in the fourth section.

Finally, in the last section a summary and conclusion are provided. We find that the startup of new firms is substantially shaped by both macroeconomic fluctuations as well as industry-specific characteristics. In particular, macroeconomic expansion serves as a catalyst for startup activity. However, new-firm startups are apparently promoted by a low cost of capital as well as a high unemployment rate. While the startup of new firms is not deterred either in capital intensive or R&D intensive industries, there is considerable evidence suggesting that industries where university research is important and where small firms tend to be innovative serve as a catalyst for new-firm startups. Thus, the results generally indicate that, at least to some extent, new firms fulfill the Schumpeterian (1950) function of "creative destruction" both by redeploying resources which have been unemployed by the incumbent enterprises as well as by introducing new products through innovative activity.

II. Measuring new-firm startups

Studies examining the determinants of entry generally suffer from two well-known limitations. First, while several notable exceptions exist (Dunne, Roberts and Samuelson, 1988 and 1989), the most common measure of entry used in studies attempting to empirically identify the determinants of entry has been the change in the number of firms over a given period, or what has become referred to as "net entry".[2] Measuring the change in the number of firms does not account for enterprises which exited from the industry during the relevant time period. That is, given an amount of gross entry, the measure of net entry will increase as the number of exits from the industry decreases. Thus, it is quite conceivable that an industry could have a negative amount of net entry, if many firms actually entered the industry (i.e., if gross entry was positive), but even more firms exited from the industry. Because the pattern of industry exits varies across industries, the extent to which net entry deviates from actual gross entry will also vary substantially from industry to industry.

The second limitation is that entry has typically been measured over a single time period. While it has been possible to measure the number of new-firm startups at the aggregate macroeconomic level (Highfield and Smiley, 1987), this has not been systematically done at the disaggregated industry level.[3]

These two limitations have made it virtually impossible to disentangle the macroeconomic influences on new-firms startups from the microeconomic influences. All that can be concluded from the existing literature is that both are probably important.

To overcome the traditional data limitations, we rely upon the U.S. Small Business Administrations's Small Business Data Base (SBDB). The data base is derived from the Dun and Bradstreet (DUNS) market identifier file (DMI), which provides a virtual census on about 4.5 million U.S. business establishments every other year between 1976 and 1986.

The raw data in the Dun and Bradstreet files have come under considerable criticism. Perhaps one of the most significant weaknesses in the DUNS data is missing records for subsidiaries and branches. Because the Dun and Bradstreet files are compiled on the basis of credit rating, branches and subsidiaries of multi-establishment firms that are unlikely to require credit independently from the parent firm are often not recorded. Similarly, there tends to be chronic underrepresentation in industries where there is a propensity for firms not to apply for credit. In addition, Jacobson (1985) found that in several cases firms and establishments are not included in the data base until several years after they have been established, particularly in rapidly expanding industries, such as certain types of services, and in new industries, such as microcomputers and software-related industries. In order to correct for at least some of these deficiencies inherent in the raw DMI files, the Brookings Institution in conjunction with the Small Business Administration and the National Science Foundation restructured, edited, and supplemented the original DUNS records with data from other sources in constructing the SBDB.[4]

Thus, it should be emphasized that the SBDB has been adjusted to clean up the raw data in the original DMI files. Several important studies have compared the SBDB data with analogous measures from the establishment data of the U.S. Census of Manufactures (Boden and Phillips, 1985; Acs and Audretsch, 1990, Chapter Two), and from the establishment and employment records of the BLS data (Brown and Phillips, 1989). Such comparisons have generally concluded that the SBDB data are remarkably consistent with these other major data bases providing observations on establishments and enterprises. The SBDB has already been applied in a number of other studies to address a wide variety of issues related to intra-industry dynamics. While Evans (1987a and 1987b) and Phillips and Kirchhoff (1989) used the SBDB to examine the relationships between firm age, growth, and size, Acs and Audretsch (1989a and 1989b) and Macdonald (1986) analyzed the determinants of entry, and Audretsch (1991) measured new-firm survival.

The annual number of new-firm startups is aggregated to major manufacturing sectors and shown for alternate years between 1976 and 1986 in Table I. The share of the total number of enterprises in the sector accounted for by new-firms startups is listed in the parentheses. There are three major points from Table I which should be emphasized. First, the number of new-firm startups and their share of the total number of enterprises varies considerably across manufacturing sectors.

Second, the amount of startups varies substantially from year to year. That is, in 1976 there were 11,154 new-firm startups in all of U.S. manufacturing; this fell by nearly one-quarter to 8,525 startups in 1980, and by nearly two-thirds to 4,239 in 1982. By 1984 the number of manufacturing startups had more than doubled to 10,055, which was nearly again at the 1976 and 1978 levels. This volatility in the number of new-firm startups is attributable, at least to some extent, to macroeconomic fluctuations. This is reflected by the fluctuations in annual growth rates of real gross national product (GNP) of 4.9 percent in 1976, 5.3 percent in 1978, −0.2 percent in 1980, −2.5 percent in 1982, 6.8 percent in 1984, and 2.8 percent in 1986.[5] The extent of startup activity for manufacturing as a whole corresponds quite closely to these macroeconomic fluctuations. In addition, there is also a clear tendency for the number of startups within each manufacturing sector to reflect the phase of the business cycle.

The third major point from Table I is that, while no industrial sector is immune from the influences of macroeconomic fluctuations, the impact varies considerably from sector to sector. New-firm startups in certain sectors, such as petroleum, textiles and apparel, and communications are apparently quite succeptible to the phase of the business cycle, at least over this period of time. By contrast, in the computer and food sectors, the number of startups seems to be less vulnerable to macroeconomic fluctuations. Just as the strong intertemporal tendency towards fewer startups in the transportation (other) sector probably reflects a longer-term decline, the pronounced tendency towards an increase in the number of startups in computers seems to suggest long-term sectorial expansion.

III. Industry and macroeconomic effects

As Blanchflower and Oswald (1990), Lucas (1978), Evans and Jovanovic (1989) and Evans and Leighton (1989) argue, each individual or agent in the economy is assumed to confront a decision between working for a wage with an established enterprise or starting his or her own new firms. These studies suggest that, while many factors influence the entrepreneurial choice, certainly not least important is the extent to which the profits from starting a new firm, Π, exceed the wage alternative, w, so that the probability of a new-firm startup, pr(NF), is positively related to $\Pi - w$, or

$$pr(NF) = f(\Pi - w) \quad (1)$$

The profitability of the new startup is simply the difference between the total revenue, price (p) times the firm's output (q), and total cost, determined by the unit cost of producing q units of output, c(q), times the number of units produced, so that the probability of an agent starting a new firm can be expressed as

$$pr(NF) = f(p * q - c(q) - w) \quad (2)$$

Rewriting equation (2) and assuming that the market price equals the average cost for firms that

TABLE I
New-firm startups by industrial sector[a]

	1976	1978	1980	1982	1984	1986
Food	474 (2.53)	481 (2.67)	374 (2.15)	209 (1.22)	480 (2.79)	535 (3.09)
Textiles and apparel	1172 (4.03)	1254 (4.20)	854 (2.95)	491 (1.69)	1026 (3.41)	992 (3.34)
Lumber and furniture	1325 (3.71)	1375 (3.70)	868 (2.28)	425 (1.12)	1060 (2.75)	1106 (2.79)
Paper	126 (2.97)	191 (4.24)	101 (2.20)	50 (1.11)	149 (3.19)	152 (3.15)
Chemicals	322 (2.95)	390 (3.52)	284 (2.54)	164 (1.45)	332 (2.85)	335 (2.83)
— Industrial	91 (3.62)	99 (3.76)	98 (3.69)	41 (1.55)	85 (3.12)	84 (3.09)
— Drugs and medicinals	34 (2.75)	54 (4.47)	22 (1.82)	26 (2.11)	48 (3.60)	49 (3.50)
— Other	123 (2.39)	154 (3.00)	116 (2.24)	65 (1.23)	130 (2.42)	138 (2.52)
Petroleum	41 (3.21)	42 (3.16)	57 (4.01)	11 (0.76)	43 (3.02)	46 (3.17)
Rubber	430 (4.72)	469 (4.78)	312 (2.97)	158 (1.44)	382 (3.26)	385 (3.18)
Stone, clay and glass	545 (3.86)	493 (3.41)	292 (2.00)	133 (0.93)	337 (2.41)	358 (2.58)
Primary metals	168 (2.97)	179 (3.07)	141 (2.36)	79 (1.32)	195 (3.22)	201 (3.25)
— Ferrous metals	85 (3.21)	90 (3.28)	61 (2.24)	45 (1.67)	102 (3.70)	110 (3.80)
— Non-ferrous metals	83 (2.76)	89 (2.89)	80 (2.47)	34 (1.04)	93 (2.82)	91 (2.76)
Fabricated metal products	962 (3.19)	1042 (3.30)	782 (2.37)	362 (1.07)	913 (2.65)	877 (2.52)
Machinery	1519 (3.14)	1731 (3.38)	1407 (2.60)	586 (1.02)	1433 (2.43)	1314 (2.22)
— Office and computers	50 (4.73)	66 (5.27)	62 (4.14)	43 (2.21)	118 (4.58)	100 (3.64)
— Other machinery, non-electrical	1469 (3.10)	1665 (3.34)	1345 (2.56)	543 (0.98)	1315 (2.33)	1214 (2.15)
Electrical equipment	635 (4.41)	620 (3.98)	461 (2.88)	274 (1.62)	665 (3.63)	606 (3.21)
— Radio and TV equipment	79 (5.02)	82 (4.63)	53 (3.00)	21 (1.15)	43 (2.38)	49 (2.73)
— Communications equipment	128 (5.27)	94 (3.59)	74 (2.77)	48 (1.62)	168 (5.02)	119 (3.40)

Table I (Continued)

	1976	1978	1980	1982	1984	1986
— Electronic components	193 (4.83)	204 (4.64)	163 (3.40)	110 (2.10)	233 (3.98)	211 (3.46)
— Other	235 (3.67)	240 (3.54)	171 (2.52)	95 (1.39)	221 (3.03)	227 (3.04)
Motor vehicles	147 (4.55)	149 (4.31)	116 (3.11)	57 (1.49)	147 (3.62)	148 (3.33)
Other transport equipment	247 (5.31)	250 (5.23)	142 (3.17)	76 (1.76)	191 (4.30)	127 (2.99)
Aircraft and missiles	26 (2.50)	36 (3.24)	26 (2.09)	13 (0.94)	33 (2.19)	42 (2.68)
Instruments	312 (3.94)	323 (3.72)	226 (2.41)	160 (1.60)	308 (2.79)	353 (3.01)
— Scientific and measuring	130 (4.56)	120 (3.63)	104 (2.76)	66 (1.55)	145 (2.99)	141 (2.72)
— Optical, surgical & photographic	182 (3.59)	203 (3.78)	122 (2.18)	94 (1.63)	163 (2.63)	212 (3.24)
Other manufacturing	2703 (3.62)	2703 (3.48)	2082 (2.67)	1081 (1.35)	2361 (2.81)	2435 (2.82)
Total manufacturng	11154 (3.56)	11728 (3.60)	8525 (2.56)	4329 (1.27)	10055 (2.86)	10012 (2.80)

[a] The share (percentage) of the total number of firms accounted for by new-firm startups is indicated in the parentheses.

have attained the minimum efficient scale (MES) level of output, q*, plus some additional factor, δ,

$$pr(NF) = f[q(c(q^*) + \delta - c(q)) - w] \quad (3)$$

where δ is determined by the market growth rate, g, the extent to which the startup is able to contribute to innovative activity, t, and the ability of the incumbent firms to retaliate against the entrant, r. The growth rate can be decomposed into a component that is induced by the macroeconomic environment, g_e, and a component representing the growth of the specific market net of the business cycle influence, g_m or $g = g_e + g_m$. As Bradburd and Caves (1982) found, industry profits and presumably prices tend to accompany high rates of market growth. Thus, $\partial\Pi/\partial g = (\partial\Pi/\partial\delta)(\partial\delta/\partial g) > 0$ producing a new or different product also enables the entrepreneur to raise the price, $\partial\Pi/\partial t = (\partial\Pi/\partial\delta)(\partial\delta/\partial t) > 0$. However, the extent to which the incumbent firms are able to engage in retalitory conduct when confronted with a new startup in the industry, r, will serve to dampen the profitability of the new firm, $\partial\Pi/\partial r = (\partial\Pi/\partial\delta)(\partial\delta/\partial r) < 0$.

One of the more striking stylized facts regarding new-firm startups emerging from several studies is their remarkably small scale of output. For example, Audretsch (1991) reports that about 95 percent of new-firm startups in U.S. manufacturing in 1976 had fewer than fifty employees. Similarly, then mean size of new firms established in 1976 was 9.55 employees. Evans and Jovanovic (1989), and Fazzari, Hubbard, an Peterson (1988) found that entrepreneurs typically are confronted with a binding liquidity constraint. Similarly, Stoll (1984) shows that the cost of credit is positively and systematically related to firm size. That is, a lower cost of credit and/or more accessible credit conditions should increase the startup size, so that $q = q(i)$, where i is the market rate of interest and $\partial q/\partial i < 0$.

Finally, the rate of unemployment influences equation (1) in two ways. First, as has been well documented in the labor literature, the wage rate is negatively related to the unemployment rate. Second, those unemployed workers may substitute their reservation wage or the value of their unemployment benefits for w in equation (1). In either case, an increase in unemployment should serve to reduce the value of w, resulting in an increase in the number of new-firm startups, ceteris parabus.

Thus, the number of new-firm startups in an industry is influenced by certain elements which are specific to the individual market and elements which reflect the macroeconomic environment. The industry-specific factors are the importance of scale economies and capital intensity, the market growth rate, the ability of incumbent firms to engage in retalitory strategies against new entrants, and the degree to which new firms are able to innovate. The macroeconomic influences associated with the business cycle are the aggregate level of economic growth, the cost of capital, and the unemployment rate. It is hypothesized that these industry specific and macroeconomic factors combine to shape the number of new-firm startups in an industry.

IV. Empirical results

To test the hypotheses raised in the previous section, a panel of data was assembled, where the unit of observation is the number of startups in a given industry for a given year over the period 1976—1986, for alternate years. To capture the extent to which new firms are able to innovate a number of various measurements, reflecting different aspects of what has been termed as the "technological regime" are used.[6] First, as Levin (1978) and Mueller and Tilton (1969, p. 5) argue, industries in which research and development (R&D) plays an important role are generally not conductive to new-firm startups, since "The chief component of these barriers generally is the extent of economies of scale in the R&D process. The second major factor contributing to R&D entry barriers is the accumulation of patents and know-how on the part of incumbent firms."[7] Thus, a negative relationship would be expected to emerge between the 1977 company R&D-sales ratio (from the Federal Trade Commission's Line of Business Survey) and new-firm startups.

As explained in the previous section, in those industries where the small firms tend to be particularly innovative, the number of startups should be greater.[8] To measure the innovative activity of small firms, the small-firm innovation rate is used, which is defined as the number of 1982 innovations from enterprises with fewer than 500 employees divided by small-firm employment. The innovation data, which were introduced by Acs and Audretsch (1987, 1988, and 1990) are from the U.S. Small Business Administration's Innovation Data Base.

In addition, several variables from a survey of 650 industrial R&D managers by a Yale University group (Levin et al., 1982; Levin et al., 1987) measuring the underlying technological conditions in 130 industries were used. These measures include the importance of learning ("How important is moving quickly down the learning curve as a means of capturing and protecting the advantages from new or improved products?"), basic science ("How relevant were the basic sciences of biology, chemistry, and physics (average of three) to technological progress in this line of business over the past 10—15 years?"), product changes, and university research. As Link and Rees (1990) note, small new firms have apparently been more successful at exploiting university research than have their more established larger counterparts, suggesting that the number of startups should be greater in industries where university research plays an important role.[9] By contrast, large laboratories are likely to be more crucial in industries dependent upon basic research, thereby deterring the startup of new firms. New firms would also be expected to be disadvantaged both in markets where the product specification changes with considerable frequency and where learning is particularly important. Not only do Spence (1981) and Fudenberg and Tirole (1983) argue that the incumbent firms have a clear cost advantage in industries where learning plays an important role, but Scherer and Ross (1990, p . 373) observe that, "Small scale entry is particularly handicapped when learning economies exist, since small firms have relatively little cumulative production and hence are slow to progress down learning curves in the absence of substantial spillovers."

Industry growth is measured by the annual percentage change in value-of-shipments using data from the U.S. Department of Commerce, Bureau of the Census, Annual Survey of Manufactures. In the previous section it was argued that new-firm startups are more likely to be impeded in industries where the incumbent firms can easily detect the new firms and respond through some type of retalitory behavior. As has been commonly argued in the industrial organization literature (Scherer and Ross, 1990), this is more likely to be the case is highly concentrated industries where just several enterprises dominate the market. The degree to which an industry is concentred is represented by the four-firm concentration ratio, measured by the Census of Manufactures at the Bureau of the Census. The importance of scale economies and capital intensity is measured by the capital-labor ratio and is expected to exert a negative influence on the number of startups.

To measure macroeconomic growth, the annual percentage change in real GNP is used. The cost of capital is measured by the average three-month interest rate paid on U.S. Treasury Bills. Both of these variables, along with the unemployment rate, are taken from the 1989 *Economic Report of the President*. While both the growth rate of real GNP and the unemployment rate are expected to exert a positive influence on new-firm startups, the interest rate should be negatively related to the number of startups. It should be emphasized that while these macroeconomic variables vary over time but not across industries for any given year, most of the industry-specific variables are measured only at one point in time. It is implicitly assumed that variables such as R&D intensity, and the various characteristics of the underlying technology in an industry are invariant over a relatively short time period. Only the measure of industry growth varies both across time and across industries.

Because of the limited number of industries for which the Yale data on industry technology are available, pooled cross-section regressions were estimated for 117 four-digit standard industrial classification (SIC) industries over the six time observations using new-firm startups as the dependent variable. The regression results are reported in Table II. Equation 1 shows that industries where university research plays an important role tend to be conducive to new-firm startups. However, if the industry is especially dependent upon basic science, there is less startup activity. New firms are apparently not attracted to industries characterized by frequent product changes. Perhaps somewhat surprisingly, as the positive but statistically non-significant coefficient of learning suggests, new firms do not seem to be deterred from entering industries where learning-by-doing is considered to be important. Thus, while learning may be advantageous to the incumbent enterprises, it apparently does not significantly deter the startup of new firms.

The statistically non-significant coefficient of R&D/Sales combined with a positive small-firm innovation rate suggests that a technological environment where the small firms have the innovative advantage is conducive to new startups. However, if the small firms are not particularly innovative, given a level of R&D intensity, then startup activity tends to be deterred.

The coefficient of the industry growth rate clearly can not be considered to be different from zero. Given the repeated finding in the cross-section studies that one of the most significant determinants of entry is market growth, this result is startling. While the negative and statistically significant coefficient of concentration suggests that new-firm startups tend to be inhibited in an environment where retaliation from the incumbent enterprises is more likely to be effective, the positive coefficient of capital intensity implies that startups are not significantly deterred from entering industries exhibiting substantial scale economies. Although this contradicts the prediction of the previous section, it is consistent with the results from a number of cross-section studies, such as Acs and Audretsch (1989a and 1989b; and Highfield and Smiley, 1987). It is also consistent with the finding of Audretsch (1991) that, although new-firm startups may not be deterred in the presence of capital intensity, their ability to survive over time is significantly less.

New-firm startups are clearly influenced by the stage of the business cycle, as evidenced by the positive and statistically significant coefficient of the growth rate of real GNP. During the expansion phase of the business cycle, while real GNP is expanding, startup activity tends to be high. By contrast, during a recession or trough, when real GNP is declining, startup activity becomes dormant. The interest rate also exerts a strong influ-

TABLE II
Pooled cross-section regression results for new-firm startups (t-statistics listed in parentheses)

	1	2	3	4
University research	2.625 (3.06)	2.167 (3.52)	2.965 (3.93)	2.295 (3.70)
Basic science	−3.331 (−3.91)	−3.127 (−4.61)	−3.691 (−4.92)	−3.300 (−4.83)
Product changes	−2.885 (−3.89)	−3.433 (−4.10)	−3.185 (−4.46)	−3.590 (−4.31)
Learning	0.917 (1.42)	1.761 (2.80)	1.205 (1.88)	1.987 (3.17)
Company R&D/sales	0.982 (1.45)	2.047 (1.83)	—	—
Small-firm innovation rate	5.339 (3.28)	1.013 (0.44)	5.672 (3.54)	1.99 (0.86)
Industry growth	0.150 (0.90)	0.083 (0.81)	0.150 (0.90)	0.084 (0.80)
Concentration	−0.145 (−3.73)	—	−0.149 (−3.78)	—
Capital intensity	0.064 (2.21)	0.130 (3.48)	0.058 (2.22)	0.138 (3.70)
GNP growth rate	0.052 (2.04)	0.053 (2.09)	0.052 (2.00)	0.054 (2.11)
Interest rate	−0.310 (−8.50)	−0.307 (−8.41)	−0.311 (−8.47)	−0.308 (−8.46)
Unemployment	0.152 (1.95)	0.142 (1.83)	0.153 (1.95)	0.141 (1.82)
R^2	0.418	0.345	0.416	0.342
F	38.051	30.402	41.058	32.606
Sample Size	702	702	702	702

ence on new-firm startups. Startup activity is apparently choked off to a considerable extent by high interest rates and promoted when the cost of capital is relatively low. Finally, as indicated by the positive and statistically significant coefficient of the unemployment rate, unemployment apparently is conducive to new-firm startups.

The positive coefficient of the capital-labor ratio might be attributable to the impact of capital intensity on startup activity being confounded with that of market concentration, due to the high correlation between concentration and capital intensity, However, in equation 2, when the four-firm concentration ratio is omitted from the regression, the coefficient of the capital labor ratio not only remains positive and statistically significant, but actually doubles in magnitude. Similarly, the company R&D/Sales ratio could be suspected as being multicollinear with the measures of the importance of university research, basic science, product changes, and learning. However, when it is omitted from Equation (3), none of these other coefficients are affected to any noticeable extent. Finally, in Equation (4) omitting both the concentration ratio and R&D intensity variables leaves the coefficients of the other variables virtually unchanged, with the exception that the small-firm innovation rate no longer has a significant impact on new-firm startups, although the coefficient does remain positive.

V. Conclusions

An important finding of this paper is that new-firm startups serve as key agents in implementing the "Schumpeterian" (1950) task of "creative destruction". This function is fulfilled in two ways. First, as incumbent enterprises reduce employment and close plants during an economic contraction, the resulting unemployment triggers an increase in the startup of new firms. That is, at least some of the resources released by the incumbent firms, presumably because they were being applied the least efficiently, will be redeployed by new startups. This redeployment of resources occurs despite the finding in this paper that "all boats are lifted by a rising tide," that is, startup activity is generally driven, to a considerable extent, by the business cycle. During periods of macroeconomic expansion, the startup of new firms increases in virtually every industry. By contrast, startup activity becomes sluggish during a recession.

The second manner in which new startups serve as Schumpeterian firms is through innovative activity. A rather startling result is that the startup of new firms is apparently not deterred either in industries which are capital intensive or R&D intensive, or where learning-by-doing plays an important role. There is at least some evidence suggesting that, under the appropriate technological circumstances, new-firm startups can compensate for their inherent size and experience disadvantages through innovative activity. One source for this innovative activity is apparently university research.

At least two important aspects regarding new-firm startups have been left unexplored by this paper. First, what happens to the firms subsequent to their startup, and how is their ability to survive related to macroeconomic fluctuations? Second, what are the normative implications of startup activity; is it desirable or undesirable? That is, would economic welfare be enhanced or undermined by encouraging the startup of new firms? While these are complicated questions, they surely need to be addressed in future research. In any case, the results of this paper show that not only is startup activity a pervasive phenomenon in U.S. manufacturing, but that it is clearly connected to both the macroeconomic environment as well as the underlying technological conditions in the industry.

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Notes

1 See for example the studies examining net entry listed in Scherer and Ross (1990) and contained in Geroski and Schwalbach (1991).

2 For examples of this literature, see Orr (1974) and Duetsch (1984).

3 Yamawaki (1991) examines the determinates of net entry into 135 three-digit Japanese manufacturing industries for five one-year periods between 1980 and 1984. However, he was not able to identify new-firm startups from his measure of net entry.

4 For further explanation of the development and editing of the SBDB, see U.S. Small Business Administration (1986 and 1987), Harris (1983), and Brown and Phillips (1989).

5 The annual growth rates of real gross national product are from the U.S. Department of Commerce, Bureau of Economic Analysis.

6 For detailed explanations of what is meant by the "technological regime", see Winter (1984), Audretsch (1991), and Acs and Audretsch (1990, chapter seven).

7 In fact, the notion that R&D intensity impedes entry has at least some empirical support. Orr (1974) found that Canadian net entry was adversely affected by R&D intensity, and Baldwin and Gorecki (1987) found that entry via plant creation is negatively related to R&D.

8 For an overview of the innovative advantages associated with new and small firms, see Nelson (1984) and Scherer (1991).

9 For evidence of R&D spillovers, see Acs, Audretsch and Feldman (1992 and 1993).

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