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The Incubator Hypothesis

Evidence from Five Cities

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In the late fifties, Hoover and Vernon in their study for the New York Regional Plan Association first put forth what has since come to be called the "incubator" hypothesis. This hypothesis states that small manufacturing establishments beginning operations will find it to their comparative advantage to locate at highly centralized locations within the metropolis. This advantage is due to any number of factors including the availability of (1) rentable production space, (2) inputs, (3) lower supply risks, (4) labor, and (5) other services at such locations.[1] The hypothesis was stated in the context of a more general discussion of the external economies available in what they term the "core" area of the metropolis.

Since its formulation, the hypothesis has been expanded in several ways to form the basis for a theory of the intra-urban industrial location process. One generalization has been to apply it to all new firms, not just small firms or those particularly dependent on especially close contact with their customers or suppliers. A second form of the generalization has been to explore the dynamic aspects of the hypothesis. This generalization implies, for example, that the high mortality rates of new ventures would account for relatively high rates of business failure seemingly observed in central cities; further, as these fledgling enterprises mature and their dependency on others is reduced, outward movement to lower density areas might be anticipated. More systematically, one might expect that areas which best provide for the incubation function will be characterized by (1) relatively high establishment birth rates, (2) relatively high establishment death

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[1]The actual statement was "The process, as we see it, is one in which persons aspiring to go into production on a small scale have found themselves less obviously barred by a high cost structure at the center of the urban area than at the periphery." E. M. Hoover and Raymond Vernon, Anatomy of a Metropolis (New York: Anchor Books, 1962), p. 47.

rates, (3) a net out-migration of successful, sufficiently matured establishments seeking space for expansion, and (4) a positive net increase in the employment of the smaller, still-existing and maturing establishments.

The purpose of this paper is to review the past evidence and to offer some new data to assess whether the hypothesis can be empirically supported. In particular the two general aspects of the hypothesis described above will be tested. First, we will examine the proposition that highly centralized locations are attracting a disproportionate number of new firms and/or the employment associated with new firms. Second, we will test the hypothesis that new firms which are formed in high density areas move outward from such sites in their early years of existence in order to expand their productive activities. We refer to ——————————————>

these as the "simple" and "dynamic" hypotheses in the rest of the paper. Our analysis is based on the experience of all manufacturers in several U.S. cities. We recognize that it is quite possible that the hypothesis could hold for certain industries even if it is unsupported for all firms together. Our intent, however, is to test the validity of the hypothesis as a general theory of intraurban location behavior.

The paper consists of three sections. The first two present evidence on the "simple" and "dynamic" hypotheses. The final section summarizes our findings and offers some conclusions.

I. THE SIMPLE HYPOTHESIS

Hoover and Vernon

Hoover, Vernon, and others associated with the New York Regional Plan Study did not directly support (as they did not directly state) the incubator hypothesis. More, it was the linking of the arguments for the necessity of external economies for small firms and for those in need of rapid communication with customers and suppliers which by implication offered support for the hypothesis as it was eventually stated.[2] Their argument was strengthened by Daniel Creamer's earlier study of the incidence of new establishments within metropolitan areas for 1929 and 1933.[3] Of special note for Hoover and Vernon was Creamer's division of industries into durable and semi-durable groups. His results showed that in major

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[2]To illustrate their argument, the data on the location of firms by employment size in the core, inner ring, and outer ring of the region showed over 60 percent of firms with 60 or fewer employees concentrated in the core area; Hoover and Vernon, op. cit., Table 9, p. 46.

[3]See Daniel Creamer, "The Changing Pattern of Industrial Location," in Carter Goodrich, et al., Migration and Economic Opportunity (Philadelphia: University of Pennsylvania Press, 1936), pp. 300-396.

metropolitan areas semi-durable industries had consistently high birth rates in central cities while for durable goods industries birth rates were essentially uniform across areas. The industries included in the semi-durables group coincided closely with those included by Vernon and Hoover in their list of industries relying on rapid communications and external economies. Further, the precarious existence of such establishments makes a high turnover probable,[4] meaning a greater number of births will be present where such industries are concentrated. Thus, given the clustering of these industries at central locations, their relatively small average size, and rapid turnover, a higher level and/or rate of births at central locations was to be expected. Finally, although Hoover and Vernon were clearly aware that as a firm grows, it becomes economical to produce internally services previously purchased outside the firm. This can make decentralization more attractive as a firm ages and expands.

Creamer

As part of a more general study of the location patterns of manufacturers, Daniel Creamer later examined the components of location

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[4]Death rates were given only for 1963. For semi-durable goods industries they are: core, 6.1 percent; inner ring, 6.8; outer ring, 2.8. As such they do not strongly support the text statement. More recent data, however, confirm that birth and death rate are highly correlated. See, for example, R. Struyk and F. James, "A Comparative Study of Manufacturing Employment Location in the Boston and Phoenix Metropolitan Areas," Explorations in Economic Research, forthcoming, and Robert A. Leone, The Location of Manufacturing Activity in the New York Metropolitan Area, forthcoming, Chapter 9.

change for Standard Metropolitan Statistical Areas (SMSA's) in Pennsylvania using the State's Industrial Census.[5] He observed that principal cities enjoy some advantage over their environs as incubators of new manufacturing establishments.[6] The comparison which Creamer makes is at a higher level of aggregation than we consider appropriate for a test of this hypothesis. Because of data limitations, Creamer was forced to define the principal city of each SMSA was geographically equivalent to the county in which it was located. The one exception was Philadelphia where the city and county are coterminous. Thus, while Creamer finds the principal cities to have higher birth rates in ten of the 18 city-year observations reported, his concept of centrality is in most instances considerably broader than that generally conceived in statements of the incubator hypothesis.

Struyk-James

Using the establishment level Dun and Bradstreet data it was possible for these researchers to use a finer geographic detail than previously employed to test the hypothesis.[7] Three different types of area within

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[5]Daniel Creamer, Manufacturing Employment by Type of Location (New York: National Industrial Conference Board Studies in Economics, No. 106, 1969), Chapter 4.

[6]In fairness it should be noted that Creamer's main comparisons involved six types of manufacturing locations: (1) principal cities of industrial areas, (2) remainder of industrial areas, (3) cities of 10,000 or greater population outside of industrial areas, (4) the remainder of large non-industrial counties, (5) other industrial counties, and (6) remainder of the state. We have limited our discussion of his findings to (1) and (2).

[7]R. Struyk and F. James, Intrametropolitan Industrial Location: Tests of Three Hypotheses (New York: National Bureau of Economic Research, Urban and Regional Study No. 3, forthcoming). The Dun and Bradstreet data is also generally described in R. Leone, "The Role of Data Availability in Workplace Location Analysis," Annals of Economic Measurement, April 1972.

each of the four included SMSA's in the study were considered as possible incubation sites: Central Industrial Districts, the Central City and Traditional Manufacturing Sites. (1) The central industrial district (CID) is best thought of as a substantially augmented central business district as defined by Census; this is generally the highest density land use area in the SMSA. (2) The central city is as defined by the Census. (3) Traditional manufacturing sites in each of the included SMSA's, although possibly not centrally located, are characterized by a significant capital infrastructure (frequently aged) which could be suitable for new enterprises; they also have skilled labor forces available as well as the services of other manufacturers. The three types of site are not, of course, mutually exclusive.

To test the hypothesis, the share of the SMSA's new firms at an incubation site was contrasted with the site's share of the SMSA's firms in the initial year of the study. If the incubation sites were attracting a disproportionate number of new firms, the ratio of these shares should be greater than 1. Table 1 presents such ratios on an establishment and on an employment basis for each incubation site in each of the sample SMSA's. The employment figures offer some support for the hypothesis. All three Cleveland zones, for example, appear to be relatively fertile, particularly the CID. The St. Paul and Phoenix central cities also passed the test as well as the traditional manufacturing centers in Boston. The tests based on the location of new establishments provided no support for the hypothesis. On balance, the Struyk-James study provided very limited

Table 1

RELATIVE DISTRIBUTION OF NEW FIRMS IN SIX SMSA'S[a]

A. Ratio of the share of new establishments to the share of base year establishments

	Central Industrial District[b]	Central City	Traditional Manufacturing Locations[c]
Boston	.77	.60	.97
Cleveland	.80	.81	.89
Minneapolis	.46	.65	.56
St. Paul	.41	.53	
Phoenix	.66	.90	.80
New York (1967-1969)	1.00	.92	1.18
New York (1969-1971)	.93	.93	.93

B. Ratio of the share of employment in new establishments to share of base year employment

	Central Industrial District	Central City	Traditional Manufacturing Locations
Boston	.93	.69	1.14
Cleveland	1.97	1.1	1.01
Minneapolis	.36	.34	
St. Paul	.17	2.0	.25
Phoenix	.32	1.03	.29
New York (1967-1969)	1.18	1.03	.64
New York (1969-1971)	1.05	.96	.83

[a] Source: Table 2.1 in R. Struyk and F. James, op. cit.; the New York data are from Leone, op. cit., Chapter 8 and original materials.

[b] Most appropriately thought of as an augmented central business district.

[c] See Source for definitions of these areas.

Unless otherwise noted, the data cover the 1965 to 1968 time period.

support of the hypothesis.[8]

Leone

Using similar Dun and Bradstreet data for the 1967-1971 period, Leone has studied the incubation process in the New York Metropolitan area.[9] The ratios in Table 1 also summarize his findings. The time period was divided into the 1967-1969 and 1969-1971 periods in order to separate periods of economic expansion and slowdown. Although not shown in Table 1, the Manhattan CBD, which dominates aggregate manufacturing activity, dominates births to a moderately greater extent in both periods. Second, the traditional manufacturing areas outside the CBD fared relatively poorly except during the 1967-1969 time period. Leone observed that the fringe areas were strongly represented in birth activity, especially for small establishments. This observation is consistent with the findings of Struyk-James. Third, the New York CID appeared to be especially attractive for the larger of the new firms.

Leone also speculated that the favorable performance of both the CID and the Traditional Manufacturing Areas in the 1967-1969 time period stemmed largely from the fact that the period was the tailend of an economic boom. During such a period, the nearly obsolete capital stock in the oldest areas is drawn upon because of capacity constraints elsewhere.

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[8] In searching for an explanation of the low birth rates at the incubation sites the authors tested the hypothesis that the industry mix present in the various areas could have a pervasive effect on the tests presented in Table 1 owing to the substantial variance in birth rates by industry. Controlling for industry mix was found to make very little difference in the outcome of the basic test.

[9] Robert Leone, Location of Manufacturing Activity in the New York Metropolitan Area (New Haven: Yale University Ph.D. thesis, 1971). The data and sample size along with additional details of the test for the 1967-1969 period can be found in Chapters 2 and 8.

Summary

The evidence we have examined provides little support to the simple incubator concept of urban growth. Hoover and Vernon, of course, originally formulated the incubator hypothesis in the New York context. It is both a credit to them and an indication of the uniqueness of the New York experience that the strongest support for the hypothesis is in New York. In general, however, the simple incubator hypothesis appears to be a weak explanation of urban growth processes.

II. THE DYNAMIC HYPOTHESIS

Even though we have not found strong support for the simple incubator hypothesis, it is worthwhile exploring the movement and growth pattern of new firms at central locations because it is possible for this aspect of the hypothesis to be supported independently of the other. In addition, because such firms constitute a substantial fraction of all new manufacturing activity, knowledge of their locational behavior will increase our understanding of urban development.

The dynamic hypothesis itself is composed of two related but separable parts. The hypothesis states that as new firms mature and grow they become less dependent on the services afforded by others at incubation sites as they are able to supply themselves with many of these services. This decreased dependence coupled with requirements for additional space to accommodate expansion push the firm away from the incubation site to lower density areas. Thus, the two parts of the hypothesis concern the growth and the relocation patterns of new firms compared to mature firms. These are examined sequentially in the following paragraphs.

To carry out the analysis we use the same 1967-1969 and 1969-1971 Dun and Bradstreet samples of the New York area manufacturing establishments employed in Leone's original test of the incubator hypothesis described in the previous section.

Employment growth rates by age of establishment

The first and simplest question to examine was whether or not there were discernibly different rates of growth in new firms versus old firms. Table 2 shows employment growth rates in the New York SMSA by age of establishment.[10] The table indicates the extent to which

[10]Note that in the data base used, there is no date of establishment formation variable for branch plants of manufacturing firms. Branch plant employment is included in the "1960, earlier and not available" category. Branches typically account for 13% of New York SMSA manufacturing employment.

Table 2

New York SMSA Manufacturing Employment by Age of Establishment, 1967-71

Date of Establishment Formation	Employment Growth Rates	
	1967-69	1969-71
1960, Earlier or Not Available	- 3.8%	-11.5%
1961	+ 2.2	-13.6
1962	+15.5	-12.4
1963	+ 4.6	- 3.3
1964	- 2.3	- 3.3
1965	+29.1	-20.7
1966	+49.5	-25.2
1967	- -	-10.7
1968	- -	+ 8.5

growth is associated with establishment age. Throughout the 1967-1971 period, which encompasses both a period of economic bouyancy (1967-69) and a period of contraction (1969-71), the oldest establishments experienced employment declines. Employment in the younger plants was much more volatile, responding quickly to variations in the business cycle.

After an initial period of expansion in the first year or two, new plants apparently experience a period of retrenchment. Given that younger plants experience more employment volatility and given that rates of establishment relocation appear to be sensitive to changing space requirements,[11] the question arises whether or not the probability that a plant will relocate is related to its age. Table 3, which gives the age distribution of all establishments and those which relocate, indicates that younger plants are more likely to relocate. Also given is the ratio of these two percentages, where a number greater than one indicates a higher than average propensity to move.

Higher rates of relocation for younger establishments, coupled with the well documented trend toward the decentralization of employment in the manufacturing sector[12] raises the question as to whether these younger plants are decentralizing more or less rapidly than their older

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[11]The sensitivity of the relocation decision to space requirement appears in a number of surveys of moving firms. See, for example, Ira S. Lowry, Portrait of a Region, Vol. 2 of the reports of the Economic Study of the Pittsburgh Region (Pittsburgh: University of Pittsburgh Press, 1963), p. 73.

[12]The long run decentralization of manufacturing employment is demonstrated in Chapter 3 of Edwin S. Mills, Studies in the Structure of the Urban Economy (Baltimore: The Johns Hopkins Press, 1972).

Table 3

Distribution of All Establishments and Moving Establishments

Only by Date of Establishment Formation

Date of Establishment Formation	1967 All Mfg. (1)	1967-79 Movers (2)	Ratio (3)=(2)÷(1)	1969 All Mfg. (4)	1969-71 Movers (5)	Ratio (6)=(5)÷(4)
1960, Earlier or Not Available	75.3%	66.4%	0.88	64.9	59.4	0.92
1961	3.8	4.8	1.26	3.2	3.6	1.13
1962	3.7	5.0	1.35	3.3	4.1	1.25
1963	3.9	5.0	1.28	3.5	4.9	1.38
1964	4.2	6.1	1.45	3.7	4.6	1.22
1965	4.2	6.2	1.48	4.0	5.4	1.37
1966	4.0	5.6	1.40	4.1	5.8	1.44
1967	0.8	1.0	1.25	4.5	6.4	1.44
1968	- -			4.8	6.8	1.43
1969	- -			4.2	1.9	0.45
Total	100.0%					

counterparts. Are today's central area births a major source of tomorrow's growth in the suburbs?

Decentralization and New Manufacturing Plants

There is very little support for the view that new plants which incubate in the CBD, after a brief period of incubation, relocate in less dense areas outside the central city. As Table 4 shows, quite the opposite is the case. The youngest plants (3 years old or less) show a greater than average tendency to relocate within the zone of origin; i.e., newer firms move shorter distances than older ones.

Table 4 does suggest that after an initial three-year incubation period, some decentralization does occur, primarily to other central city areas outside the CBD. This is also observable in Table 5 which shows the destination patterns of relocating plants originating in the Core Outside the CBD. Plants three to six years old have a greater probability of moving to the Inner Ring.

Particularly interesting in Table 5 is the relocating pattern of the Core area's youngest plants. One and two-year-old plants are quite likely to move into the CBD. Both Tables 4 and 5 indicate that younger plants change their relocation pattern in short moves. The net effect is decentralization. Almost certainly a large number of plants incubating in the central city eventually end up in the less dense Inner and Outer Ring counties, but our evidence implies that it often takes more than one move to get there.[13] In fact, the evidence of core area

[13]The tendency for the relocation of manufacturers to cover relatively short distances has been widely observed. See Leone, op. cit., Chapter 4; R. Struyk, "A Progress Report on a Study of Intra-metropolitan Location of Industry," paper delivered to Committee on Urban Economics, Resources for the Future, 1969; and, Leon Moses and Bill Williamson, "The Location of Economic Activity in Cities," American Economic Review, May, 1967.

Table 4

The Destination Patterns of Relocating Plants

Originating in the CBD by Age of Establishment

Percent Distribution of Destinations

(measured in 1967 employment)

Date of Establishment Formation	1967-1969 Central Business District[a]	Core[a]	Inner Ring[a]	Outer Ring[a]
1960, earlier not available	78.1%	19.4%	1.9%	0.6%
1961	87.8	11.0	1.2	0.0
1962	72.0	26.0	1.6	0.4
1963	77.1	20.1	1.3	1.5
1964	74.2	21.6	4.2	0.0
1965	85.0	13.7	1.3	0.0
1966	83.5	12.4	3.3	0.8
1967	99.7	0.0	0.3	0.0
All Relocating Mfg. Plants	80.7%	17.1%	1.7%	0.5%

[a]The CBD is defined as the area on Manhattan south of 61st Street. It includes Zip Code zones 10001-10023, 10036, and 10038.
The Core is defined as the four boroughs of Manhattan, Brooklyn, the Bronx, and Queens.
The Inner Ring includes Richmond (Staten Island), Nassau and Westchester counties. These counties are less congested than the Core and constitute the area conventionally thought of as the suburbs.
The more remote Suffolk and Rockland counties are defined as the Outer Ring.

Table 5

The Destination Patterns of Relocating Plants Originating in the Core Outside the CBD by Age of Establishment

Present Distribution of Destinations

(measured in 1967 employment)

Date of Establishment Formation	Central Business District[a]	1967-1969 Core[a]	Inner Ring[a]	Outer Ring[a]
1960	17.3	77.3	3.2	2.2
1961	5.3	89.3	5.1	0.0
1962	6.7	83.3	9.3	0.8
1963	10.1	79.4	10.5	0.0
1964	12.1	82.4	2.3	3.2
1965	11.3	84.9	3.8	0.0
1966	24.2	73.6	2.2	0.0
1967	36.8	59.3	3.9	0.0
All	18.2%	76.6%	3.5%	1.7%

[a]See Table 4 for definitions.

plants suggests that some recentralization may even take place during the early stages of the life cycle of a typical manufacturing plant. The process is apparently a complex one and as our data show, not subject to easy generalization.

Because establishment relocation and employment growth are highly correlated, a final question arises as to whether or not the faster growing plants incubating in the CBD are decentralizing more rapidly than other plants. The evidence is contained in Table 6.

Table 6 indicates, first, that plants relocating outside the zone of origin generally grow more than those relocating within the zone of origin. This finding holds for plants originating in the CBD as well as others. Further for all plants, growth tends to be greater among newer plants (those established since 1962). However, those younger plants relocating outside the zone of origin grow more slowly than their older relocating counterparts.

The final column of Table 6 for the first time lends support to the view that the plants incubating in the CBD are later a source of growth outside the CBD. The highest rates of growth for relocating establishments originating in the CBD is experienced for plants over three years old with destinations outside the CBD. These were also the plants identified in Table 2 as the most likely to decentralize. It does appear, therefore, that the most successful plants (measured in employment growth) incubating in the CBD do move out to lower density areas.

Table 6

Growth Rates of Relocating Establishments by Age of Establishment, 1967-69

Date of Establishment Formation	All Relocating Establishments		Establishments Originating in the CBD Only	
	All Moves	Non-Local Move Only	All Moves	Moves out of CBD Only
1960	+ 3.7%	+ 7.5%	- 3.5%	+10.5%
1961	+17.5	57.6	+14.3	+52.5
1962	+16.9	133.8	+17.6	+14.0
1963	+40.6	36.3	+27.2	+53.4
1964	+23.5	39.9	+23.4	+27.3
1965	+27.7	3.5	+22.4	-13.0
1966	+31.3	12.9	+30.7	+ 5.3
1967	+26.1	44.8	+20.9	6.0
All	+ 8.1%	13.7%	+ 0.8%	+11.5%

III. CONCLUSIONS

According to the incubator hypothesis, new, small manufacturing plants might be expected to concentrate in the older areas in central cities due to the ready availability of low cost easily divisible loft space. Upon reaching maturity these plants might be expected to decentralize in keeping with well documented relocation trends. If today's plants incubating in decaying areas of central cities are a source of growth to less dense, more recently developed areas in the future, then there are implications for public policy in the area of urban renewal, local economic development and even fiscal policy.

Previous research had demonstrated that the births of new manufacturing enterprises were not concentrated in the old cities, as the incubator hypothesis would suggest. The dynamic aspects of the hypothesis, however, had not been subjected to empirical test.

In this paper we have examined the growth and relocation patterns of a sample of manufacturing firms in the New York metropolitan area. Stratifing by age of establishment, we were able to add little in the way of support to the incubator concept. We did observe both higher growth rates and greater probabilities of establishment relocation for younger plants, but there was little evidence that these activities were contributing disproportionately to decentralization. To the contrary, we found that the younger plants were more likely to relocate within the zone of origin.

After an incubation period lasting on the order of three years, we did observe that the fastest growing relocating plants originating in the CBD decentralized with greater frequency than their slower growing

counterparts. This phenomenon, however, was not peculiar to younger plants. Relocating firms, generally, tend to move longer distances when they experience higher rates of employment growth.

In sum, the formation of new plants is an important contributor to the economic vitality of urban areas. Firms initially locating in central areas tend to relocate outside the area slowly. Births of new plants and their growth and development over time contribute little to the growing disparities between central area and suburban employment opportunities.

While the incubator hypothesis was not confirmed, the evidence is consistent with a "life cycle" explanation of firm location patterns. This illustrates the necessity in further research of examining the characteristics of the locating establishments. Research which focuses on the location behavior of industries or the characteristics of geographic areas is incomplete without the consideration of firm structure and history.