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DETERMINANTS OF INTRA-URBAN LOCATION OF  
MANUFACTURING EMPLOYMENT: AN ANALYSIS OF SURVEY  
RESULTS FOR BOGOTA, COLOMBIA\*

By

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(Revised)

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## PREFACE

This paper forms part of a large program of research grouped under the rubric of the "City Study" of Bogota, Colombia, being conducted at the World Bank in collaboration with Corporacion Centro Regional de Poblacion. The goal of the City Study is to increase our understanding of the workings of five major urban sectors — housing, transport, employment location, labor markets, and the public sector -- in order that the impact of policies and projects can be assessed more accurately.

The author has benefited from comments and discussions with Gregory Ingram, Douglas Keare, Steve Putman, and participants in seminars at The World Bank and Corporacion Centro Regional de Poblacion. He thanks Maria Clara de Posada and Jose Fernando Pineda who conducted the survey of establishments; Wilhelm Wagner and Leslie Kramer for research assistance.

## ABSTRACT

This paper describes the sampling strategy of the establishment survey conducted in Bogota to study the determinants of manufacturing employment location, and reports descriptive findings based on the survey.

The analysis of the survey results revealed that the industry is dominated by single plant operations with a moderate production scale; most firms use a line-flow type production process housed in a single story plant; new firms are small and operate in old buildings. Most of shipments of inputs and final products are made by trucks; rail is seldom used. The firms export less than 50% of their products to outside Bogota. The plant relocation tends to accompany changes in production technology. For most movers, the distance moved was short, about 1-2 km; the large size firms moved longer distances. More than 80 percent of workers stayed with the same firms after relocation. For the majority of firms, both input and output delivery distances and the commuting distance of production workers stayed about the same after move while the commuting distance of administrative workers increased only slightly.

The plant space was the most important factor in the firm's location choice, followed by rent payment, proximities to suppliers, amenities of zones, road access, proximities to clients and the quality of public services. Twenty-two percent of sample firms had a plan to relocate within the next five years; the medium size firms (with about 50 employees) showed the highest propensity to relocate, while most of the large firms (with more than 100 employees) did not have such a plan.

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## 1. Introduction

The work reported in this paper is part of the continuing research effort in the Bogota "City Study" project in the World Bank. This paper presents selected findings on the determinants of manufacturing employment location in Bogota, Colombia, based on the establishment survey conducted for the City Study project.

Using the annual industrial directory data compiled by the National Statistics Department (DANE), Bogota's manufacturing location patterns and their changes were extensively analyzed before (Lee, 1981); this analysis, performed in terms of births, deaths, and relocation of firms, revealed a high degree of employment location dynamics and strong evidence of the spatial decentralization of manufacturing employment in Bogota, which is briefly described in the next section.

In order to explain these location patterns, a survey of manufacturing establishments was conducted in Bogota using the industrial directory as the sample base. The survey questionnaire was designed to take no more than one hour to respond and did not require the respondents to look up their accounting books, but the questionnaire contained a large amount of information with nearly 300 computer readable variables. This paper will present most salient aspects of the survey results which provide the basis for understanding the changing location patterns of manufacturing employment summarized in the next section. The analysis in this paper is descriptive; an analytical model of employment location was constructed earlier and estimated using this survey data (Lee, 1982).

After a brief overview of the manufacturing employment location patterns in Bogota, the sampling strategy is briefly described and the nature of the sample outcome is summarized.<sup>1/</sup> In the rest of the paper, the survey results are presented in three categories of findings: (1) Establishment characteristics, (2) site characteristics, and (3) the factors considered to be important for the respondent's location choice. These results are contrasted and compared among the sample establishments by establishment size, location history (i.e., mature firms, births, and movers), and type of industry.

The underlying theoretical framework is that of a firm of particular type will locate at a site with particular attributes in such a way that the selected location is optimal to the firm in an urban area, in terms of profits, costs, or some other criteria.<sup>2/</sup> The establishment characteristics include type of products, production process, building characteristics, lot size, floor space, and employment size by skill. The site attributes include proximities to product markets and input suppliers, commuting distance, transport modes, the quality and availability of public utilities and municipal services.

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1/ The studies by Schmenner (1981) on Cincinnati and New England were useful for the survey work reported in this paper.

2/ See Lee (1982) for a formulation of such a model and the estimation results using the same data set described in this paper.

## 2. Overview of Bogota's Employment Location Patterns<sup>3/</sup>

In the studies of employment location in the literature, changes in location patterns in an urban area were examined at the margin by decomposing changes in the stock of employment in an area by the flows of births and deaths, relocation of jobs, and stationary growth and decline of employment.<sup>4/</sup> This approach is analytically attractive and avoids cross-section bias. The Bogota study also followed this approach, and the survey results reported in this paper will contrast and compare the behavioral responses by this classification of firms.

According to a 1977 DANE household survey, manufacturing jobs accounted for 25 percent of employment in Bogota,<sup>5/</sup> which comes close to the manufacturing share of 25 to 30 percent in large U.S. cities such as Boston, Chicago, and Los Angeles. In terms of employment dynamics, however, Bogota does not resemble large old U.S. cities

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<sup>3/</sup> This part comes from a previous study reported in Lee (1981).

<sup>4/</sup> Schmenner (1981), Struyk and James (1975), and Leone (1971) in the U.S., and Firn (1976), Dennis (1978), and Mason (1980) in the U.K.

<sup>5/</sup> In 1977, Bogota's population was less than 4 million.

like New York, Boston, or Cleveland. Table 1 indicates that the annual birth rate of firms in Bogota exceeds that of all five U.S. cities compared; Phoenix, with a birth rate of 7.6 percent, comes closest to Bogota's 8.8 percent. It should be also noted that the annual birth rate is greater than the annual death rate for Bogota, Cali,<sup>6/</sup> Phoenix, and New York;<sup>7/</sup> the opposite is true for Boston, Minneapolis, and Cleveland. In all cases, the activity rates in terms of establishments are greater than the rates based on employment. This indicates that the marginal firms are small ones which have a greater propensity to move, to start up and close down business.

Bogota is divided into 38 subareas called comunas. To observe changes in employment location patterns, we aggregated the comunas to 6 rings (see the attached map). In Table 2, we find strong evidence of decentralization of manufacturing employment in Bogota. During 1970-75, the central business district (Ring 1) experienced a net loss of manufacturing jobs, but manufacturing employment grew at an accelerating rate as the distance from the city center increases. This resulted from a steady movement of manufacturing firms outward as they grew larger and needed more space. Moreover, small new firms (with less than 25 employees) tended to locate in the central area where various externalities were readily available,<sup>8/</sup> and the birth of large new firms (with 100 or more employees) tended to take place in the outer areas of the city.

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6/ Cali is the third largest city in Colombia with a population of about 1 million.

7/ This was for the late 60's. The situation might have been reversed by now.

8/ The data were unable to reject the "incubator hypothesis" (Lee, 1981).

Table 1: BIRTH, DEATH AND RELOCATION RATES IN BOGOTA, CALI  
AND U. S. CITIES

	Births				Deaths				Movers <sup>d/</sup>			
	Establish-	Employment	Establish-	Employment	Establish-	Employment	Establish-	Employment	ments	base	% of Annual base rate	rate
	ments	base	% of Annual base rate	rate	ments	base	% of Annual base rate	rate	ments	base	% of Annual base rate	rate
Cleveland <sup>a/</sup>	9.97	3.22	2.59	0.86	14.07	4.49	7.75	2.52	13.83	4.41	5.77	1.89
Minneapolis- St. Paul <sup>a/</sup>	12.29	3.94	6.17	2.02	18.00	5.67	11.25	3.62	15.93	5.05	8.28	2.69
Boston <sup>a/</sup>	6.10	1.99	1.30	0.43	13.40	4.28	8.00	2.60	9.80	3.17	4.70	1.54
Phoenix <sup>a/</sup>	24.40	7.55	12.10	3.88	20.20	6.32	5.30	1.74	8.90	2.88	4.70	1.54
New York <sup>b/</sup>	10.21	4.98	3.95	1.96	7.56	3.71	3.55	1.76	11.45	5.57	1.24	0.62
Bogota <sup>c/</sup>	52.38	8.79	31.96	5.70	27.01	4.90	12.61	2.40	19.12	3.56	16.59	3.12
Cali <sup>c/</sup>	43.13	7.44	24.48	4.48	26.88	4.88	11.27	2.16	18.33	3.42	10.40	2.00

<sup>a/</sup> From R. Struyk and F. James, Intrametropolitan Employment Location, Lexington Books, 1975; covered 1965-68 period (1965 was the base year).

<sup>b/</sup> From R. Leone, Location of Manufacturing Activity in the New York Metropolitan Area, 1971; covered 1967-69 period (1967 was the base year).

<sup>c/</sup> The period covered was 1970-1975; 1970 was used as the base year. The base year figures can be seen in Lee (1978).

<sup>d/</sup> In the case of Bogota, the figures include establishments which moved at least to another sección changing DANE's six-digit zone code; in the case of Cali the figures include establishments which moved at least to another barrio changing the first four digits of DANE's zone code. Including the moves within the same sección, the annual relocation rate of establishments was 5.12 percent for Bogota and 4.28 percent for Cali.

Source: Lee (1981).

BOGOTA: Ring System Based on Comunas

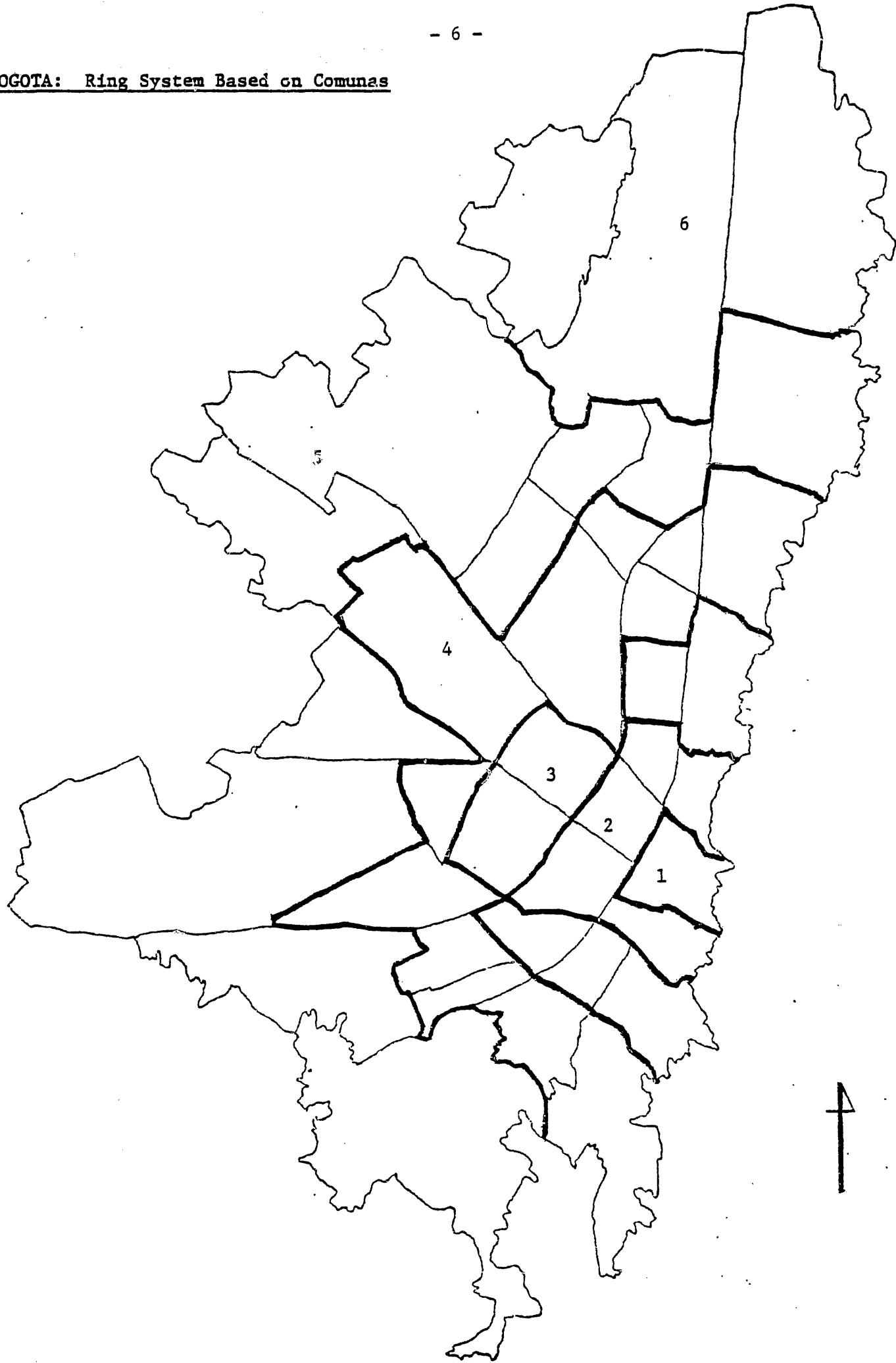


Table 2: DISTRIBUTION OF MANUFACTURING EMPLOYMENT<sup>a/</sup> BY RING, BOGOTA, 1970-75

<u>Ring</u>	<u>1970</u>		<u>1975</u>		<u>Annual Average Growth Rate (%)</u>
	<u>Persons</u>	<u>%</u>	<u>Persons</u>	<u>%</u>	
1(CBD)	4,538	5.60	4,102	3.47	-2.00
2	11,767	14.53	14,898	12.59	4.83
3	34,351	42.42	47,858	40.44	6.86
4	18,112	22.37	25,958	21.94	7.46
5	11,548	14.26	24,047	20.32	15.80
6	391	0.48	729	0.62	13.27
n.a.	266	0.33	741	0.63	-
Total	80,973	100.00	118,333	100.00	7.88

a/ Establishments with 10 or more employees.

Source: Lee (1981).

### 3. Sampling Strategy and Sample Outcome <sup>9/</sup>

A sample of 126 establishments interviewed in the survey was drawn from DANE's 2,629 distinct firm records in the industrial directory files covering 1970-1975, <sup>10/</sup> stratified by the following four categories: (1) location history, i.e., mature firms, movers, and births; <sup>11/</sup> (2) the zone system defined by 38 comunas; (3) the type of industry defined by three digit SIC codes; and (4) firm size by employment.

In order to minimize the cost of sampling while having a sufficient number of observations for econometric estimation, we chose the textile industry and the fabricated metal industry as two main industries to be studied. These industries without much locational idiosyncrasy should be more amendable to policies than some other industries such as cement or steel. Moreover, both industries had a large share of establishments in Bogota's manufacturing, accounting for 50 percent of total manufacturing employment. The homogeneity of firms in each industry group makes it possible to test behavioral hypotheses with sufficient degrees of freedom. However, we added as a third group, the "other industries" category, to do mainly descriptive studies about establishments in various other types of industries.

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<sup>9/</sup> This part was reported earlier in Lee (1982) where the same data set was used.

<sup>10/</sup> The original DANE (National Statistics Department) files had 3,388 records for the six-year period. In order to maintain consistency in coverage over the period, however, firms with less than 10 employees or those which appeared only for one year in the directory were not included in our master file. The basic structure of the industrial directory data was documented in Lee (1978).

<sup>11/</sup> Mature firms are defined as those that appeared in all six annual directories with the same address; "births" are those that appeared for the first time in any year during 1971-1975; movers are those that relocated within Bogota during 1971-1975.

The second consideration given in the sampling process was to over-sample large firms so that the number of workers included in the sample could be maximized. Finally, an attempt was made to cover a wide geographic area in such a way that spatial analyses could be possible including the estimation of the rent and wage gradients covering the entire city area. Our target sample size was 120 with about equal shares of establishments among the three types of location history.

The realized sample of 126 establishments<sup>12/</sup> consists of 58 mature firms, 50 movers (including two firms that moved to Bogota from outside) and 18 births (see Table 3). The newly established firms were mostly small (Table 5). <sup>13/</sup> The sample coverage across zones was satisfactory; with 27 comunas covered, the spread was fairly even over the three Rings which have high manufacturing employment densities (see Table 2 and the map on page 6). On the other hand, only a small number of establishments was selected from Ring 1 (CBD) and Ring 6 (three residential comunas in the north).

In some cases the four-way stratification severely limited the possibility of drawing sample establishments from a specific population category. For example, not enough textile firms were located in certain comunas. Therefore, sample establishments were also selected from two

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<sup>12/</sup> Of the 128 interviews completed successfully, two cases had to be dropped from the final sample: One firm was located outside Bogota, and the other one had recently moved to another city (Barranquilla).

<sup>13/</sup> Making interview appointments with small new firms was extremely difficult and the rate of making a final visit for interview was low.

Table 3: SAMPLE COMPOSITION: NUMBER OF ESTABLISHMENTS  
BY ZONE AND FIRM TYPE

Zone	Mature	Births	Movers Within Bogota	Movers From Outside	Total
Ring 1	0	2	2	0	4
	0.00	50.00	50.00	0.00	100.00
	0.00	11.11	4.17	0.00	3.17
Ring 2	7	3	5	0	15
	46.67	20.00	33.33	0.00	100.00
	12.07	16.67	10.42	0.00	11.90
Ring 3	17	6	13	1	37
	45.95	16.22	35.14	2.70	100.00
	29.31	33.33	27.08	50.00	29.37
Ring 4	16	3	13	1	33
	48.48	9.09	39.39	3.03	100.00
	27.59	16.67	27.08	50.00	26.19
Ring 5	16	4	12	0	32
	50.00	12.50	37.50	0.00	100.00
	27.59	22.22	25.00	0.00	25.40
Ring 6	2	0	3	0	5
	40.00	0.00	60.00	0.00	100.00
	3.45	0.00	6.25	0.00	3.97
Total	58	18	48	2	126
	46.03	14.29	38.10	1.59	100.00
	100.00	100.00	100.00	100.00	100.00

Source: The City Study Establishment Survey

Table 4: SAMPLE COMPOSITION: NUMBER OF ESTABLISHMENTS  
BY ZONE AND INDUSTRY

Zone	Textile	Apparel	Fabricat- ed Metal	Non- electric Machinery	Other	Total
Ring 1	1 25.00 3.03	1 25.00 10.00	1 25.00 2.86	0 0.00 0.00	1 25.00 2.56	4 100.00 3.17
Ring 2	3 20.00 9.09	1 6.67 10.00	4 26.67 11.43	1 6.67 11.11	6 40.00 15.38	15 100.00 11.90
Ring 3	6 16.22 18.18	6 16.22 60.00	13 35.14 37.14	4 10.81 44.44	8 21.62 20.51	37 100.00 29.37
Ring 4	12 36.36 36.36	1 3.03 10.00	9 27.27 25.71	2 6.06 22.22	9 27.27 23.08	33 100.00 26.19
Ring 5	10 31.25 30.30	1 3.13 10.00	6 18.75 17.14	2 6.25 22.22	13 40.63 33.33	32 100.00 25.40
Ring 6	1 20.00 3.03	0 0.00 0.00	2 40.00 5.71	0 0.00 0.00	2 40.00 5.13	5 100.00 3.97
Total	33 26.19 100.00	10 7.94 100.00	35 27.78 100.00	9 7.14 100.00	39 30.95 100.00	126 100.00 100.00

Source: The City Study Establishment Survey

Table 5: SAMPLE COMPOSITION: NUMBER OF ESTABLISHMENTS  
BY FIRM TYPE AND EMPLOYMENT SIZE

	1 - 4 <sup>a/</sup>	5 - 9	10 ~ 19	20 - 49	50 - 99	100 - 9,999	Total
Mature	0	1	8	13	4	32	58
	0.00	1.72	13.79	22.41	6.90	55.17	100.00
	0.00	25.00	38.10	34.21	23.53	72.73	46.03
	-	6.00	16.25	33.54	81.75	324.72	194.66
Births	1	2	3	9	1	2	18
	5.56	11.11	16.67	50.00	5.56	11.11	100.00
	50.00	50.00	14.29	23.68	5.88	4.55	14.29
	3.00	6.00	13.00	26.56	63.00	174.00	39.11
Movers	1	1	10	16	12	10	50
	2.00	2.00	20.00	32.00	24.00	20.00	100.00
	50.00	25.00	47.62	42.11	70.59	22.73	39.68
	3.00	7.00	13.50	31.94	78.75	335.60	99.14
Total	2	4	21	38	17	44	126
	1.59	3.17	16.67	30.16	13.49	34.92	100.00
	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	3.00	6.25	14.48	31.21	78.53	320.34	134.53

a/ Persons.

b/ The bottom number in each cell is the mean employment size of firms in that cell.

Source: The City Study Establishment Survey.

other industry categories that are closely related with the two main industries, namely, the textile industry was supplemented by the apparel industry, and the fabricated metal industry by the non-electric machinery industry. As shown in Table 4, the final sample has fairly even shares among the three industry groups: about 35% each for the two main industry groups and 30% for the "other" category.

In Table 5, we see that the average size of mature firms in the sample is about four times larger than the average size of births, and more than twice that of movers. This resulted from the design of over-sampling of large size firms; the sample average firm size of 135 persons is about twice as large as the average firm size of the establishments in the population.<sup>14/</sup>

#### 4. Selected Findings<sup>15/</sup>

This section presents selected findings of the survey results in three categories, as mentioned above: (1) Establishment characteristics, (2) site characteristics, and (3) important factors for location choice. Particular attention is given to the characteristics of the movers and important factors that influence their location choice. The discussion will be focused on variations among the three

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<sup>14/</sup> According to the industrial directory file of 1975, the average firm size of 1,829 establishments with 10 or more employees was 65 persons.

<sup>15/</sup> The data file has gone through a number of iterations of cleaning and editing. The final data file is stored with a label, D/WILI/KSLSURVEY297, at the World Bank computer center.

types of firms and variations across the space as the distance from the CBD increases.

#### Establishment Characteristics

Production plant. Table 6 shows several aspects of operational characteristics of the production plant. For the sample firms as a whole, more firms use a line-flow type production process housed in a single story plant. There is, however, an interesting contrast between the births on one hand, and the mature firms and the movers on the other. The "birth firms" <sup>16/</sup> are much smaller in size (about one-third of the sample average) without having much land space for expansion. Compared with other two types of firms, a large proportion of the birth firms tend to produce with a batch process type production technique on a single shift basis. The buildings used by the birth firms are much older (twice as old as those of movers) and tend to be more complex with a combination of single and multi-level structures. These general plant attributes of the birth firms represent the characteristics of places of manufacturing activities in the central area. These findings on the attributes of the birth firms are consistent with the "incubator hypothesis" which states that small new firms tend to locate in a central area where various externalities are readily available. <sup>17/</sup>

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<sup>16/</sup> For convenience, the births, i.e., newly established firms, will be called the "birth firms."

<sup>17/</sup> The "incubator Hypothesis" was formally tested in Lee (1981) for Bogota. Struyk and James (1975) tested this hypothesis for U.S. cities.

Table 6: PLANT CHARACTERISTICS BY FIRM TYPE

	<u>Mature</u>	<u>Births</u>	<u>Movers</u>	<u>All</u>
<b><u>Production Process (% of estab.)</u></b>				
Batch	29	44	24	29
Line flow	45	33	50	45
Both	16	11	10	13
Other	10	12	16	13
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>
<b><u>Average Age of Buildings (years)</u></b>				
	19	24	12	17
<b><u>Land for Expansion (% of estab.)</u></b>				
Yes	41	17	30	33
No	57	78	56	60
n.a.	2	5	14	7
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>
<b><u>Number of Floor Levels (% of estab.)</u></b>				
One story	64	67	64	64
Two stories	19	17	14	17
Three stories	5	0	8	6
Four or more	2	0	2	2
Combination	10	17	12	12
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>
<b><u>Number of 8-Hour Shift (% of estab.)</u></b>				
One	48	83	70	62
Two	33	6	14	21
Three	16	11	16	15
n.a.	3	-	-	2
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>
<b><u>Average Employment Size (Persons)</u></b>				
	195	39	99	135
<b><u>Number of Establishments</u></b>				
	58	18	50	126

Source: The City Study Establishment Survey.

The plant characteristics of the recent movers are quite similar to those of the mature firms except that the latter have a larger firm size and use more multi-shift operations. It is possible that the level of production technology of the movers tends to approach that of the mature firms, which may represent the currently available level of technology.

Multi-plant operations. It is worth to note that only fifteen firms in the sample reported multi-plant operations; of these fifteen establishments visited, eleven were the company headquarters with their main plant and only the remaining four were branch plants. Eight firms had two branch plants while one firm had as many as seven. Of a total of 33 branches reported in the survey, 20 were located in Bogota. Only two establishments of the multi-plant firms were specializing in a portion of manufacturing process, indicating the near absence of the vertical integration of production process. We may conclude that the manufacturing industry in Colombia is dominated by single-plant operations with a moderate scale of production. 18/

#### Site Characteristics

Shipments and market access. In order to assess various means of input and output shipments, the questionnaire asked the percentage distribution of the value of goods shipped by different modes of

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18/ Based on the industrial directory data, Bogota's average firm size in the largest size category (500 or more) was about 700 persons, only about half the size of the same category in large U.S. cities.

transport. The use of trucks was by far the dominating means of goods shipments; Table 7 shows that 81 percent of firms use trucks for shipping more than 95 percent of their final products, and 79 percent of firms receive more than 95 percent of their inputs delivered by truck. On the average the sample firms use trucks for shipments of about 87 percent of both inputs and outputs. The use of trucks by the birth firms was much less than in the case of the other two groups, indicating their apparent difficulties with the access to roads and trucking facilities in the central area; or they may use cheaper means of transport.

The use of trucks has been well documented as a major explanatory factor for the decentralization trend in the U.S. cities.<sup>19/</sup> Although the highway network in Colombia is by no means at a scale comparable to the U.S., it seems clear that the extensive use of trucks (or the lack of the importance of rail) has contributed to the decentralization trend of manufacturing employment in Bogota. It is remarkable to note that none of the 126 firms uses rail for shipment of outputs and only three firms indicated that they receive about 20% of their inputs by rail. Only two decades ago, the rail station near the CBD played the central role for goods shipments.

On the average the sample firms exported (to outside Bogota) about 43 percent of their outputs and imported about the same percent

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<sup>19/</sup> For example, Hoover and Vernon (1959), and Moses and Williamson (1967).

Table 7: SHIPMENTS OF OUTPUT AND INPUTS BY FIRM TYPE

	<u>Mature</u>	<u>Births</u>	<u>Movers</u>	<u>All</u>
<u>Output Shipped by Truck (% of estab.)</u>				
Less than 50%	1.7	0.0	2.0	1.6
50-94%	6.9	0.0	12.0	7.9
95-100%	84.5	77.8	78.0	81.0
n.a.	6.9	22.2	8.0	9.5
Total	100.0	100.0	100.0	100.0
(mean) a/	(89.7)	(77.8)	(88.8)	(87.7)
<u>Inputs Shipped by Truck (% of estab.)</u>				
Less than 50%	1.7	11.1	2.0	3.2
50-94%	13.8	5.6	6.0	9.5
95-100%	81.0	66.7	80.0	78.6
n.a.	3.5	16.7	12.0	8.7
Total	100.0	100.0	100.0	100.0
(mean) a/	(92.4)	(75.3)	(84.6)	(86.8)
<u>Output Sold in Bogota (% of estab.)</u>				
Less than 25%	15.5	16.7	22.0	18.3
25-49%	19.0	0.0	20.0	16.7
50-74%	25.9	33.3	34.0	30.2
75-100%	39.7	50.0	22.0	34.1
n.a.	0.0	0.0	2.0	0.8
Total	100.0	100.0	100.0	100.0
(mean) a/	(58.8)	(71.7)	(50.6)	(57.4)
<u>Inputs Bought in Bogota (% of estab.)</u>				
Less than 25%	31.0	5.6	12.0	19.8
25-49%	13.8	11.1	24.0	17.5
50-74%	15.5	11.1	12.0	13.5
75-100%	32.8	66.7	44.0	42.1
n.a.	6.9	5.6	8.0	7.1
Total	100.0	100.00	100.0	100.00
(mean) a/	(50.7)	(75.7)	(58.1)	(57.2)
<u>Number of Establishments</u>				
	58	18	50	126

a/ The average percent of the value of output or inputs for categories of firms.

Source: The City Study Establishment Survey.

of inputs (Table 7). The extent of exports by the manufacturing industries in Bogota is small compared to that of large U.S. cities. The birth firms are more oriented to the local markets for both output and inputs than the other two groups. On the whole it seems difficult to classify the manufacturing industries as the export sector in Bogota. According to Schmenner (1981), in Cincinnati, for example, manufacturing firms exported between 70 to 90 percent of their output depending on the size of the firm; the mover firms with 100 or more employees in that city exported 95 percent of their outputs.

Evaluation of present location. In order to evaluate the conditions of the present locations, the respondent was asked to state whether he feels very satisfied, more or less satisfied, or dissatisfied with respect to various locational attributes. Table 8 reports the percent of firms in each firm type that answered "very satisfied" with respect to each individual attribute. For example, 43 percent of the mature firms responded "very satisfied" with respect to plant capacity at the present site. On the whole, the sample firms were "very satisfied" with road access, proximities to clients and suppliers, and the availability of unskilled workers, while dissatisfied with the quality of municipal services, zonal amenities, the availability of skilled workers, and the cost of land for expansion.

It is interesting to note that a much larger proportion of the movers felt "very satisfied" with plant capacity than the mature firms. However, only a few movers responded "very satisfied" with respect to the cost of land for expansion. This may indicate the

Table 8: EVALUATION OF PRESENT LOCATION BY FIRM TYPE

	<u>Mature</u>	<u>Births</u>	<u>Movers</u>	<u>All</u>
(Percent of Establishments in Each Type)				
<u>"Very satisfied"</u> with:				
Plant Capacity	43	39	62	50
Cost of Land for Expansion	31	17	16	23
Availability of Skilled Workers	31	22	10	21
Availability of Unskilled Workers	62	39	60	58
Quality of Public Services	26	50	36	33
Quality of Municipal Services	14	11	16	14
Road Access	81	72	88	83
Proximity to Clients	78	72	74	75
Proximity to Suppliers	72	28	52	58
Amenities of Zone	24	6	18	19
Number of Establishments	58	18	50	126

a/ The questionnaire offered three possible responses: very satisfied, satisfied, not satisfied.

b/ Electricity, water, etc.

c/ Police, fire protection, etc.

Source: The City Study Establishment Survey.

potential for further growth of the movers and subsequent relocations. Another point to note is the unavailability of skilled workers in the case of movers. Since the majority of workers stays with the firm after move (Table 11), this need for skilled workers must be for additions to the current work force after move. The new location may be too far from high income residential areas or may have other undesirable attributes. The birth firms seem to have difficulties with attracting even unskilled workers.<sup>20/</sup> All three types of firms felt dissatisfied with the quality of municipal services. The birth firms showed the highest satisfaction with the quality of public services and the lowest for zonal amenities relative to the other two types of firms, again indicating the characteristics of their central locations.

The information in Table 8 was processed according to the zone of location (by ring) and reported in Table 9. The level of satisfaction increases with the distance from the center with respect to all attributes except for the quality of public services, the quality of municipal services, and the proximity to clients. This may indicate that public policies for infrastructure investment have been lagging behind the demand for better-quality utilities and municipal services and for improved transport facilities in the outer areas.

The quality of public services was more closely evaluated in the survey for specific items. Table 10 shows spatial variations in

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<sup>20/</sup> The average monthly wage paid by this group of firms (2,700 pesos) was much lower than the sample average (3,400 pesos).

Table 9: EVALUATION OF PRESENT LOCATION BY ZONE

	Ring 1	Ring 2	Ring 3	Ring 4	Ring 5	Ring 6	All
<u>(Percent of Establishments in Each Ring)</u>							
<u>"Very satisfied"</u> with:							
Plant Capacity	75	47	38	52	59	60	50
Cost of Land for Expansion	0	27	5	33	38	0	23
Availability of Skilled Workers	25	7	14	15	47	0	21
Availability of Unskilled Workers	25	53	58	55	66	80	58
Quality of Public Services	50	40	41	36	19	20	33
Quality of Municipal Services	0	27	14	18	9	0	14
Road Access	50	47	89	85	94	80	83
Proximity to Clients	75	80	89	76	59	60	75
Amenities of Zone	0	7	14	21	25	60	19
Number of Establishments	4	15	37	33	32	5	126

a/ The questionnaire offered three possible responses: very satisfied, satisfied, not satisfied.

b/ Electricity, water, etc.

c/ Police, fire protection, etc.

Table 10: QUALITY OF PUBLIC SERVICE BY ZONE

	Ring 1	Ring 2	Ring 3	Ring 4	Ring 5	Ring 6	All
<u>(Percent of Establishments in Each Ring)</u>							
Electricity Never Interrupted	75.0	66.7	73.0	63.6	62.5	40.0	65.9
Excellent Fire Protection	0.0	20.0	8.1	15.2	6.3	20.0	11.1
Sewerage and Garbage Collection Seldom Interrupted	75.0	73.3	32.4	33.3	31.3	60.0	39.7
Road Never Interrupted	100.0	100.0	70.3	90.9	96.9	80.0	87.3
Number of Firms	4	15	37	33	32	5	126

Source: The City Study Establishment Survey.

the quality of public services in terms of the frequency of interruption. For all four items considered, the quality level shows a declining tendency as the distance from the center increases. Such tendency was most vivid in the case of sewerage and garbage collection. On the whole the sample firms were least satisfied with fire protection while most satisfied with road services.

Important Factors for Location Choice

Characteristics of movers. As shown in Table 11 in all three main industry categories, the proportion of movers that had "still serviceable" conditions at the previous plant was greater than that of firms with previous plants which were cramped, obsolete, or worn out. Nevertheless, the majority of the movers went through considerable changes in production technology. The fabricated metal industry, however, experienced only moderate changes in technology; as much as 40 percent of firms in this industry kept the same production method after move. In the case of the textile industry and the "other industry" category, the plant relocation tends to accompany substantial changes in technology.

The fabricated metal industry, without much changes in production technology, was able to retain the highest percent of workers after relocation. For all sample firms, 80 percent of employees stayed with the same establishment after relocation.

Table 11: CHARACTERISTICS OF MOVERS

	<u>Textiles</u>	<u>Apparel</u>	<u>Metal</u>	<u>Fabricated Machinery</u>	<u>Non-elect. Other</u>	<u>All</u>
(Percent of Establishments)						
<u>Condition of Previous Plant</u>						
Good but cramped	18	25	30	0	31	24
Good but obsolete	24	50	20	33	19	21
Still serviceable	35	0	50	67	31	31
Worn out	23	25	0	0	13	11
n.a.	0	0	0	0	6	6
Total	100	100	100	100	100	100
<u>Change in Technology After Move</u>						
Considerably	47	100	0	67	38	41
Moderately	41	0	60	33	31	31
No change	12	0	40	0	19	11
n.a.	0	0	0	0	13	13
Total	100	100	100	100	100	100
<u>Percent of Workers Stayed After Move</u>						
Less than 50%	18	0	0	33	19	11
50-99%	29	0	50	0	25	31
100%	53	100	50	67	44	51
n.a.	0	0	0	0	13	13
Total <sup>a/</sup> (mean)	100 (79)	100 (100)	100 (90)	100 (90)	100 (67)	100 (8)
<u>Number of Establishments</u>						
	17	4	10	3	16	5
<u>Distance of Move by Firm Size</u>						
	<u>Less Than 25 Persons</u>		<u>25-99 Persons</u>		<u>100 or More Persons</u>	
1-2 km	67%		32%		30%	
3-5 km	11		18		20	
6-10 km	6		36		30	
more than 10 km	11		9		20	
n.a.	6		5		0	
Total (mean in km)	100 (3.5)		100 (5.3)		100 (46.3) <sup>b/</sup>	
<u>Number of Establishments</u>	18		22		10	

<sup>a/</sup> Average percent of the number of workers who stayed after move.

<sup>b/</sup> Includes two firms that moved to Bogota from other cities.

Table 11 also shows that the moving distance increases with firm size.<sup>21/</sup> Most of small firms moved about 1 to 2 kilometers while large ones more than 5 kilometers. For the movers as a whole, the majority moved only a short distance.<sup>22/</sup>

Important Location Factors for Movers. In order to examine the experiences of the movers after relocation, the respondent was asked to evaluate changes in various attributes of the establishment and the plant site. Table 12 lists these attributes and reports to what extent they changed after relocation. First we note that in terms of median percent increase after move, the plant space increased most, followed by land space and the cost of public services.<sup>23/</sup> On the other hand, there were virtually no changes in the input delivery distance and the product shipment distance as was also the case for commuting distance of workers. This does not mean that these factors were unimportant for location choice; it is more likely that these factors were so important that the firms tended to move without affecting proximities to the markets and suppliers, and access to labor.

Table 13 lists a number of factors that may influence the location choice. Seventy-five percent of the movers indicated that

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<sup>21/</sup> This is consistent with the previous findings based on the industry directory files in Lee (1981), and also confirms the similar findings by Moses and Williamson (1967) in the case of Chicago.

<sup>22/</sup> Schmenner (1981) found similar evidence.

<sup>23/</sup> This increase is obviously in total cost of public services, not unit cost.

Table 12: EXPERIENCES AFTER RELOCATION OF MOVERS

		Percent of Movers <sup>a/</sup>			Median % Increase <sup>d/</sup>
		After < Before	After - Before	After > Before	
1. Production		12.2	8.5	79.6	29
2. Plant space		10.4	2.1	87.5	60
3. Land space		12.5	2.1	85.4	51
4. Number of skilled workers <sup>c/</sup>		8.7	39.1	52.2	22
5. Wage of skilled workers <sup>c/</sup>		0.0	43.4	56.5	30
6. Number of unskilled workers	10.4	25.0	64.6	25	
7. Wage of unskilled workers <sup>b/</sup>	0.0	34.0	66.0	31	
8. Distance to work by managers	18.8	43.8	37.5	9	
9. Distance to work by workers	22.9	52.1	25.0	1	
10. Distance of product shipment	12.5	68.8	18.8	2	
11. Distance of input delivery <sup>b/</sup>	18.8	62.5	18.8	0	
12. Profits	17.0	29.8	53.2	11	
13. Local tax payments	2.1	29.2	68.8	32	
14. Costs of public services <sup>c/</sup>	6.5	26.1	67.4	51	

a/ 48 movers of the sample; sum equals 100 (%) for each item.

b/ One firm did not respond.

c/ Two firms did not respond.

d/ Median of actual percent increase after move among all firms responded.

Source: The City Study Establishment Survey.

Table 13: IMPORTANT FACTORS FOR CHOOSING PRESENT LOCATION  
(Percent of Movers)

<u>Factors</u>	<u>Order of Importance</u>		
	1st	2nd	3rd
1. Plant capacity	74.5	6.1	13.0
2. Rent payment	4.3	18.2	-
3. Availability of Skilled workers	-	3.0	-
4. Cost of skilled workers	-	-	4.3
5. Availability of unskilled workers	-	-	-
6. Cost of unskilled workers	-	-	-
7. Cost of public services	-	-	-
8. Quality of public services	-	6.1	13.0
9. Cost of land for expansion	6.4	6.1	13.0
10. Proximity of suppliers	2.1	18.2	4.3
11. Proximity of clients	6.4	6.1	17.4
12. Proximity of competitors	-	-	-
13. Road access	2.1	9.1	8.7
14. Rail access	-	-	-
15. Proximity to business services	-	3.0	-
16. Property taxes	-	-	-
17. Municipal services	-	3.0	4.3
18. Security	-	-	-
19. Amenities of zone	4.3	18.2	17.4
20. Community attitude	-	-	4.3
Other	-	3.0	-
TOTAL	100.0	100.0	100.0

a/ Of 48 movers, 47 responded to 1st, 33 to 2nd, 23 to 3rd.

Source: The City Study Establishment Survey.

plant capacity is the most important factor. Those factors that emerged with secondary importance were rent payment, the proximity to suppliers, and amenities of the zone. The proximity of clients, the quality of public services, and the cost of land for expansion were also considered moderately important.

In Table 14, it is significant to note that the quality of public utilities and municipal services did not improve after relocation for the majority of firms; moreover, 63 percent of firms felt that the service level of waste removal became worse. Electricity was the only item that showed some sign of improvement after relocation. This may imply that in Bogota the public sector plays an insignificant role in influencing location choice of manufacturing firms; it may also reflect the lack of specific policies to induce industries to certain areas.

Plans to expand and relocate should reflect the extent of the location dynamics, i.e., the need for adjustment toward a locational equilibrium in an urban area. About a third of the mature firms in the sample indicated that they seriously considered relocation during the eight year period since 1970, and 16 percent considered opening branch plants (Table 15). It should be noted that the mature firms that considered relocation were mostly medium-size firms. While only a few firms opened branch plants during this period, the majority of establishments had on-site expansion.

Table 16 shows that for the sample establishments as a whole including all types of firms, 22 percent indicated having a plan to relocate in the next five years, which amounts to an annual relocation

Table 14: CHANGES IN QUALITY OF PUBLIC SERVICES AFTER RELOCATION  
(Percent of Movers)

	Substantially Improved	Somewhat Improved	Unchanged	Became Worse	TOTAL
Electricity	29.2	10.4	52.1	8.3	100.0
Water	18.8	6.3	72.9	2.1	100.0
Fire Protection	8.3	16.7	68.8	6.3	100.0
Police Service	2.1	8.3	66.7	22.9	100.0
Sewerage	12.5	6.3	70.9	10.4	100.0
Waste Removal	2.1	6.3	29.2	62.5	100.0
Road Maintenance	10.4	8.3	54.2	27.1	100.0

Source: The City Study Establishment Survey.

Table 15: RELOCATION, BRANCH OPERATION, ON-SITE EXPANSION  
OF MATURE FIRMS BY EMPLOYMENT SIZE  
(Percent of Establishments)

	<u>Less Than 25 Persons</u>	<u>25-99 Persons</u>	<u>100 or more Persons</u>	<u>All</u>
<u>Relocation Considered Since 1970</u>				
No	91	27	81	69
Yes	9	73	19	31
Total	100	100	100	100
<u>Branch Considered Since 1970</u>				
No	91	93	78	84
Yes	9	7	22	16
Total	100	100	100	100
<u>Branch Opened Since 1970</u>				
No	100	93	84	90
Yes	0	7	16	10
Total	100	100	100	100
<u>Expanded on Present Site Since 1970</u>				
No	45	60	9	29
Yes	55	40	91	71
Total	100	100	100	100
<u>Average Firm Size (persons)</u>				
	16	48	325	195
<u>Number of Establishments</u>				
	11	15	32	58

Source: The City Study Establishment Survey.

Table 16: FUTURE EXPANSION AND RELOCATION PLANS BY  
FIRM TYPE AND EMPLOYMENT SIZE  
(Percent of Establishments)

	<u>Mature</u>	<u>Births</u>	<u>Movers Within</u>	<u>Movers from Outside</u>	<u>All</u>
<u>Plan to Expand Next 5 Years</u>					
No	60	61	50	0	56
Yes	40	33	50	100	44
N.A.	0	6	0	0	1
Total	100	100	100	100	100
<u>Plan to Relocate Next 5 Years</u>					
No	66	72	73	50	69
Yes	22	17	23	50	22
N.A.	12	11	4	0	9
Total	100	100	100	100	100
<u>Number of Establishments</u>					
	58	18	48	2	126
	<u>Less Than 25 Persons</u>	<u>25-99 Persons</u>	<u>100 or more Persons</u>		<u>All</u>
<u>Plan to Expand Next 5 Years</u>					
No	68	60	41	56	
Yes	30	40	59	44	
N.A.	2	0	0	1	
Total	100	100	100	100	
<u>Plan to Relocate Next 5 Years</u>					
No	65	52	89	69	
Yes	20	38	9	22	
N.A.	15	10	2	9	
Total	100	100	100	100	
<u>Average Firm Size (persons)</u>					
	15	54	320	135	
<u>Number of Establishments</u>					
	40	42	44	126	

Source: The City Study Establishment Survey.

rate of about four percent, which is consistent with what was observed in Table 1. It was also true that the medium size firms (with an average of 54 persons) showed the highest propensity to move when all types of firms were considered.

##### 5. Summary of Findings and Concluding Remarks

A survey of manufacturing establishments was conducted in Bogota to obtain information on the location choice at the individual firm level. This paper presented the establishment survey results to verify and explain the observed patterns of Bogota's employment location reported in an earlier work (Lee, 1981).

The survey results revealed the following characteristics of manufacturing establishments in Bogota: the industry is dominated by single-plant operations with a moderate production scale. The majority of the establishments uses a line-flow type production process housed in a single story plant and operates on a one-shift basis. The newly established firms (i.e., births) are small and tend to operate in much older and more complex building structures; for them, a batch process type production technique is more common. Most shipments of inputs and final products are made by trucks; rail is seldom used. Nevertheless, the extent of truck use by the birth firms was less than that of other types of firms, indicating their apparent difficulties with the access to trucking facilities in a congested area. These characteristics of small new firms support the "incubator hypothesis" that their birth place tends to be in an old district near the city center where various externalities are readily available.

The sample establishments as a whole export less than 50 percent of their products to outside Bogota. It would be difficult to treat the manufacturing industries in Bogota as the export sector in the Lowry (1964) context. The lack of multi-plant operations and the moderate production scale seem to be consistent with the local market orientation of manufacturing establishments in Bogota.

The majority of firms expressed their satisfaction with respect to the availability of unskilled workers, road access, proximities to clients and suppliers (i.e., markets), while dissatisfied with the cost of land for expansion, the availability of skilled workers, the quality of public services and zonal amenities. The level of satisfaction increased with the distance from the center with respect to all locational attributes considered in the survey except for the quality of public utility services, the quality of municipal services, and the proximity to clients.

In general the plant relocation tends to accompany changes in production technology. In the case of the fabricated metal industry, however, 40 percent of the movers kept the same production method after relocation. For the majority of movers, the distance moved was fairly short, about 1-2 kilometers; the large size firms moved longer distances. More than 80 percent of workers stayed with the firm after relocation. Nevertheless, not many movers found skilled workers readily available after move indicating their inability to attract skilled workers at the new location. The movers substantially increased both plant and land areas at the new location and experienced moderate

increases in production and profits as well as wages and taxes. For the majority of the firms, however, both input and output delivery distances and the commuting distance of production workers stayed about the same after move while the commuting distance of administrative workers increased only slightly. This is consistent with the fact that most of the recent movers in the sample moved only a short distance. The plant space was the most important factor in the firm's location choice, followed by rent payment, proximity to suppliers, amenities of the zone, road access, proximity to clients, the quality of public services, and the cost of land for expansion.

Twenty-two percent of sample firms have a plan to relocate within the next five years; the medium size firms (with about 50 employees) showed the highest propensity to relocate, while most of the large size firms (with more than 100 employees) did not have such a plan.

The survey findings on the individual firm behavior support the changing patterns of employment location summarized in Section 2, and provide some explanations for the observed patterns. It should be also noted that many of the results for Bogota are similar to those obtained by Schmenner (1981) for U.S. cities.

The survey results are of an acceptable quality in terms of the sample composition and the stochastic nature of the observations over the space. For example, the land price gradient estimated with the survey data was well-behaved with an exponent of -0.11. The estimation of a model of firm location using this data (Lee, 1982) reveals that

the manufacturing firms respond to relative shadow prices of various location factors to attain the locational equilibrium situation in an urban area.

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