Policy, Planning, and Research

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Manufacturers' Responses to Infrastructure Deficiencies in Nigeria

Private Alternatives and Policy Options

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and
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This paper presents selected findings from a survey of manufacturing establishments including the costs of private infrastructure provisions and develops policy options for improving the service delivery.

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Urban Development

As cities in developing countries grow, the need to meet increasing demand for urban infrastructure services has become an important policy problem. Failure to respond adequately affects productivity and the quality of life in those cities.

To make the Bank's lending programs in this area more effective, greater understanding is needed of: (1) the ways inadequate services affect business and productivity in urban areas, (2) the options for more efficiently providing and maintaining the delivery of various infrastructure services (such as electricity, water, transport, telecommunications, and waste disposal), and (3) potential cost savings from improved services.

Lee and Anas report research responses to such questions (on the demand side) as: How do firms respond to the constraints caused by deficient infrastructure? What alternatives do firms have, and what do they cost? Is the private provision of services a viable alternative to their public provision?

They also report responses to questions on the supply side: What causes failure to deliver adequate services? To what extent are such failures caused by lack of capacity expansion or by poor operations and maintenance? How do inappropriate pricing and user charges contribute to the problem? What options exist in terms of investment, technology, institutions, regulations, and financing?

Based on empirical observations, Lee and Anas suggest policy options for improving the provision of infrastructure services in Nigeria, the first country for which the Bank has undertaken this type of research:

- Regulatory changes to enable fuller use of existing private capacity (for example, allowing the sale of excess private electrical power).

- Participation of the private sector in the supply of infrastructure-related services.

- Pricing policies that are more efficient in the presence of congestion, system failures, and variations (by firm size and location) in the private provision of services.

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MANUFACTURERS' RESPONSES TO INFRASTRUCTURE DEFICIENCIES IN NIGERIA

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I. INTRODUCTION

1.01 In many countries in Africa, infrastructure provision suffers from two kinds of inefficiencies. The first is the presence of a public sector with a relatively high level of capital investment in place but which remains non-performing or unable to provide steady and reliable infrastructural services. The second, a consequence of the first, is that many users of the public infrastructural services find it necessary to provide their own facilities in whole or in part by incurring the much higher costs of private provision. These two extremes, (i) the non-performing public sector and (ii) the private provision responses of firms, are well known to exist in Nigeria.

1.02 The solution to this problem of infrastructural deficiencies in Nigeria and other African countries is not likely to be a technological one. It is generally understood that in these countries large additional capital outlays or extensive rehabilitation programs cannot be fully effective without progress in improving institutional organization, logistical support services, and administration. Yet, it is these areas which are the least well understood and where progress has remained elusive, difficult and unpredictable. Thus, it is realistic to assume that the public sector will continue to remain non-performing for some time to come and that the infrastructural deficiency problem will need to be addressed in a way which minimizes the social cost in a shorter timeframe. This would require fine-tuning regulatory regimes and the existing institutional structure, and coming up with more efficient pricing policies in order to induce active private sector participation in infrastructure service provisions.

1.03 The purpose of this paper is threefold. First, we document how infrastructural deficiencies affect manufacturing firms of different sizes in different regions. Second, we describe how firms respond to the deficiencies, identify the costs of these responses, and estimate the extent of private cost as a measure of the willingness of firms to pay for reliable services. Third, based on these observations, we offer alternative policy options for improving infrastructure provisions in Nigeria. These policy options provide alternatives between the two extremes of the non-performing public sector and the private provision by individual manufacturers. The policy options discussed in this paper include: (i) regulatory changes for enabling fuller utilization of existing private provision capacities, for example, by allowing the sale of excess private power supply; (ii) private sector participation in selected infrastructure support activities, such as production, distribution, maintenance, metering or revenue collection; and (iii) alternative pricing and tariff strategies which exploit observed variations in private provisions by firm size and location.

1.04 Our analyses in this paper are based on the empirical results from the survey of manufacturing establishments conducted for this research project. The

questionnaire was developed by the World Bank (supported by then the West Africa Regional Research Fund) in collaboration with the Nigerian Industrial Development Bank. The field survey was implemented by Arthur Andersen & Co., Lagos. A stratified random sample was drawn from the sample frame of manufacturing establishments provided by the Nigerian Federal Office of Statistics. The sample covered five states: Lagos, Anambra, Imo, Kaduna and Kano. The survey consisted of 36 pages with 349 computer readable variables, and was completed in late 1988 for 179 manufacturing establishments. The sample firms covered all manufacturing industries (at the two-digit level of the Standard Industrial Classification) and a continuum of firm sizes as measured by employment. (See Appendix Tables A19 through A23 for the sample outcome and the composition of sample firms.) Infrastructural deficiencies and firms' private provision responses are covered for five subsectors: electricity, water supply, transportation of freight and personnel, telecommunications, and waste disposal. (The Nigerian Industrial Development Bank has completed the survey on an additional 66 establishments among its client firms. This data is still being processed and not included in our analysis in this paper.)

1.05 The paper is organized as follows. Chapter II documents and discusses the extent, apparent causes, and incidence of infrastructural deficiencies in Nigeria. We have drawn from the World Bank project reports, institutional and other qualitative information on the state and causes of deficiencies in selected infrastructural subsectors in order to complement the information from the establishment survey data collected. Chapter III focuses on the alternative private provision responses of manufacturers. Prior to the survey of establishments, our knowledge of private response options of the firms was based on rough aggregate figures, anecdotal descriptions of selected cases, or specific field interviews of several firms. The survey findings clearly document the presence of a wide range of responses, and the frequency of their occurrences, and also their incidence and costs by region, size of firm, and other characteristics. Chapter IV presents the estimates of capital costs of various private provisions and analyzes the private cost as a measure of the willingness of firms to pay for reliable services. Chapter V discusses several policy options developed and their economic rationale. To the extent possible, we use the survey results to give a preliminary empirical justification of the potential benefits of the policy options considered.

1.06 To make quantitative estimates of the benefits of the suggested policies it will be necessary to implement empirically the analytical framework developed in Anas and Lee (1988), by estimating the degree by which individual firms in the sample will respond to changes in policies such as tariffs or regulatory constraints. The current paper sets the stage for such an analysis by identifying the appropriate response patterns. The plan for an econometric analysis and the associated measurement needs are briefly mentioned in the concluding section.

II. THE EXTENT AND CAUSES OF INFRASTRUCTURE DEFICIENCIES

2.01 It is common knowledge that Nigerian manufacturers suffer from frequent interruptions of publicly provided services such as electricity, water, telecommunications, transport, and waste disposal and by the poor quality of these services when and where they are available. A detailed discussion of these problems for each infrastructural sector is given in Anas and Lee (1988; pp.3-8).

2.02 The Nigerian Industrial Development Bank, the collaborating local institution of this study, has been particularly concerned about these problems, since financing industrial projects has been its main activity. According to NIDB's staff, frequent power cuts and voltage fluctuations have forced almost every industrial establishment in the country to undertake extra investments in generators in order to avoid production losses as well as damage to machinery and equipment. For similar reasons, extra investments are also made in sinking boreholes and installing water treatment plants. Such extra investments raise industrial costs and make it difficult for local industrial products to compete in price with their imported counterparts. By unduly enlarging the overhead and running costs, they lengthen the gestation period of industrial projects.

2.03 State monopoly enterprises such as the Nigerian Electric Power Authority (NEPA) or the Nigerian Telephone Company (NITEL) have a large amount of capital investment already in place but fail to deliver their services at the level required to meet the demand. Such failures not only result in the waste of scarce resources but also significantly affect manufacturing and other productive activities in the Nigerian economy. Therefore, it is important to emphasize that infrastructure services are intermediate inputs used in producing final goods and services and that the inadequate supply of these services will adversely affect the productivity growth of industries and economic development in general.

2.04 The causes of infrastructural failures may be grouped into two kinds. The first is relatively well understood and relates to shortcomings of the technology used by the public sector, including problems in the day to day management, and operation and maintenance of the facilities. The second is more complex in nature and less well controlled, and relates to general problems with administration, bureaucracy, planning, metering, billing for services delivered, revenue collection, personnel training in the public sector, and lack of appropriate incentives for management and personnel in part because of civil service pay ceilings. This second set of factors has remained the key problem over the years because further investments in additional facilities is easily rendered ineffective if the institutional organization and logistical support systems are lacking.

2.05 Assessing the actual burdens imposed by the current inadequacies and the costs of ongoing adjustments will be useful as the government continues to make strategic investment choices which involve the following types of trade-offs: (i) among different users of the infrastructural services such as residential versus manufacturing; (ii) between additional capital investments

versus maintenance and rehabilitation of existing facilities or the training and recruitment of personnel; (iii) among different infrastructural subsectors such as electric power versus telecommunications; (iv) between as well as within regions and cities; (v) between alternative pricing and tariff structures; (vi) between assisting the private sector in its self-provision efforts versus supporting further the public infrastructure sectors, and (vii) between different organizational and structural reforms focused on deregulation, commercialization, and the partial privatization of selected infrastructure related functions in individual subsectors.

A. Causes of the Deficiencies

2.06 World Bank studies and project work in the last decade have documented the extent and causes of infrastructural failures in each sector. Taking electricity generation as one example, the current situation can be gleaned from two project appraisal reports which are eight years apart (World Bank, 1981 and 1989). The basic types and causes of failure remain essentially unchanged over the entire decade of the 1980s. Technological causes of failure in this sector are primarily related to transmission and distribution. The ratio of the available capacity to that of the installed capacity is generally low and as much as 50 percent of installed capacity may be essentially inoperable at any given time. However, operable generating capacity is still considered substantial and essentially adequate. Most power interruptions (nearly two thirds) are a result of bottlenecks on the transmission and distribution networks. These recurring transmission problems are believed to be due to the lack of spare parts or the delays in obtaining them. In addition, shortages of materials, vehicles and foreign exchange have been the key factors which have constrained the expansion of the distribution system. In recent years these factors have been aggravated by the sharp fall in the price of oil which has reduced the public budget, as well as by the sharp devaluation in the value of the naira which makes imported spare parts even more expensive. A persistent problem has been the frequent overloading of transformers. The fact that only 400 to 500 of NEPA's fleet of 3000 vehicles are operational has systematically hampered routine maintenance of the distribution network. Similarly, properly trained personnel is the apparent cause of failures to maintain circuit breakers on the transmission network. Another area which contributes to these problems is the inadequacy of NEPA's monitoring facilities in its National System Control Center which is supposed to track and quickly service failing components on the national network (World Bank, 1989).

2.07 Most recent studies have paid attention to the nontechnological factors contributing to power interruptions and failures, and the current government efforts to partially commercialize a number of parastatals have also included NEPA (World Bank, 1989). NEPA will therefore have more autonomy in wage and compensation policy, tariff setting and in determining its own capital expenditure program. It is generally recognized that current NEPA tariffs for electricity have essentially no relationship to economic opportunity costs. For example, electricity tariffs remain unchanged since 1979 when they were raised to 7 kobos per kWh. At this level, it is estimated that they are about one seventh of the long run marginal cost of supply and do not even cover the cash operating costs of generation, transmission and distribution. It is known that

in most of developed and advanced developing countries such as Korea, the tariff per kWh is about 7 US cents (52.5 kobos). With the already established commercialization of the Nigerian National Petroleum Company (NNPC) which supplies gas fuel to NEPA, gas prices are going up and NEPA would have to raise its electricity tariff soon, as NEPA becomes subject to a higher degree of market discipline. In addition, it has been recommended that the tariff be raised in stages in the next several years (World Bank, 1989).

2.08 The problems of underpricing are also observed in water supply. The Lagos State Water Commission (LSWC) since 1986 is operating under a new tariff which raised water prices for manufacturers by about 40 percent and a further increase of 270 percent was due for approval. A vendor licensing system authorized to levy direct charges for water sold at public standposts is under discussion (World Bank,1988). Since industrial water use is beginning to exhaust the groundwater supplies of the Lagos State region, it is reasonable to expect that tariff increases for industrial use of water may become more feasible in the future. (More detailed discussions of the causes of deficiencies appear in Lee, Stein, and Lorentzen, 1989.)

B. The Incidence of the Deficiencies by Firm Size and Region

2.09 Our data reveal that there are large variations in the availability and quality of public infrastructure services and in firms' private provision responses across regions and firm sizes. Such observations imply an important role in government strategy regarding infrastructural policy reform. Variations in private provision patterns can be summarized as follows. Figure 1 and Table A1 in Appendix show that only 14 out of the 179 firms, or 7.8 percent do not have their own electricity generators. Twelve of these firms are in Anambra and Imo and two are in Lagos while all firms in Kaduna and Kano have their own generators. For the firms that do not have their own generators (or "captive firms"), the supply is not 100 percent reliable. Figure 2 and Table A2 in the Appendix show that the captive firms are generally small ones. Moreover, Figure 3 and Table A3 show that the smaller firms are subject to the bulk of the power failure incidents. Some small firms do not have their own generating equipment, not because the burden of poor electricity supplies is less per unit of output for them, but rather because the generation cost per unit of electricity is higher for them because of economies of scale in electricity generation.

2.10 The subsequent figures and tables in the Appendix show that small firms are the ones that cannot afford capital investments for boreholes (Figure 4, Table A4 and Figure A3), for vehicles for the shipment of products (Figure 5, Table A5 and Figure A4), for motor cycles and for couriers (Figure 6, Table A6 and Figure A5), and for radio equipment (Figure 7, Table A7 and Figure A6). Compared to the other two regions, Anambra-Imo has a higher concentration of small firms and the burden of inadequate infrastructure seems to be more serious there.

2.11 The heavy incidence of infrastructural failures among small firms has an implication for the growth of industries and the generation of employment. According to the "incubator hypothesis" that was tested in the earlier Bank research on industrial location in Bogota (Lee, 1989a) and in Seoul (Lee, 1985),

it was observed that small new firms spend their early years near the city center or in an old industrial area with easy access to good utilities and other essential services. They do so because it is prohibitively expensive for small firms to operate in outlying areas where infrastructure services are poor. As they grow and become more independent, they tend to move out of the central area for more space. In Nigeria and perhaps in most African countries, large cities with poor infrastructure cannot offer the incubator function for small new firms. Since small firms cannot afford their own generators and boreholes and other facilities, the burdens of inadequate public infrastructure services are especially severe for the small firms which start and grow in those cities. This has a serious negative implication for the birth and growth of small firms and for the generation of employment and income. The studies mentioned above (Lee 1985, 1989a) showed that small new firms generate between 60 to 80 percent of the new jobs created in large cities in Asia and Latin America. This implies high returns in Nigeria to selectively improving infrastructure service provisions for particular users at particular locations, since the observed service reliability problems are to an extent location and user specific.

Figure 1: DISTRIBUTION OF MANUFACTURING ESTABLISHMENTS REGION BY SOURCE OF ELECTRICITY

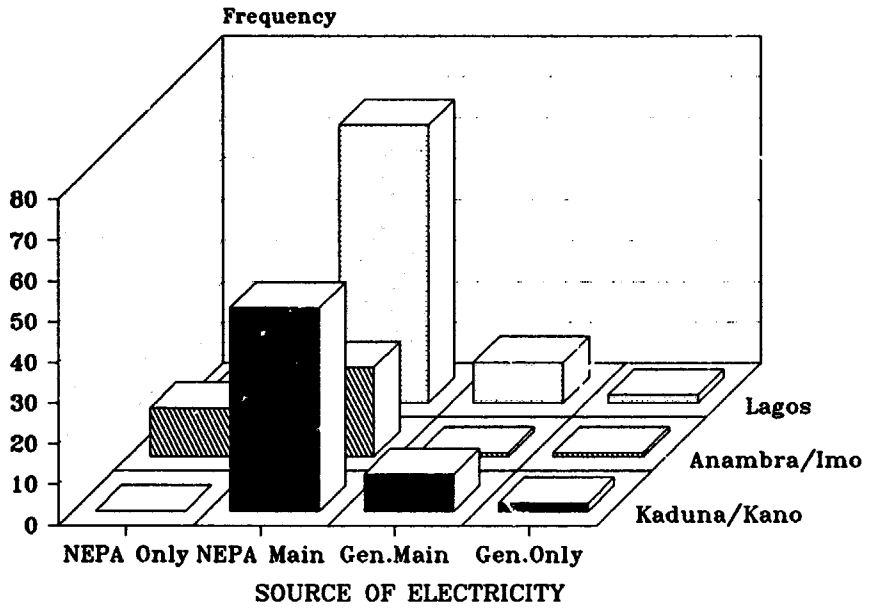


Figure 2: DISTRIBUTION OF MANUFACTURING ESTABLISHMENTS SOURCE OF ELECTRICITY BY FIRM SIZE

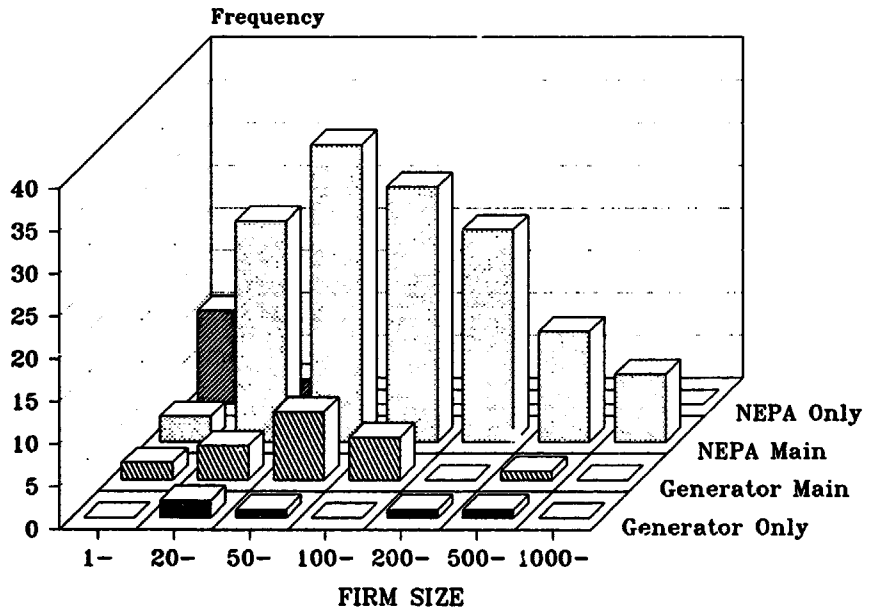


Figure 3: DISTRIBUTION OF MANUFACTURING ESTABLISHMENTS POWER OUTAGE BY FIRM SIZE

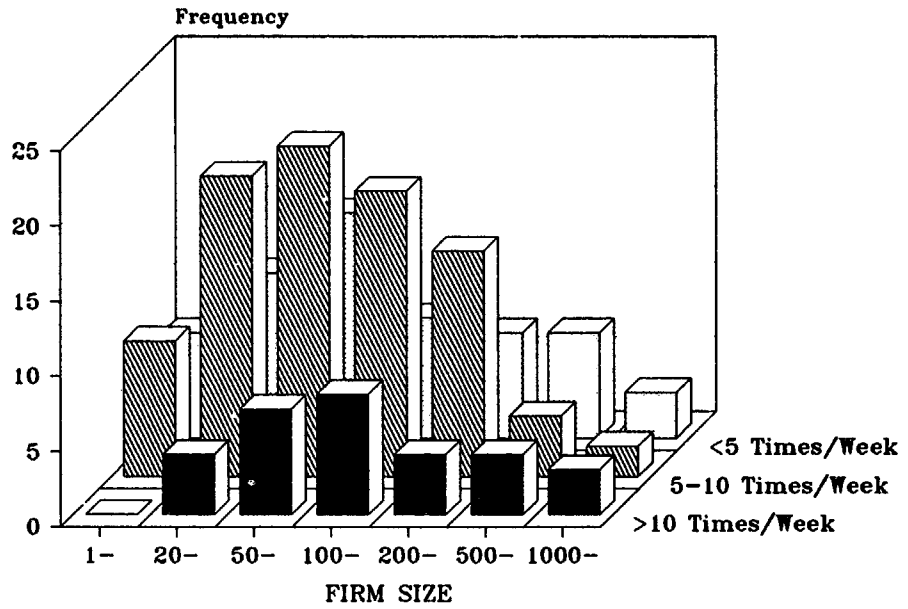


Figure 4: DISTRIBUTION OF MANUFACTURING ESTABLISHMENTS BOREHOLES BY FIRM SIZE

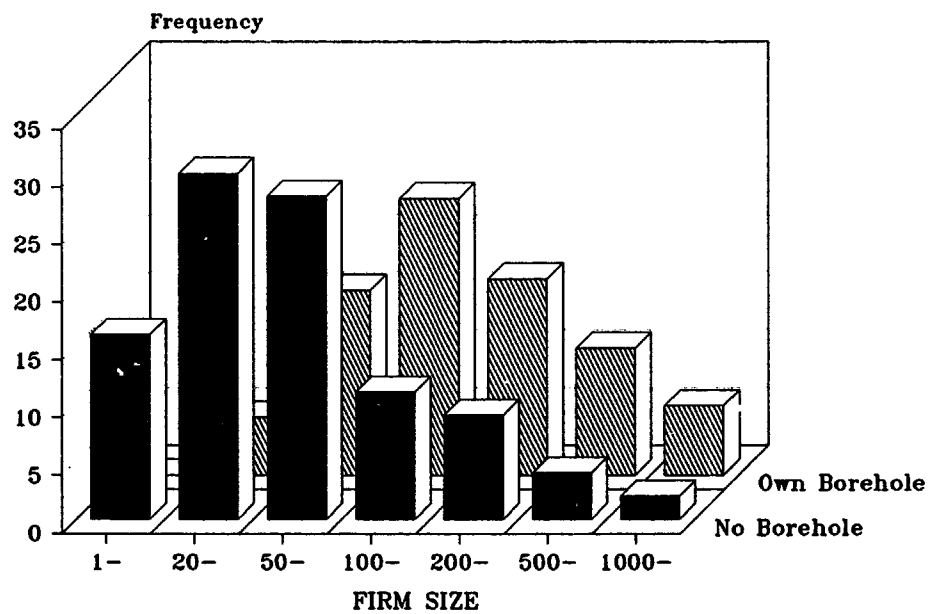


Figure 5: DISTRIBUTION OF MANUFACTURINC ESTABLISHMENTS VEHICLES FOR SHIPMENT BY FIRM SIZE

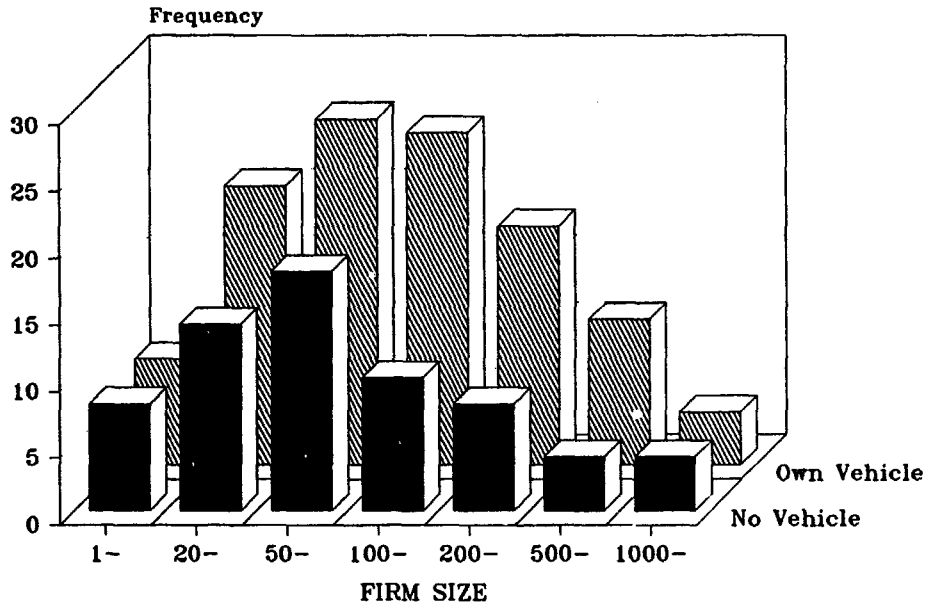


Figure 6: DISTRIBUTION OF MANUFACTURING ESTABLISHMENTS MOTORCYCLES BY FIRM SIZE

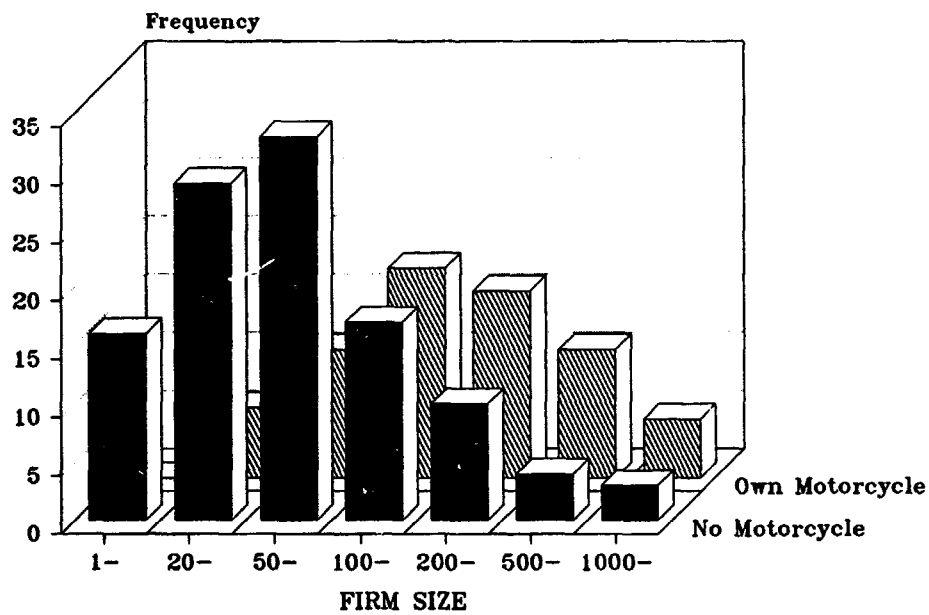


Figure 7: DISTRIBUTION OF MANUFACTURING ESTABLISHMENTS
RADIO EQUIPMENT BY FIRM SIZE

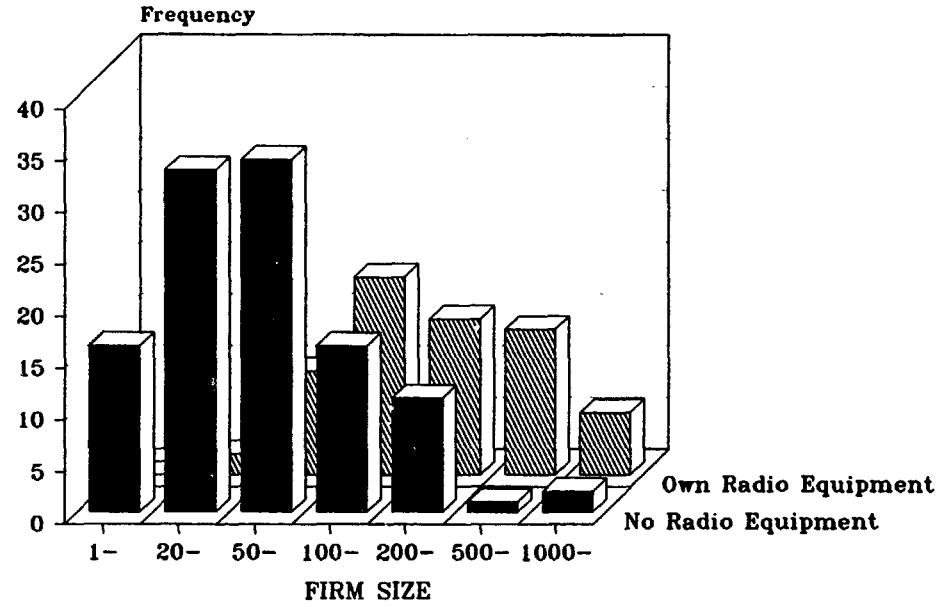
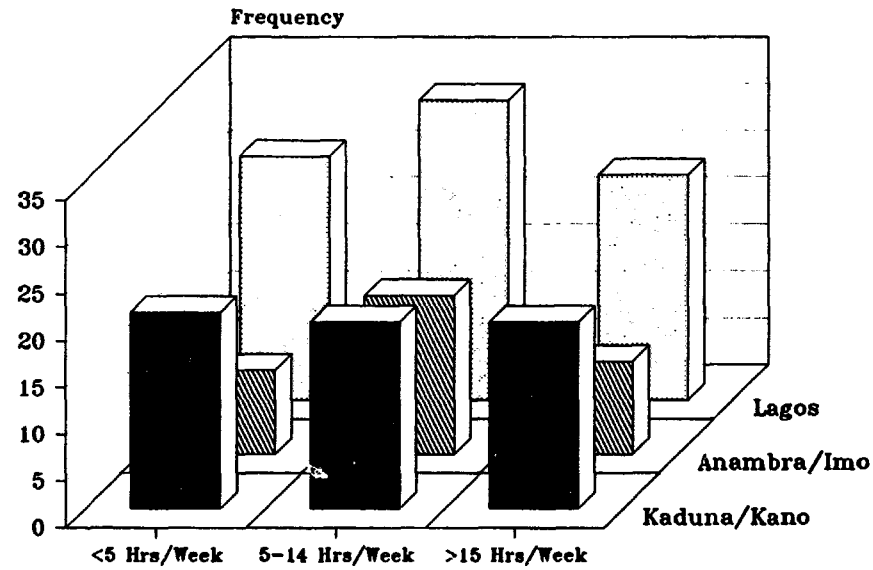


Figure 8: DISTRIBUTION OF MANUFACTURING ESTABLISHMENTS
REGION BY TRAVEL HOURS



III. ALTERNATIVE RESPONSES OF MANUFACTURERS

3.01 There are essentially four ways in which firms might respond to infrastructural deficiencies. These are: (i) relocation; (ii) factor substitution; (iii) private provision; and (iv) output reduction. Below we discuss the economic rationale behind each of these responses, and why they are or are not observed in Nigeria.

A. Relocation

3.02 The firm may relocate to a site with better infrastructure services. Such relocation can occur within a city or from one region to another. Our survey results show that Nigerian firms do not move to other locations from the initial site. Even though 50 percent of the firms had been at their present location since 1980, only two out of the 179 sample firms indicated that they had relocated from another location. This absence of mobility is striking considering that the average annual moving rate observed in large cities in other developing countries is about 5 percent. The relative immobility of Nigerian firms is consistent with the fact that the capacity, regularity and quality of infrastructure vary from bad to worse within and across Nigerian cities (as shown in Chapter II). This tends to limit the gains in infrastructure quality that can be achieved by moving to new locations. Nigerian firms instead undertake their own extensive capital expenditures (to be discussed below) and incur regular operations and maintenance outlays to provide their own services. The high setup cost with a large amount of initial capital investment for own service provision would make it difficult for the firms to move.

3.03 Another problem with relocation is that it often involves trading one infrastructural deficiency for another. For example, a firm that moves into the Lagos area because it is much cheaper to sink boreholes there (since the water table is high), might better its water supply, but the firm may face new problems such as losses in production time due to the commuting delays of employees.

B. Factor Substitution

3.04 The firm may substitute away from the use of the poorly provided service by adjusting its mode of production in favor of those inputs and raw materials which are less infrastructure intensive. For example, if a firm has a choice between a labor intensive and a capital intensive process and if the labor intensive process relies less on infrastructure than the capital intensive one, the firm's strategy would be to substitute labor for capital thus reducing the quantity of infrastructure inputs. The various private provision activities with large capital expenditures undertaken by the Nigerian firms indicate that their ability to adjust to the relative prices of labor, machines, materials, or various infrastructure service inputs is rather constrained by the current technologies in use. Since such input substitution possibilities are limited,

the firms operate inefficiently by providing their own infrastructure services when these are crucial for their operations. In case of a milk processing plant, for example, even if the public power supply were available at proper voltage for as much as 90 percent of the time, the firm could not afford to eliminate its own generators with 100 percent capacity because any voltage surges and drops at a critical time would threaten key equipment in the production process and result in much waste.

C. Private Provision

3.05 As lready mentioned, numerous strategies are available for the firms to provide their own infrastructure services. The fact that the vast majority of firms do so even when the publicly provided infrastructure services are extremely inexpensive, indicates the importance of having reliable infrastructural inputs. Private provision as a strategy is not entirely separate from factor substitution. In fact, by providing their own infrastructural services, firms are substituting internal capital in the form of equipment, machinery as well as labor in the form of maintenance personnel for the publicly provided infrastructure services which are not forthcoming. As documented in Anas and Lee (1988), Nigerian firms are observed to pursue four different private response strategies. These are:

(a) Self-sufficiency: The firm provides its own infrastructural services to the point where it does not need any public inputs. For example, Table A1 (in the Appendix) shows that only 5 out of the 179 surveyed firms are in this mode with respect to electricity generation.

(b) Standby private provision: The firm has its own infrastructural facilities in place and switches to these facilities when the quality or reliability of the public services falls below a critical level. From Table A1, 140 firms or 78 percent of those surveyed are in this situation with respect to power supply.

(c) Public source as standby: The firm relies primarily on its own facilities but switches to the public supply during those times of the day when the public source delivers a high quality service. Again, from Table A1, twenty firms or about 11 percent of the surveyed firms reported such behavior.

(d) Captivity: The firm continues to rely on the public source exclusively despite the very low reliability of such a service. It is reasonable to expect that captivity will be the dominant mode among the very small firms who cannot afford infrastructural capital investments. Only 14 or 7.8 percent of the surveyed firms reported such behavior in the case of electricity.

3.06 Anas and Lee (1988) argued that there are economic incentives for three additional regimes of private provision which are not observed in Nigeria because of government regulations on the supply and trading of infrastructure services by private entities. These regimes are: (i) joint production; (ii)

satellite behavior; and (iii) shared production. "Joint production" refers to the case where a firm, typically a large one, which has already made a substantial investment in infrastructural capital finds it profitable to sell part of its infrastructural output to other firms. With few exceptions, this has not been possible in electricity production in Nigeria, because private producers of electricity are not normally allowed to sell surplus power to other firms or even back to NEPA. "Satellite behavior" is the other side of the coin with respect to joint production. A satellite firm is one which purchases infrastructure services from another firm that has surplus infrastructure services to sell. At times of power interruption, for example, a satellite firm would switch from NEPA to the generators of a nearby private producer. "Shared production" refers to the possibility of firms coming together in a club type of arrangement called "utility pool" to share the cost of infrastructural capital inputs by building their own facilities. (A theoretical framework for the club type arrangement is in McGuire, 1974.) The above typology of private provision alternatives is applicable to all five infrastructure subsectors considered in this study.

D. Output Reduction

3.07 This response to infrastructural deficiencies is also common. Firms which are captive or use their own standby equipment are subject to output reduction either on a regular basis or when their own equipment fails to operate properly. However, the chief impact of output reduction necessarily falls on small firms which find it too expensive to pursue another response, or on very large power intensive firms which cannot find appropriate size equipment (e.g. generators) to meet their service needs. It is difficult to observe, but it undoubtedly happens that many small firms in Nigeria have either shut down or have failed to grow to any critical size because of infrastructural deficiencies. Also, births of new firms will be reduced if many must shut down soon after birth because of infrastructural inadequacies.

IV. COSTS OF PRIVATE PROVISION

A. Capital Costs and Their Incidence

4.01 The firms that we have surveyed provide a telling story of the incidence of private provision which is by far the most dominant response among Nigerian manufacturers. Tables A11 through A17 in the Appendix show the average current market values of various equipment and facilities used for own service provisions and their share of the total value of the firm's machinery and equipment for production. In Table 1, which summarizes the findings, we find that the capital value of generators and support facilities such as the switches and transformers is on the average 25 percent of the total value of machinery and equipment for small firms (with less than 50 employees) and 10 percent for large firms. This share varies widely across the five states and by firm sizes, from 4 percent for large firms in Imo to 36 percent for small firms in Anambra. The average value of capital for electricity generation including all firms is 954,000 naira (about 130,000 U.S. dollars). This value is almost four times larger than the share of capital for boreholes and treatment facilities. The average value is 260,000 naira for all firms with boreholes (Table A12), which is about 2 percent of the total value of machinery and equipment. This share value varies from 0.5 percent in Kano to 2.1 percent, or six times higher, in Lagos. Although water supply takes up a much smaller share of equipment and machinery than does electricity, the share is again higher for small firms than it is for large ones, by about 50 percent.

4.02 From Table A13, although only about 15 percent of the firms provide transport for their workers, the share of these vehicles in total capital equipment is 5.5 percent for small firms and just under 2.8 percent for large firms. The low ratio of self-provision observed in transporting one's own workers mean that, at least in Lagos, a great deal of production time is lost because of the late arrival of workers. When firms choose not to make capital expenditures for their own provision of certain services, they often incur comparable costs in other forms such as in lost production time. In Lagos, long commuting time is not due to the distances between residences and workplaces but due to long waiting times for buses. Savings from employing workers with lower wages are limited by the firms' inability to get them to the factory on time. In the shipment of goods (Table A14) 63 percent of the surveyed firms had their own vehicles. These vehicles make up 11 percent of total capital equipment for small firms but only slightly more than 4 percent for large firms. The average capital value of these vehicles was 387,000 naira for each firm. Capital expenditures such as radio equipment (Table A16) and motorcycles for couriers are small compared to generators and boreholes, but returns to these investments are extremely high. About 37 percent of the firms have radio equipment and its share in the total value of machinery and equipment is nearly three times higher for small firms. On the average, managers spend more than 10 hours per week on the road (Figure 8 and Table A8) to deliver messages or hold conversations that could be handled in moments over a working phone line.

Table 1: VALUES OF PRIVATE INFRASTRUCTURE PROVISION AS PERCENT OF TOTAL VALUE OF MACHINERY AND EQUIPMENT
(Percent)

Private Provision	Small Firms a/	Large Firms	Total
Generators	24.78	10.06	10.42
Boreholes	2.81	1.91	1.91
Vehicles for Workers	5.49	2.84	2.86
Vehicles for Shipments of Goods	10.95	4.47	4.62
Vehicles for Garbage Disposal	0.15	0.48	0.48
Radio Equipment	1.48	0.59	0.59

Note: The values of generators, boreholes, and radio equipment are included in the total values of machinery and equipment, but those of vehicles are not included.

a/ Establishments with less than 50 employees.

Source: Table A11 through Table A17 in the Appendix.

B. The Private Cost as A Measure of Willingness to Pay for Reliable Services

4.03 As documented in the above section, manufacturers incur high capital cost in installing own facilities for providing their own services. In the case of electric power generation, the survey reveals that nearly all standby firms have installed capacity sufficient to run the entire plant during a period of NEPA power interruption. The data also indicates that the sample firms as a whole 25 percent of all power used by them during 1987 came from their own generators and 75 percent from NEPA. (The breakdown by firm size is shown in Figure 9.) Because the typical installed private generation capacity is approximately sufficient to run the entire plant (with some reserve for maintenance), this means that about 75 percent of the generation capacity remains idle. This idle capacity results in extremely high total average cost of private power generation as shown below. The high cost of private provision sustained by the firms is the implicit value of service reliability that the firms are willing to pay for. A precise measure of willingness to pay can be determined by calculating the average cost (per kWh) of electricity produced by the firms own generators (as the lower bound). When the average cost of the privately produced power is higher than the price charged by NEPA, the difference between these two gives the premium which manufacturers are willing to incur in order to insure themselves of an uninterrupted power supply at all times.

4.04 Tables 2 and 3 show two such sets of computations on the average cost of private power generation. Table 2 shows the average cost computed using each firm's reported power consumption from own generators during 1987 for different firm size categories (25.48 percent of the total consumption for the sample firms as a whole). Thus, these figures reflect the cost of holding idle generating capacity. Table 3 shows the average cost of electric power generation for different firm size categories assuming that 100 percent of power supply comes from own generators. In both Tables 2 and 3, the capital recovery cost is computed by annualizing the current market value of the firm's generators and accessories using the remaining service life. The recurring costs of fuel, maintenance, and labor, are added to the capital cost (see Table A18 for this cost breakdown). In Table 3, these reported recurring costs are appropriately adjusted for the full utilization case as explained in footnote (a) to Table 3. The average cost schedule by firm size has been calculated with different sets of assumptions on (i) the real rate of interest and (ii) the exchange rate. In our discussion below, we refer to the average cost schedule computed with the 10 percent real interest rate and the current exchange rate of 7.5 Naira per US dollars. (During the 1980s the average inflation rate was about 12 percent and the current commercial lending rate is about 20 percent.)

4.05 Table 2 shows that at the actual average utilization rate of 25 percent of the generating capacity, the average cost per kWh is 4.61 Naira, which is 66 times the present NEPA price of 7 kobos! Suppose that the NEPA tariff were to be adjusted to 30 kobos, a rate currently charged by a private supplier in Lagos (para. 5.08). The average firm would still be incurring 15 times the new NEPA price at the actual utilization rate of 25 percent. Even

under the assumption of 100 percent supply from own generators, the average cost of 1.41 Naira for all firms (Table 3) will be five times higher than NEPA's 30 kobos. The premium is highest for the 20-49 person firm size category with a factor of 6 while for the largest size category of 1,000 or more persons the premium is a factor of only 1.3. Small firms pay for a higher premium because of economies of scale in electric power generation. From the 20-49 person firm size category the average cost declines exponentially with the firm size. The cost schedules in Tables 2 and 3 have been fitted to semi-log and double-log regressions as reported in Table 4. The slope coefficients are all statistically significant. The average cost values shown in Tables 2 and 3 are plotted in Figures 10 (excluding the values for firms with less than 20 employees).

4.06 The premium paid by firms varies with firm size. Such variation should be a central concern in the design of appropriate policies for both efficiency and equity reasons. The smallest group with less than 20 employees shows an average cost that is lower than the sample mean. This is not because they can generate electric power at lower cost however. Rather it is because they cannot afford to make the expensive capital investment to meet the required power need. They may be able to generate enough power to support the lighting and other critical elements.

4.07 The evidence of the presence of economies of scale in electric power generation is clear from the 20-49 size category as mentioned above. The cost of producing 100 percent of power supply from the installed generating capacity falls by a factor of 4.4 (from 1.752 to 0.399 in Table 3) as firm size increases from "20-49" to "1,000 and over." When the cost of idle capacity is included, the average cost in the same range of firm sizes falls by only a factor of 1.9 (from 6.457 to 3.315 in Table 2). Since large firms can achieve great scale economies when their capital intensive equipment is fully utilized, the fall in average cost is higher in the case of fuller utilization. From the above analysis, we can conclude that the premium over the NEPA price declines with an increase in firm size and that even after a hypothetical tariff increase to 30 kobos per kWh, the fuller utilization case premiums would still be larger than the NEPA price for all firm sizes. Of the average total cost of 4.61 naira in the case of underutilization, the average variable cost is 80 kobos for the sample firms as a whole (Table 5). A NEPA price of 30 kobos will be only about a third of the average variable cost of self-generation. In some developed countries, gas turbine generators are widely used and they do not manifest economies of scale. This technology is seldom used in Nigeria as yet. The minimum size for gas turbine generators however is likely to be too large for the need of most individual firms.

Figure 9: PROPORTION OF ELECTRIC POWER SUPPLY FROM OWN GENERATORS, 1987

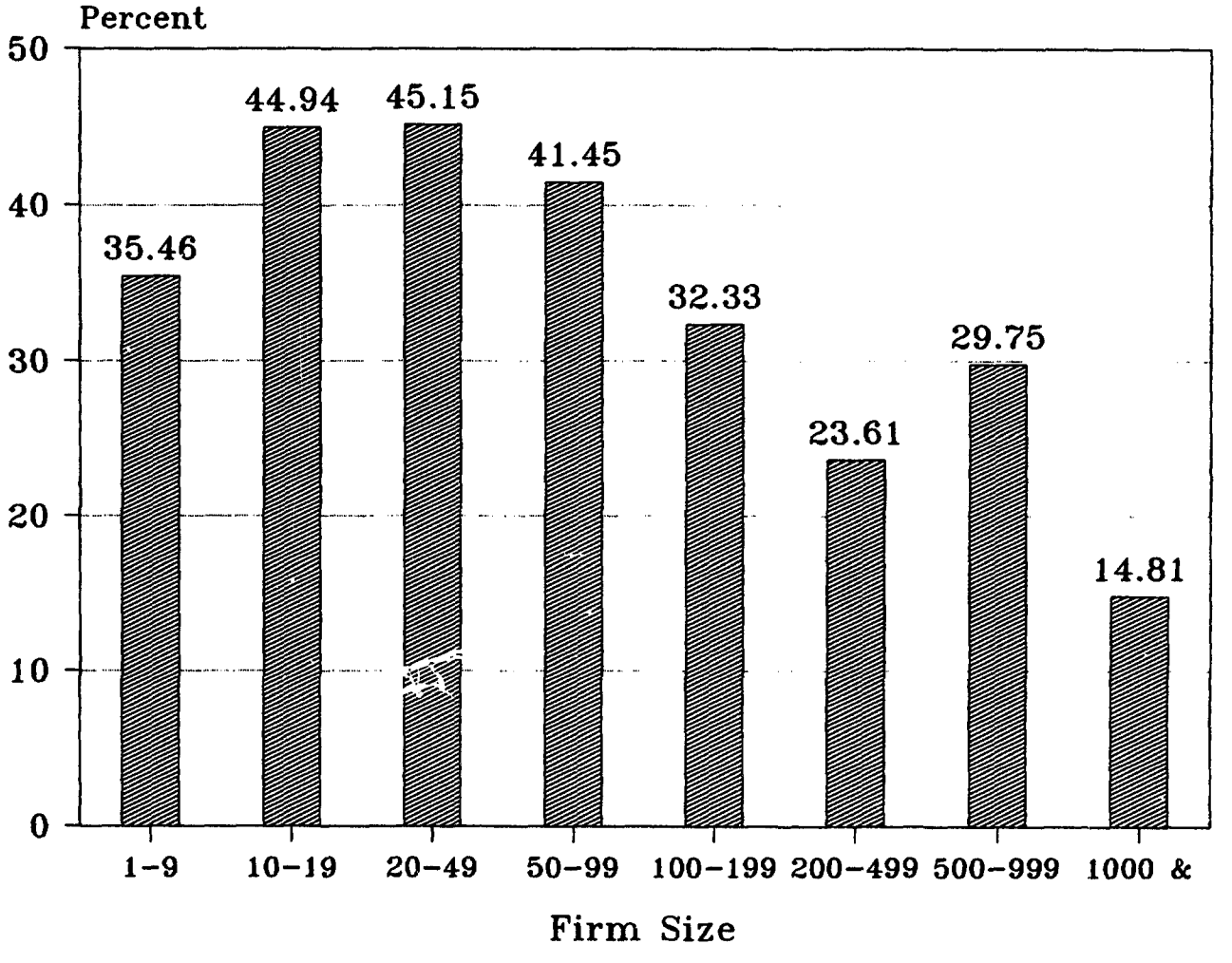


Table 2: AVERAGE COST OF ELECTRIC POWER GENERATION BY FIRM SIZE: UNDERUTILIZATION CASE a/

Firm Size	Average Cost (Naira/kWh)		
	Interest Rate b/ 5 percent	10 percent	15 percent
	(1987 exchange rate US$1=4.0 Naira)		
All Firms	2.540	2.834	3.150
0-9	0.374	0.426	0.483
10-19	0.698	0.781	0.871
20-49	3.336	3.740	4.171
50-99	2.698	3.009	3.346
100-199	2.573	2.936	3.328
200-499	2.357	2.564	2.780
500-999	1.442	1.611	1.793
1000 & Over	2.327	2.439	2.556
	(1989 exchange rate US$1=7.5 Naira) c/		
All Firms	4.061	4.612	5.204
0-9	0.634	0.732	0.838
10-19	1.086	1.243	1.412
20-49	5.701	6.457	7.267
50-99	4.191	4.775	5.407
100-199	4.196	4.876	5.611
200-499	3.718	4.106	4.512
500-999	2.063	2.379	2.721
1000 & Over	3.105	3.315	3.534

a/ The average utilization of installed generating capacity was 25.48%.

b/ Interest rates represent hypothetical real rates.

c/ Adjusted for the values of generators and accessories only.

Source: NIDB/IBRD Project Establishment Survey 1988.

Table 3: AVERAGE COST OF ELECTRIC POWER GENERATION BY FIRM SIZE: FULL UTILIZATION CASE a/

Firm Size	Average Cost (Naira/kWh)		
	Interest Rate b/ 5 percent	10 percent	15 percent
	(1987 exchange rate US$1.00=4.0 Naira)		
All Firms	0.959	1.021	1.086
0-9	0.143	0.155	0.169
10-19	0.435	0.463	0.493
20-49	1.101	1.180	1.263
50-99	1.045	1.122	1.206
100-199	1.023	1.091	1.163
200-499	1.018	1.060	1.104
500-999	0.675	0.712	0.752
1000 & Over	0.314	0.326	0.339
	(1989 exchange rate US$1.00=7.5 Naira) c/		
All Firms	1.291	1.407	1.530
0-9	0.205	0.228	0.253
10-19	0.568	0.621	0.677
20-49	1.606	1.752	1.908
50-99	1.380	1.525	1.682
100-199	1.444	1.572	1.708
200-499	1.243	1.322	1.406
500-999	0.821	0.890	0.966
1000 & Over	0.376	0.399	0.423

a/ Assumed 100% of electric power supply comes from own generators. Fuel consumption and maintenance cost are adjusted accordingly: Fuel by a factor of 4 and maintenance and parts by 3, when the utilization rate increases from 25% to 100%.

b/ Interest rates represent hypothetical real rates.

c/ Adjusted for the values of generators and accessories only.

Source: NIDB/IBRD Project Establishment Survey 1988.

Table 4: REGRESSION OF AVERAGE COST OF ELECTRIC POWER GENERATION ON FIRM SIZE

	Semi-log			Double-log		
	5% a/	10%	15%	5%	10%	15%
			Full Utilization Case b/			
Constant	-0.172	-0.095	-0.005	1.153	1.323	1.432
	(1.50)	(0.83)	(0.04)	(2.41)	(2.77)	(3.06)
Slope	-0.000619	-0.000625	-0.000636	-0.306	-0.325	-0.328
	(3.25)	(3.26)	(3.39)	(3.19)	(3.39)	(3.49)
R^2	0.0669	0.0670	0.0720	0.0649	0.0721	0.0761
N	149 c/	150	150	149	150	150
			Underutilization Case d/			
Constant	0.646	0.773	0.870	1.629	1.830	1.921
	(4.89)	(5.86)	(6.46)	(2.95)	(3.33)	(3.41)
Slope	-0.000503	-0.000522	-0.000513	-0.229	-0.246	-0.244
	(2.30)	(2.39)	(2.29)	(2.07)	(2.23)	(2.16)
R^2	0.0355	0.0379	0.0349	0.0289	0.0332	0.0310
N	146	147	148	146	147	148

Note: The dependent variable is the log of the average cost in Naira per kWh. The value of capital was calculated using the current exchange rate of US$1.00= 7.5 Naira. The independent variable is the total number of employees in the semi-log case and the log of the total number of employees in the double log case. Establishments with less than 20 employees are not included in the regressions.

a/ Interest rates represent hypothetical real rates.

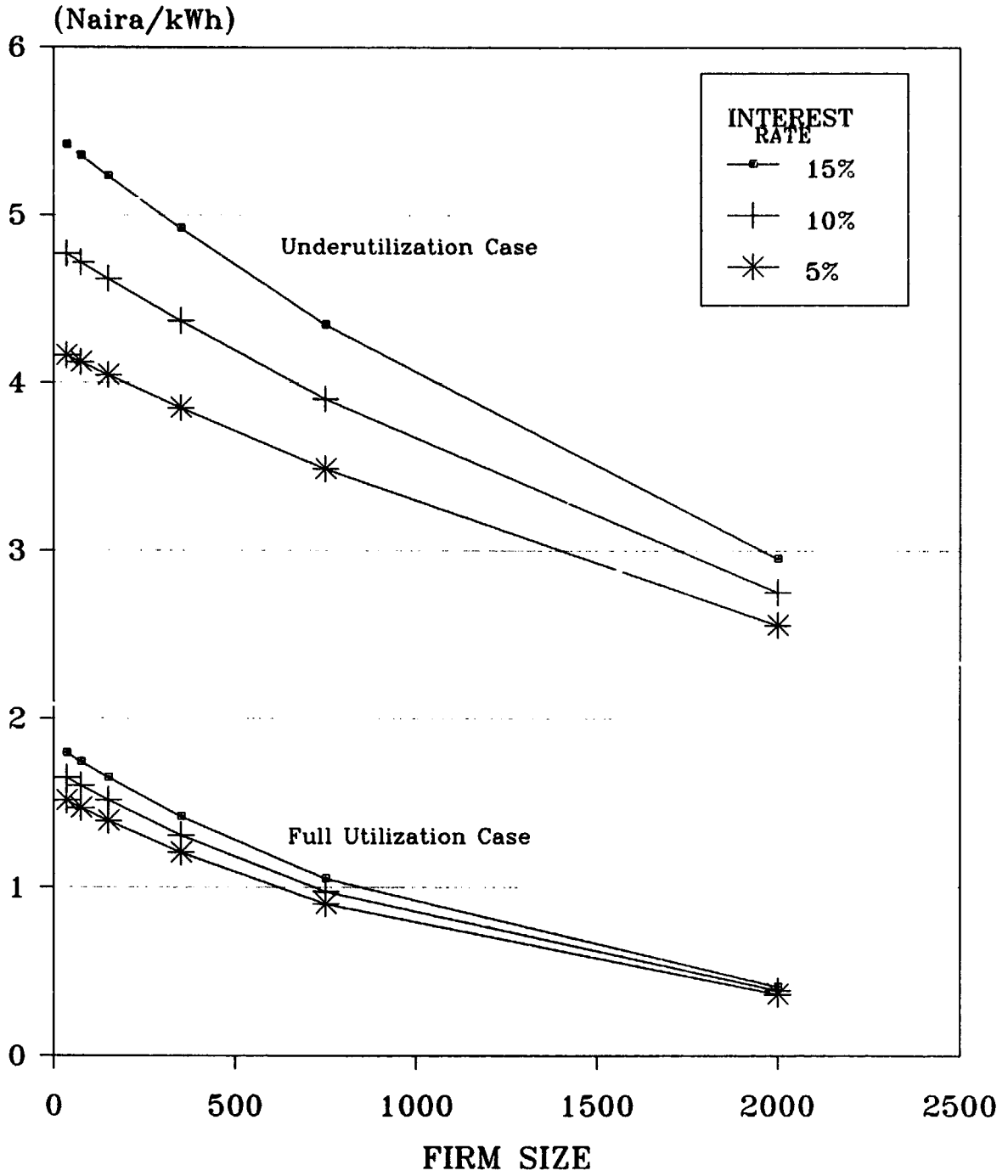
b/ Assumed 100% of electric power supply comes from own generators. Fuel consumption and maintenance cost are adjusted accordingly: Fuel by a factor of 4 and maintenance and parts by 3, when the utilization rate increases from 25% to 100%.

c/ The total number of observations may not be the same because the log of negative values is not defined and they are treated as missing values.

d/ The average utilization rate of installed generating capacity was 25.48%.

Source: NIDB/IBRD Project Establishment Survey 1988

Figure 10: AVERAGE COST OF ELECTRIC POWER GENERATION



Note: The plotted values are from the regression of the values in Tables 2 and 3 excluding establishments with less than 20 employees (using the exchange rate of US$1.00=7.5 naira).

Table 5: AVERAGE FIXED AND VARIABLE COSTS OF OWN ELECTRIC POWER GENERATION PER KWH

Firm Size	Fixed Cost a/	Variable Cost b/	Total
All Firms (Naira)	3.810	0.803	4.612
(Percent)	82.60	17.40	100.00
0-9	0.655	0.077	0.732
	89.50	10.50	100.00
10-19	0.990	0.253	1.243
	79.62	20.38	100.00
20-49	5.824	0.634	6.457
	90.19	9.81	100.00
50-99	3.784	0.991	4.775
	79.24	20.76	100.00
100-199	4.157	0.719	4.876
	85.26	14.74	100.00
200-499	3.305	0.801	4.106
	80.49	19.51	100.00
500-999	1.646	0.733	2.379
	69.19	30.81	100.00
1000 & Over	1.877	1.438	3.315
	56.62	43.38	100.00

Note: For the smaple firms as a whole, 25.48 percent of electric power supply came from own generators.

a/ Annualized capital value of generators and accessories.

b/ Include fuel, maintenance, parts, and labor.

Source: Table A18.

V. DEVELOPING POLICY OPTIONS FOR IMPROVING SERVICE PROVISION

5.01 As explained in the introduction, in Nigeria two extreme cases of inefficiency in the provision of infrastructural services are observed: First, the non-performing public sector with heavy capital investments; Second, the costly provision of services by individual firms themselves. The self-provision response has developed over the years because of non-performance in the public sector. Without the extensive private provision responses, the total welfare loss resulting from the public sector failures would have been much higher in Nigeria.

5.02 At best, public sector performance is likely to improve very gradually. In addition, improvements in public sector performance will be accompanied by considerable upward adjustment in pricing and tariffs. Such adjustments which are necessary for long run efficiency however are bound to create hardships in the short run, as firms of all sizes and in all sectors and regions make their own adjustments. For these reasons, the correct policy perspective for Nigeria is not to stress improvements in public sector performance to the exclusion of private sector incentives. Rather, the challenge is to find feasible intermediate term policy options which bridge the gap between the above mentioned two extreme cases of inefficiency, namely, the nonperforming public sector and costly private provision by individual firms.

5.03 As discussed in Anas and Lee (1988), there are numerous opportunities that can be exploited for strengthening those already existing markets for the private supply of infrastructure services or creating new ones such that the costs of private provision are significantly reduced and more efficient private provision alternatives are offered. Policy options can be grouped into three categories: (i) regulatory changes which will induce fuller utilization of existing private provision capacities; (ii) private sector participation in selected subactivities; and (iii) changes in pricing and tariff structures. We will discuss below each of these policy areas as illustrations for possible policy options drawing on the survey results. More definitive policy recommendations will be made later in the study based on formal empirical analyses to be conducted.

A. Regulatory Changes for Fuller Utilization of Private Provision Capacities

5.04 Some minor regulatory changes can generate significant benefits to individual firms. As noted earlier, most firms have standby generators which stay idle about 75 percent of the time. These firms however are not allowed to sell the excess power they produce to NEPA or to other firms. The potential cost savings from allowing such transactions can be large. The current regulations inhibit the regimes of "joint production", "satellite behavior", and "shared production" which were discussed in Chapter III (para. 3.06). Indeed, the efficiency gains of allowing large firms with a high level of installed capacity to exploit fully their scale economies and to compete with NEPA by supplying smaller satellite firms could be significant. The presence of

economies of scale was shown in Chapter IV in the case of electric power generation.

5.05 Such regulatory changes could also motivate "shared production" whereby private manufacturers join forces to form certain types of "utility pools" to exploit economies of scale in the provision of each type of infrastructural service and economies of scope in the provision of several different infrastructural services at the same time. Utility pools should be quite feasible in the existing industrial estates or in areas with a relatively high concentration of industries. The participation of large firms in the infrastructure production process and competition with the public suppliers broadens the choices available to small firms and especially the "captive firms." Small firms in such an environment can become satellite firms or can join in utility pools. As shown in Chapter IV, small firms have very high willingness to pay for reliable electric power supply. Thus, they would be motivated to join a utility pool or to become satellites to larger firms.

5.06 A good example of a "utility pool" in place is the central effluent collection and treatment facility in the Agbara Industrial Estate which was established by a private developer. This central facility is operated by a management company. As the government attempts to tighten industrial pollution control, treating the effluent within individual firms would be prohibitively expensive, especially for small firms. Similarly, in industrial layouts in Lagos, the central collection and treatment of effluent by the management board should be technically feasible and will induce economies of scale. Such a management board could be further empowered to operate and manage "utility pools" which include a wide range of services such as electric power generation, garbage collection, and the shipment of goods. Another example of a central facility in place is the six megawatt standby generator of the University of Ibadan which serves the entire campus. A note prepared for a recent Industrial Sector Study (Lee, 1989b) further discusses such possibilities for the existing industrial areas in Nigeria.

B. Private Sector Participation in Contestable Markets for the Supply of Infrastructure Related Services

5.07 Although more efficient pricing systems combined with appropriate relaxation of regulatory constraints can be introduced to induce improved public sector performance and to minimize the adverse impacts of infrastructural deficiencies on manufacturers, these strategies alone are unlikely to significantly improve the current situation in the short run or even in the medium term, because of the various x-inefficiencies in administration, financial management, and the operation and maintenance practices of the public agencies. Based on what is observed in Nigeria, a sensible way of breaking this inertia seems to be the encouragement of private sector participation in various infrastructure related functions and subactivities.

5.08 Indeed, in Nigeria we observe that some private firms are already engaged in certain types of infrastructure related subactivities. Recently, NEPA began subcontracting certain segments of its operations, such as maintenance for a power station and transmission facilities, to private firms.

Many foreign firms including Siemens and ITT have already had maintenance contracts with the Nigerian Telephone Company (NITEL). The government allowed a private firm, DHL, to operate in Nigeria. DHL charges a much higher fee than the Nigerian Postal Service, but it is faster and more reliable, and thriving with good business. This is additional evidence that users of services have high degrees of willingness to pay when reliable services become available. This was also observed in the Maroko low income area in Victoria Island. This area, which NEPA never included in its network, has been served by a private entrepreneur who charges 30 kobos per kWh, four times higher than NEPA's 7 kobos. But this rate of 30 kobos is still many times lower than the average cost of own power generation as shown in Chapter IV. Another example is the air freight and passenger transport sector. In this area, a number of small privately owned domestic airlines provide stiff competition to Nigerian Airways because they supply more reliable service. Railroads, where the high sunk costs associated with the capital facilities make the industry less contestable, cannot as easily benefit from such private competition, but trucking has emerged as a very viable alternate transport mode.

5.09 In Nigeria, a broad continuum of options exist between the two extremes of inefficiency characterized above. These options amount to providing incentives for private entrepreneurs to engage in the supply of certain infrastructure services, thus creating appropriate market mechanisms. Such markets can be specialized to infrastructural services in the areas of production, distribution, maintenance, administration, metering and monitoring, or bill collection. The feasibility of creating and expanding such markets for the supply of these services by the private sector lies in the fact that the government fails to provide adequate services whereas the users are willing to pay for more reliable services when such are available as demonstrated in Chapter IV for the case of electric power supply.

5.10 A recent Bank case study by Whittington, Lauria and Mu (1989) documents how high willingness to pay for water has led to the emergence of a complex web of private market mechanisms for water distribution in Onitsha, a Nigerian town of 700,000. In this town, the private sector operates about 275 tanker trucks which purchase water from about 20 privately owned boreholes and sell it to businesses and households with storage tanks. Many of the households purchasing such water in turn sell it to individuals who are not equipped to store in large quantities, or to thousands of small mobile private vendors. The private vendors provide two times more water on the aggregate compared to the public utility and collect 10 times the revenue in rainy season and 24 times the revenue in dry season. Households pay these private vendors over twice the operations and maintenance costs of piped water, a strong indication of the willingness to pay for reliability, and clear evidence of the private sector's ability to compete with the public sector.

5.11 To operationalize a workable framework for promoting private participation in the infrastructure subsectors, the following strategies in three key areas need to be considered.

Regulatory regimes and market mechanisms

5.12 The first step is to improve the present regulatory regimes to provide a more favorable environment for private investors so that they can enter the market for a specific service and offer alternative sources of supply. Many of the public sector failures in Nigeria stem from the fact that most infrastructure services are provided by strongly centralized government monopolies. As discussed in Anas and Lee (1988), however, even some services which have the characteristics of public goods can be supplied with the participation of the private sector (also see Roth, 1985). To the extent that the markets for certain infrastructural services are contestable (Baumol, Panzar and Willig, 1982) because there are no large sunk costs involved in capital facilities, it should be feasible to liberalize restrictions against the setup and operation (entry and exit) of private firms.

5.13 There are a number of situations where such a strategy can be successful. A good example is the utility pool already discussed above. Individual firms in a pool may prefer to have a private infrastructure provider who will manage and operate a pool with shared facilities such as vehicles and waste collection equipment. This would allow the pool to take advantage of the economies of scale and scope, as well as to pass the transaction costs of administration and management to the private entrepreneur who would be self-financing by levying charges on the pool members.

5.14 As mentioned earlier, power generation is an area where private participation can be greatly increased by allowing private entrepreneurs to set up power plants which compete with NEPA. A successful arrangement exists at Jos where a privately owned power plant which was setup in colonial times has been allowed to operate. This firm supplies much of the local power needs and sells its excess power to NEPA. Additional private power providers are likely to emerge throughout Nigeria if the existing regulatory constraints were relaxed. If this were to happen, NEPA could stiffen its tariff structure since users would have the freedom to switch to the private suppliers. NEPA's transmission and distribution grids should be made accessible to such private power companies which can be required to pay appropriate access fees which reflect the marginal costs of serving them. Allowing access to the grids makes the generation of power a contestable activity which greatly increases the incentive for private participation. The levying of efficient access fees by NEPA would provide a source of revenue which aids in cost recovery while reducing some of NEPA's own power generation costs. This approach has been followed in Britain with respect to both the power authority (Henney, 1987) and British Telecom (Beesley, 1981). A wide range of options for private sector participation have also been considered in the past. These include, for example, farming out distribution functions to private firms (World Bank, 1983b; Coyaud, 1986).

Organizational and institutional mechanisms

5.15 To induce the development of appropriate market mechanisms for private sector participation in infrastructure supply, it will be necessary to allow appropriate institutional arrangements such as subcontracting or franchising to carry out a particular type of infrastructural service. Such mechanisms will

tend to vary from sector to sector and will depend on the strength of incentives which are needed and the efficiency gains which will occur from private sector participation.

5.16 A good illustration is available in the waste collection and disposal subsector in Nigeria where a number of alternative institutional responses have been observed in recent years (Sulu, 1987). While Lagos approached the problem of solid waste disposal by authorizing large capital expenditures (World Bank, 1985), Ibadan implemented a citizen participation procedure in which private firms haul their garbage to designated points to be picked up by private licensed subcontractors or by the public sector. In Owerri the solution was to enter into a subcontract with the German firm SULO A.G., which made an unsolicited offer.

5.17 Luger (1989) in a recent World Bank discussion brief argues for more private sector participation in solid waste collection in the Lagos area to increase its share of industrially generated waste up from the current 7 percent. Luger breaks down solid waste collection into the following subactivities: (i) pickup at the source and delivery to processing plant or transfer station; (ii) pickup at processing plant or transfer station and delivery to tipping site or resource recovery facilities; (iii) transfer points, tipping sites, processing facilities, or incinerators; (iv) maintenance of various facilities; and (v) administration including bill collection. While the Lagos State Waste Disposal Board (LSWDB) could continue to maintain control over regulation, the remaining subactivities are candidates for various forms of privatization on a case by case basis. For example, the private sector could be induced to set up landfill sites or resource recovery facilities if they are allowed to produce gas, energy, or compost which can be sold profitably. In finance, bill collection can be contracted out, where the contractor's payment is based on the percentage of outstanding revenues that are collected. Such a private collecting entity would be more motivated than the existing bureaucracy to achieve full revenue accrual. In the areas of pickup and delivery to intermediate points, there is a variety of available options including direct delivery by the manufacturing establishment's own vehicles, pickup by private entrepreneurs on a demand activated basis, or pickup by a private entity licensed to operate as a spatial monopoly within a particular district.

Monitoring mechanisms for market operations and service quality

5.18 As various infrastructure related functions currently under government control are decentralized and privatized, it will be important to redefine the role of the government for appropriate monitoring and supervision of efficient market operations. For example, if a subactivity such as bill collection or garbage pickup is contracted out to private firms, it will be necessary to monitor their success with revenue collection or quality of service in garbage pickup. Their contract renewal could be determined by a periodic competitive bidding process.

5.19 In sum, the government will play an important role in implementing the new institutional setups resulting from the policy options and reforms that might be adopted. More systematic analyses of economic and institutional feasibility will follow in this study.

C. Congestion, System Failures, and Pricing Policy

5.20 The fluctuations in the quality of public infrastructure services observed in Nigeria are, in part, a result of congestion in the use of the system. While the demand for the service from a public agency such as NEPA is a function of quality, the quality itself is a declining function of the quantity demanded due to congestion effects. The public agencies must consider the trade-offs between the quantity supplied and the quality (and reliability) of services in determining the pricing policy, especially in the short run when the ability to expand the system is limited. Treating congestion as endogenous is common in transportation and other urban infrastructure systems, and congested situations require the levying of an optimally set congestion toll which will reduce the load and congestion to a socially optimal level.

5.21 As an illustration, consider the electric power pricing by NEPA. As indicated in Chapter II, most power interruptions (nearly two thirds) are a result of bottlenecks on the transmission and distribution networks. It is commonly observed that in the industrial areas in Lagos when large energy intensive manufacturing plants such as steel mills start operating, the resulting voltage surge often damages machinery and equipment of smaller firms located in the vicinity. Large energy intensive firms place heavier loads on the system, thus tying up more operable transmission capacity. However, these large firms are the ones which can afford to have own generators, have a greater amount of unused generating capacity, and can produce electric power at a much lower average cost than small firms.

5.22 In the case of NEPA, the congestion is so severe that the system tends to fail completely resulting in frequent power outages. In such a situation, it would be desirable to raise the tariff to a sufficiently high level to clear the market. For example, at a NEPA tariff of 50 kobos per kWh, large firms may find self-generation cheaper and use their own generators more fully, thereby reducing congestion. Deregulation, to allow those firms to sell excess power, should provide added incentives to own generation of power. Small firms will then have better access to the system. Public supply quality is expected to improve at the higher NEPA price which smaller users may find still lower than the cost of self-generation. We have requested NEPA to provide us with the necessary data to document statistically the correlation between loads on the transmission network and the frequency of power failures, in order to measure the quality improvements that can be expected from inducing firms with different private provision capacities to reduce their use of the public supply in response to higher prices. A more comprehensive study of the market structure, including NEPA's costs and variations in demand by user types and locations is needed to determine the order of the price that will remove congestion.

5.23 Producing specific tariff systems for individual subsectors such as electric power, water, and telecommunications is beyond the scope of this study. In this research project, however, we intend to quantify relative efficiencies of alternative pricing regimes by simulating the responses of different types of firms to such regimes that reflect particular types of market structures. Possibilities for considering variations of the "two-part tariff", for example, were discussed in detail in the framework paper (Anas and Lee, 1988). Bahl and

Linn (1989) present an excellent review of pricing urban services. A recent paper by Heady (1988) stresses the role of public sector prices as instruments of cost recovery and explains the Bank's two-step practice in setting public sector prices. The first step calculates the marginal cost; the second step adjusts marginal cost to take account of other factors such as revenue shortfalls, market distortions, and distributional effects. All these factors are relevant to the Nigerian situation. Another recent paper by Julius and Alicbusan (1988) documents the two-step approach in more detail and surveys the use of such pricing policies in many countries and various public sectors. A clear discussion of short-run marginal cost pricing, economic user charges, and budget deficits is given in Meier (1983, pp.192-203) which is reprinted from Walters (1968) and Bennathan and Walters (1979) who also discuss nonlinear "two-part tariff" pricing.

VI. CONCLUSIONS AND FURTHER EMPIRICAL STUDY

6.01 The main objectives of this paper were to document the extent, causes, and incidence of infrastructural deficiencies as they affect Nigerian manufacturers; to observe the responses of the manufacturers to these deficiencies; and to develop viable policy options based on the observations from the data collected. The results of the establishment survey revealed general patterns of deficiencies and self-provision responses by manufacturers which cut across all five infrastructure subsectors included in the study. In particular, in nearly all infrastructural activities, small firms face higher unit costs than larger firms do and the patterns of self-provision by firms differ a great deal by region within the country as well as by type of firm.

6.02 Our main thrust in developing policy options is that the ongoing structural adjustments in Nigeria, including changes in pricing, regulation, and institutional structure in most sectors, need to be extended to managing and accommodating the costs of the widespread private provision of infrastructure services resulting from public sector failures. Because improvements in public sector performance are likely to remain slow in the short and intermediate terms, manufacturers and especially small firms will continue to bear the costs of self-provision. Furthermore, with the ongoing upward adjustments in tariffs the burdens of the deficiencies which are borne by small firms will increase. To ease these private burdens and to improve the overall infrastructural provision in Nigeria, we have considered plausible policy options in the following three areas:

(a) Regulatory reforms such as the relaxation of regulatory restrictions against the trading of infrastructural services among manufacturers.

(b) Private sector participation in contestable markets for the supply of infrastructural services, wherever appropriate for selected subactivities such as production, delivery, maintenance, revenue collection, and finance, by means of various institutional mechanisms such as subcontracting, franchising, and districting.

(c) Alternative pricing policies taking into account the capacity limitation and congestion effects on the service facilities.

6.03 A set of more definite policy recommendations will be provided later in the study on the basis of the formal empirical analysis to be conducted with the establishment survey data. In particular, econometric work outlined in the framework paper (Anas and Lee, 1988) and Verma and Lee (1988) will enable us to estimate key production and cost function parameters which will provide firm quantitative bases for policy analyses. Such econometric models can be used to simulate the responses of selected firms to various policy changes. Such simulations are essential in order to obtain better insight about the probable economic benefits that are likely to result from the policy options and the implementation strategies which we have discussed.

APPENDIX TABLES AND FIGURES

Table A1: DISTRIBUTION OF MANUFACTURING ESTABLISHMENTS REGION BY SOURCE OF ELECTRICITY

Region	Source of Electricty for Production Operation a/				
Frequency Row Pct Col Pct	NEPA only	NEPA main	Own gen. main	Own gen. only	Total
Lagos	2	68	10	2	82
	2.44	82.93	12.20	2.44	100.00
	14.29	48.57	50.00	40.00	45.81
Anambra/Imo	12	22	1	1	36
	33.33	61.11	2.78	2.78	100.00
	85.71	15.71	5.00	20.00	20.11
Kaduna/Kano	0	50	9	2	61
	0.00	81.97	14.75	3.28	100.00
	0.00	35.71	45.00	40.00	34.08
Total	14	140	20	5	179
	7.82	78.21	11.17	2.79	100.00
	100.00	100.00	100.00	100.00	100.00

a/ NEPA only=using 100% from NEPA; NEPA main=NEPA as the main source and own generators as standby; Own gen. main=NEPA as standby; Own gen. only=100% from own generators.

Source: NIDB/IBRD Establishment Survey, 1988.

Table A2: DISTRIBUTION OF MANUFACTURING ESTABLISHMENTS SOURCE OF ELECTRICITY BY FIRM SIZE

Source of Electricty	Firm Size							
Frequency Row Pct Col Pct	1 - 19	20- 49	50- 99	100-199	200-499	500-999	1000 & Over	Total
NEPA only	11	3	0	0	0	0	0	14
	78.57	21.43	0.00	0.00	0.00	0.00	0.00	100.00
	68.75	8.57	0.00	0.00	0.00	0.00	0.00	7.82
NEPA main	3	26	35	30	25	13	8	140
	2.14	18.57	25.00	21.43	17.86	9.29	5.71	100.00
	18.75	74.29	79.55	85.71	96.15	86.67	100.00	78.21
Own gen. main	2	4	8	5	0	1	0	20
	10.00	20.00	40.00	25.00	0.00	5.00	0.00	100.00
	12.50	11.43	18.18	14.29	0.00	6.67	0.00	11.17
Own gen. only	0	2	1	0	1	1	0	5
	0.00	40.00	20.00	0.00	20.00	20.00	0.00	100.00
	0.00	5.71	2.27	0.00	3.85	6.67	0.00	2.79
Total	16	35	44	35	26	15	8	179
	8.94	19.55	24.58	19.55	14.53	8.38	4.47	100.00
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Source: NIDB/IBRD Establishment Survey, 1988.

Table A3: DISTRIBUTION OF MANUFACTURING ESTABLISHMENTS POWER OUTAGE BY FIRM SIZE

Average Number of Power Outage per week

Frequency Row Pct Col Pct	Firm Size							
	1 - 19	20- 49	50- 99	100-199	200-499	500-999	1000 & Over	Total
Less than 5 / week	7	11	15	8	7	7	3	58
	12.07	18.97	25.86	13.79	12.07	12.07	5.17	100.00
	43.75	31.43	34.09	22.86	26.92	46.67	37.50	32.40
5 - 10 / week	9	20	22	19	15	4	2	91
	9.89	21.98	24.18	20.88	16.48	4.40	2.20	100.00
	56.25	57.14	50.00	54.29	57.69	26.67	25.00	50.84
More than 10/week	0	4	7	8	4	4	3	30
	0.00	13.33	23.33	26.67	13.33	13.33	10.00	100.00
	0.00	11.43	15.91	22.86	15.38	26.67	37.50	16.76
Total	16	35	44	35	26	15	8	179
	8.94	19.55	24.58	19.55	14.53	8.38	4.47	100.00
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Source: NIDB/IBRD Establishment Survey, 1988.

Table A4: DISTRIBUTION OF MANUFACTURING ESTABLISHMENTS BOREHOLES BY FIRM SIZE

Own Boreholes for Production Operation?

Frequency Row Pct Col Pct	Firm Size							
	1 - 19	20- 49	50- 99	100-199	200-499	500-999	1000 & Over	Total
YES	0	5	16	24	17	11	6	79
	0.00	6.33	20.25	30.38	21.52	13.92	7.59	100.00
	0.00	14.29	36.36	68.57	65.38	73.33	75.00	44.13
NO	16	30	28	11	9	4	2	100
	16.00	30.00	28.00	11.00	9.00	4.00	2.00	100.00
	100.00	85.71	63.64	31.43	34.62	26.67	25.00	55.87
Total	16	35	44	35	26	15	8	179
	8.94	19.55	24.58	19.55	14.53	8.38	4.47	100.00
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Source: NIDB/IBRD Establishment Survey, 1988.

Table A5: DISTRIBUTION OF MANUFACTURING ESTABLISHMENTS VEHICLES FOR SHIPMENT BY FIRM SIZE

Own Vehicles for Shipment of Goods?

Frequency / Row Pct / Col Pct	Firm Size							
	1 - 19	20- 49	50- 99	100-199	200-499	500-999	1000 & Over	Total
YES	8	21	26	25	18	11	4	113
	7.08	18.58	23.01	22.12	15.93	9.73	3.54	100.00
	50.00	60.00	59.09	71.43	69.23	73.33	50.00	63.13
NO	8	14	18	10	8	4	4	66
	12.12	21.21	27.27	15.15	12.12	6.06	6.06	100.00
	50.00	40.00	40.91	28.57	30.77	26.67	50.00	36.87
Total	16	35	44	35	26	15	8	179
	8.94	19.55	24.58	19.55	14.53	8.38	4.47	100.00
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Source: NIDB/IBRD Establishment Survey, 1988.

Table A6: DISTRIBUTION OF MANUFACTURING ESTABLISHMENTS MOTORCYCLES BY FIRM SIZE

Own Motocycles for Messenger/Courier?

Frequency / Row Pct / Col Pct	Firm Size							
	1 - 19	20- 49	50- 99	100-199	200-499	500-999	1000 & Over	Total
YES	0	6	11	18	16	11	5	67
	0.00	8.96	16.42	26.87	23.88	16.42	7.46	100.00
	0.00	17.14	25.00	51.43	61.54	73.33	62.50	37.43
NO	16	29	33	17	10	4	3	112
	14.29	25.89	29.46	15.18	8.93	3.57	2.68	100.00
	100.00	82.86	75.00	48.57	38.46	26.67	37.50	62.57
Total	16	35	44	35	26	15	8	179
	8.94	19.55	24.58	19.55	14.53	8.38	4.47	100.00
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Source: NIDB/IBRD Establishment Survey, 1988.

Table A7: DISTRIBUTION OF MANUFACTURING ESTABLISHMENTS RADIO EQUIPMENT BY FIRM SIZE

Own a Radio Transmitting Equipment?

Frequency / Row Pct / Col Pct	Firm Size							
	1 - 19	20- 49	50- 99	100-199	200-499	500-999	1000 & Over	Total
YES	0	2	10	19	15	14	6	66
	0.00	3.03	15.15	28.79	22.73	21.21	9.09	100.00
	0.00	5.71	22.73	54.29	57.69	93.33	75.00	36.87
NO	16	33	34	16	11	1	2	113
	14.16	29.20	30.09	14.16	9.73	0.88	1.77	100.00
	100.00	94.29	77.27	45.71	42.31	6.67	25.00	63.13
Total	16	35	44	35	26	15	8	179
	8.94	19.55	24.58	19.55	14.53	8.38	4.47	100.00
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Source: NIDB/IBRD Establishment Survey, 1988.

Table A8: DISTRIBUTION OF MANUFACTURING ESTABLISHMENTS REGION BY TRAVEL HOURS

Region

Frequency / Row Pct / Col Pct	Travel Hours for Managerial Meetings			
	Less than 5 hours	5 - 14	15 & more	Total
Lagos	26	32	24	82
	31.71	39.02	29.27	100.00
	46.43	46.38	44.44	45.81
Anambra/Imo	9	17	10	36
	25.00	47.22	27.78	100.00
	16.07	24.64	18.52	20.11
Kaduna/Kano	21	20	20	61
	34.43	32.79	32.79	100.00
	37.50	28.99	37.04	34.08
Total	56	69	54	179
	31.28	38.55	30.17	100.00
	100.00	100.00	100.00	100.00

Source: NIDB/IBRD Establishment Survey, 1988.

Table A9: DISTRIBUTION OF MANUFACTURING ESTABLISHMENTS VEHICLES FOR WORKERS BY FIRM SIZE

Own Vehicles for Workers?

Frequency / Row Pct / Col Pct	Firm Size							
	1 - 19	20- 49	50- 99	100-199	200-499	500-999	1000 & OVER	Total
YES	2	2	8	5	5	3	1	26
	7.69	7.69	30.77	19.23	19.23	11.54	3.85	100.00
	12.50	5.71	18.18	14.29	19.23	20.00	12.50	14.53
NO	14	33	36	30	21	12	7	153
	9.15	21.57	23.53	19.61	13.73	7.84	4.58	100.00
	87.50	94.29	81.82	85.71	80.77	80.00	87.50	85.47
Total	16	35	44	35	26	15	8	179
	8.94	19.55	24.58	19.55	14.53	8.38	4.47	100.00

Source: NIDB/IBRD Establishment Survey, 1988.

Table A10: DISTRIBUTION OF MANUFACTURING ESTABLISHMENTS VEHICLES FOR GARBAGE DISPOSAL BY FIRM SIZE

Own Vehicles for Garbage Disposal?

Frequency / Row Pct / Col Pct	Firm Size							
	1 - 19	20- 49	50- 99	100-199	200-499	500-999	1000 & OVER	Total
YES	0	0	5	11	3	3	2	24
	0.00	0.00	20.83	45.83	12.50	12.50	8.33	100.00
	0.00	0.00	11.36	31.43	11.54	20.00	25.00	13.41
NO	16	35	39	24	23	12	6	155
	10.32	22.58	25.16	15.48	14.84	7.74	3.87	100.00
	100.00	100.00	88.64	68.57	88.46	80.00	75.00	86.59
Total	16	35	44	35	26	15	8	179
	8.94	19.55	24.58	19.55	14.53	8.38	4.47	100.00

Source: NIDB/IBRD Establishment Survey, 1988.

Table A11: CAPITAL COST OF PRIVATE POWER GENERATION
(Average Current Market Value)

State	Firm Size	(A) Generators	(B) Other Facilities	(C) Machinery & Equipment	(D) A/C	(E) B/C	(F) (A+B)/C
		(1000 Naira)			(Percent)		
All States	All	825.56	128.28	9150.71	9.02	1.40	10.42
All States	Small	220.08	17.03	956.78	23.00	1.78	24.78
	Large	1007.20	161.11	11608.88	8.68	1.39	10.06
Lagos	All	973.04	165.31	9675.00	10.06	1.71	11.77
Anambra	All	667.79	73.50	9091.29	7.35	0.81	8.15
Imo	All	547.50	103.40	14490.80	3.78	0.71	4.49
Kaduna	All	988.30	158.89	7921.48	12.48	2.01	14.48
Kano	All	492.71	50.79	7274.00	6.77	0.70	7.47
Lagos	Small	207.93	17.13	786.33	26.44	2.18	28.62
	Large	1167.56	202.35	11934.83	9.78	1.70	11.48
Anambra	Small	254.37	14.63	738.75	34.43	1.98	36.41
	Large	1219.00	152.00	20228.00	6.03	0.75	6.78
Imo	Small	120.00	3.00	400.00	30.00	0.75	30.75
	Large	595.00	114.56	16056.44	3.71	0.71	4.42
Kaduna	Small	326.00	42.50	1261.50	25.84	3.37	29.21
	Large	1103.48	180.05	9079.74	12.15	1.98	14.14
Kano	Small	168.12	8.25	1411.63	11.91	0.58	12.49
	Large	605.61	64.40	9313.09	6.50	0.69	7.19
Number of Observations		156	158	156	--	--	--

Source: Establishment Survey 1988, Nigeria Infrastructure Research Project.

Table A12: CAPITAL COST OF PRIVATE WATER SUPPLY
(Average Current Market Value)

State	Firm Size	(A) Boreholes	(B) Other Facilities	(C) Machinery & Equipment	(D) A/C	(E) B/C	(F) (A+B)/C
		(1000 Naira)			(Percent)		
All States	All	144.57	116.84	13670.46	1.06	0.85	1.91
All States	Small	22.50	9.25	1130.50	1.99	0.82	2.81
	Large	151.97	123.36	14430.45	1.05	0.85	1.91
Lagos	All	146.93	98.96	11786.13	1.25	0.84	2.09
Anambra	All	428.00	180.00	2850.00	15.02	6.32	21.33
Imo	All	117.00	363.80	25529.00	0.46	1.43	1.88
Kaduna	All	103.33	133.00	15038.33	0.69	0.88	1.57
Kano	All	72.50	42.83	23670.17	0.31	0.18	0.49
Lagos	Small	22.50	9.25	1130.50	1.99	0.82	2.81
	Large	156.88	106.14	12638.58	1.24	0.84	2.08
Anambra	Small	--	--	--	--	--	--
	Large	428.00	180.00	2850.00	15.02	6.32	21.33
Imo	Small	--	--	--	--	--	--
	Large	117.00	363.80	25529.00	0.46	1.43	1.88
Kaduna	Small	--	--	--	--	--	--
	Large	103.33	133.00	15038.33	0.69	0.88	1.57
Kano	Small	--	--	--	--	--	--
	Large	72.50	42.83	23670.17	0.31	0.18	0.49
Number of Observations		70	70	70	--	--	--

Source: Establishment Survey 1988, Nigeria Infrastructure Research Project.

Table A13: CAPITAL COST OF PRIVATE TRANSPORT FOR WORKERS
(Average Current Market Value)

State	Firm Size	(A) Vehicles for Workers	(B) All Vehicles	(C) Machinery & Equipment	(D) A/B	(E) A/C	(F) B/(B+C)
		(1000 Naira)			(Percent)		
All States	All	426.35	1419.48	14913.96	30.04	2.86	8.69
All States	Small	82.50	2089.50	1502.50	3.95	5.49	58.17
	Large	459.10	1355.67	16191.24	33.86	2.84	7.73
Lagos	All	787.10	1578.00	29086.90	49.88	2.71	5.15
Anambra	All	150.00	1679.00	505.00	8.93	29.70	76.88
Imo	All	198.00	1596.00	2976.60	12.41	6.65	34.90
Kaduna	All	115.00	1832.00	3017.00	6.28	3.81	37.78
Kano	All	113.00	709.00	6146.00	15.94	1.84	10.34
Lagos	Small	--	--	--	--	--	--
	Large	787.10	1578.00	29086.90	49.88	2.71	5.15
Anambra	Small	150.00	1679.00	505.00	8.93	29.70	76.88
	Large	--	--	--	--	--	--
Imo	Small	--	--	--	--	--	--
	Large	198.00	1596.00	2976.60	12.41	6.65	34.90
Kaduna	Small	--	--	--	--	--	--
	Large	115.00	1832.00	3017.00	6.28	3.81	37.78
Kano	Small	15.00	2500.00	2500.00	0.60	0.60	50.00
	Large	137.50	261.25	7057.50	52.63	1.95	3.57
Number of Observations		23	23	23	--	--	--

Source: Establishment Survey 1988, Nigeria Infrastructure Research Project.

Table A14: CAPITAL COST OF PRIVATE TRANSPORT FOR SHIPMENT OF GOODS
(Average Current Market Value)

State	Firm Size	(A) Vehicles for Shipments	(B) All Vehicles	(C) Machinery & Equipment	(D) A/B	(E) A/C	(F) B/(B+C)
		(1000 Naira)			(Percent)		
All States	All	386.73	786.75	8368.68	49.16	4.62	8.59
All States	Small	82.14	203.57	750.11	40.35	10.95	21.35
	Large	489.48	983.48	10938.80	49.77	4.47	8.25
Lagos	All	407.19	1006.65	10286.63	40.45	3.96	8.91
Anambra	All	150.57	249.79	757.50	60.28	19.88	24.80
Imo	All	1144.00	1929.57	18203.57	59.29	6.28	9.58
Kaduna	All	387.68	595.42	5242.68	65.11	7.39	10.20
Kano	All	224.79	350.84	8230.37	64.07	2.73	4.09
Lagos	Small	60.50	144.00	928.70	42.01	6.51	13.42
	Large	489.74	1212.05	12514.71	40.41	3.91	8.83
Anambra	Small	89.17	242.42	328.08	36.78	27.18	42.49
	Large	519.00	294.00	3334.00	176.53	15.57	8.10
Imo	Small	--	--	--	--	--	--
	Large	1144.00	1929.57	18203.57	59.29	6.28	9.58
Kaduna	Small	50.00	166.67	1172.33	30.00	4.26	12.45
	Large	451.00	675.81	6005.88	66.73	7.51	10.11
Kano	Small	158.33	283.67	1420.67	55.82	11.15	16.64
	Large	237.25	363.44	9507.19	65.28	2.50	3.68
Number of Observations		111	111	111	--	--	--

Source: Establishment Survey 1988, Nigeria Infrastructure Research Project.

Table A15: CAPITAL COST OF PRIVATE TRANSPORT FOR GARBAGE DISPOSAL
(Average Current Market Value)

State	Firm Size	(A) Vehicles for Garbage	(B) All Vehicles	(C) Machinery & Equipment	(D) A/B	(E) A/C	(F) B/(B+C)
		(1000 Naira)			(Percent)		
All States	All	64.72	1012.08	13411	6.39	0.48	7.02
All States	Small	2.00	40.00	1300.00	5.00	0.15	2.99
	Large	67.33	1052.58	13915.62	6.40	0.48	7.03
Lagos	All	98.33	632.83	6403.83	15.54	1.54	8.99
Anambra	All	73.00	1860.00	28997.50	3.92	0.25	6.03
Imo	All	--	--	--	--	--	--
Kaduna	All	71.00	2753.50	26902.00	2.58	0.26	9.28
Kano	All	41.09	277.36	6659.45	14.81	0.62	4.00
Lagos	Small	--	--	--	--	--	--
	Large	98.33	632.83	6403.83	15.54	1.54	8.99
Anambra	Small	2.00	40.00	1300.00	5.00	0.15	2.99
	Large	96.67	2466.67	38230.00	3.92	0.25	6.06
Imo	Small	--	--	--	--	--	--
	Large	--	--	--	--	--	--
Kaduna	Small	--	--	--	--	--	--
	Large	71.00	2753.50	26902.00	2.58	0.26	9.28
Kano	Small	--	--	--	--	--	--
	Large	41.09	277.36	6659.45	14.81	0.62	4.00
Number of Observations		25	25	25	--	--	--

Source: Establishment Survey 1988, Nigeria Infrastructure Research Project.

Table A16: CAPITAL COST OF PRIVATE COMMUNICATIONS
(Average Current Market Value)

State	Firm Size	(A) Radio Equipment	(B) Machinery & Equipment	(C) A/B
		(1000 Naira)		(Percent)
All States	All	84.15	14296.02	0.59
All States	Small	19.00	1283.00	1.48
	Large	86.19	14702.67	0.59
Lagos	All	118.00	14063.12	0.84
Anambra	All	40.75	29222.50	0.14
Imo	All	104.33	7241.00	1.44
Kaduna	All	37.77	13918.31	0.27
Kano	All	38.00	13818.00	0.28
Lagos	Small	--	--	--
	Large	118.00	14063.12	0.84
Anambra	Small	--	--	--
	Large	40.75	29222.50	0.14
Imo	Small	--	--	--
	Large	104.33	7241.00	1.44
Kaduna	Small	30.00	1529.00	1.96
	Large	38.42	14950.75	0.26
Kano	Small	8.00	1037.00	0.77
	Large	41.33	15238.11	0.27
Number of Observations		66	66	--

Source: Establishment Survey 1988, Nigeria Infrastructure Research Project.

Table A17: CAPITAL COST OF TOTAL PRIVATE INFRASTRUCTURE
(Average Current Market Value)

State	Firm Size	(A) Total Private a/ Infrastructure	(B) Total b/ Capital Stock	(C) A/B
		(1000 Naira)		(Percent)
All States	All	1331.48	9867.69	13.49
All States	Small	252.07	1013.56	24.87
All States	Large	1710.96	12980.48	13.18
Lagos	All	1644.94	10253.56	16.04
Anambra	All	700.77	6376.45	10.99
Imo	All	1859.50	15952.10	11.66
Kaduna	All	1468.18	10840.50	13.54
Kano	All	716.06	8590.58	8.34
Lagos	Small	253.87	888.75	28.57
Lagos	Large	1992.70	12594.77	15.82
Anambra	Small	218.37	639.75	34.13
Anambra	Large	1987.17	21674.33	9.17
Imo	Small	148.00	400.00	37.00
Imo	Large	2049.67	17680.11	11.59
Kaduna	Small	413.50	1424.50	29.03
Kaduna	Large	1643.96	12409.83	13.25
Kano	Small	248.12	1882.00	13.18
Kano	Large	865.80	10737.32	8.06
Number of Observations		173	173	--

a/ Includes electric generators, boreholes, radio transmission equipment, and vehicles for workers' commuting, goods shipments, and waste disposal.

b/ Includes machinery, equipment, and all vehicles

Source: Establishment Survey 1988, Nigeria Infrastructure Research Project.

Table A18: COST COMPOSITION OF OWN ELECTRIC POWER GENERATION PER KWH

Firm Size	Generators	Accessories	Fuel	Maintenance	Wage	Total
All Firms (Naira)	3.482	0.327	0.352	0.318	0.132	4.612
(Percent)	75.50	7.10	7.64	6.91	2.86	100.00
0-9	0.571	0.085	0.077	0.000	0.000	0.732
	77.93	11.57	10.50	0.00	0.00	100.00
10-19	0.843	0.147	0.100	0.109	0.045	1.243
	67.82	11.80	8.03	8.74	3.61	100.00
20-49	5.579	0.244	0.238	0.263	0.133	6.457
	86.40	3.78	3.69	4.07	2.06	100.00
50-99	3.403	0.382	0.390	0.420	0.181	4.775
	71.25	7.99	8.17	8.79	3.80	100.00
100-199	3.808	0.349	0.280	0.298	0.140	4.876
	78.11	7.15	5.74	6.12	2.88	100.00
200-499	2.791	0.514	0.433	0.277	0.091	4.106
	67.98	12.51	10.53	6.76	2.22	100.00
500-999	1.488	0.159	0.502	0.165	0.066	2.379
	62.52	6.67	21.09	6.95	2.77	100.00
1000 & Over	1.799	0.077	0.566	0.718	0.155	3.315
	54.28	2.33	17.07	21.65	4.66	100.00

Note: For the smaple firms as a whole, 25.48 percent of electric power supply came from own generators.

Source: NIDB/IBRD Establishment Survey, 1988.

Table A19: DISTRIBUTION OF MANUFACTURING ESTABLISHMENTS BY STATE AND FIRM SIZE

State	Firm Size							
Frequency Percent Row Pct Col Pct	1 - 19	20- 49	50- 99	100-199	200-499	500-999	1000 & Over	Total
Lagos	2 2.44 12.50	16 19.51 45.71	22 26.83 50.00	15 18.29 42.86	14 17.07 53.85	10 12.20 66.67	3 3.66 37.50	82 100.00 45.81
Anambra	12 46.15 75.00	8 30.77 22.86	3 11.54 6.82	0 0.00 0.00	1 3.85 3.85	1 3.85 6.67	1 3.85 12.50	26 100.00 14.53
Imo	1 10.00 6.25	0 0.00 0.00	2 20.00 4.55	2 20.00 5.71	3 30.00 11.54	1 10.00 6.67	1 10.00 12.50	10 100.00 5.59
Kaduna	0 0.00 0.00	4 14.29 11.43	9 32.14 20.45	6 21.43 17.14	4 14.29 15.38	2 7.14 13.33	3 10.71 37.50	28 100.00 15.64
Kano	1 3.03 6.25	7 21.21 20.00	8 24.24 18.18	12 36.36 34.29	4 12.12 15.38	1 3.03 6.67	0 0.00 0.00	33 100.00 18.44
Total	16 8.94 100.00	35 19.55 100.00	44 24.58 100.00	35 19.55 100.00	26 14.53 100.00	15 8.38 100.00	8 4.47 100.00	179 100.00 100.00

Source: NIDB/IBRD Project Establishment Survey, 1988

Table A20: DISTRIBUTION OF MANUFACTURING ESTABLISHMENTS BY STATE AND INDUSTRY

State / Frequency / Percent / Row Pct / Col Pct	Industry 3100	3200	3300	3400	3500	3600	3700	3800	3900	Total
Lagos	6	10	4	7	23	3	2	25	2	82
	7.32	12.20	4.88	8.54	28.05	3.66	2.44	30.49	2.44	100.00
	30.00	29.41	44.44	36.84	65.71	20.00	66.67	59.52	100.00	45.81
Anambra	3	1	2	6	4	8	0	2	0	26
	11.54	3.85	7.69	23.08	15.38	30.77	0.00	7.69	0.00	100.00
	15.00	2.94	22.22	31.58	11.43	53.33	0.00	4.76	0.00	14.53
Imo	1	3	0	2	2	1	0	1	0	10
	10.00	30.00	0.00	20.00	20.00	10.00	0.00	10.00	0.00	100.00
	5.00	8.82	0.00	10.53	5.71	6.67	0.00	2.38	0.00	5.59
Kaduna	4	6	2	3	3	1	0	9	0	28
	14.29	21.43	7.14	10.71	10.71	3.57	0.00	32.14	0.00	100.00
	20.00	17.65	22.22	15.79	8.57	6.67	0.00	21.43	0.00	15.64
Kano	6	14	1	1	3	2	1	5	0	33
	18.18	42.42	3.03	3.03	9.09	6.06	3.03	15.15	0.00	100.00
	30.00	41.18	11.11	5.26	8.57	13.33	33.33	11.90	0.00	18.44
Total	20	34	9	19	35	15	3	42	2	179
	11.17	18.99	5.03	10.61	19.55	8.38	1.68	23.46	1.12	100.00
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Notes: The Standard Industrial Classification (SIC) codes refer to the following: 31=food and beverages; 32=textiles and leather; 33=wood; 34=paper; 35=chemical and rubber; 36=non-metal mineral; 37=basic metal; 38=fabricated metal, electrical machinery, and transport equipment; and 39=others.

Source: NIDB/IBRD Project Establishment Survey, 1988

Table A21: DISTRIBUTION OF MANUFACTURING ESTABLISHMENTS BY INDUSTRY AND FIRM SIZE

Industry	Firm Size							
Frequency Percent Row Pct Col Pct	1 - 19	20- 49	50- 99	100-199	200-499	500-999	1000 & Over	Total
3100	1 5.00 6.25	7 35.00 20.00	4 20.00 9.09	4 20.00 11.43	4 20.00 15.38	0 0.00 0.00	0 0.00 0.00	20 100.00 11.17
3200	1 2.94 6.25	3 8.82 8.57	7 20.59 15.91	9 26.47 25.71	4 11.76 15.38	4 11.76 26.67	6 17.65 75.00	34 100.00 18.99
3300	1 11.11 6.25	3 33.33 8.57	2 22.22 4.55	1 11.11 2.86	2 22.22 7.69	0 0.00 0.00	0 0.00 0.00	9 100.00 5.03
3400	5 26.32 31.25	6 31.58 17.14	3 15.79 6.82	2 10.53 5.71	1 5.26 3.85	2 10.53 13.33	0 0.00 0.00	19 100.00 10.61
3500	0 0.00 0.00	5 14.29 14.29	14 40.00 31.82	7 20.00 20.00	4 11.43 15.38	3 8.57 20.00	2 5.71 25.00	35 100.00 19.55
3600	7 46.67 43.75	0 0.00 0.00	3 20.00 6.82	2 13.33 5.71	3 20.00 11.54	0 0.00 0.00	0 0.00 0.00	15 100.00 8.38
3700	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 66.67 5.71	0 0.00 0.00	1 33.33 6.67	0 0.00 0.00	3 100.00 1.68
3800	1 2.38 6.25	10 23.81 28.57	10 23.81 22.73	8 19.05 22.86	8 19.05 30.77	5 11.90 33.33	0 0.00 0.00	42 100.00 23.46
3900	0 0.00 0.00	1 50.00 2.86	1 50.00 2.27	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 100.00 1.12
Total	16 8.94 100.00	35 19.55 100.00	44 24.58 100.00	35 19.55 100.00	26 14.53 100.00	15 8.38 100.00	8 4.47 100.00	179 100.00 100.00

Notes: The Standard Industrial Classification (SIC) codes refer to the following: 31=food and beverages; 32=textiles and leather; 33=wood; 34=paper; 35=chemical and rubber; 36=non-metal mineral; 37=basic metal; 38=fabricated metal, electrical machinery, and transport equipment; and 39=others.

Source: NIDB/IBRD Project Establishment Survey, 1988

Table A22: SAMPLE FRAME: LISTING FROM FEDERAL OFFICE OF STATISTICS

All five states

STATE	Small a/	Large	Total
A. Lagos	108	357	465
B. Anambra	137	64	201
C. Imo	36	21	57
D. Kaduna	63	45	108
E. Kano	344	119	463
Total	688	606	1294

A. Lagos State

LGA	Small	Large	Total
Badagry	5	4	9
Epe	0	1	1
Ikeja	41	159	200
Ikorodu	2	5	7
Lagos Island	17	66	83
Lagos Mainland	27	48	75
Mushin	15	61	76
Shomolu	1	13	14
Total	108	357	465

B. Anambra State

	Small	Large	Total
Enugu	54	24	78
Onitsha	32	24	56
Total	86	48	134

C. Imo State

	Small	Large	Total
Ikwuano/Umuahia	6	2	8
Obioma-Ngwa (Aba)	19	14	33
Owerri	7	5	12
Total	32	21	53

D. Kaduna State

	Small	Large	Total
Kaduna	19	28	47
Kaduna South	2	8	10
Zaria	31	7	38
Total	52	43	95

E. Kano State

	Small	Large	Total
Kano	105	114	219

a/ Establishments with less than 50 employees.

Table A23: REALIZED SAMPLE

A. Target Size and Realized Sample Size

State	Target		Realized Sample					
	Freq	(%)	A.A. & Co.	(%)	NIDB [a]	(%)	Total	(%)
Lagos	100	30.8	82	45.8	12	35.3	94	44.1
Anambra	60	18.5	26	14.5	7	20.6	33	15.5
Imo	35	10.8	10	5.6	6	17.6	16	7.5
Kaduna	55	16.9	28	15.6	6	17.6	34	16.0
Kano	75	23.1	33	18.4	3	8.8	36	16.9
Total	325	100.0	179	100.0	34	100.0	213	100.0

a/ NIDB completed the survey for 32 establishments located in 12 other states.

B. Sample Distribution by Small and Large Establishments

State	Target				Realized Sample			
	Small [b]	Large	(%)	Total	Small	Large	(%)	Total
Lagos	24	76	76.00	100	19	75	79.79	94
Anambra	28	32	53.33	60	23	10	30.30	33
Imo	21	14	40.00	35	3	13	81.25	16
Kaduna	25	30	54.55	55	4	30	88.24	34
Kano	36	39	52.00	75	9	27	75.00	36
Total	134	191	58.77	325	58	155	72.77	213

b/ Establishments with less than 50 employees.

Figure A1: DISTRIBUTION OF MANUFACTURING ESTABLISHMENTS:
SOURCE OF ELECTRICITY BY FIRM SIZE IN EACH REGION

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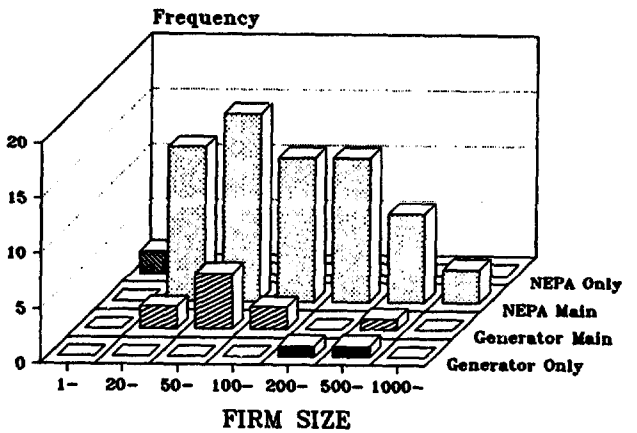

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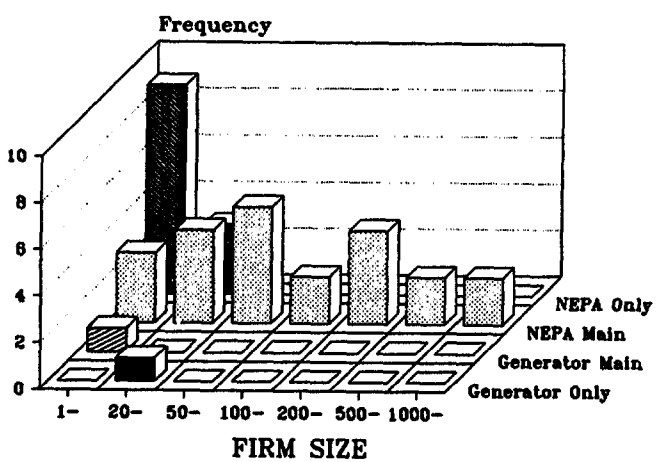

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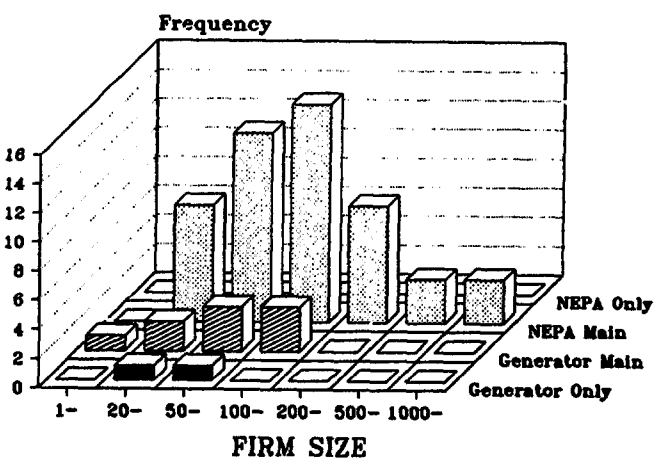

Figure A2: DISTRIBUTION OF MANUFACTURING ESTABLISHMENTS:
POWER OUTAGE BY FIRM SIZE IN EACH REGION

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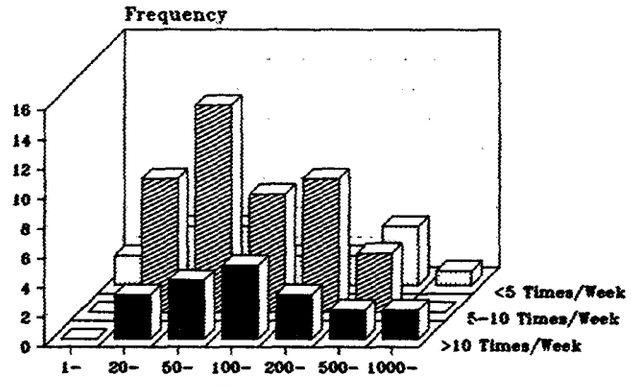

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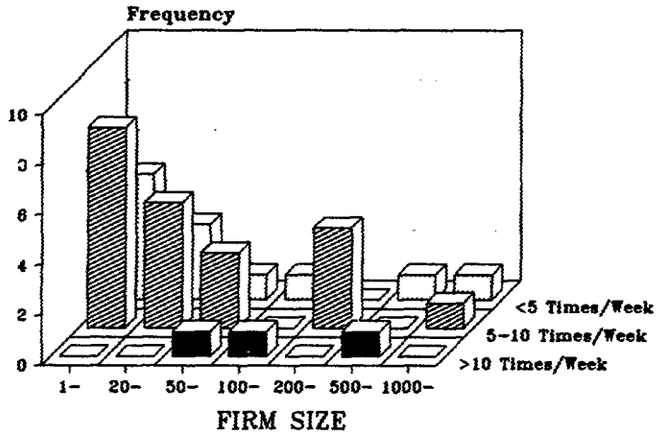

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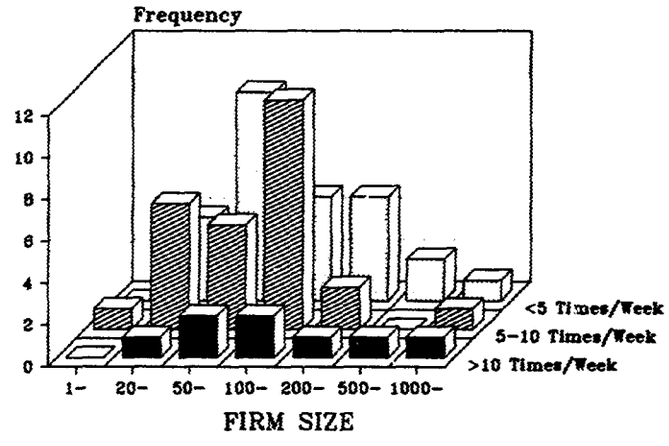

Figure A3: DISTRIBUTION OF MANUFACTURING ESTABLISHMENTS:
BOREHOLES BY FIRM SIZE IN EACH REGION

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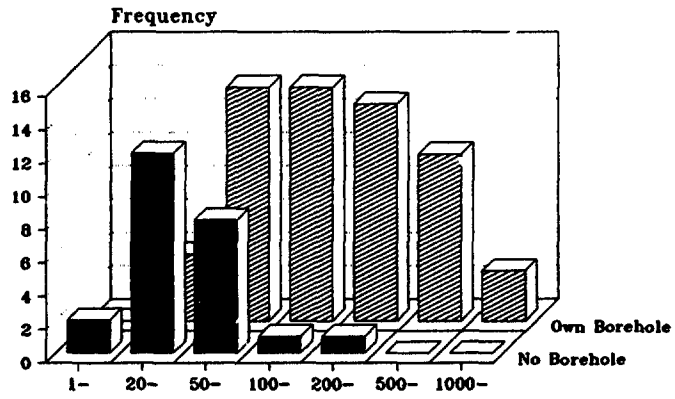

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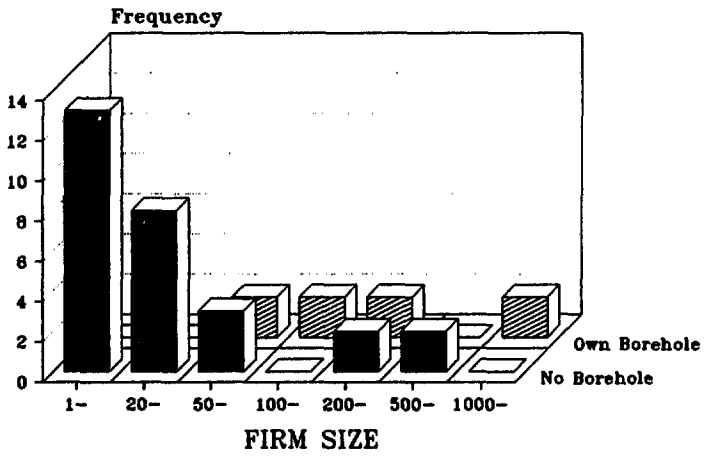

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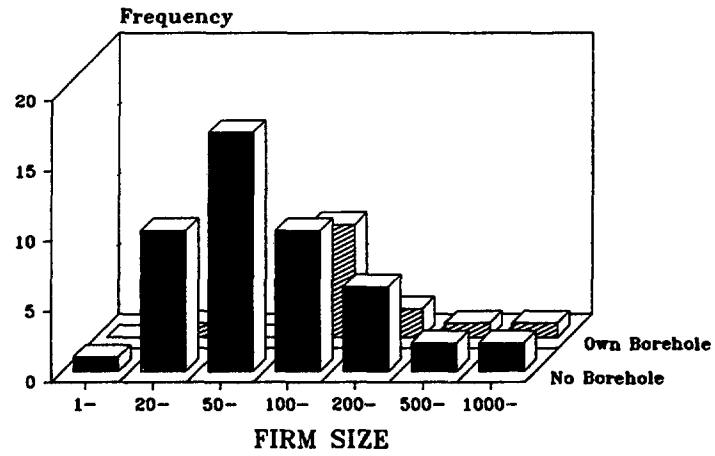

Figure A4: DISTRIBUTION OF MANUFACTURING ESTABLISHMENTS: VEHICLES FOR SHIPMENT BY FIRM SIZE IN EACH REGION

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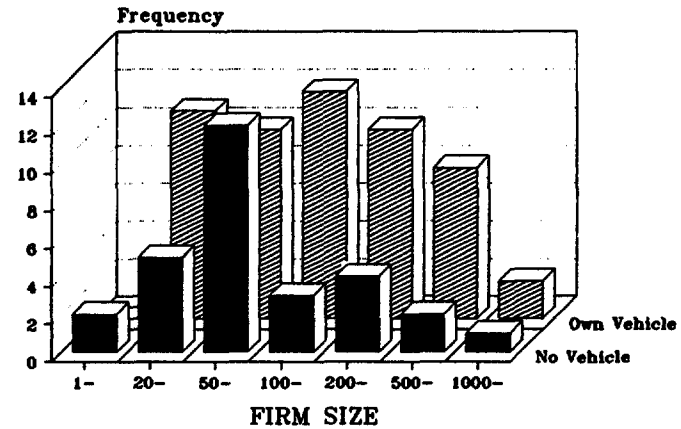

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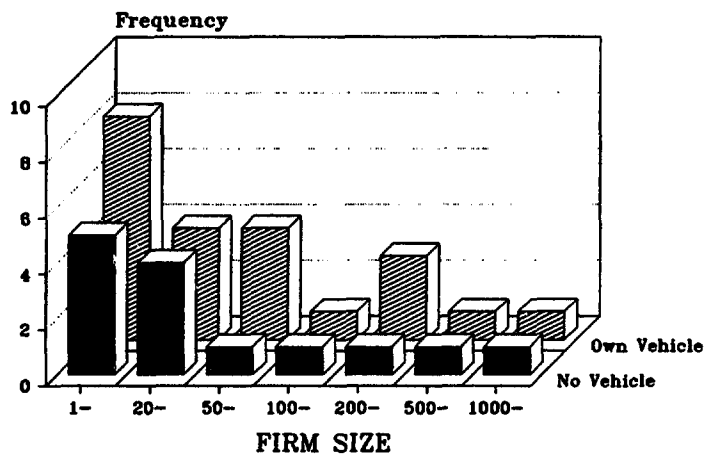

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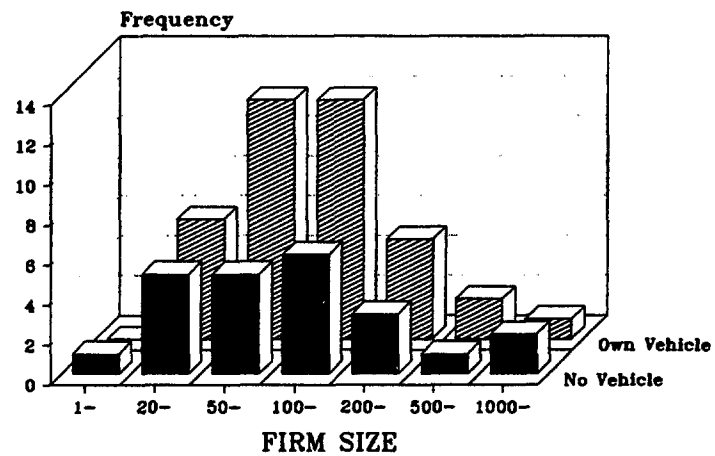

Figure A5: DISTRIBUTION OF MANUFACTURING ESTABLISHMENTS: MOTORCYCLES BY FIRM SIZE IN EACH REGION

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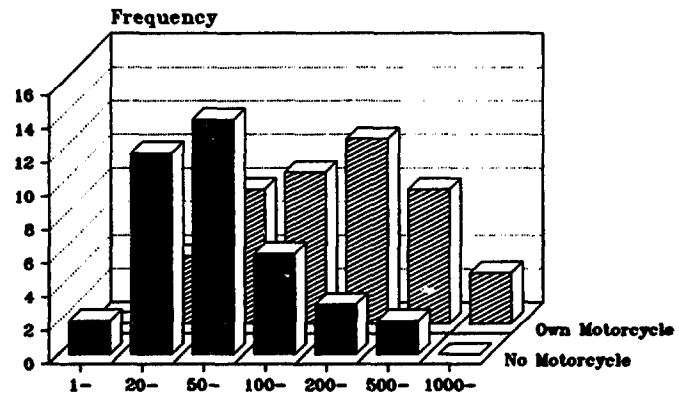

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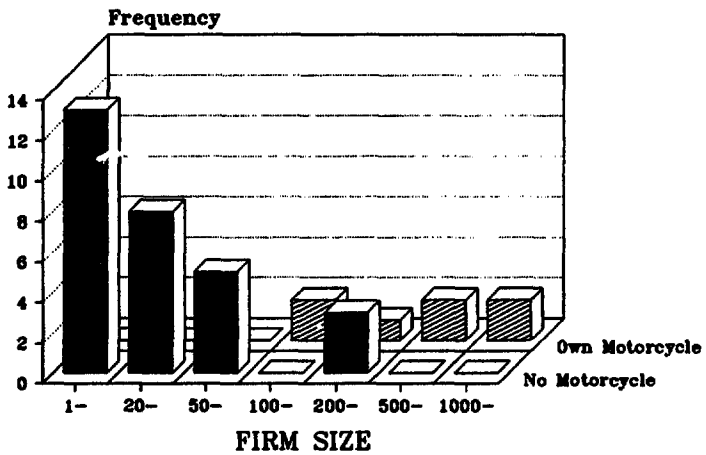

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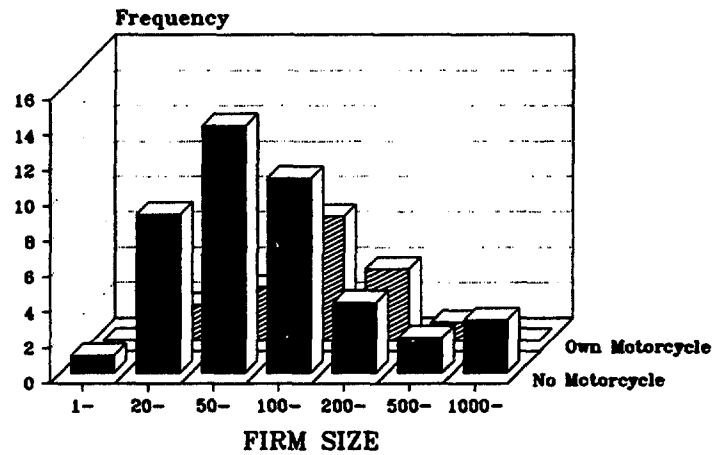

Figure A6: DISTRIBUTION OF MANUFACTURING ESTABLISHMENTS: RADIO EQUIPMENT BY FIRM SIZE IN EACH REGION

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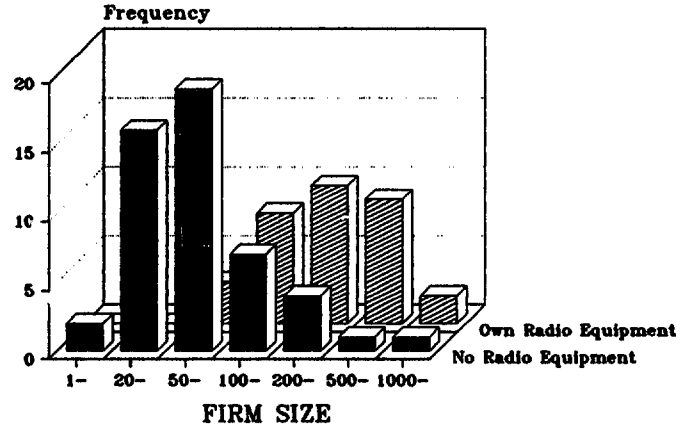

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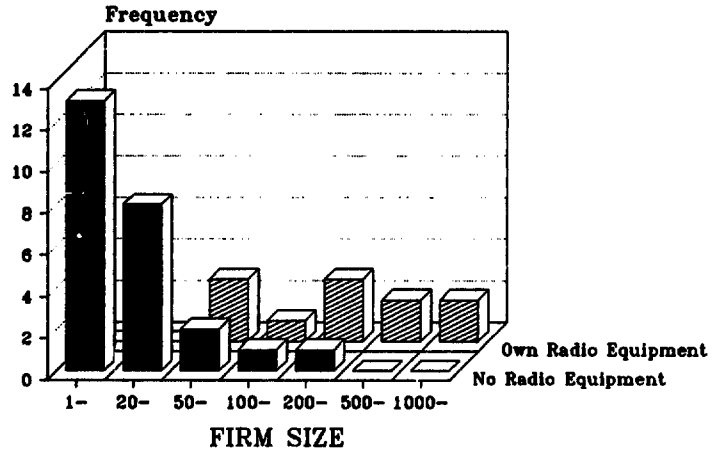

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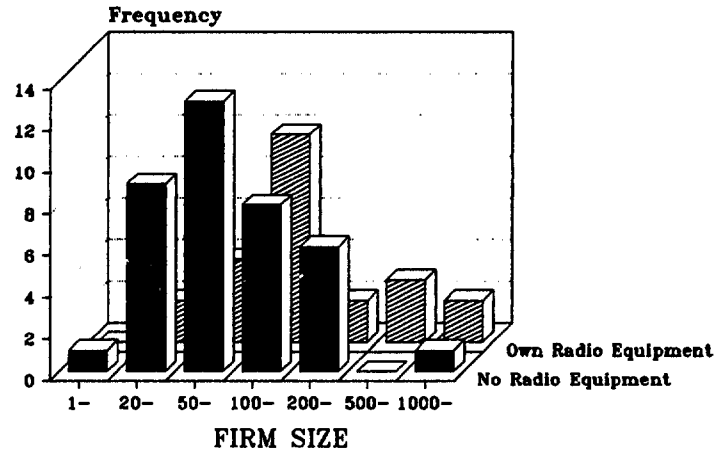

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