Nigerian firms complain about the high cost of manufacturing. Ninety-four percent of them report that infrastructure is their biggest problem (2.5 times more worrisome than finance), and 97 percent of firms own generators. This article, which explores the nature and costs of the problem, is based on a sample of 232 firms with a detailed examination of 26 electricity accounts. (In considering the cost of electricity, one should note that both publicly- and privately-produced electricity is subsidised. NEPA, the public provider, produces power for 11 US cents per KWh but only charges 3-5 US cents per KWh while diesel fuel, which accounts for 75 percent of private costs, is subsidised).

Costs of public and private electricity provision

Manufacturers’ responses to electricity deficiencies

Kyu Sik Lee et al., 1999, report that firms might respond to infrastructure deficiencies through business relocation, factor substitution, private provision and/or output reduction. The study from which this article is derived, found that there was a further response mechanism, i.e., product substitution. These mechanisms are considered below.

Relocation. There was no evidence of firms relocating to obtain improved supply - little would be gained as evidenced by the slight variation (from 96 to 98 percent) in the incidence of generators in firms in the different regions of Nigeria. Firms did, however, note “encouraging” NEPA to load-shed elsewhere.

Factor substitution. There was much evidence of factor substitution, e.g., adjusting the mode of production in favor of less electricity-intensive inputs. Firms commonly reported that they were avoiding machines with electronic controls which were observed to be more susceptible to damage from power fluctuations and outages. Typically, it might take three weeks to import parts and fix electronically-controlled machines. (Pharmaceutical firms were commonly affected, losing up to 180,000 tablets per machine-hour). Because older machines are no longer available, firms are buying modern ones and converting them to mechanical or electrical operation. In such cases, firms may have to modify their raw materials so that the down-graded machines could process the inputs. A leading lighting manufacturer noted that better electricity supply in a similar-sized Malaysian firm enabled automated...
machinery to be used there which resulted in three times the output.

There is relief for some firms in the recent availability of natural gas, although they stated that it is hard to get permission to hire foreign gas-power technicians, whose skills are unavailable in Nigeria.

Private provision. Although nearly all Nigerian firms can generate their own power, they are not strictly substituting public for private provision—they have to pay for the provision of both in parallel.

Table 2: Cost of Publicly—Compared to Privately-Provided Electricity (N. per KwH, US cents per KwH)

<table>
<thead>
<tr>
<th></th>
<th>Publicly provided</th>
<th>Privately provided</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lowest (N. per KwH)</td>
<td>5.36</td>
<td>9.00</td>
</tr>
<tr>
<td>Highest (N. per KwH)</td>
<td>20.76</td>
<td>38.60</td>
</tr>
<tr>
<td>Mean (N per KwH)</td>
<td>7.86</td>
<td>19.05</td>
</tr>
<tr>
<td>Mean (US cents per KwH)</td>
<td>6.5</td>
<td>15.9</td>
</tr>
</tbody>
</table>


NEPA’s bills consist of three charges: the consumption, the fixed, and the demand (based on the installed capacity of the firm) charge. The last two charges are levied whether the firm uses public power or not. In some firms, the demand charge is constant, while in other firms it may be in inverse proportion to the amount of fuel consumed, as shown in Table 1. In this table, a furniture firm in one month consumed 1,938 KWh and the demand charge was for 135 units; in another month, the consumption was lower at 489 KWh while the demand charge was higher at 180 units. In the case of a plastics firm, in one month the consumption was 33,550 units while the demand units numbered 150; and in another month, the consumption was 13,970 units, with the demand units constant at 150 units. The examples tabled illustrate that the demand charge can vary from 22 to 1,836 percent of the consumption charge. The table also shows that the cost of public-provided electricity can vary from N5.78 to N93.06 per KwH depending on the relationship between consumption and demand charges as a percentage of consumption charge.

Output reduction. Firms reported output reductions (commonly up to 30 percent) due to deficiencies in the public provision of electricity. A top manufacturer stated that its steel sheet machine is constrained by the lack of power, and by wear and tear due to constant power interruptions. The machine has the capacity to make 480 sheets per day, but it takes five days to make them because of the outages; some 20 minutes’ start-up each time power is restored; and repairs caused by the outages. This results in an 80 percent output loss—valued at some N173m. per year, excluding repair costs.

Product substitution. Several firms noted that the products they made were influenced by the power supply. A pharmaceutical firm, for example, has reduced its range from 26 products to the five fastest-moving ones because of outages affecting refrigerated storage in the supply chain.

Capital costs and their incidence

Firms spend a considerable amount of capital on the private provision of electricity. On average, the cost of generators and accessories, and the annual cost of maintenance, amounts to 22 percent
and 3 percent respectively of the total value of machinery and equipment. Firms want to run their entire plant during outages, but many cannot because of the capital cost.

The impact of these costs can be considerable on firms, threatening their development. In the case of a new auto-parts manufacturer, the Indian engineers (who were practiced in turn-key operations in several countries) planned for production to be rolled in phases, with on-site spare parts dedicated to each phase. However, because of power deficiencies during the trial period, spares dedicated to the first two phases had to be used, and then the firm had to cannibalize second-phase equipment for spares. In the first three months, an unexpected USD 25,000 in parts had been used; the lead time in getting more spares threatened the roll-out; and the management entered an “undreamt-of inventory mentality.”

The private cost as a measure of willingness to pay for reliable services

Overall, firms are using generators for 67 percent of the production time causing substantial additional cost. Table 2 shows that the cost of privately-provided electricity is 2.42 times more than that charged by NEPA—N19.05 per KwH compared with N7.86 per KwH. It also shows the considerable variation between the extremes in both the case of privately and publicly-provided electricity even after outliers have been removed. The highest cost of publicly-provided electricity per KwH is 3.9 times the lowest cost, while the highest cost of privately-provided electricity is 4.4 times the lowest cost.

Variation in the cost of privately-provided power is mainly due to the demand charge which, as noted earlier, may vary between 22 and 1,836 percent of the consumption charge. On the other hand, variation in the cost of privately-provided electricity depends mostly on the variation in the cost of fuel and the efficiency of the generators. Fuel, at an average of 75 percent of total cost, is six times higher, as shown in Table 3, than servicing, the next highest cost.

While the official price of diesel is N21 per litre, the average price paid was N31.29. Few firms can obtain diesel at the official price and many paid up to N50 per litre. One of Africa’s biggest multi-nationals got fuel for N21 in Lagos, while its plant in Aba paid N40, leading to privately-provided power costing N9.00 per KwH and N13.5 respectively in the two locations.

Firms, additionally, have high search and transaction costs. One firm, which needed 400 litres of diesel per day and was willing to pay N40 per litre, spent from 5-48 hours getting fuel to run the generator for a day. Moreover, there are problems over adulterated fuel, in obtaining cash to pay for it, and in providing security for the cash collector - with the possibility that both security and cash collector would abscond!

The cost and inconvenience of providing electricity privately leads firms despairingly to opine that they would pay twice the price for a stable public supply.

Production cost increases

<table>
<thead>
<tr>
<th>Item</th>
<th>Actual</th>
<th>Nigerian production cost</th>
<th>Estimated cost with Indian infrastructure</th>
<th>Indian production cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Box of 96 Paracetamol tablets (Naira)</td>
<td>45</td>
<td>36</td>
<td>38</td>
<td></td>
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</tbody>
</table>


Power supply is adding considerably to the overall cost of production in firms as touched upon above. Paint firms state that the bad infrastructure “doubles the cost of production.” In the case of plastic pipes’ and steel pipes’ manufacturers, poor electricity supply increase production costs by 7 percent and by 33 percent respectively. With carton manufacturers, production costs are increased by some 25 percent, not including a 10 percent loss of materials. Pharmaceutical firms believe that poor supply increases production costs by around 20 percent. In a specific instance, charted in Table 4, a firm observed that it had stopped production of Paracetamol tablets when the cost of production at N45 was N7 higher in Nigeria than in India. The firm estimated that if it enjoyed the same standard of in-

Table 3: Cost of Fuel, Staff, Servicing and Depreciation as a Percentage of Total Cost of Privately-Provided Power

<table>
<thead>
<tr>
<th>Cost item</th>
<th>% of total cost</th>
</tr>
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<tbody>
<tr>
<td>Fuel</td>
<td>75</td>
</tr>
<tr>
<td>Staff</td>
<td>4</td>
</tr>
<tr>
<td>Servicing</td>
<td>12</td>
</tr>
<tr>
<td>Depreciation</td>
<td>10</td>
</tr>
</tbody>
</table>

Source: Interviews with 15 firms
Infrastructure, particularly electricity, as enjoyed in India, its production costs would be N2 lower than in India.

Conclusions

While most of the imported competition firms face currently comes from suppliers in South and South-East Asia, within the region firms are most worried about competition from Ghana. It is reported that electricity there costs 7 US cents per Kwh, about the same as publicly-provided power in Nigeria, as shown in Table 2, but that firms use self-generated electricity for less than 10 percent of the time (nearly one-seventh of the Nigerian figure).

High production costs in Nigeria result in large measure from poor public provision of electricity. This requires 97 percent of firms to depend on privately-provided power for 67 percent of the time to generate electricity costing 2.42 times more than would have been paid with reliable public provision. This clearly puts Nigerian firms at a competitive disadvantage compared with Ghanaian, let alone Asian firms. Nigerian firms are right to consider infrastructure, particularly the cost of electricity, as their biggest business problem.

Findings

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