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Abbas, Malaika

The Shahid Javed Burki Institute of Public Policy a Netsol

5 October 2016

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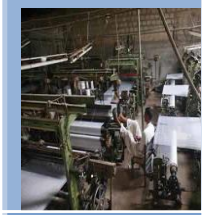
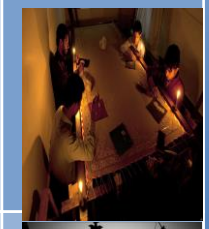
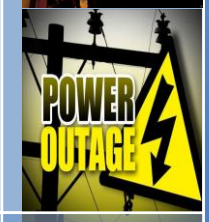
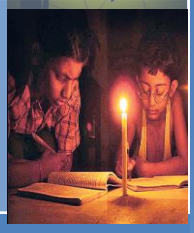








The Direct and Indirect Costs of Power Outages to Small Scale Manufacturing Industries of Punjab

Malaika Abbas

Research Associate the Shahid Javed Burki Institute of Public Policy a Netsol

Mphil Business Economics Department School of Social Sciences and Liberal Arts Beaconhouse National University, Lahore, Pakistan

ABSTRACT

The paper quantifies the various costs incurred due to power outages in Punjab by the small scale manufacturing sector. The previous studies that calculated the cost of power outrages have focused at a national level only. The type of costs identified are: Direct Costs like spoilage cost and value of output loss and Adjustment Costs like inbuilt power generation costs (capital cost, fuel cost, operation and maintenance costs of generators etc.) and costs of other adjustments. The methodology used for quantifying the cost of outages is based largely on Pasha, et al. (1989). In conclusion, the paper estimates that the total outage cost for small scale industry of Punjab for 2012 is almost Rs. 21 billion which accounts for 12.4 percent of small scale manufacturing value added. Policy recommendations are made to mitigate the impact of load shedding.

KEYWORDS:

Punjab

Power outages

Direct Costs

Adjustment Costs

Small Scale Manufacturing

1. INTRODUCTION

Since early 2008 Pakistan has been confronted with the major energy crisis which resultantly has adversely impacted its people and industry. People have been suffering in terms of both the impact on quality of their daily life and huge constraint on their economic activities and productivity and thus earnings. Industry on the other hand is facing multiple problems e.g., under capacity utilization, production volume losses, increased costs, employee's retention, market competitiveness depleting profits etc.

The GDP growth rate has also stalled and reversed because of the power shortage, unforeseen falling out and shut down of industrial units on a large scale leading also to huge job losses and unemployment. Indeed, there is hardly any growth in GDP per capita in the last five years which

averaged at merely 0.2 percent. This means that there has been no tangible improvement in the economic well-being of people in the last five years especially the poor and low income segments.

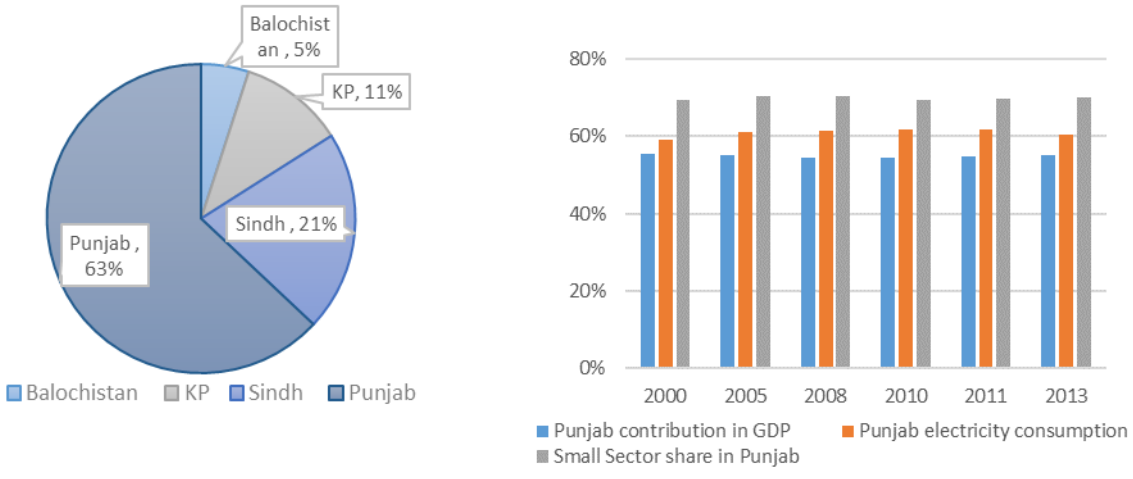
The main objective of this paper is accordingly to specifically focus on the nature and long term consequences of power outages encountered by small scale manufacturing sector of Punjab. By the end of this paper, it is my intent that the reader will have adequate understanding of the following:

- The electricity intensity at Small Scale Manufacturing units of Punjab
- The outage frequency, incidence of outages and per kWh outage cost in Punjab
- The total outage cost to Small scale industry
- The nature, reasons and outcomes of these costs
- Policy recommendations to address the power shortage problem

Power sector is an essential input for the productive sectors of an economy. Power outages not only hinder the functioning of these sectors but in the long run it sets back the whole economy. The figure below demonstrates the province-wise electricity consumption and Punjab's contribution to GDP and its consumption patterns.

Figure.1. Province wise Consumption of Electricity

Punjab contribution of GDP, electricity consumption and share of small sector industry



As is evident from Figure 1, Punjab consumes the major chunk equivalent to 63 percent of the total energy generated nationwide. This in itself is indicative of the magnitude of the power outages' impact on the provincial economy as well as the general public.

Punjab's contribution to the gross national product, electricity consumption over time and the share of its small scale industry, reveals no significant change in these three factors; instead they seem to be following an identical trend over a period of time. This is however understandable given Punjab's economic role in Pakistan both strategically and productively. Accordingly, it not only consumes the major share of electricity especially in the industrial sector majority of which comprises small scale industry., but also is a major contributor to the GDP. Obviously, the power outages impact this sector the most.

This paper, we believe is the first attempt to focus on the analysis of various outage costs encountered by the small scale manufacturing sector of Punjab. Earlier Studies seem to have been carried out at the national level.

2. REVIEW OF PAST STUDIES ON POWER COST OUTAGES

The shortfall in energy has enormously affected the industrial sector especially the SMEs in Punjab. It has increased their costs, lowered their productivity and seriously disrupted their market supplies both nationally and internationally. Due to lack of adequate basic infrastructure, firms need to incur huge costs in the form of expensive backup which is on average three times the cost of publicly supplied electricity companies (Udochukwu and Okoro, 2004). The units on average lost 3.3 hours per day. In terms of adjustments, 76 percent of the units opted for stand-by generators. 69 percent of firms reported delays in delivery of orders. The resulting loss in value of production is estimated at Rs 400 billion for Punjab with an 8-hour shift and Rs 267 billion with 12-hour shift. For Pakistan as a whole, the estimated cost of load-shedding is Rs 176 billion for the large-scale manufacturing sector, equivalent to 12 percent of the total national value added by the sector. Overall, the industrial sector encountered, on average, a loss of 22.36 percent of value added due to un-served energy (Siddiqui and Nasir, 2011).

The Pasha, et al (1987) study was undertaken when load-shedding first emerged as a problem in late 1980's. The study involved an in-depth survey of 843 units, randomly selected from different locations in Pakistan. This study in the first instance demonstrated that the outage costs due to unplanned power shut-down were substantially higher, by 75 percent, in comparison to the costs associated with planned outages.

Second, outage costs in continuous process industries were five to six times higher than in batch-making industries. Third, there is substantial variation in outage costs among industries, ranging from a minimum of 24 cents to 185 cents per kWh. The Pakistan Economic Survey (2012-2013) also pointed out that the unscheduled/scheduled load-shedding has compromised and hindered the feasibility of the textile industry as the exporters were unable to meet their commitments. Rest of the industries suffered the similar consequences.

3. THEORETICAL FRAMEWORK

Theoretical framework and the methodology used for the quantification of outage costs are primarily based on Pasha *et al.* (1989) work with necessary modifications as per the objectives of this paper. It may be added that this was the first attempt, in Pakistan, to quantify the national costs of power outages to the industrial sector while the focus of this paper is on Punjab.

3.1. A firm's behavior in case of outages

We know from the economic theory that the primary objective of a firm is to make an economic profit both in the short- and long-run. The firms can bear losses in the short-run but in the long-run if the losses prevail they are most likely to quit the industry. Recently, this has been the case in Pakistan when an increase in the cost of production along with difficulties in firms' operations due to excessive power load-shedding over a long period of time led many firms to quit the businesses which led to large job losses and unemployment. Those who left in business mainly survived by adopting alternative sources of power.

During this phase of high power outages, it was observed that the firms adopted the following type of behaviors to keep themselves in the business:

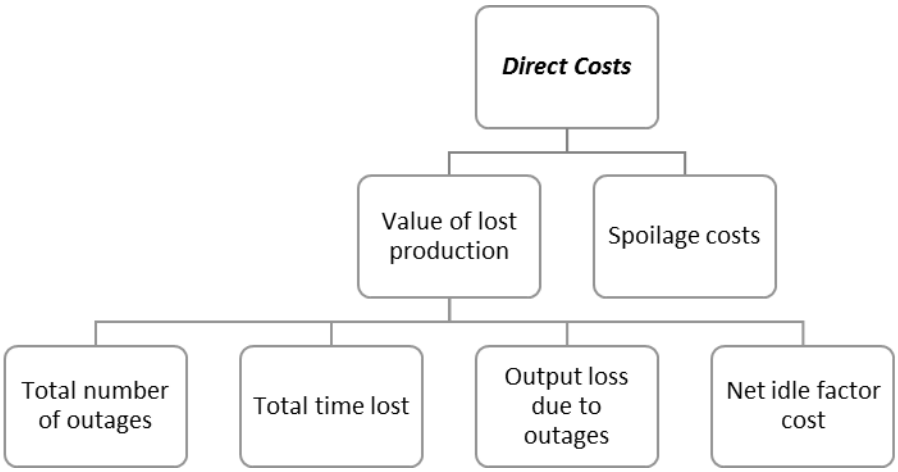
- If power outages were considered to be somehow everlasting in nature, the optimal size of the firm was adjusted downwards with the possibility of the firm letting go some labor.
- The chance of the firm to make appropriate adjustments to pull through some of the output which was lost depended on the following characteristics.
    a) The complexion of the market e.g., raw material, processing involved etc., and its complementarity towards the firm.
    b) If the firm's dependency of the production process is less on electricity, it is more likely that the firm will make an adjustment for alternate source of supply and or through management action.

c) If the cost of adjustment is low the firm is most likely to go for it.
d) The firm will undertake an adjustment if the power outages are large and are expected to continue for a long period of time.

3.2. METHODOLOGY

As discussed above, the existence of regular and constant outages prompts the firms to make adjustments. However, the coverage and character of these adjustments will depend on a number of features including the costs related to outages. These are generally of two types. The first type is direct costs:

Figure 2: Direct Costs



The second type is adjustment costs. While undertaking any type of adjustment mechanisms to recover their lost output, the major effort is the cost minimization. A firm will go for an adjustment which it considers will be less expensive than the other available options. Therefore, a firm can opt for more than one adjustments at one time, which depends on firm's size and the amount of outages.

3.2.1. Direct Costs

Through the following methodology, the Direct Costs of Outages is calculated.

The Total Number of Outages during the year is given by:

n_i = number of times of incidence of outage daily on average of duration i. i = 1, 2, 3, 4, 5. The durations are 0-1/2 hr; ½ hr to 1 hr; 1 hr to 2 hrs; 2 hrs to 3 hrs; 3 hrs and above.

$$\text{NOUT} = \sum_{i=1}^{5} n_i \times 365 \qquad \ldots\ldots\ldots (1)$$

The Total Time Lost due to outage is:

γ_i = restart time after an outage of duration i.

d_i = The duration of the outage.

$$\text{TOUT} = \sum_{i=1}^{5} (n_i[d_i + \gamma_i] \times 365) \qquad \ldots\ldots\ldots (2)$$

The probable extent of Output Loss due to Outages is given by:

ϵ_i = amount of output lost during an outage of duration i.

$$\text{LOUT} = \sum_{i=1}^{5} n_i[d_i + \gamma_i]\,\epsilon_i \times 365 \ \ldots\ldots\ldots (3)$$

But there is a possibility that the firm might not operate for the entire year and for twenty-four hours every day so the Actual Output Lost is:

H is the normal hours worked during the year.

$$\text{ACOUT} = LOUT.\frac{H}{8760} \qquad \ldots\ldots\ldots (3a)$$

8760 is the number of hours per year calculated by: 24 x 365= 8760.

We will calculate the Value of Output Loss through following method:

Where V is the value added by the firm per hour.

$$\text{VOUT} = \text{ACOUT.V} \ \ldots\ldots\ldots (4)$$

Nevertheless, the firm might undertake adjustment mechanisms to recover its lost output. The Net Idle Factor Cost, NIFC, is as follows:

λ as the degree of output which was recovered

$$\text{NIFC} = (1-\lambda)\ \text{VOUT} \qquad \ldots\ldots\ldots (5)$$

Now we will represent the Spoilage Costs:

Then the Spoilage Cost, SPC, is derived as follows:

S_i = spoilage cost (in rupees) in each outage of duration i.

$$\text{SPC} = \sum_{i=1}^{n} n_i s_i .365 \times \frac{H}{8760} \qquad \ldots\ldots\ldots (6)$$

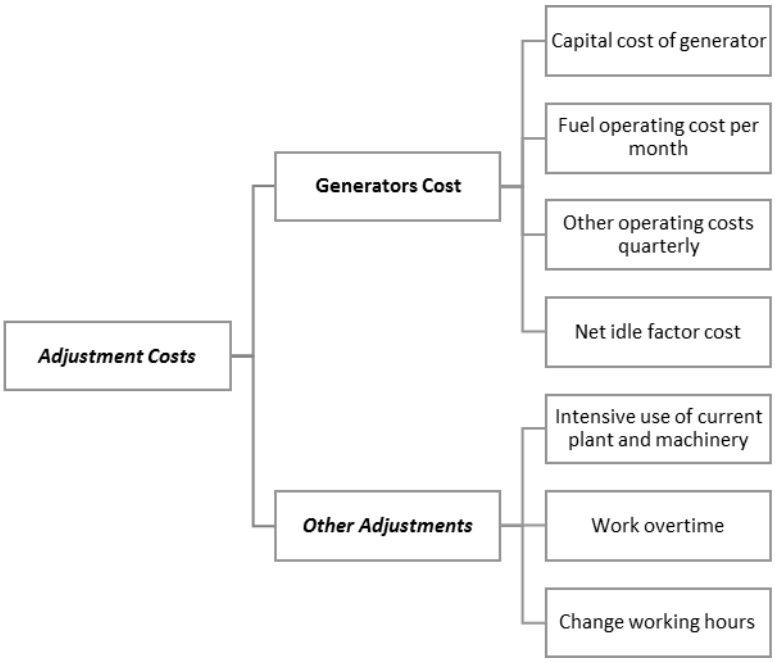
Now we can calculate the Direct Costs of Outages.

$$TDC = NIFC + SPC \quad \ldots\ldots\ldots (7)$$

3.2.2. Adjustment Costs:

The second type is Adjustment Costs as depicted in Figure 3 below:

Figure 3: Adjustment Costs



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3.2.3. Generators Cost

In Pakistan we have generally observed that the foremost adjustment undertaken by a firm is the investment in generator where they can control the source of energy supply. This is the outcome of the frequent and prolonged hours of power outages since 2007 and the realization by the firms that these outages are going to stay for a long time and they might even get worse.

In order to go for a substitution of the main source of electricity which is supplied by the DISCOs, the firm evaluates its option based on energy required, the costs of adjustments and the extent of the availability of initial capital for a particular option.

The cost of capital for installing generators is high relatively to small scale units as compared to large firms.

In order to calculate the total costs of owning and running a generator, the following specifics are factored in:

- A unit owns a generator or not.
- The capital cost of the generator.
- Monthly running cost of fuel for operating the generator.

– Other costs (including labor, repairs and maintenance cost, etc.) on a quarterly basis.

The calculation of the Annual Generator Cost (GENCO) is accordingly as follows:

K_g = capital cost of generator.

foc = fuel operating cost per month.

opc = other operating costs quarterly

τ stands for the cost of capital and δ is the rate of depreciation. The combined value of τ *and* δ is taken as 0.32.

$$\text{GENCO} = (\tau + \delta)K_g + 12(\text{foc}) + 4(\text{opc}) \dots\dots\dots (8)$$

Once we have considered a firm to be operating a generator it means that firm is saving on the energy supplied by the local DISCO. So now the (NGENCO), is given by:

K = electricity consumption per hour in Kwh.

TOUT = total hours lost

ADJ_G = extent of adjustment by use of generators.

tf = tariff per Kwh of the DISCO.

$$\text{NGENCO} = \text{GENCO} - \text{k}\,(\text{TOUT}) \times (\text{ADJG}) \times \text{tf}\frac{H}{8760} \dots\dots\dots (9)$$

3.2.4. Other Adjustments

These adjustments, as enumerated below, are more or less short run in nature when power outages are considered to be of limited duration:

– A firm can consider utilizing its present plant, equipment and machinery more intensively to cope with power outages.

– Loss of output can be recovered by working overtime or by adding more labor or having longer work shifts.

– It can consider changing the working hours and timings based on the timetable of power load shedding.

The costs related to these adjustments are not significantly large but majority of the firms have not undertaken these adjustments. They are represented by other total cost (OTC).

Overall, the Total Adjustment Cost, TAJCO, is derived as:

$$\text{TAJCO} = \text{NGENCO} + \text{OTC} \dots\dots\dots (10)$$

And the Total Outage Cost, TOUTCO, as follows:

Total direct costs: $\text{TOUTCO} = \text{TDC} + \text{TAJCO} \dots\dots\dots (11)$

4. SAMPLE DISTRIBUTION AND CHARACTERISTICS OF UNITS

As the focus of this study is the small scale manufacturing sector of Punjab, data on population of the industrial units was derived from the Economic Census 2005, published by the Pakistan Bureau of Statistics (PBS) which covered province and industry group wise segregated information.

Once the sample distribution across cities and industrial groups was finalized, the individual sample units were selected from the population of units obtained from the Provincial Directories of Industries prepared by the respective Provincial Labour Departments.

Table 1
Distribution of Sample units by City, Province and Industry

Province	Cities	Food Beverages and Tobacco	Textiles, Wearing Apparel and Leather	Wood & Wood Products	Fabricated Metal Products	Others	Total
Punjab	Lahore	23	46	14	12	19	114
	Faisalabad	14	29	9	7	12	72
	Sialkot	6	12	4	3	5	30
	Gujranwala	5	10	3	2	4	24
	Multan	6	12	4	3	5	30
	Rawalpindi/Islamabad	8	14	4	5	8	39
	Total	**62**	**123**	**38**	**33**	**54**	**310**
Total		**100**	**200**	**60**	**50**	**90**	**500**

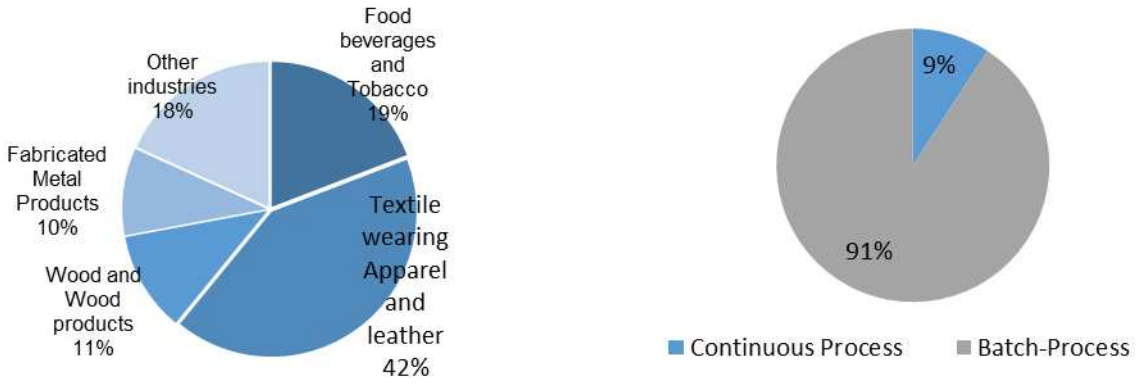
4.1. DISTRIBUTION OF UNITS STUDIED

The data reveals that 63 percent of the sample units are in the province of Punjab, given the concentration of small-scale industry in Punjab, while 37 percent are in rest of the Pakistan. The distribution by industry group and nature of production process is given below.

Table 2
Distribution of Sample Analyzed by Cities

Cities	Numbers	%
Lahore	104	25.2
Faisalabad	61	14.8
Gujranwala	16	3.9
Multan	29	7.0
Sialkot	23	5.6
Rawalpindi / Islamabad	27	6.6
Other regions	152	36.9
Total	**412**	**100.0**

Figure 4: Distribution of Selected Units by Industrial Group and Process



In Punjab, the average value added by sample units in 2012 is projected at Rs 1.8 billion, highest being in food, beverage and tobacco industry followed by wood and wood products. Sample units have, on an average, purchased over 18 thousand kilowatt hours (Kwh) of electricity annually from the public distribution companies. The average value added per Kwh is Rs 101. This is the first estimate of the outage cost per Kwh. As highlighted earlier, it overstates the magnitude because it does not incorporate the impact of adjustments.

Table 3
Average Value Added, Electricity Purchased and Value Added per Kwh of Electricity of Sample Units, 2012
Punjab

	Value Added (Thousands)	**Electricity Consumed (Kwh)**	**Value Added Per Kwh (Rs.)**
Food beverages and Tobacco	1922	21059	91
Textile wearing Apparel and leather	1688	16808	100
Wood and Wood products	1991	14733	135
Fabricated Metal Products	1909	17315	110
Others industries	1910	19995	96
Total	**1829**	**18045**	**101**

Source: Author's estimation

5. RESULTS AND DISCUSSION

Power is one of the main inputs of the industrial sector. Frequent and consistent power outages mean that the firm's cost of production and doing business rises in the form of added adjustments, spoilage costs, lost in output and production time. These increased costs reduce their profits and may lead them to quit the business.

As the results show that the foremost kind of adjustment mechanism is that the firms resort to the use of generators. Generator's main running expense is oil, which is an imported product. At that

point of time, oil prices were skyrocketing which brought in the foreign inflation to aggravate the domestic inflationary trends. The ultimate outcome was the increase in the costs, decrease in the supply but at the same time rise in the demand for products because of the mismatch between supply and demand.

5.1. POWER OUTAGES

Overall, the average number of outages in Punjab in 2012 is estimated at 2680. Highest number of outages have occurred in Gujranwala at 3050, followed by Sialkot at 2962, Lahore at 2740, and Multan at 2609 as is evident from the following Table:

Table 4
Frequency of Load-shedding in 2012
By Province/City

Location	**Average**
Punjab	
Lahore	2740
Faisalabad	2372
Gujranwala	3050
Multan	2609
Sialkot	2962
Total	**2680**

Source: Author's estimation

In Punjab Industry-wise, the highest incidence was experienced by the textile, wearing apparel and leather industry (1561), followed by other industries (1528) and wood and wood products (1473). Also, the incidence of outages is higher in continuous- process units as revealed by the following Table:

Table 5
Number of power outages, Punjab

By Industrial Group	**Average**
Food beverages and Tobacco	1439
Textile wearing Apparel and leather	1561
Wood and Wood products	1473
Fabricated Metal Products	1354
Others industries	1528
Total	**1502**
By Process	
Nature of Production	
Continuous process	2112
Batch-Process	1429
Total	**1502**

Source: Author's estimation

The table below shows the overall duration of outages, which include both the time lost due to an outage and the restart time (time lost in restarting work following an outage). In Punjab the total hours, on an average, lost per annum due to load-shedding are estimated at 2680. The highest number of hours lost is in Gujranwala. These durations are for 24 hrs a day
for 365 days a year.

Table 6
Duration of Outages (Outage + Restart Time) [Hours] 2012
By City

Cities	**Average**
Punjab	
Lahore	2740
Faisalabad	2372
Gujranwala	3050
Multan	2609
Sialkot	2962
Rawalpindi / Islamabad	2763
Total	**2680**

Source: Author's estimation

As for the SME specific losses due to load shedding in Punjab, on an average the maximum impact of the total hours, lost per annum is estimated to be on Textile wearing Apparel and leather at 2818 followed by Fabricated Metal Products at 2683 for the sample units. The incidence is higher in batch-making (2680) and in continuous process industries (2623 hours).

Table 7
Duration of Outages (Outage + Restart Time) [Hours] 2012
By Industrial Group

Industrial Group	**Punjab**
Food beverages and Tobacco	2358
Textile wearing Apparel and leather	2818
Wood and Wood products	2453
Fabricated Metal Products	2683
Others industries	2846
Total	**2680**
Nature of Production	
By process	
Continuous Process	2623
Batch-Process	2680
Total	**3149**

Source: Author's estimation

5.2. ADJUSTMENT MECHANISMS

Adjustments are undertaken by firms in order to recover their lost output due to loss in production time. These adjustments differ from firm to firm as they hugely depend on the size of their business, profitability and how power intensive is their production line.

5.2.1. Types of adjustments

The results indicate, first, that higher incidence of outages lead to greater resort to generators; and second, units with lower electricity-intensity are more likely to use generators as it is more cost efficient. Beyond the use of generators, the next most frequent form of adjustment is the working overtime by 26 percent of the units. Approximately 8 percent of the firms have opted for changing shift timings.

Table 8

Percentage of Sample units Adjusting through Various Mechanisms, Punjab 2012 (%)

	Buying or Operating Existing Generator	**Working Overtime**	**Increasing Intensity of Machinery Operation**	**Changing Shift Timings**	**Changing Working Days**	**Working Additional Shifts**
By Industrial Group						
Food beverages and Tobacco	50.0	21.6	3.4	9.1	3.4	12.5
Textile wearing Apparel and leather	60.7	25.7	0.7	8.6	0.0	4.3
Wood and Wood products	52.3	34.1	0.0	4.5	2.3	6.8
Fabricated Metal Products	59.3	29.6	3.7	7.4	0.0	0.0
Others industries	55.1	24.5	0.0	10.2	2.0	8.2
Total	**56.0**	**25.9**	**1.4**	**8.3**	**1.4**	**6.9**

Source: Author's estimation

5.3. COSTS OF POWER OUTAGES

5.3.1 Operating Costs

Average annual operating cost of sample units is Rs 3.0 million. Out of this, the highest proportion, (56 percent), is spent on purchase of raw materials, followed by wages (24 percent). Electricity costs purchased from the distribution companies and self-generation combined account for 16 percent of the costs.

Table 9
Operating Cost Structure of Sample Units (%)Punjab, 2012

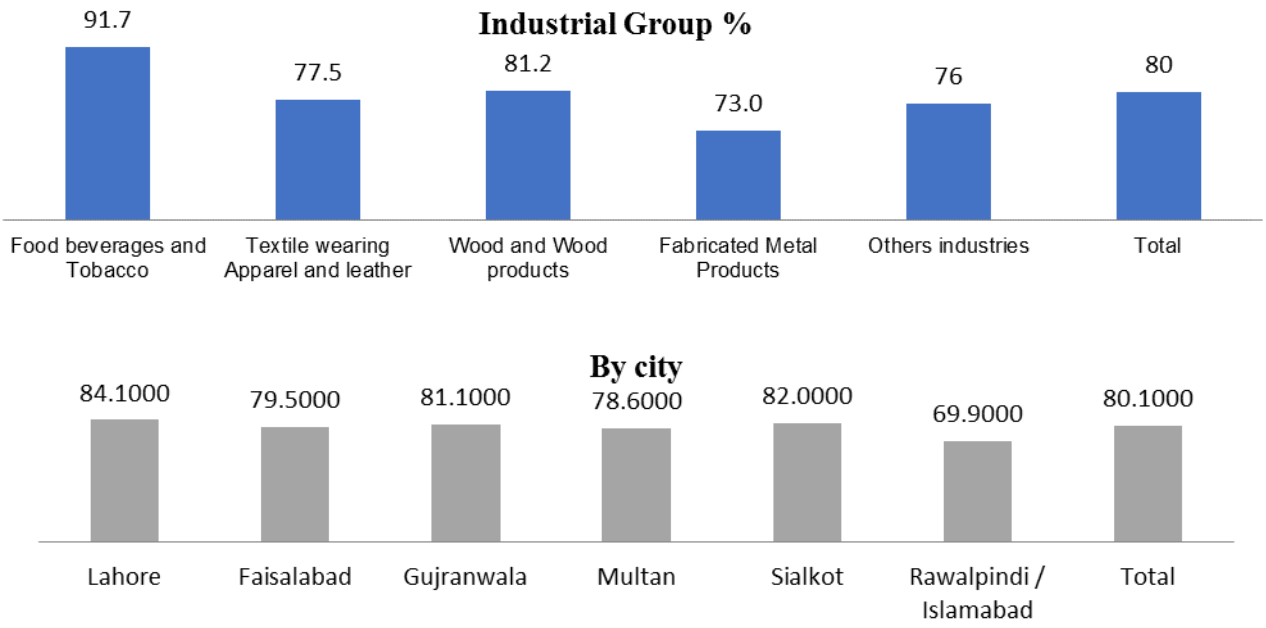
	Total Operating Cost (Rs. In Thousands)	**(Percentage of Operating Cost)**					
		Wages/ Salaries	**Raw Material**	**Repairs/ Maintenance**	**Cost of Electricity**	**Cost of Self Generation**	**Others**
Food beverages and Tobacco	3638.4	23.6	57.0	2.3	10.8	5.5	0.8
Textile wearing Apparel and leather	2722.5	23.9	55.8	2.4	10.8	5.2	1.9
Wood and Wood products	3361.3	22.3	59.7	3.6	8.2	4.6	1.6
Fabricated Metal Products	2963.8	20.2	58.0	4.2	10.6	4.0	3.0
Others industries	2670.3	28.1	50.1	3.7	11.8	4.2	2.2
Total	**2986**	**24.1**	**55.6**	**2.9**	**10.7**	**4.9**	**1.8**

Source: Author's estimation

5.3.2. Attainment of Production targets

The highest rate of target achievement is by food, beverages and tobacco industry at 92 percent, followed by wood and wood product industry at 81 percent. In Punjab, Lahore was able to achieve a higher proportion of the target as compared to the other cities, followed by Sialkot.

Figure 5: Actual as percent of Target Production in 2012 by Industrial Group, Punjab



Source: Author's estimation

The principal reasons given for not being able to achieve their targets are high level of power outages, law and order situation and market related factors.

Table 10
Reasons Why Production Target was Not Attained Punjab, 2012 (%)

Reason for Not Attaining Targets	Food Beverages and Tobacco	Textiles wearing Apparel and Leather	Wood and Wood Products	Fabricated Metal Products	Other Industries
Power outages	39.3	31.7	32.8	32.8	30.6
Law and order	5.6	14.1	9.4	15.5	17.1
High inflation & market competition	11.2	10.4	15.6	13.8	16.2
Shortage or high cost or raw materials	7.5	13.7	7.8	10.3	18.0
Other reasons	36.4	30.1	34.4	27.6	18.0
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source: Author's estimation

Table 11 below shows that in Punjab the highest proportion of output loss was experienced by fabricated metal products while the average loss appears similar both in continuous and batch process SMEs.

Table 11
Proportion of output Loss Not Recovered, Punjab 2012 (%)

By Industrial Group	
Industrial Group	**Average**
Food beverages and Tobacco	7
Textile wearing Apparel and leather	7
Wood and Wood products	7
Fabricated Metal Products	10
Others industries	12
Total	**8**
By Process	
Nature of Production	**Average**
Continuous Process	9
Batch-Process	9
Total	**8**

Source: Author's estimation

5.3.3. Extent of total time lost

On average, overall Punjab lost 31 percent of their production time in 2012 due to load-shedding. The highest, 35 percent, is lost in Gujranwala, and the least, 27 percent, in Faisalabad. The Textile wearing Apparel and leather lost 32 percent of their production time, while the loss for continuous process industries is 36 percent.

Table 12
Proportion of Time Lost during outages, 2012 (%)

By City	
Cities	**Average**
Punjab	
Lahore	31
Faisalabad	27
Gujranwala	35
Multan	30
Sialkot	34
Rawalpindi / Islamabad	31
Total	**31**
By Industrial Group	
Food beverages and Tobacco	27
Textile wearing Apparel and leather	32
Wood and Wood products	28
Fabricated Metal Products	31
Others industries	32
Total	31
By Process	
Continuous Process	36
Batch-Process	30
Total	31

Source: Author's estimation

As indicated in Table 13, in Punjab 42 percent of the respondent's loss of inconvenience to customers was the most disruptive consequence of load-shedding, for 24 percent it was idle labor and for 19 percent equipment shut down. Losses of product, breakdown of production process and spoilage costs were cited as other disruptions.

Table 13
Ranking of Disruptions Due to Outages in Punjab, 2012 (%)

	Equipment Shut down	**Labor will be idle**	**Product will be lost**	**Loss of / Inconvenience to Customers**	**Break down of production process**	**High spoilage cost of raw material**	**Total**
By Industrial Group							
Food beverages and Tobacco	16	20	8	49	6	2	100
Textile wearing Apparel and leather	15	20	12	41	12	0	100
Wood and Wood products	35	38	0	28	0	0	100
Fabricated Metal Products	17	25	17	42	0	0	100
Others industries	23	27	2	46	2	0	100
Total	**19**	**24**	**9**	**42**	**7**	**0.4**	**100**
By Process							
Continuous Process	39	7	4	25	25	0	100
Batch-Process	16	26	9	44	4	0.4	100
Total	**19**	**24**	**9**	**42**	**7**	**0.4**	**100**

Source: Author's estimation

5.3.4. Multidimensional costs of outages

The highest total outage cost is estimated for food beverages and tobacco which is Rs. 228,000. The average outage cost per Kwh is Rs 41 as is evident from Table 14 below.

Table 14
Outage Costs Per kwh, 2012, Punjab

	Total Outage Cost (000 Rs)	**Electricity not Provided during Outages (000 kwh)**	**Outage Cost per Kwh (Rs)**
Food beverages and Tobacco	228	5.7	40
Textile wearing Apparel and leather	213	5.3	40
Wood and Wood products	222	4.4	51
Fabricated Metal Products	219	6.5	34
Others industries	261	6.0	43
Total	**227**	**5.5**	**41**

Source: Author's estimation

5.4. PROVINCIAL/PUNJAB ESTIMATE OF OUTAGE COSTS

For the 260 sample of small-scale industrial units, the total outage cost is estimated at Rs 59 million on a value added of Rs 475 million. Value added in SSMS of Punjab in 2011-12 is estimated at Rs 167 billion. We use the value added as the blow up factor from the sample to the national estimate as follows:

*National Estimate of Outage Costs (= (.059/0.475) * 167 Billion) equals Rs = 20.7 Billion.*

5.5. NATIONAL ESTIMATE OF OUTAGE COSTS

For the 412 sample of small-scale industrial units the total outage cost is estimated at Rs 121 million on a value added of Rs 950 million.

Value added in SSMS of Pakistan in 2011-12 is estimated at Rs 242 billion.

We use the value added as the blow up factor from the sample to the national estimate as follows:

*National Estimate of Outage Costs (= (.121/0.950) * 242 Billion) equals Rs = 30.8 Billion Rs.*

6. CONCLUSION

Costs incurred due to power load-shedding to Punjab is the main concern of this study. While working towards calculating the highest frequency of power load-shedding to Punjab, the average number of outages in Punjab in 2012 is estimated at 2680. These power outages frequently occur between one to two hours. The total hours, on an average, lost per annum due to load shedding are estimated at 2680 for the sample units.

On average Punjab seems to have lost 31 percent of the SMEs production time in 2012. Regarding the absolute costs, the highest proportion of output loss was experienced by fabricated metal products while the highest total outage cost seems to have been witnessed by food beverages and tobacco SMEs. It is also estimated that Punjab, on average, has suffered 41 Rs outage cost per kwh.

As far as adjustment mechanisms are concerned, in Punjab the results indicate, first, that higher incidence of outages leads to greater resort to generators; and, second, units with lower electricity-intensity are more likely to use generators being a more cost efficient means. Beyond the use of generators, the next most frequent form of adjustment is the working of overtime by 26 percent of the units. Approximately 8 percent of the firms have opted for changing shift timings.

It also appears that almost 42 percent of the units without generators make no adjustments at all while 20 percent of the units with generators make another adjustment.

The study also concludes that in Punjab for the 260 sample of small-scale industrial units, the total outage cost came to Rs 59 million on a value added of Rs 475 million.

7. RECOMMENDATIONS

Given the enormity of the costs associated with power outages and their concomitant impact on cost of production, unemployment and aggravation of poverty due to loss of income, it is absolutely imperative for the government to develop a robust strategy, policy framework and operational plan to diversify the provision of energy sources and to ensure its uninterrupted and smooth supply to the industrial sector especially the SMEs. This policy and strategic framework and operational plan should, *inter alia,* factor in the following:

- The induction and introduction of the private sector in the power generation and distribution field should be encouraged and incentivized by creating an enabling environment. While the gestation period for this to become cost efficient may be longer, in the long run it would produce sustainable results and solutions through cost optimization for the SMEs. The government has recently started privatizing the energy sector starting from Karachi which initiative needs to be expanded and up-scaled.

- The power sector is not only highly monopolized but it also is highly politicized. The important prerequisite of privatization is to break this monopoly and bring it under the regular competitive market conditions. So that competition and innovation go side by side.

- The government needs to comprehensively address the institutional dysfunctions and inadequacies of infrastructure to ensure sustainable development of energy sector in the province. Once this is accomplished, government can introduce differential billing system or two-tiered billing system to avoid the wastage of energy at household level and to efficiently manage the power distribution function with a view to ensuring adequate supplies to the productive sectors of the economy.

- The results show that use of generators is not alien to small scale manufacturing sector of the country. As such, to facilitate this sector in this crisis situation and to further sustain and boost their operation and growth, government should introduce robust incentive packages including finance, technical advice, capacity development etc., for the use of generators so that the SMEs may adequately recover the proportion of their output loss.

- A clear schedule of power outages should be announced well in advance which should be rigorously implemented. This would enable the firms not only to make necessary adjustments but also conform their production operations and processes accordingly.

- Given the geo-strategic location of Pakistan and proximity to energy rich and surplus countries, the government should fully harness the potential to import cheap and inexpensive electricity especially for the productive sectors of the economy. This would go a long way in minimizing and indeed eradicating the national economic losses due to power outages. This would also allow the government to explore in county power generation of which there is no dearth of potential to achieve self-sufficiency.

- Finally, there is a huge potential for Pakistan both for energy efficiency and in the renewable energy sector. The troika of BIT- building, industry and transport- present enormous potential in Pakistan to save on energy use; achieve efficiency gains and pursue environmentally friendly and efficient energy options. In this connection, the hydle (especially the micro systems), the solar and wind energy sectors have not been fully exploited by Pakistan though they represent immense reservoir and sources for power generation. The policy and strategic framework must fully embrace and focus on these options to achieve energy and power self-sufficiency in Pakistan.

ACKNOWLEDGEMENT

The paper is a part of my MPhil thesis so I feel appreciative of my supervisor Dr. Hafiz Pasha for his constant guidance and Mr. Muhammad Imran who frequently supervised me throughout this paper. Finally, I am extremely grateful to Mr. Shahid Najam who thoroughly reviewed my paper under such busy schedule.

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