

WHAT COULD REDUCE THE COST OF SUGAR? THE CASE OF STATE-OWNED SUGAR MILLS IN BANGLADESH

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Abstract

Since the early 2000's trade liberalization, the state-owned sugar mills in Bangladesh have started to lose competitiveness. Before that this industry used to be considered a strategic sector because sugar is an essential food and the industry creates thousands of rural employments. In 2020, the government suspended operation of six out of fifteen mills with the excuse of loss. The closure of six mills has reduced the sugar production and negatively impacted the lives of farmers, workers, and businessmen. The government is considering foreign investment without considering the potential of government investment to revive the industry. Therefore, it is important to re-examine the factors that increased the cost and find out how the state could revive the industry under its ownership. This paper analysed the data of 15 state-owned sugar mills for 14 years (2006-07 to 2019-2020) using mixed method (fixed effect regression and interview) to explain the mechanisms of the cost increase. It found that the recovery rate, price of sugarcane, availability of sugarcane, age of mills, and interest payment are the most important determinants of cost. Modernizing the mills, making sugarcane available through sugarcane price incentives, timely payment to farmers, and diversifying products could contribute to cost reduction.

Keywords: Sugar industry, State-owned sugar mills, Sugar cost, Trade liberalization

I. Introduction

Sugar industries in Bangladesh are increasingly facing competition after trade liberalization since early 2000 started to facilitate import of raw sugar. As a result, local sugar refineries, dependent on refining imported raw sugar, have started

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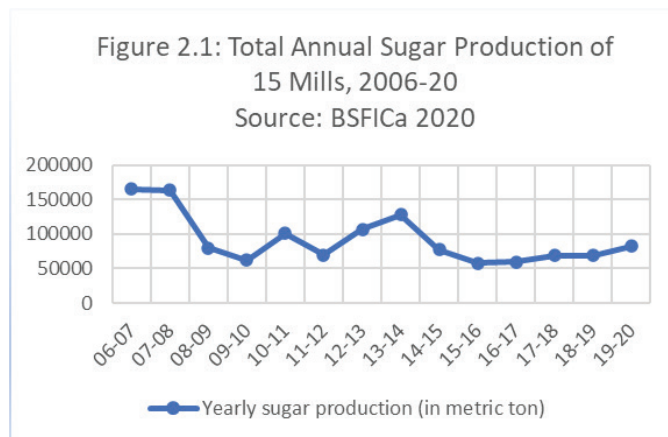
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to expand their market share (Mustafa & Sultana, 2016). Refining imported raw sugar at international price and selling it to the local market has given the privately-owned refineries some competitive advantages. The state-owned sugar mills, which were suffering from inefficiency, have started to face new challenges. Besides, the gradual decline of land for sugar production, lack of incentive to sugarcane producers, low price of sugarcane, and low recovery rate of sugarcane have contributed to the declining sugar production in recent years. The sugar mills needed to buy sugarcane at a slightly higher price to provide an incentive to the sugarcane farmers and ensure supply of sugarcane. The situation has exacerbated when the sugar mills failed to regularly pay for the sugarcane. The government has gradually reduced subsidies and made the state-owned mills depend on loans. The farmers became demotivated to produce as the government delayed payment for sugarcane. Even when they produced, they found it more profitable to make molasses from sugarcane than selling it to sugar mills. Thus, the lack of supply of sugarcane, higher production cost, low sugar price made it very difficult for the sugar mills to survive and increase production in recent years. Besides, the cumulative loan stands at 7 thousand 895 Taka in 2020 (Kormokar, 2020). In 2018-19 the interest rate payment was 36.7% of the total production cost of sugar (BSFIC, 2019). In cropping season of 2020, the government has stopped giving loans to farmers for sugarcane production. Finally, in December of the threshing season in 2020, government has decided to stop production of sugar in 6 out of 15 sugar mills (Atik, 2020).

This research attempts to explore the causes of rising cost of sugar and finds out what could reduce the cost and increase competitiveness of sugar mills in the increasingly liberalized economy. It has used fixed effect regression analysis and interviews to analyse the findings.

II. Crisis in Sugar Industry

Bangladesh and its surrounding areas are historically renowned for sugarcane cultivation. As much as 2,000 tons of sugar was exported annually during the colonial period. Official records suggest that at least 17 sugar mills existed in the early 19th century. At the time of 1947 Partition of India, there were five sugar mills whose combined production capacity was 31,000 tons of sugar per annum (Muhammad, 1980).

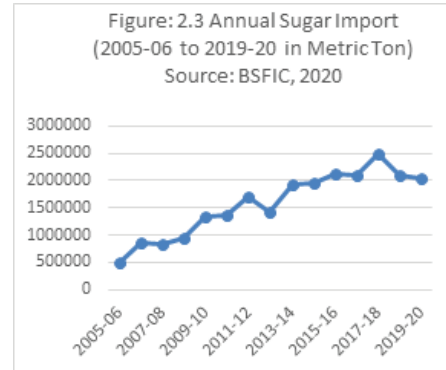
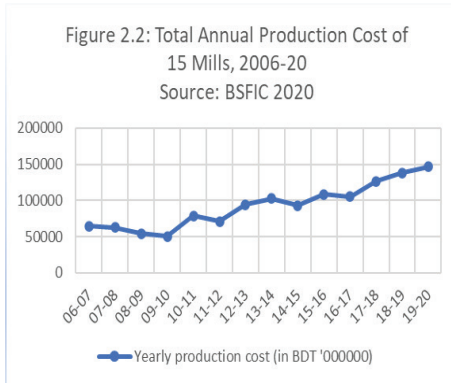


After independence, Bangladesh Sugar and Food Industries Corporation (BSFIC) was founded in 1972 by the President’s Order No. 27. At present, there are 15 sugar factories owned by BSFIC: North Bengal Sugar Mill (NBSM), Setabgonj Sugar Mill (SSM), Carew & Co. (Bangladesh) Limited (KCB), Rangpur Sugar Mill (RSM), Thakurgaon Sugar Mill (TSM), Zealbangla Sugar Mill (JBSM), Joypurhat Sugar Mill (JSM), Rajshahi Sugar Mill (RASM), Kushtia Sugar Mill (KSM), Mobarakgonj Sugar Mill (MSM), Shampur Sugar Mill (SHSM), Panchagar Sugar Mill (PSM), Faridpur Sugar Mill (FSM), Nator Sugar Mill (NSM), and Pabna Sugar Mill (PASM); among which three were established during the British rule (1757-1947), nine in the Pakistan period (1947-1971) and three after 1971. In aggregate, these mills can produce 2.1 million tons sugar every year. The production capacity is calculated based on an average recovery rate of 8% from crushing 2.31 million tons of sugarcane. Around 16,000 people are directly employed by BSFIC and the mills (BSRI, 2019).

Although sugar consumption has risen steadily in the last decade, production capacity of state sugar mills has not followed suit. Total annual production of the 15 state-owned mills was 165,003 tons in 2006-2007. But it has fallen by 58% to around 68,952 tons in fiscal year (FY) 2018-2019 (Figure 2.1). In the interim, quantity produced grew in 2012 to 2014, only to register a sharp downturn in the following period (BSFICb, 2018). This decline in sugar production was caused by farmers’ reluctance to cultivate sugarcane after experiencing significant delay in payment by BSFIC in the previous year.

While production capacity is declining, cost has skyrocketed in the last 15 years. Figure 2.2 shows that the cost of production is ever-increasing. From BDT 64

million in FY 2006-2007, the total annual production cost rose to BDT 126.41 million in FY 2017-2018, almost a 100-percent increase. Such a surge in costs has caused the firms to incur huge losses. The industry's cumulative loss amounted to BDT 68.3 billion in FY 2018-2019 (BSFIC, 2019).

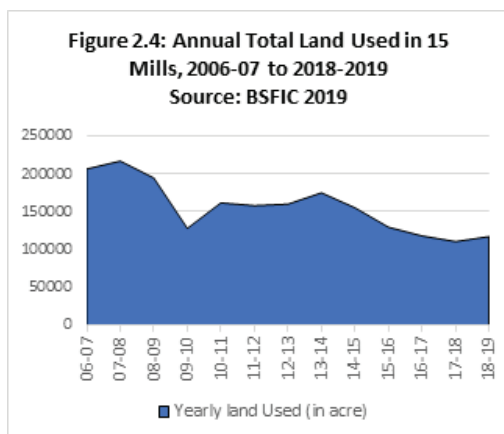


Skyrocketing production costs and declining efficiency of the state-owned sugar mills have paved the way for private players to get into the market. In 2004, six private sugar refineries came into operation. They were permitted to import raw sugar and produce by refining it. Five of these private refineries are still in operation and their combined production capacity is 3.2 million tons sugar per annum (BSFICb, 2014).

Prior to 2002, the 15 state mills were the only producers, importers, and distributors of sugar around the country. It used to give the government the leverage to control prices in the local sugar market and protect consumer interests. The liberalization of sugar import, however, has transformed the scenario. The rationale behind liberalizing the market was that private refineries would import raw sugar, refine it and then export it to earn foreign currency. Any surplus would be stocked and supplied to the local market when necessary.

For private producers, it is more profitable to sell refined sugar in the domestic market than to export it, forcing BSFIC to sell sugar at lower prices. It has ultimately resulted in a price war in the market where the state mills are making immense losses. During the four years from 2011 to 2014, BSFIC lowered the price of sugar five times. When price was lowered for the first time in September 2011, it was BDT 60 per kg. Then, it declined to BDT 37 per kg in 2016 (Hasnat, 2015). Private refineries have responded to any price cut by BSFIC by setting their prices slightly below what BSFIC charges. Both made losses in this competition.

The private refineries, however, are able to offset the losses from selling other consumer goods (Hasnat, 2014). As a result, import of raw sugar has increased by 27 percent from a year earlier to 2.67 million tons in FY 2017-18 (BSRI, 2019.) The government has attempted to intervene into the market by imposing various regulatory and tax duties. In the meantime, the private refineries have gained much ground in the market, making it tougher for the government to regulate.



The state-owned sugar industries play a key role in our economy. Approximately 5 million people including 500,000 farmers in the south- and north-west Bengal depend on sugarcane cultivation for their livelihood. Over the years, the sugar factories have given birth to interconnected communities. Many infrastructures and institutions in the rural areas including roads, electricity, banks, markets, and other trade centres have emerged surrounding the agro-based sugar industry (BSFICa, 2014). The sugar mills have been underperforming for few decades for several reasons. Former BSFIC Chairman AKM Delwer Hussain claimed that major problem was the low supply of sugarcane (Siddique, 2017). But the problems in the industry can be traced back to other critical issues, e.g. sugarcane producers not receiving the right price and timely payment while selling sugarcane to the mills, debilitating machinery, rampant corruption in the factory management and absence of an effective sugar policy.

Low recovery rate and unused arable land inside the mill premises are also key reasons why the mills are gravely underperforming. Sugar recovery rate ranges from 6 to 7 per cent in the state-owned sugar mills in Bangladesh which is considerably lower than other countries (BSFICb, 2018). Recovery rate is determined as a ratio of sugar produced to sugarcane used in a particular period. In 2012, recovery rates

in India and Brazil were 11.23% and 14.10% respectively (Gani, 2012), while Bangladesh recorded a mere rate of less than 7%. Such a low rate, in effect, raises the costs of raw material and ultimately results in excessive costs of production for sugar per kg. Worn out machines and high amount of sugar loss during the production process can be blamed for the low rates.

Land used for sugarcane cultivation is another grave concern. According to BSFIC data (Figure 2.4), total land used for sugarcane cultivation has been steadily declining, reaching an all-time low in FY 2017-18. Sugarcane farmers are not motivated enough to cultivate sugarcane for several reasons including the length of time needed to grow sugarcane and the delay in receiving dues from the sugar mills. Aside from the outer lands, mills having their own lands can narrow the gap by providing incentives to the farmers. But only five out of the 15 state sugar mills have their own land, most of which remain unused throughout the year (Siddique, 2017).

III. Literature Review

From 1972 to 2019, the cumulative loss of sugar mills stood at 68.3 billion Taka (BSFIC, 2019). Scholars and practitioners both identified high cost of sugar as one of the reasons for the loss. The annual report of BSFIC mentioned that the cost of sugar is one of the reasons for such loss. In an interview BSFIC chairman Ajit Kumar Pal blamed rampant corruption, mismanagement, lack of skilled workers and modern technology for low production and losses by the mills (FT Online, 2019). Scholars and researchers have also pointed out that high cost of sugar is to blame for the loss. For example, to find out why despite facing losses almost every year, sugar industries managed to make profit in 1994-95 and 2005-06, Alam (2009) used the profit and price data from 1971-72 to 2009-10 and showed two possible reasons of profit on those years. He found that price of domestic sugar was higher than the production cost of domestic sugar. During those two years, imported sugar price was also higher because the international sugar price was higher than the domestic sugar price.

Islam (2015) estimated the production efficiency of ten sugar mills of Bangladesh by using Data Envelopment Analysis (DEA), a linear programming-based technique, and found that production efficiency is 0.96 percent and on average the firms could increase their output by 3 percent with the existing level of inputs. The empirical results suggest that the entire sugar factories are technically efficient during the study period. Only TSM had lowest technical efficiency by 91 percent for the

entire period while TSM, PBSM, SHSM and KSM had decreased production efficiency for 2nd half significantly.

Khan et al. (2016) shows that per acre inputs cost of sugarcane production is Tk. 42,767.46 where the output value is Tk. 63,887.83 and the net return is Tk. 21,120.37. They pointed out that although sugarcane is a profitable crop, net returns from sugarcane cultivation is low compared to vegetables, pulses, wheat or maize because it involves more time and huge cost. Per acre yield of sugarcane is also low in Bangladesh compared to India and Brazil. The authors noted that the reasons of low profit of sugarcane producer are lack of proper training, use of local variety, inadequate supply of inputs, high price of human labour, extended harvesting period and late payment by the sugar mills. He suggested that invention of high yield variety, use of modern cultivation method, introducing intercropping, use of new machines and techniques in planting and harvesting can increase the profitability of the sugarcane farmers.

Alam et al. (2009) conducted growth rate analysis of sugar mills from 1972-2006 to find out the causes of low recovery rate. They found that recovery growth was negative (-0.87) during the period. They also found that from 1972-2006, growth rate of sugarcane cultivation area increased by 1.2%, sugarcane production increased by 2.9%, yield per hectare increased by 1.60%. During that time mean capacity utilization of all the mills was 77.51 percent. Their Break-even analysis found that on average 8.91 recovery was required for making the industry viable during that time. They identified low per hectare sugarcane and sugar yield, low capacity utilization, high processing loss, post-harvest losses, environmental factors and inefficient management as the main causes for low recovery in Bangladesh.

Rahman, Khatun, and Rahman (2016) investigated the causes of low production and pointed out that since sugar production and sugar recovery rate decreased simultaneously, there is a relation between sugar recovery rate and sugar production. They showed that from 1992 to 2015, the sugar production decreased from 2.28 MMT to 1.56 MMT and sugar recovery rate decreased from 7.68% to 6.85%. They also revealed that “the causes of lower yield in the non-mill zone compared to mill zone includes lack of recommended high yielding sugarcane varieties, absence of disease-free clean seeds program and finally not following modern cultivation technologies. The main causes of low sugar production by the industry are insufficient supply of sugarcane in the factory and very poor recovery of sugar. Besides this, the yield of cane per unit area is also lower compared to other countries” (Rahman et al., 2016).

Alam (2009) noted that government support in the form of financial support to farmers enables farmers to use proper inputs for sugarcane production which led to increasing sugarcane and sugar production. He found that additional sugar productions as result of subsidy program in 2003-04, 2004-05, 2005-06, 2006-07 and 2007-08 cropping year were 1385.43, 5881.85, 10847.00, 9641.37 and 3922.29 tons, respectively. There is a lack of understanding about the most effective way for using the government subsidy in case of sugarcane. In case of Khulna, Haider et al. (2011) found that the availability of the credits positively and significantly affects the profitability and productivity. They emphasized the effective redesigning of the credit instrument for encouraging the farmers. In case of Pakistan, Nazir, Jariko, and Junejo (2013) found that the costs of inputs of sugarcane (fertilizer, land preparation, seed, weeding, and irrigation) significantly influence the returns of sugarcane. They used the Cobb-Douglas production function and concluded that the high prices of inputs, delay in payments are responsible for low sugarcane production. Providing timely government support to farmers can incentivize sugarcane production.

Mustafa and Sultana (2016) identified the amount of sugar cane used and the recovery rate as two of the most important determinants of high cost of sugar. And then they explored why the amount of sugarcane used in sugar production and recovery rate decreased. They found out that lack of incentives to the sugarcane farmers, decreasing use of land used, use of low yield variety of sugarcane are responsible for decreasing availability of sugarcane. They also pointed out that the process loss in the factory, loss of quality of sugarcane for lack of timely transportation facility, technical performance of the mills was mostly responsible for the low recovery rate. They provided some recommendations to solve the existing problems that include: ensuring timely payment to farmers, promoting high yield variety, improving agricultural techniques and infrastructural support, ensuring timely transportation, decreasing process loss. The authors have also pointed out that by increasing the use of by product (molasses, bagasse, press mud, spent wash etc.) in producing alcoholic drinks, bio compost, fertilizer, electricity can contribute to decrease in the cost. They also underscored the need for keeping the mill active throughout the year by establishing refineries in the sugar mills.

IV. Method

This research has used mixed method for exploring and explaining the determinants of cost of sugar. This is an empirical study that used quantitative method mainly for identifying the most important determinants of per unit sugar cost. It has used

qualitative method to explain the findings from quantitative results and provide a comprehensive explanation of why certain variables are statistically more significant than the others.

Since this is an empirical study focusing mostly on the firm behaviour in determining cost, it did not formulate the cost function to estimate the marginal cost of using inputs, substitutability of inputs, or level of technology. The objective of the research was to explore the determinants of per unit cost by analysing empirical evidence. It has used fixed effects method using panel data for 14 years to explain the variability of cost per unit and selected variables based on empirical observations from qualitative analysis.

There are currently 15 state owned sugar mills in Bangladesh. This research has used panel data for 15 sugar mills for 14 years, from 2006-2007 to 2019-2020. It has used per KG cost of sugar as dependent variable and nine variables as independent variable. The independent variables include price of sugarcane, recovery rate, production of sugar, salary payment, repair and maintenance cost, number of sugar cane crushing days, age of mill, and interest payment as a percentage of cost.

Cost of sugar = f (price of sugarcane, recovery rate, salary payment, production of sugar, repair and maintenance cost, number of sugar cane crushing days, age of mill, interest payment)

$$C_{it} = \beta_0 + \beta_1 PSUGARCANE_{it} + \beta_2 RECOVERY_{it} + \beta_3 PRODUCTION_{it} + \beta_4 SALARY_{it} + \beta_5 REPAIR_{it} + \beta_6 DAYS_{it} + \beta_7 AGE_{it} + \beta_8 INTERESTPAY_{it} + \epsilon_{it}$$

The sugar mills are very old. While three of the mills were established during the British period (before 1947) and nine in the Pakistan period (before 1970), only three were built after 1971. The fixed cost is considered sunk cost and all other costs are variable cost. Among the variables identified as independent variable, no significant correlation was found, particularly in interpreting the empirical result and explaining the possible reasons of the findings.

This research used fixed effect model for analysing the effects of independent variables on the per unit cost. Fixed effect is used when the unobserved characteristics do not change over time as FE removes the effect of those time-invariant characteristics so we can assess the net effect of the predictors on the outcome variable. In this research the culture of corruption, governance, and administrative structure are unobserved and are invariant over time and this means any change in the dependent variable (per unit cost) is influenced by other things

except the unobserved fixed characteristics. In order to confirm whether random effect model or fixed effect model should be used Durbin-Wu-Hausman test is conducted. From the Durbin-Wu-Hausman test result we reject the null hypothesis that there are no systematic differences in the coefficient of REM and FEM. Since, the following result shows that there is systematic difference in the coefficient of REM and FEM, we need to use FEM for the data set used in this research.

This research has also used interviews to explain the possible reasons of managerial behaviour of the sugar mills that contribute to the per unit cost. Findings from ordinary least square regression analysis can only explain the empirically found significance and magnitude of the determinants of per unit cost but cannot explain why some determinants are statistically significant while others are not. A comprehensive understanding of the production process, technology, management, and behavioural pattern is necessary to explain the reasons of the findings. Thus, the interpretation of the result found through regression result required an in-depth exploration of mechanisms behind per unit cost determination.

For this research we conducted ten interviews by different open-ended questions to different types of people including three farmers, two trade union leaders, one accountant, one engineer, and two employees at the procurement department, MIS department, and a manager at higher level. The interviews and field level experiences enriched the understandings of the issues, selection of variables, scope of relating the theory with field level experience.

V. Analysis of Findings

The empirical analysis reveals that price and quality of input, availability of sugarcane, age of mill, agricultural technique and management in production process play very important role in determining the per unit cost of sugar. The fixed effect regression result (Table 5.1) shows that price of sugarcane, recovery rate, days of operation, age of mill are some of the most important determinants of cost of sugar.

When price of sugarcane increases by Tk 1, sugar cost decreases by Tk 0.16. Although at first instance it might seem that the finding is inconsistent with the cost theory that claims increase in the price of input increases cost, actually it is not inconsistent. Because here the dependent variable is per unit cost of sugar, which is calculated by dividing total cost by total production. As price of sugarcane increases, farmers have higher incentive to produce more sugar and because

of higher availability of sugar cane the per unit cost of sugar decreases. Thus, this empirical result shows that the increase in the price of sugarcane has in fact contributed to the reduction of the per unit cost.

A 1% increase in the recovery rate can on average reduce the per unit cost by approximately Tk 37.5. This empirical finding is consistent with all other findings of previous research. One new additional finding is that it estimates the marginal cost reduction for every 1% increase in the recovery rate. Compared to all other determinants increase in the recovery rate has the highest potential to reduce the sugar cost. Besides, it also found that one day increase in the operation of the mill in every crushing season on average decreases the cost by Tk 1.2. This shows that increase in crushing days in every crushing season is highly significant and cost reducing. By ensuring the availability of sugar for expanded period of time during the crushing season can reduce the cost.

Per unit cost increases only Tk 0.007 as sugar production increases by 1 ton. Although there is negligible impact of sugar production on per unit cost this shows there exists diseconomy of scale. However, this diseconomy of scale did not occur due to production above optimum level as happens in usual diseconomy of scale scenario. In this case, as the capacity of sugar mills is under-utilized there are other reasons for diseconomy of scale. Here diseconomy of scale can occur because of both factors internal to the operation or external conditions beyond a firm's control. It might also result from technical inefficiency in a production process, organizational management difficulties, or resource constraints of inputs. One explanation of diseconomy of scale due to internal factors may be the inactivity of the mill during the non-crushing season. The per unit cost could be decreased by increasing the number of days of operation during the crushing season and by making use of the employees and labour force in other income generating activities throughout the year. For example, by building refineries with imported sugar, producing alcoholic beverage, making sanitizers, generating electricity using bagasse, producing fertilizers can make use of the idle hours of paid employees and at the same time generate revenue from using the by-product after sugar production. One explanation of diseconomy of scale due to external factors could be the demand for input for alternative use and decrease in the land use because of higher demand for alternative use. In this case, there is higher incentive among farmers to use sugarcane for molasse production because of higher profitability. Decrease in land use for sugar production can also be a cause of diseconomy of scale as it works as supply constraint of input. Moreover, lack of transportation facilities and inefficient logistic coordination in the peak crushing seasons might

also increase the cost as a result of deterioration of the quality of sugarcane for which recovery rate might have decreased.

The result shows that all other things remaining same, on average for every year of aging of the mill per unit cost increases by Tk 8.44 because of the decreasing efficiency resulting from using old machines, equipment, and facilities. This finding is consistent with the accounts by the interviewees, who anonymously argued that the technical efficiency of mills are decreasing every year because of the quality deterioration of machine, equipment, roller etc. According to BSFICa (2014) the daily capacity of the mills is hampered by the dilapidated and inefficient boiler, milling plant, centrifugal machine, and filter station. While age is a significant determinant of per unit cost, the finding also reveals that repair and maintenance cost is insignificant in determining the per unit cost. This means that there has been inadequate expense on repair and maintenance to solve the problems of the aging mills and hence these expenses do not significantly influence the per unit cost. In the past, some older mills like North Bengal Sugar Mill and Carew have gone through major replacement of age-old boilers, turbines, centrifugal machine, roller, and filters, while some other older mills had partial replacement of some of the machines and equipment. So, partial replacement did not ensure significant efficiency increase. Moreover, the mills have grown the capacity to repair and maintain the plants locally and cheaply. Most of the sugar mills have their own workshops for minor repair and there are others for major repair and maintenance. So, the insignificant role of repair and maintenance during the period 2005-2019 can be due to minor replacement and low repair and maintenance cost.

After facing losses, the sugar mills demanded subsidies from the government. But instead of giving subsidies the government arranged loans for the mills. This loan has accumulated for years and in 2018-19 the interest payment was 36.7% of the total cost for all the sugar mills under BSFIC. In Thakurgaon sugar mill interest payment was about 44% of the production cost. Our finding shows that for every 1% increase in the interest payment out of total cost, per KG sugar cost increases by Tk 1.57.

Although there is variability in farm ownership across sugar mills, it was not possible to measure the impact of this variability on sugar cost using fixed effect model. So, we relied on interviews and published news to understand whether this variability mattered. Out of 15 sugar mills 5 mills have their own farming areas where they are supposed to cultivate sugarcane for supplying to the mills. Theoretically, these farm ownerships should have comparative advantage as this

may create opportunities for confirmed land use, close monitoring of cultivation, coordination in cutting, transporting, and crushing, and earning revenue. From figure 2.1 and figure 2.2 it is evident that from 2015-2017 when the average cost of sugar was increasing, the production remained stable, indicating that per unit cost increased sharply for all types of mills regardless of their farm ownership. The period following 2014 were the year the mills delayed the sugarcane farmers' payment for six months. This worked as a disincentive for sugarcane cultivation in the following years (2015-2017) and the cost increased mainly due to lack of availability of sugarcane. This means that farmers were less interested in taking lease from the mills for sugar production.

Group variable		mills	Number of Observation	209		
			Number of groups	15		
R-sq	within	0.8346	Observation per group	min	13	
				avg	13.9	
				max	14	
	between	0.0027	F(8,186)	117.31		
overall	0.1336	Prob > F	0.0000			
corr(u_i , X_b)		-0.8790				
Cost	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
Sugarcane Price	-.1624154	.0709598	-2.29	0.023	-.3024039	-.1022425
Recovery Rate	-37.55594	5.54991	-6.77	0.000	-48.5048	-26.60707
Sugar Production	.0077179	.0027844	2.77	0.006	.0022248	.013211
Salary	.0222171	.0084665	2.62	0.009	-.0055144	.0389197
Repair	-.011532	.0567977	-0.20	0.839	-.1235825	.1005185
Days	-1.225211	.2476308	-4.95	0.000	-1.713737	-.7366851
Age	8.446965	2.781562	3.04	0.003	2.9595	13.93443
Share of Interest Payment	1.571833	.5316525	2.96	0.004	.522989	2.620677
cons	-35.66391	122.1734	-0.29	0.771	-276.6877	205.3599
sigma_u	144.1041		F test that all $u_i = 0$: F(14, 186) = 3.19 Prob > F = 0.0002			
sigma_e	31.760377					
rho	.95367463 (fraction of variance due to u_i)					

The mills having own farms were affected because of the mismanagement of leasing and monitoring sugarcane production. Management failure was caused by use of land for producing other crops, and other irregularities in leasing and using farmlands less efficiently. One incidence in November 6, 2016 brought to light a

particular form of the misuse of farmlands. On that day police fired on Santals as they protested misuse of power of the sugar mill authority. “The Santal households were looted of their meagre valuables - domestic animals and crops - from their makeshift houses from morning till noon in the presence of law enforcers” (Parvez, 2016). Santals, one of the oldest and largest indigenous tribes in north-western Bangladesh, has been in a long dispute over land since the Rangpur Sugar Mill authorities started leasing plots for cultivation of rice and other crops. This is a violation of “the contract agreed under the then Pakistan government, which acquired 1,842 acres of land from Santals for the mill on the understanding that only sugarcane would be farmed there, and the land would be returned to the original owners if it were used for any other purposes. According to the indigenous leaders, the mill authorities have been allowing tobacco and rice farming on the land “for years”. As the contract was violated, indigenous Santal people and some Bengali locals began to occupy around 100 acres of land, building makeshift houses there and demanding return of their lands that belonged to their forefathers. Local sources at Gobindaganj said the mill was closed from 2003 to 2008 but came into partial operation from the end of 2008. “The mill opened on condition that the leasers will have to harvest at least 10% as sugarcane while other products can be harvested in the remaining 90% of the space. This was a violation of law,” said a source” (Parvez, 2016).

Figure: 5.1 Sugar Cost in All State-owned Sugar Mills (2006-07 to 2019-20)

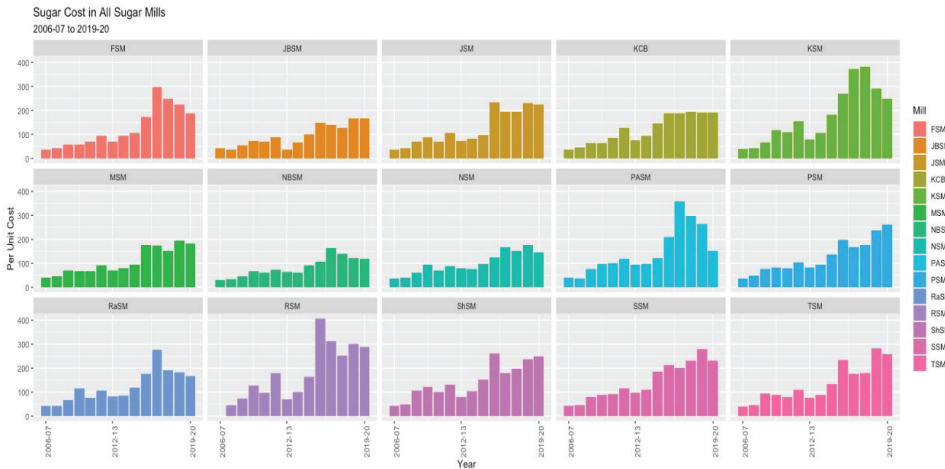
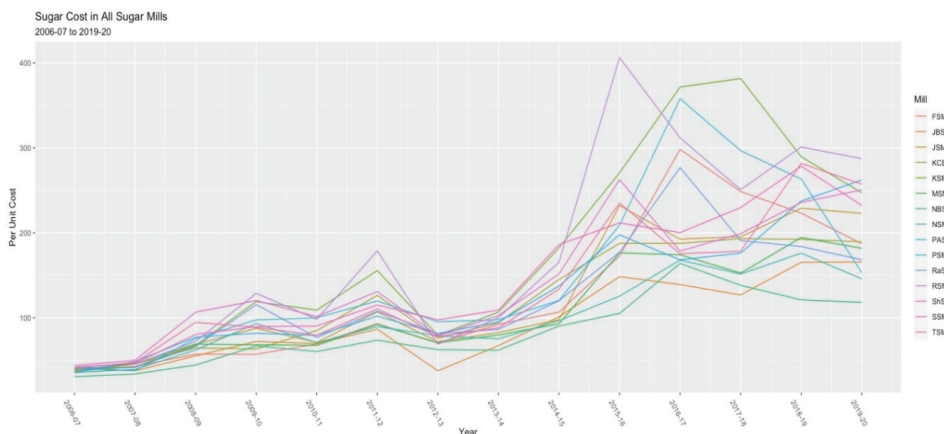


Figure: 5.2. Cost increase of 15 State-owned Sugar Mills from 2006-07 to 2019-20



There is no significant variability of the technology across the mills in the population. This homogeneity does not allow us to compare more advanced technology with the less advanced ones. Figure 5.1 shows that per unit cost was comparatively low for JBSM, KCB, MSM, NBSM, and NSM. First of all, crushing days for all these mills are comparatively higher than other mills. Second, the sugar mills that had undertaken massive overhaul of older structure (Figure 5.1: NBSM), had diversified final products (Figure 5.1: KCB), and had relatively more supply of quality sugarcane, (Figure 5.1: JBSM, NSM, MSM) have on average lower per unit cost and less volatile cost. Third, the mills undertaking partial renovation every year could not improve efficiency. Fourth, among all other factors Figure 5.1 shows that the age of the mill significantly affects the per unit cost.

The fact that 2006-07 to 2018-19 per unit cost shows a rising trend for almost all sugar mills, indicates that it is not farm ownership, rather incentives like loans and seeds to all types of farmers that affected the availability of sugarcane. So, we used number of crushing days as a proxy to measure the availability of sugarcane in crushing season. The result shows that for every one day increase in the operation during crushing season, on average the per unit cost of sugar decreases by Tk 1.2.

One limitation of this research is that it does not take into account the number of idle days when machines fail to operate in peak time. This kind of failure are not well documented and hence it is difficult to measure whether quality of maintenance had any impact on the per unit cost. It only measured the cost of repair but not the quality of repair and renovation. Trade Union leaders reported that corruption, irregularities in purchase, sale, and allocation of resources, are causes of excessive

cost of sugar. The regression analysis could not quantify and measure the role of these qualitative variables because of unavailability of data.

VI. Further Scope of Study

One limitation of this analysis is that it fails to provide sufficient explanation of the cause of low recovery. The analysis identified what cause the recovery rate to be low, but it did not find to what extent technology used in mill operation and technology used in agriculture responsible for low recovery rate. It did not disaggregate the effect of technical efficiency in mill and technology used in agriculture and did not calculate the magnitude of these determinants. Previous studies also failed to perform this analysis because of lack of case for comparison. Further study could be done by comparing two different sugar mills using similar variety of sugarcane and sharing other similar characteristics but having difference in the quality of machine and the services they provide. This can help disaggregate the determinants of recovery rate to find out to what extent new investment in the mills can cause the recovery rate to increase and thereby can contribute to reducing per unit cost.

VII. Conclusion

As Bangladesh's economy opens up by facilitating import of raw sugar and encouraging private sector participation in refining sugar to meet the domestic demand, the state-owned sugar mills are facing competition from low international price of raw sugar. The increasing share of private firms in the market has taken over control of price from government, leaving the state-owned companies to face the challenge of cost reduction and price competition. This research findings are consistent with the existing cost theories and other previous research and contribute to understanding how the cost could be reduced. Because it found out input cost and its availability, quality of input, management, and technology as important determinants of per unit cost. However, the main contributions of the empirical findings are that it found out the most key factors, the magnitude of the reduction of cost as a result of change in some of the most crucial factors, and the causal mechanism behind them. It found out recovery rate as the most important variable that can cause the per unit cost to rise. It suggests that increasing sugar production did not ensure average cost reduction because of diseconomy of scale arising from factors both internal and external to the mill operation. It identified high interest payment, weak transportation management, lack of income generating activities using the by-product during idle (non-crushing) season as internal factors causing

diseconomy of scale. More production is associated with creation of more by-product (bagasse, spirit, ethanol etc.) The inefficient use of those by-products or irregularities in selling those can raise the cost. It shows that there are also external factors causing diseconomy of scale. Growth of competing industry (molasse production) using sugarcane, competing use of land used for sugarcane production, and lack of timely government support during crisis situation (i.e., delay in payment to farmers in 2014 and onwards) are making it costly to produce sugar.

Increase in sugar production had to be coupled with reduction of cost of input through making full utilization of labour and capital during the off-season, improving quality of input (quality of sugarcane contributing to recovery rate), improving management (minimizing process loss and transportation time contributing to increasing recovery rate, timely payment to farmers), and advancing technology (agricultural techniques and modernizing mills).

Government's recent decision to shut down six sugar mills instigated debate over profitability and dependency on government subsidy. This research is a contribution in revealing how new investment in the sugar mills can contribute to increasing recovery rate and could reduce cost in the long run. It shows that average cost of sugar in older mills are higher than that of the newer mills. When the question of new investment arises, the focus generally goes to subsidy and increasing recovery rate through using agricultural technique to improve high yield variety. Modernizing the mill technology has been largely neglected by different quarters as this involves investment. Although the government now provides meagre amount of subsidy to increase the use of high yield variety, over the last decades, it did not invest sufficiently to increase efficiency of the mills. The limited subsidy promoting high yield variety did not have any sustainable impact on the sugar industry. In the absence of subsidy, the mills became indebted gradually and every year the interest payment has increased so much that it has become 36.7% of the total cost in the industry. In order to protect the industry, the government needs to waive the outstanding loans. Allocation of more resources need to be viewed as the new investments to increase efficiency rather than as mere unproductive subsidy. Increasing efficiency through minimizing cost can be possible by improving management and modernizing technology of mills and improving quality of high yield variety.

This research has limited its scope of analysis within exploring determinants of cost and explaining the mechanisms of cost determination. Further research can be done to disaggregate the magnitude of cost reduction as a result of change in factors influencing the recovery rate.

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