COVID-19, Agglomeration Economies and Firm recovery: Evidence from Bangladesh

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Abstract:

Agglomeration economies may help firms to cope with the pandemic-induced crisis and speed their recovery. To test this hypothesis, we analyze data from a sample of 216 micro, small and medium enterprises from 16 industrial estates in Bangladesh. Data spanning the period of hard lockdown (March-May 2020) and subsequent periods of more limited lockdown and opening up are merged with a broader sample from 2017 that encompasses the same firms. We explore the role of the following two factors in weathering and recovering from the crisis: (i) access to local value chains; and (ii) proximity to business hubs at district or sub-district levels. The findings suggest that agglomeration economies (mainly local market access indicators) have provided benefits to firms during the pandemic. Such agglomeration benefits in the context of the pandemic provide insight into cluster-based industrialization in developing countries that aim to exploit local inputs and business potentials.

Keywords: BSCIC industrial estates, agglomeration economies; COVID-19 pandemic; MSMEs; recovery; Bangladesh

JEL classifications: R120; R340

1. Introduction

The COVID-19 pandemic, that began in Wuhan, China in early December 2019 has spread all over the world at an unfathomable rate, and left economies with grave recession. The very infectious nature of coronavirus compelled the governments to impose lockdowns that halted normal activities of the people and businesses. In the context of restrictions on the movement of

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The authors are grateful for the funding support received from the European Union-supported PRISM project for this study, and in particular, we thank Ali Sabet for his continuous cooperation. We also than Calla Weimer for her initial reflections and feedback on the paper.

people and transportations, the industry sectors have been severely affected through supply chain disruptions and limited demand for goods and services. SMEs are among the worst hit by the pandemic because of their low capital base, inadequate access to finance and other opaqueness (Sonobe, 2020; Dai et al., 2020; Bartik et al., 2020; Fang et al., 2020; IFC, 2020; LightCastle Partner, 2020). With limited restrictions in the context of declining severity of infections, from the second half of 2020, many economies started recovering, particularly in developing countries (World Bank, 2020).

To understand the pathways to recovery from the COVID-19 pandemic induced crisis in agglomeration economies, in this study we focus particularly on the recovery of MSMEs[3] that are located in BSCIC industrial estates.[4] Agglomeration economies provide various spatial and other benefits that might help firms cope with the crisis as well as recover from the crisis. For example, smaller firms in the industrial estates mainly target local markets for sourcing raw materials and selling products, production and sales of such local-market oriented firms are expected to be less affected by the limited restrictions on mobility imposed in the pandemic. Since some of the firms had to retrench laborers during the lockdowns, they took the advantage of specialized pool of labor force that an enclave may offer (Otsuka and Sonobe, 2011; Hossain, 2021).

Furthermore, intra-industry benefits, such as access to specialized know-how (for example, textile firms have delved into masks and PPE manufacturing), the presence of buyer-supplier

[3] According to the Industrial Policy 2016, those firms having less than 15 workers (or asset amount less than Tk.10 Lac) are considered as a cottage; firms having workers 16-30 persons (or asset amount Tk.10-75 Lac) are treated as micro; having workers 31-120 persons (or asset amount Tk. 75 Lac-1.5 crore) are defined as small and having workers 121-300 persons (or asset amount Tk. 15-50 crore) are defined as a medium size firm.

[4] Bangladesh Small and Cottage Industries Corporation (BSCIC), a state-owned enterprise, has been developing and managing the estates since mid-1960s. A total of 74 such estates were established mainly to promote cottage and MEMEs to exploit regional business potentials. Estates and clusters are interchangeably used in this paper.

networks, and opportunities for efficient subcontracting may also help firms recover faster. Industry-specific skills concentration gives rise to access to a larger specialized labor pool. Another aspect of agglomeration economies is 'urbanization economies' that are related to benefits that accrue from being located in close proximity to firms in other industries. These inter-industry benefits include easier access to complementary services (publishing, advertising, banking), availability of a large labor pool with multiple specializations, inter-industry information transfers, and the availability of less costly general infrastructure.[5] Since we do not know yet whether agglomeration economies offer any special benefits to the recovery of firms in Covid-19 pandemic, this study will cast light on certain aspects of agglomeration economies which will lead to rethinking cluster development strategy in the context of Covid-19 pandemic.

Agglomeration factors include four sets of indicators: (i) Market access (MA); (ii) Localization of economies (LoC); (iii) Locational advantage: distance from business hubs (LA); and (iv) Tertiary economies: urbanization indicators (TE) (Lall et al ,2004). In principle, BSCIC estates were established to unlock the local market potentials—for both inputs and outputs. During the lockdown in Covid pandemic, firms that rely more on local markets for raw materials, other factor inputs and sales are expected to recover more quickly than others because limited mobility was allowed within local areas during the lockdown in Bangladesh. The firms also took advantage of spatial locations because of the proximity to the business hubs which will provide firms with a larger choice of transport providers and intermediate input suppliers.

We intend to assess the firms' performance against any exogenous shock when firms are located in industrial-enclave enjoying the benefits of agglomeration economies. For example,

[5] These benefits of agglomeration, dating back at least to the works of Marshall (1920), might give a boost to the pandemic-inflicted firms in their recovery process. There is a rich body of literature on the benefits to firms from co-locating in close proximity to other firms in the same industry (Henderson, 1974 and 1988; Carlino, 1978; Selting et al.,1994).

smaller firms in the industrial estates mainly target local markets for sourcing raw materials and selling products; production and sales of such local-market oriented firms are expected to be less affected by the limited restrictions on mobility imposed in the pandemic. Therefore, despite being in industrial-cluster, the degree of "agglomeration benefits" varies across firms and they may perform differently during any external shock. We wanted to examine the recovery span of cluster-based firms with different level of agglomeration benefits during COVID-19. Restrictions of mobility enforced globally in terms of "lock down" during COVID-19 pandemic, affected firms' performance. We were motivated to explore if firms located in industrial cluster with different level of "agglomeration benefits" performed differently under different modes of "movement restriction".

We specify agglomeration benefits in terms of "local market orientation" that vary across firms. Our objective is to assess whether local market-oriented firms that are based in estates have gained any additional benefits in the face of Covid-19 pandemic and we did not draw comparison between clustered and non-clustered firms. This issue is also important as the BSCIC estates were established with a view to achieving industrialization in an inclusive manner by taking advantages of rural market potentials. We consider two indicators of local market orientation: (i) whether firms collect raw materials from their own district or domestic sources; and (ii) whether firms sell their products at their own district.

Firms are expected to enjoy the advantages of being at industrial cluster, particularly those who target local markets for sourcing raw materials and for selling products as they are supposed to face fewer difficulties during country-wide movement restriction (lock down). Firm level heterogeneity in a cluster might make difference in their performances. We, therefore, attempted to address the following question: Does the performance of the cluster-based firms

vary with their market orientation/access during COVID-19 pandemic? We are also interested to examine the variation of performances with the variation of gravity of movement restrictions during the lock-downs in Covid-19 crisis (strict lockdown, limited lockdown, re-opening).

We conduct a survey of over 200 firms in recent times (from January to March, 2021) from selected sixteen BSCIC industrial estates in Bangladesh. We collect information on losses and recovery of firms during lockdown (March-May, 2020) and subsequent periods of limited lockdown and without lockdown in 2020. The sampling framework is based on our earlier survey in these estates conducted in 2017 on 500 firms. The survey data in Covid-19 pandemic are merged with 2017 survey data to control estate and industry fixed effects.

As mentioned earlier, we wanted to assess whether local market-oriented firms that are based in estates have gained any additional benefits in the face of Covid-19 pandemic, and therefore we did not compare with non-clustered firms. We first employ OLS regression methods with or without agglomeration factors. Later to check the robustness, we employ Instrumental Variable (IV) regressions as spatial distribution of firms may be endogenous to firm recovery. If Covid-19 infection rates are high in a district, firms are more likely to explore local market opportunities to collect raw materials and market their products. To encounter this apparent selection bias, we consider district-wise infection rate as well as distance to local markets as instruments.

The results suggest that agglomeration economies provide strong support for the firms to recover from the adverse impact of Covid-19 pandemic. Firms that rely on local market value chains, that is firms that target local market for raw material collection and sales showed a faster recovery from lockdown effects. The paper is structured as follows. Section 2 provides an overview of BSCIC industrial estates and section 3 represents descriptive statistics of surveyed

firms. Section 4 discusses the model specifications, estimation methods and results. Finally, Section 5 concludes the paper.

2. An overview of BSCIC industrial estates in Bangladesh

The adverse impact of Covid-19 pandemic on firms in industrial estates might shed further insights on industrial policy of the countries like Bangladesh that rely heavily on zone/enclave-based industrialization, such as special economic zones (SEZ), export processing zones (EPZ), BSCIC estates, and so on in the context of scarcity of serviced land and other facilities. An overview of BSCIC industrial estates from which firms are surveyed might be relevant here to get insights into the extent of agglomeration that might be attributable to firms' recovery.

BSCIC industrial estates are the oldest industrial estates in Bangladesh which started in the mid-1960s. Initially, a total of 18 estates were established by the end of 1970 with a plan of 'one estate in one district' in order to promote industrialization in rural areas using the geographic specialization in products and goods (Hossain, 2021). The estates were established for the MSMEs (including cottages) only. Currently, there are 76 industrial estates located across 64 districts of Bangladesh, among which, four were specialized estates, such as "Jamdani Palli" (women fine cloths with special brand) and "Hosiery" in Narayanganj, Leather in Savar, and Electronics in Mirpur, Dhaka. Dhaka and Chattogram divisions have the highest concentration of estates (24 & 17), followed by Rajshahi (9), Rangpur (8), Khulna (7), Sylhet (5), and Barishal (4).

Table 1 presents the aggregate picture of BSCIC industrial estates. The total land area occupied by the 74 industrial estates is 1969.2 acres, and 5822 units were established in 10053

plots in 2017. The estates created employment of 0.56 million people with an average employment of 7626 persons per estate. About 20% firms in these estates are exporting and about 4% firms became sick/closed. Among the established units, about 78% are in operation. The estimated compound annual growth over 2013-2017 shows that the annual growth of industrial units and plots is around 1%, but growth of sick/ units is over 4%. Growth of employment and exporting firms is about 3%. Production of firms grew by 11% and value of exports grew by 5%.

Table 1: Key indicators of BSCIC industrial

Items	2013	2017	CAGR (%)
Total land area (in acres)	1969.2	1969.2	-
No of Industrial plots	10339	10389	0.1
No of allotted industrial plots	9837	10053	0.5
No of established industrial units in the allotted plots	5745	5822	0.3
Average number of plots per industrial unit	1.71	1.73	-
No of industrial units in production	4205	4547	2.0
% of units in production among established units	73.2	78.1	1.6
No of sick/closed industrial units	285	339	4.4
No. of export oriented industrial units	865	946	2.3
% of export units among total units in production	20.6	20.8	-
Number of employed persons in the industrial estates	503551	564319	2.9
Employment per estate	6805	7626	2.9
Total production value (crore Tk.)	36097.4	55262.3	11.2
Total export value (crore Tk.)	20889.9	25528.5	5.1
Government revenue (crore Tk.)	2312	2950.1	6.3
Number of industrial estates	74	74	-

Source: Management Information Services (MIS) of BSCIC, various years, 2012-2013 & 2016-2017.

As Table 2 shows, textile and agro food processing industries occupy a relatively higher number of industrial units in BSCIC industrial estates (34.6% and 28.1%). Export oriented units are the highest in the textile sector (about 90%). The concentration of different types of industries varied across regions, possibly due to availability of the raw materials, local demand, labor cost, and connectivity to the business hubs. Rajshahi, Rangpur, and Sylhet have a larger concentration of agro food processing industries (48% vs. 55.8% vs. 45.9%) relative to other

divisions. About three-fifths of the textile firms are located in Dhaka. More than a fifth of the chemical and pharmaceutical industries are concentrated in Chattogram, Rajshahi, and Rangpur.

Table 2: Share of industrial units and export oriented units by sectors

Sector	2016		2021 Sample Survey	
	Share of Units	Share of export-oriented units	Share of Units	Share of export-oriented units*
Agro food processing	1209 (28.12%)	39(3.79%)	50 (23.14%)	10 (7.3%)
Textile	1489 (34.64%)	922 (88.63%)	66 (30.56%)	26 (18.98%)
Forestry/Wood/furniture	79(1.85%)	0 (0.00%)	4 (1.85%)	2 (1.46%)
Jute and jute related products	36(0.84%)	9 (0.83%)	13 (6.02%)	9 (6.57%)
Paper board, printing & packaging	154(3.58%)	5 (0.47%)	16 (7.41%)	15 (10.95%)
Tannery, leather & rubber	59(1.38%)	4 (0.36%)	14 (6.48%)	10 (7.30%)
Chemical & pharmaceutical	611 (14.22%)	47 (4.50%)	17 (7.87%)	5 (3.65%)
Engineering	552 (12.84%)	14(1.30%)	32 (14.81%)	20 (14.6%)
ICT	8 (0.18%)	0 (0.00%)	-	
Others	102(2.37%)	1 (0.12%)	1 (0.46)	40 (29.20%)
Total	4299	1040	216	137
No. of estates	72		16	

Note: (i) Percentage shares in brackets; * export-oriented firms include firms that sell in both domestic and export markets with varying degrees.

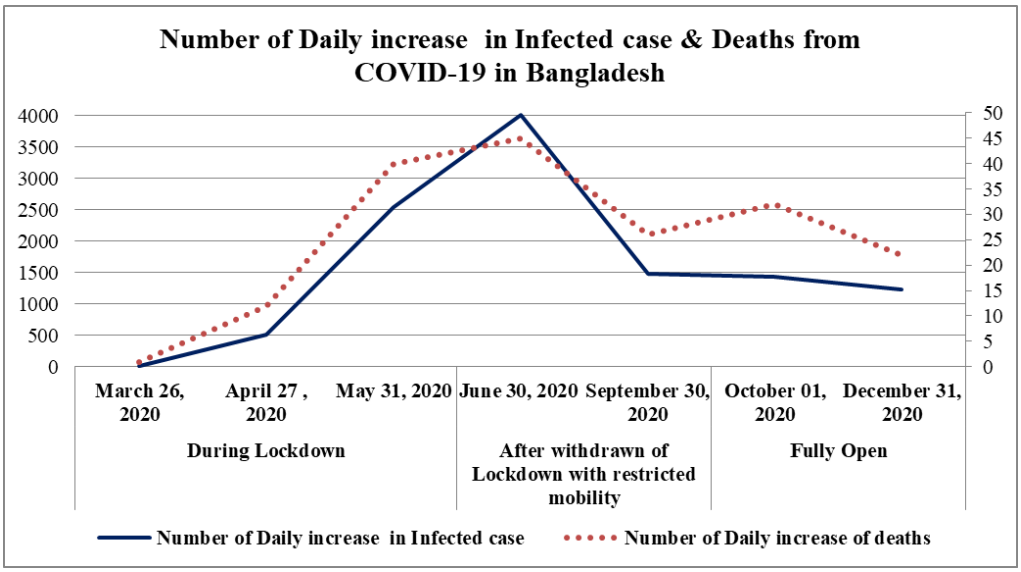
Source: BIDS Survey, 2017 and PRISM Survey, 2021

3. Descriptive statistics

We collect information on firm recovery for three periods: March-May, 2020 (strict lockdown); June-September, 2020 (limited restrictions), and October-December, 2020 (completely open). We consider these three periods based on the situation of Covid infection rates and lockdown status (Figure 1). Lockdown lasts from 26 March 2020 to 30 May 2020 and after that there have been limited restrictions on inter-city transportations and people's mobility until the end of September 2020. From October 1, 2020, all sorts of restrictions have been withdrawn. We, therefore, expect that firm performance and recovery would vary in these three

periods. We collect firms' information for these three periods compared to the same periods in 2019 so that their recovery can be assessed.

Figure 1. Daily increase of COVID-19 positive cases and deaths in Bangladesh, March to December, 2020



Source: World Health Organization (2021)

Our current survey in 2021 of 216 firms is based on the same sampling frame of our previous survey from 25 BSCIC industrial estates on 500 firms (see Table A1 in appendix for sampling distribution). The survey is being carried out through a structured questionnaire with physical visits by enumerators. The survey started from the third week of January 2021 and ended in the third week of March 2021 at the advent of sharp rise of COVID-19 positive cases in its second wave in Bangladesh. The samples are representative in the sense that our current survey follows the same sampling framework of the BIDS 2017 survey that was based on representative aspects of estates (age, size, location, specialization, etc.). Moreover, our sample firms represent 10

industrial sectors and are distributed across 16 estates in 16 districts, and are therefore largely representative of geographic locations and industrial sectors (see Table A1 in appendix).

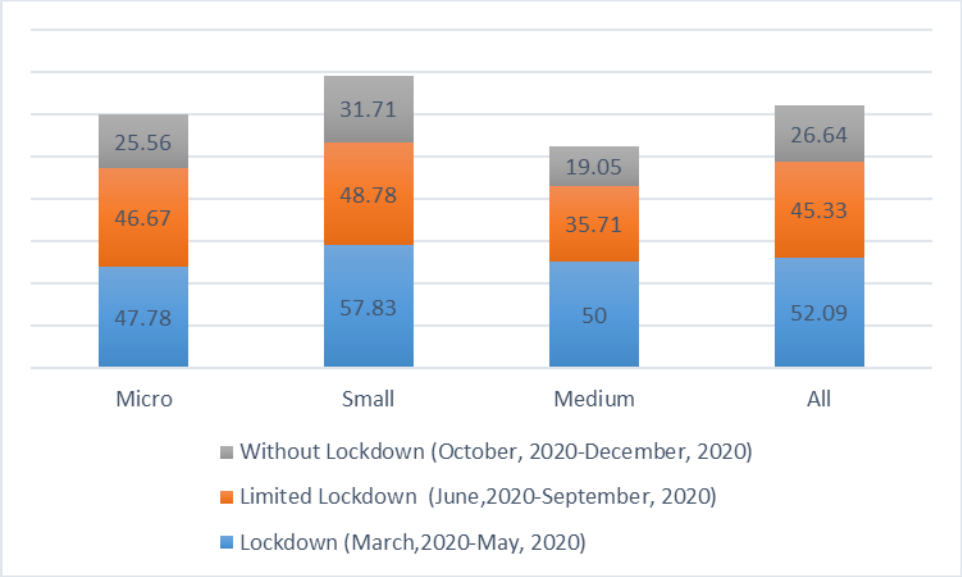
Production/Sales/Profit: We collected information on the impact of COVID-19 on firms' output in terms of either increase, decrease or unchanged compared to the same pre-COVID periods. The descriptive results in Table 3 show that during the lockdown period, about 98% of the firms have lost about 57% of their output (production/sales), suggesting that firms had continued their production and sales during the lockdown period, albeit at a less scale, which was possible because of relaxed lockdown and advantages of agglomeration economies in the estates. Our result is almost consistent with similar studies (Sonobe, 2020; IFC 2020). A recent survey in selected Asian countries show that more than one quarter of firms expect a drop of sales by more than 40% in the first half of 2020 compared to the same period in 2019 (Sonobe, 2020). An IFC survey (IFC, 2020) conducted from June to August 2020 among 500 MSMEs found that around 37% of the workers in Bangladesh's MSMEs lost their jobs, 70% were in a vulnerable position, as 94% of enterprises were experiencing a sharp drop in sales due to the COVID-19 impact. In the subsequent periods, we find that 86% and 72% of the firms reported a decrease of output at 33% and 23% respectively. The results indicate that firms recovered at a faster rate when the economy was reopened fully by the end of December 2020. However, decline in profitability is relatively less indicating that firms have been able to retain their profit despite a decline in production/sales.

Table 3: Average decrease (%) in production, sales, profit and employment after outbreak of COVID-19 (N=216)

	Lock Down (Apr-May, 2020)	After Lock Down (June-Sept, 2020)	After Lock Down (Oct-Dec, 2020)
Production	57.04	33.26	22.92
	(98.13)	(85.98)	(71.76)
Sales	56.65	29.21	24.81
	(97.65)	(85.92)	(71.63)
Profit	49.97	30.60	23.48
	(69.5)	(45.59)	(34.63)

Note: % of firms are reported in parentheses

Figure 2: Percentage of firms retrenched their employees after outbreak of COVID-19 (N=216)



Furthermore, the results suggest that during the lockdown, almost 100% of the micro and small firms were affected, however, after the lockdown, they started recovering gradually (see Table A2 in appendix). In the last quarter, by the end of December 2020, about 67% of small firms reported a decrease in production/sales while the proportion is 50% for micro and medium firms. For sales and profitability, micro and medium firms showed strong recovery (less than 50% suffered loss of sales or profit). In terms of magnitude of loss, while all three categories of firms had incurred a loss of output by over 65% during the lockdown, the loss went down to about 25% for micro and medium firms and about 40% for smaller firms in the latter periods. By

the end of 2020, the loss was about 20% for all the MSMEs implying that the recovery was almost 80%.

*Employment***:** Our survey results suggest that only about 5% of firms retrenched their employees (non-workers) in three periods; however, about 40% of the firms had retrenched their workers during and immediately after the strict lockdown (June-Sept., 2020). However, in the last quarter of 2020, only a small proportion of firms (about 14%) had retrenched their workers. On an average, 18% of workers lost their job across firms.

4. Model Specification, Estimation and Results

4.1. Model Specification

The following regression model has been used to explore the effects of different factors on firms' performance in terms of production during COVID-19:

$$Y_{it} = \beta_0 + \beta_1 raw\_material_{it} + \beta_2 local\_market\_orientation_{it} + \beta_3 firm\_size_{it} + \beta_4 ownership\_dummy_{it} + \beta_5 assoc\_membership\_dummy_{it} + \beta_6 experience\_years_{it} + \beta_7 plot\_type\_dummy_{it} + \beta_8 change\_production\_dummy_{it} + \beta_9 change\_market\_strategy\_dummy_{it} + \beta_{10} distance\_city_{it} + \mu_{it}$$

Outcome Variable: Recovery of Production

Y_{it} refers to the amount of production in period t in 2020 expressed as percentage of production/sales/profit in period t in 2019. We asked the firms if production was increased, decreased or remained same in three different periods: strict lockdown period (April-May, 2020); limited Lockdown period (June-September, 2020) and re-opening of economy (October-December, 2020) in 2020 compared to production in each of these periods in 2019. Therefore, the production in 2020 was reported in relative terms in comparison with production in 2019. The reported percentage of production in 2020, in other words, represents the percentage of

recovery of production.

Considering the base production in 2019 as 100, the series of production in 2020 used in regressions were computed by subtracting (adding) the reported decreased (increased) percentage of production from 100. For instance, if firms reported that production decreased by x% at period t in 2020; then the corresponding value of production at period t used in the series was (100-x). In case of increased production, if firms reported that production increased by y% in at period t 2020; then the corresponding value of production at period t used in the series was (100+y). On the other hand, if firms reported that production remained same at period t in 2020; the corresponding value of production/sales/ profit used in the series was 100.

Agglomeration variables (Key intervention factors):

In our model, percentage of raw material collected from local source and local market orientation (percentage of goods sold in own district) have been used as regressors to find if local market orientation and sourcing raw materials from own locality contributed to sustenance of production or not during the abovementioned three different periods of movement restrictions. We have used "distance to nearest town/city (district)" as another explanatory variable to explore if firms located with higher distance from town/city (district) had lower production or not.

Control Variables:

Firms' characteristics used as explanatory variables in regressions are firm size; type of plot where firm is located (according to size: for example, Type A is the largest plot); type of ownership of firm; years of experience of firms' owner; change in firms' production process (1 if firms have any changes in production process); change in firms' market strategy (1 if firm have changes in market strategy).

Table 4: Summary Statistics

	Mean	N	Std.	Min	Max
Production_t1_strict_lockdown	45.29	216	39.36	5	150
Production_t2_limited_lockdown	42.92	214	31.75	5	150

Production_t3_re-opening	45.32	215	39.45	5.00	150.00
% of raw material collected from local source	42.26	215	29.83	0.00	91.67
% of goods sold in own district	50.08	215	31.67	0.00	100.00
years of experience of firm's owner	92.64	215	9.62	58.00	100.00
Distance (km) between firm and nearest city (district)	1.96	215	1.04	0.00	3.22
Firm_size (Proportion %)					
micro	42.59	92			
small	37.96	82			
medium	19.44	42			
Ownership_pattern (Proportion, %)					
single	66.2	143			
joint/partnership	14.35	31			
limited company	19.44	42			
association membership (Proportion %)					
Yes	90.74	196			
No	9.26	20			
Plot_type (Proportion %)					
A	35.19	76			
B	30.56	66			
C	17.13	37			
D	8.8	19			
S	8.33	18			
if firms have any changes in production process (Proportion : %)					
yes	12.09	26			
no	87.91	189			
if firm have changes in market strategy(Proportion : %)					
yes	38.43	83			
no	61.57	133			

Source: BIDS Survey 2017 and PRISM Survey 2021

4.2. Estimation and Results

OLS estimates of the abovementioned regression is presented Table 5. The results suggest that both of the agglomeration variables; "percentage of raw material collected from local source" and "percentage of goods sold in own district" came out positively significant in the first interval (strict lock down period) only which means that higher local market orientation facilitated the firms in terms of higher production under stringency on movement.

Table 5: OLS estimates
COVID-19 & Production of MSMEs (Production in 2020 as % of Production in 2019)

VARIABLES	(1) **Prod_2020_ t_1:** ***strict lockdown***	(2) **Prod_2020_t_2:** ***limited lockdown***	(3) **Prod_2020_t_3:** ***re-opening with free movement***
% of raw material collected from local source	0.144*	0.118	0.126
	(0.085)	(0.081)	(0.100)
local market orientation (% of goods sold in own district)	0.119*	-0.031	-0.155*
	(0.068)	(0.065)	(0.079)
1 if firm size: small (base=micro)	8.465*	5.199	1.791
	(4.984)	(4.764)	(5.833)
1 if firm size: medium (base=micro)	4.234	8.442	4.786
	(6.584)	(6.293)	(7.745)
1 if firm has joint/partner ownership (base: single)	-9.910	1.952	9.634
	(6.218)	(5.943)	(7.302)
1 if firm is limited company (base: single)	-5.491	-5.554	13.029*
	(6.364)	(6.083)	(7.439)
1 if firm has any association membership	-7.548	-1.167	-7.495
	(7.339)	(7.015)	(8.635)
years of experience of firm's owner	0.673***	0.359	0.297
	(0.240)	(0.230)	(0.282)
Plot type:B (Base: A)	-3.110	5.941	-0.532
	(5.566)	(5.319)	(6.549)
Plot type:C (Base: A)	-4.006	-5.923	6.362
	(6.610)	(6.318)	(7.779)
Plot type:D (Base: A)	-1.059	6.407	6.118
	(8.330)	(7.962)	(9.382)
Plot type: S (Base: A)	-4.154	-3.428	10.885
	(8.295)	(7.929)	(9.761)
1 if firms have any changes in production process	14.326**	10.608	7.370
	(6.984)	(6.675)	(8.218)
1 if firm have changes in market strategy	21.230***	14.070***	17.750***
	(5.053)	(4.830)	(5.938)
Distance (km) between firm and nearest city (district)	14.535***	9.892***	13.013***
	(2.331)	(2.228)	(2.741)
Constant	-53.622**	-23.647	-20.098
	(25.470)	(24.344)	(29.870)
Observations	213	213	215
R-squared	0.378	0.259	0.270

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Robustness of results: IV regression

OLS results suggest that firms take spatial advantage of clusters, such as the use of local raw materials and local market to cope with the COVID-induced crisis; specifically, during strict restrictions on movement. One of the objectives of this study is to explore spatial benefits of clusters, not the typical agglomeration benefits of clusters per se as we are not comparing with similar non-clustered firms. In this context, spatial distribution of firms may be endogenous to firm recovery. Considering the possibility of endogeneity embedded into "percentage of raw material collected from local source" and "percentage of goods sold in own district", we used a defensible approach of estimating the model through "Instrumental Variable (IV)" technique instead of OLS method (Table 6). If COVID-19 infection rates are high in a district, firms are more likely to explore local market opportunities for raw material collection and marketing of their products. To encounter this apparent selection bias, we consider district-wise infection rate as well as distance to local markets as instruments.

Averages of growth (change) of daily infection rate[6] across region, distance between each firm and nearest local market, square distance to local market have been used as the three IVs. We found these variables reasonable to be used as these variables are unlikely to affect outcome variable independently as well as to be correlated with the unobservable of the model. As restriction on movement imposed by the government was based on the infection rate; strict lockdown was imposed when the infection was at the peak. Collecting raw materials from local source as well as selling goods at local market became difficult during strict lockdown which affected firms' production. Therefore, gradual rise in COVID-19 infection rate is expected to affect the production indirectly and the effect is transmitted through collection of raw materials and sales of the goods in local market. On the other hand, firms which are located near local market seem to be prone to collect raw materials and sell goods in local market due to fewer

[6] Averages of growth of daily infection rate are computed by authors based on the data from http://dashboard.dghs.gov.bd/webportal/pages/covid19.php

difficulties and therefore; the distance between local market and firm affects the production indirectly through these two factors.

Table 6: IV estimates
COVID-19 & Production of MSMEs (Production in 2020 as % of Production in 2019

VARIABLES	(1) ***Prod_2020_ t_1: strict lockdown***	(2) ***Prod_2020_t_2: limited lockdown***	(3) ***Prod_2020_t_3: re-opening with free movement***
% of raw material collected from local source	0.563**	0.363**	0.425***
	(0.271)	(0.157)	(0.145)
local market orientation (% of goods sold in own district)	1.345**	0.725	0.101
	(0.563)	(0.688)	(0.814)
1 if firm size: small (base=micro)	19.087**	12.104	4.783
	(9.295)	(8.613)	(10.461)
1 if firm size: medium (base=micro)	15.763	15.911	4.263
	(12.473)	(12.555)	(14.380)
1 if firm has joint/partner ownership (base: single)	-7.916	2.976	9.299
	(9.836)	(7.520)	(7.357)
1 if firm is limited company (base: single)	6.641	1.585	16.042*
	(11.283)	(9.373)	(9.118)
1 if firm has any association membership	-13.446	-4.684	-11.618
	(11.956)	(8.907)	(8.861)
years of experience of firm's owner	1.153***	0.646**	0.577*
	(0.446)	(0.319)	(0.314)
Plot type :B (Base: A)	-2.346	6.956	-2.921
	(9.293)	(7.604)	(7.808)
Plot type :C (Base: A)	-8.451	-8.286	-0.257
	(11.648)	(8.916)	(8.843)
Plot type:D (Base: A)	-13.628	-1.050	2.694
	(14.224)	(10.876)	(9.481)
Plot type: S (Base: A)	2.837	0.992	11.812
	(13.492)	(10.895)	(11.254)
1 if firms have any changes in production process	21.312*	14.590*	10.036
	(11.395)	(8.738)	(8.861)
1 if firm have changes in market strategy	18.051**	12.323*	19.104**
	(8.409)	(7.061)	(7.677)
Distance (km) between firm and nearest city (district)	15.294***	10.271***	14.205***
	(3.773)	(2.868)	(2.804)
Constant	-186.042***	-104.019*	-73.497
	(70.105)	(59.984)	(66.749)
Observations	212	212	214
R-squared	-0.667	-0.242	0.210

Diagnostics test[7]			
F-statistics	F(15,194) = 3.23	F(15, 196) = 2.98	F(15, 198) = 4.72
	p>F=0.00	p>F=0.00	p>F=0.00
Over identification test	Sargan Statistics: 2.108	Sargan Statistics: 1.017	Sargan Statistics: 2.500
	Chi-sq(1) P-val = 0.1466	Chi-sq(1) P-val = 0.3133	Chi-sq(1) P-val = 0.1139
Endogeneity test	Chi-sq (1)= 14.505 p-val= 0.0007	Chi-sq (1)= 7.213 p-val= 0.0272	Chi-sq (1)= 8.631 p-val= 0.0134

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The IV estimates of "percentage of raw material collected from local source" came out positively significant across all the three-time intervals which show that the firms with higher proportion of raw material collected from local source has higher production during COVID-19 with different modes of movement restrictions in 2020 (strict lock down period, limited lockdown period and re-open of economy). However, IV estimates of "percentage of goods sold in own district" turned out positively significant in the first interval (strict lock down period) only which means that higher local market orientation in terms of sales in local market facilitated the firms by higher production under stringency on movement. When mobility is strictly restricted; firms which are more oriented with local market in terms of sales; gain more from the opportunity of having access to market. Whenever movement restriction becomes flexible or economy performs with free-movement; firms produce irrespective of being local-market oriented or not in terms of sales.

5. Conclusions

In this study, we assess the impact of Covid-19 on MSMEs and their subsequent recovery taking samples from selected industrial estates in Bangladesh. Industrial estates offer various agglomeration benefits to firms, such as market access, thick labor pool, specialization and

[7] Coefficients are jointly significant with high F-value (p-value is 0.00) implying the fact that the model is strongly identified. p-value is insignificant in over-identification which means that null hypothesis "the instruments are exogenous" is not rejected. Therefore, over identification assumption is satisfied. p-value of endogeneity test is significant implying the fact that null hypothesis "the treatment variables are exogenous" is rejected. Hence, endogeneity test is also satisfied.

competition, and localization of economies. These factors appear to be important for overcoming pandemic-induced crises in the context of lockdown and restrictions on mobility.

We assess the recovery from the impact of covid-19 in the context of their local market orientation. Note that to recover at the pre-COVID level depends on many factors including both demand and supply side factors. COVID-19, in general, creates health and income burden on the households, aggravates poverty situation in developing countries, and pushes the vulnerable in a more defenseless situation. This situation also refrains firms from utilizing the full capacity of their production. However, some firms might recover fully if they can undertake innovations and dynamism in their activities. Therefore, firm level heterogeneity might matter in their recovery at the pre-Covid level.

BSCIC Industrial estates were established to uncover locational advantages in terms of market access, use of local labor as well as to exploit local potentials of raw materials. These agglomeration economies factors provide a leap to the recovery of firms from the adverse impacts of lockdown. Because it is observed that firms continued their production at half of their capacity even in the lockdown last year that they have been able to sell in the local market. The firms that recover faster from lockdown impacts are apparently local market-oriented firms, which are also less productive to some extent, as suggested in the literature. These local market focused firms take certain advantages of agglomeration, such as supply of raw materials from local sources, sales of products in the local market, and so on. Therefore, industrial clusters that were established to tap the potentials of local economy have provided a big support in the pandemic that deters physical movements and long-distance movements.

Given the agglomeration benefits, choice of locations, urbanizations, infrastructure development are some of the important issues that might be considered while developing industrial estates. The agglomeration benefits in the context of Covid-19 pandemic provide a new pathway to rethinking cluster-based industrialization, particularly in developing countries.

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Appendix:

Table A1: The distribution of samples across divisions/districts and estates

Division	District	Estate Name	Establishment year	2017 survey	2021 survey
Rajshahi	Bogura	Bogura (ext.)	1991	22	-
Chattogram	Chattogram	Patiya	1990	8	7
Chattogram	Cumilla	Cumilla	1961	39	39
Chattogram	Cox bazaar	Cox bazar	1975	11	1
Dhaka	Dhaka	Dhamrai	1990	29	15
Rangpur	Dinajpur	Dinajpur	1964	25	1
Chattogram	Feni	Feni (Charipur)	1962	20	20
Dhaka	Gazipur	Tongi	1964	40	39
Sylhet	Habigonj	Habigonj	1995	18	18
Dhaka	Jamalpur	Jamalpur	1987	25	-
Rajshahi	Joypurhat	Joypurhat	1993	20	2
Khulna	Khulna	Khulna	1961	20	18
Dhaka	Kishoregonj	Kishoregonj	1986	18	-
Rajshahi	Naogaon	Naogaon	2000	20	-
Dhaka	Narayangan	Jamdhani	1999	24	18
Dhaka	Narayangonj	Narayangonj	1996	44	22
Dhaka	Narsingdi	Narsingdi	1989	25	-
Chattogram	Nohakhali	Nohakhali	2007	11	11
Rangpur	Panchagarh	Panchagarh	1994	8	1
Barishal	Patuakhali	Patuakhali	1982	10	-
Barishal	Pirojpur	Swarupkathi	1961	14	1
Khulna	Satkhira	Satkhira	1988	10	2
Dhaka	Shariatpur	Shariatpur	2000	10	-
Sylhet	Sunamganj	Sunamganj	2000	10	-
Rangpur	Thakurgaon	Thakurgaon	1998	19	1
Total		25		500	216

Table A2: Average decrease (%) in production, sales, and profit across firm size after outbreak of COVID-19 compared to pre-covid period in 2019 (N=216)

	Lockdown (March 2020-May 2020)	Limited Lockdown (June 2020-September 2020)	Without Lockdown (October 2020-December 2020)
Production			
Micro	53.30	32.33	21.28
Small	62.48	36.38	25.83
Medium	54.62	28.73	20.87
All firms	**57.04**	**33.26**	**22.92**
Sales			
Micro	52.67	31.47	20.81
Small	61.82	35.85	25.60
Medium	55.13	27.57	18.48
All firms	**56.61**	**32.46**	**22.23**
Profit			
Micro	40.10	28.95	23.71
Small	58.20	34.58	24.10
Medium	57.23	24.31	21.18
All firms	**49.97**	**30.60**	**23.48**