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Effects of COVID-19 restrictions on mechanization service providers and mechanization equipment retailers: Insights from phone surveys in Myanmar

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Abstract

Agrifood sector mechanization service providers (MSP) and mechanization equipment retailers (MER) have increasingly become the providers of mechanical technologies for smallholders in developing countries, including Myanmar. Evidence remains scarce on the effects of COVID-19 on these MSPs and MERs. This study provides insights into the effects of COVID-19 restrictions on MSPs and MERs in Myanmar, using unbalanced panel data from five rounds of phone surveys. Direct responses to COVID-19 involving movement restrictions, market disruptions, and growing financial challenges had significant negative effects on revenue prospects, service delivery, and sales of machines and equipment. Negative revenue prospects during a particular period can further hurt revenue prospects in subsequent periods. This is consistent with the hypotheses that MSPs who had incurred high sunk costs in machines can engage in more desperate and, thus, potentially suboptimal business practices to recover the sunk cost. Overall, policies to minimize movement restrictions and various financial struggles and mitigate any pessimism at the beginning of the production season are all important to make sure MSPs

and MERs continue to function effectively under COVID-19.

KEYWORDS

COVID-19, mechanization equipment retailers, mechanization service providers, Myanmar, panel data

1 | INTRODUCTION

The COVID-19 pandemic and measures to contain its spread have had serious effects on society and the economic functions of small businesses in the agrifood sector (IFPRI, 2020; Minten et al., 2020; Zidouemba et al., 2020). These preventative measures, combined with the direct health effects of the disease, can have significant adverse effects on global food security and economic livelihood. As the pandemic persists, it remains critical that policy measures that are aimed at dealing with COVID-19 and other related crises are developed to effectively support the agrifood sector. An understanding of the effects of these preventative measures on actors in the agrifood sector is integral to the policymaking process.

One function within the agrifood sector, disruption of which can potentially lead to significant economic losses, is the supply of agricultural mechanization services. The use of mechanical power for farming operations has historically had significant economic effects both on-farm and off-farm. In the United States, between 1910 and 1954, the replacement of animal powers by tractors and related equipment alone contributed to raising U.S. GDP by 8% (Steckel & White, 2012). In smallholder-dominated Asia, tractors alone accounted for 15%–16% of rice production growth during the early phase of the Green Revolution (Barker et al., 1985). Agricultural mechanization through the use of tractors and combine harvesters has spread extensively in the developing world in the past few decades (Diao et al., 2020). In some of the least developing countries like Myanmar, which has seen rapid mechanization growth during the past decade, the economic roles played by mechanization subsector actors have expanded substantially (Win et al., 2020). These actors include mechanization service providers (MSP), who serve many smallholders that still account for much of farm production without having the capacity to own machines by themselves, and mechanization equipment retailers (MER), who work through long supply chains of machines most of which are imported from abroad or manufactured mostly in a few major cities.

Despite the growing literature on the effects of COVID-19 on the agrifood sector, evidence on MSP and MER remains scarce. MSPs, who provide custom hiring mechanization services to farmers, and MERs, who sell machines, attachments, and spare parts, have distinct characteristics that are different from other inputs and service providers (SP) in the agrifood sector. In developing countries, land preparation, harvesting, and other farm operations have increasingly become mechanized (Diao et al., 2020). Mechanical power can reduce the drudgery for rural workers, including women and children, and the nonfarm economy more broadly.

A key question on how COVID-19 restrictions on movement and sales practices have impacted MSPs and MERs remains. Movement restriction may not have constraining effects on MSPs if the mobility of machines is inherently low (e.g., Takeshima et al., 2015). However, if the mobility is sufficiently high, movement restrictions can be binding constraints. Equivalently, if disruptions to the acquisition of machines, equipment, and attachments occur before

or early in the production season or late in the season, changes to market conditions may have less effect on MSP or MER.

Another key question is how sudden changes in revenue prospects for the upcoming production season affect MSP business practices, particularly the desperate, suboptimal use of their machines to recover sunk costs. These risky practices may result in a vicious cycle where machines may be inoperable for a further period. Support may need to be provided early, when a pessimistic outlook exists, to mitigate risky business practices associated with sunk costs for similar future shocks.

This paper aims to fill some of these knowledge gaps by providing insights from multiround phone surveys administered to MSPs and MERs in Myanmar in 2020. Given the relatively high frequency of survey rounds, we also assess the dynamic effects of revenue prospects in the early period on those in subsequent periods. Myanmar is also a particularly suitable country to assess these effects as MSPs and MERs have only grown quite recently (Belton et al., 2017, 2018, 2019; Win et al., 2020) compared to many other Asian countries. Therefore, Myanmar can be more fragile and less resilient to shocks like COVID-19 than other Asian countries where the sector is more mature.

Moreover, this study contributes to the growing literature on the effects of COVID-19 on the agrifood sector (IFPRI, 2020), including in Myanmar (Boughton et al., 2021), and on agricultural mechanization, MSPs, and MERs in developing countries (e.g., Diao et al., 2020; Takeshima et al., 2015, 2018) and in Myanmar (Belton et al., 2017, 2018, 2019; Win et al., 2020). The study also adds to the literature the effects of sunk costs on dynamic decision making (e.g., Dawes, 1998; Staw, 1976).

This paper is structured in the following way. Section 2 describes empirical analyses and methodologies. Section 3 describes the data and descriptive statistics. Section 4 presents and discusses the results. Lastly, Section 5 concludes.

2 | EMPIRICAL ANALYSES

Our empirical analyses consist of the static and dynamic aspects of the association between COVID-19-related restrictions, indirect effects on the market and financial challenges, and perceptions by MSP and MER.

2.1 | Static effects of COVID-19 restrictions on perceptions by MSP and MER

Our first set of analyses investigates the static associations between prospects on business outcomes and challenges, coping mechanisms pursued, preferences on different policies by MSP and MER, and indicators of restrictions or disruptions as direct or indirect outcomes of COVID-19 containment measures by the government in 2020.

Specifically, we estimate

$$y_{it} = \alpha + c_i + \beta x_{it} + \varepsilon_{it} \tag{1}$$

where y_{it} includes outcome indicators of interests for respondent i at survey round t and x_{it} is a set of time-variant exogenous variables related to the COVID-19 restrictions or disruptions. Parameter β is a set of coefficients on the association between y_{it} and x_{it}. Parameters α, c_i, and

ε_{it} are estimated intercept, respondent-specific fixed effects that are unobserved and time-invariant fixed effects, and idiosyncratic error terms, respectively.

Equation 1 is a linear probability model (LPM) since, as described later, our outcome variables are binary variables. LPM has advantages over other common binary outcome models like probit or logit. First, LPM is consistent even when ε_{it} is heteroskedastic, while probit or logit models become inconsistent with heteroskedastic error terms (Greene 2003). Second, binary models like probit cannot incorporate unobserved time-invariant fixed effects, and alternatives like the Correlated Random Effects model (e.g., Chamberlain 1984) require stronger assumptions on which observed variables are correlated with the unobserved time-invariant fixed effects. Similar recent studies that use binary outcomes from phone surveys in Myanmar have also used LPMs (e.g., Headey et al. 2022).

As described in the data section, our sample of MSP consists of tractor service providers (TSP) and combine-harvester service providers (CSP). We estimate Equation 1 separately for TSP and CSP because they differ considerably in characteristics and may be affected by and respond to COVID-19-related restrictions in different ways. For example, TSP can be relatively more flexible in revenue generation if, for example, tractors can also be used for nonfarm purposes outside the main agricultural season, mitigating the short-term effects of restrictions. Combine harvesters are more often moved by transporters than tractors (e.g., Zhang et al., 2017), and their costs of moving across locations can be of different natures, potentially leading to different effects of movement restrictions. Also, relatively more CSPs are located in the delta zone than TSPs are (Win et al., 2020), and COVID-19-related restrictions, if implemented differently across regions within Myanmar, can have different effects on TSPs and CSPs.

2.1.1 | Outcome variables

y_{it} includes various outcomes for both MSPs and MERs; (1) revenue and profit prospects from their respective business for the current production season, measured as 1 if the prospects for final revenue in 2020 are worse than the revenue earned in 2019, held at the time of each survey round in 2020, and 0 otherwise; (2) facing financial and business challenges (1 if yes and 0 otherwise), including the inability to repay loans or to pay invoices, facing any other increased financial problems (MSP), the perceptions of severe sales reduction of different machines and equipment (MER), facing disruptions in their logistics, and, whether facing any of these collectively, inability to deliver existing orders or facing disruption to logistics; (3) pursuing a particular coping mechanism to deal with business and financial challenges (1 if yes and 0 otherwise), including seeking loans from the government, commercial banks, or other private individuals, liquidating business assets, or reallocating other earned incomes; (4) most preferred set of policies to mitigate the negative effects associated with COVID-19 restrictions and disruptions (1 if yes and 0 if otherwise), including reduction in taxes/fees, reduction in financing costs/loan extension/debt relief, reduction of rent/utility for business assets like warehouse or shops, easing of movement restrictions of machines across regions, keeping machine/parts shops open, or expansion of loans for small enterprises.[1]

2.1.2 | Exogenous variables

x_{it} includes three types of variables that capture the intensity of constraints faced by respondents due to COVID-19-related regulations: (1) movement restrictions on business-related

spatial movement, (2) equipment market constraints, and (3) financial constraints that are likely to be exogenous or predetermined for respondents. Variable (1) include binary variables indicating whether the respondents face movement restrictions within village tracts (for MSP), within townships (for MER), and within states or regions. For MER, related variables also include a sales restriction index, taking the value between 0 and 3 based on the sum of three binary variables, that is, whether being banned from in-store sales, banned from storefront sales, and banned from sales through delivery. Variable (2) is proxied by a variable taking the value between 0 and 2, based on a sum of two original binary variables, namely, whether the market prices are higher than those during the same period in the previous year for machines and equipment transacted by MER or used by MSP and whether the availability of these machines and equipment is less than that during the same period in the previous year. Variable (3) is proxied by a variable taking the value between 0 and 4, based on a sum of four original binary variables, namely, whether the respondent is still indebted to the formal sector lenders like dealers or banks (for MSP), whether facing loan or credit repayment requirement that cannot be extended, whether facing more requests for late payment from customers compared to the same period in the previous year, and whether facing imminent exhaustion of financial assets within 3 months based on the current rate of cash flow (for MSP). We use these aggregated sets of explanatory variables, as we found during the preliminary analyses that using the aforementioned variables individually often suffers from multicollinearity problems.

x_{it} also includes rainfall level relative to the historical norm, measured as the percentile with respect to the rainfall distribution in the corresponding month of the survey in the past 40 years. A similar measure has been used in past studies (e.g., Takeshima et al., 2020).

x_{it} further includes survey-round dummy variables, as well as their interactions with a few key time-invariant variables, which can capture heterogeneity in these survey-round specific effects. For MSPs, these time-invariant variables include their home states/regions, whether providing tractor-based mechanization service(land preparation in the plant season and transportation during the harvesting season), and how many years they have been in their business. For MERs, these time-invariant variables include whether the MER is based in the Ayeyarwady, Yangon, or Bago region (which consist mostly of the delta zone), whether selling four-wheel tractors (4wt), and whether franchise dealers.

Given that our surveys are entirely phone based, most outcome variables and explanatory variables are measured as binary variables. Covering many outcome variables through such binary variables keeps our insights informative regarding how MSPs and MERs have been affected under COVID-19 restrictions and disruptions and what policies can help them in the upcoming production season in 2021.

2.2 | Dynamics of MSP revenue prospects under COVID-19 restrictions

Our second set of analyses focuses on the dynamic effects, as was described briefly in the introduction section. Specifically, we assess the dynamic effects of having more pessimistic revenue prospects at the beginning of the production season on the subsequent seasons and potential pathways.

MSPs, relative to some of the other SPs in the agrifood sector, can be characterized as having high sunk costs incurred on capital assets, including machines they had purchased outright or had invested significant payments toward eventual ownership. The presence of sunk costs in the face of economic crises like COVID-19 restrictions is an important issue. The potentially

negative effects of sunk costs incurred on assets on the economic efficiency of the agents in the subsequent period have long been discussed in the literature (e.g., Dawes, 1998; Staw, 1976). One of the related hypotheses for MSPs is as follows; faced with reduced revenue prospects under COVID-19 restrictions, MSPs may resort to more desperate uses of their machines, such as using machines on poorer-than-desired farm conditions, servicing farmers at a further distance, servicing smaller groups/acreages at a time, excessively reducing service fees, or accepting more late payments (thus taking risks on payment recovery), for fear of being unable to recover the sunk costs. However, a rational decision would likely be to instead reduce machine use in the short term by realizing that desperate machine use today can raise the marginal cost of machine use in the long run. Desperate machine use today can forego higher earnings that could have been made in the future if machines were not used desperately during the current period and kept in better condition. In such a case, having a negative revenue prospect can result in lower revenue prospects in subsequent periods, leading to a vicious cycle.

Of course, sunk costs may not lead to these behaviors, for example, if machine markets are highly efficient, where machines can be easily resold, and sunk costs can be easily recovered. In such a case, negative revenue prospects in the current period should have a limited effect on the revenue prospects in subsequent periods. The dynamic effects of negative revenue prospects on MSPs are, therefore, empirical questions worth testing.

2.2.1 | Empirical estimation of dynamic effects

We empirically test this hypothesis in the dynamic-panel estimation method:

$$y_{it} = \alpha + c_i + \gamma y_{it-1} + \beta x_{it} + \varepsilon_{it} \tag{2}$$

in which y_{it} is one of the outcome variables used for Equation 1, that is, a binary variable measured as 1 if the prospects of revenue in 2020 are worse than the revenue earned in 2019 held at the time of survey round t in 2020 and 0 otherwise. The same set of other variables and parameters from the static panel data method (1) apply. The additional parameter γ measures the dynamic effects on y_{it}. This class of dynamic models, like Equation 2, tends to suffer from potential endogeneity problems, including that between y_{it-1} and c_i (Nickell, 1981). We therefore employ generalized methods of moment (GMM)–based estimation methods for Equation 2, which can mitigate the effects of potential endogeneity associated with parameter γ, developed by Arellano and Bond (1991), and further by Blundell and Bond (1998). We present the results of the Blundell and Bond (1998) estimator (also known as the "system GMM" estimator [Roodman, 2009]). We also demonstrate that the results are robust across two major types of GMM estimation methods (one-step GMM and two-step GMM estimators) within the system GMM estimator.

3 | DATA AND DESCRIPTIVE STATISTICS

3.1 | Data set and sample size

Our data consist of five rounds of unbalanced panel data of MSPs and MERs interviewed through phone surveys in May (round 1), June (round 2), July (round 3), November (round 4),

and December 2020. Rounds 1–3 typically fell during land preparation and planting seasons, while rounds 4–5 fell during harvesting seasons (IFPRI, 2020). Both MSPs and MERs were purposively sampled, using the contact information obtained from previous studies (Belton et al. 2017, 2018, 2019), as well as from snow-balling methods.

The sample sizes for MSP and MER surveys across rounds and different categories are presented in Table 1. In total, we ended up with 1,351 and 330 panel observations of MSPs and MERs, respectively, who responded to at least two rounds. Among MSP observations, approximately two-thirds are TSP and one-third is CSP. Among MER observations, slightly more than half are handling 4wt, together with other equipment, while the rest handle only other equipment.[2] Among MSP, the composition of TSPs and CSPs also varies between round 3 and round 4, where major farm operations switch from land preparation or planting activities to harvesting, and we, therefore, split the analyses accordingly.

3.1.1 | Rainfall data

The primary data are complemented by monthly rainfall data at the township levels for the year 2020 and historical data since 1980 from the Climate Hazards Group Infrared Precipitation with Stations (CHIRPS) (Funk et al., 2015). Averages are extracted for the rainfall data at ward/township levels of respondents' locations in Myanmar.

3.2 | Descriptive statistics

Table 2 summarizes the descriptive statistics of the outcome variables for MSPs and MERs, respectively. Overall, most MSPs and MERs interviewed experienced unfavorable outcomes (or perceptions thereof). Note that most MSPs and MERs reporting "No" (other than coping methods and policy preferences) indicated "no change" from the previous year rather than any "improvement". Therefore, for those variables, values > 0 suggest that average conditions lean toward negative outcomes. About 64% of MSPs and 61% of MERs reported perceptions of reduced revenue prospects for 2020 compared to the revenue earned in 2019. Many of them also reported a higher rate of perceived prospects of revenue reduction than cost reduction.

A significant fraction of MSPs and MERs also reported emerging financial and business challenges. A significant share of MSPs reported greater financial problems compared to the previous year, and a significant share of MERs reported a more than 20% drop in the sale of machines and equipment. MSPs and MERs also resorted to diverse coping methods, indicating heterogeneous responses. Lastly, MSPs and MERs reported a relatively diverse set of preferences for policy measures to mitigate the negative effects of COVID-19 disruptions.

Table 3 summarizes the descriptive statistics of explanatory variables. Most MSPs and MERs faced movement restrictions either within the state/region, township, or even within village tracts (MSP). Some MERs faced complete bans against selling machines or equipment in-store, at store front, or through delivery. Significant shares of MSPs and MERs faced either higher prices or reduced machine availability they had to acquire. While not shown, these patterns are highly correlated with similar market conditions for attachments and spare parts (both imported and locally manufactured). Significant shares of MSPs and MERs also faced a range of financial constraints at the beginning of each survey round, including indebtedness, loans that could not be extended, greater credit demand from customers, and risk of imminent exhaustion

TABLE 1 Samples of MSP and MER

Type of respondents	Subcategories of respondents	Round 1	Round 2	Round 3	Round 4	Round 5	Interviewed in all of rounds 1-3	Interviewed in all of rounds 4-5	Among those interviewed in all five rounds Interviewed in all of rounds 1-3	Interviewed in all of rounds 4-5	Total observations appearing for at least two rounds
MSP	Tractors	286	285	226	56	51	216	51	57	33	904
	Combine harvesters	43	26	12	188	180	12	180	6	25	447
	Total	329	311	238	244	231	228	231	63	58	1,351
MER	4wt	40	50	45	32	28	35	28	18	14	195
	Others	24	35	30	25	21	19	21	10	14	135
	Total	64	85	75	57	49	54	49	28	28	330

Source: Authors.

Note: 4wt, four-wheel tractors; MER, mechanization equipment retailers; MSP, mechanization service providers.

TABLE 2 Descriptive statistics: outcome variables

Variables	TSP	CSP	MER
Holds prospect of lower revenue in 2020 than in 2019	0.629	0.684	0.609
Holds prospect that drops in revenue is more than the drop in cost	0.399	0.528	0.403
Face challenges in loan repayment	0.216	0.232	
Face challenges in payment of invoices	0.131	0.116	
Face increased financial problems	0.668	0.655	
Sales drop by more than 20% (4wt)			0.511
Sales drop by more than 20% (combine harvesters)			0.467
Sales drop by more than 20% (spare parts)			0.405
Sales drop (any equipment handled)			0.812
Sales drop by more than 20% (any equipment handled)			0.576
Business challenges			
Cannot deliver existing orders	0.116	0.290	0.230
Face disruption to logistics	0.360	0.624	0.497
Coping methods			
Obtain loans from the government	0.128	0.196	0.103
Obtain loans from commercial banks	0.065	0.065	0.161
Obtain loans from private individuals	0.224	0.205	0.130
Liquidate assets	0.273	0.212	0.152
Use other incomes	0.237	0.250	0.082
Preferred policies			
Reduce taxes/fees	0.132	0.147	0.497
Extend loans/debt relief	0.369	0.287	0.276
Allow movement of machines across regions	0.146	0.443	0.245
Keep machine/parts shops open	0.127	0.151	0.024
Reduce rent/utilities	0.202	0.220	0.303
Additional loans for small enterprises	0.353	0.298	0.333
Number of full panel observations (combined)	904	447	330
Average numbers of panel rounds	3.5	2.9	3.3

Source: Authors.

Note: All outcome variables are binary variables, taking value of 1 if yes and 0 otherwise. 4wt, four-wheel tractors; CSP, combine-harvester service providers; MER, mechanization equipment retailers; TSP, tractor service providers.

of financial assets for their business. Lastly, MSPs and MERs were generally in areas where rainfall leading up to the time of the survey had been less than the historical standard (around 30 percentile of the historical rainfall distribution).

Descriptive statistics of time-invariant variables suggest that approximately 45% of MER respondents were franchise dealers who had a stronger tie with the suppliers and were selling particular brands of machines. About half of MERs were in Yangon, Ayeyarwady, or Bago. Among MSPs, a majority of CSPs were in Ayeyarwady, while a majority of TSPs were in

TABLE 3 Descriptive statistics: exogenous variables

Variables	Unit	TSP	CSP	MER
Time-variant variables				
Movement restricted within village tracts	Yes = 1	0.369	0.062	
Movement restricted within township	Yes = 1			0.155
Movement restricted within state/region	Yes = 1	0.967	0.922	0.336
Banned from in-store sales	Yes = 1			0.079
Banned from storefront sales	Yes = 1			0.091
Banned from delivery	Yes = 1			0.209
Sales restriction index (sum of the above three variables)	Count			0.379
Face higher machines costs than the previous year	Yes = 1	0.367	0.278	0.185
Face reduced machine availability than the previous year	Yes = 1	0.209	0.185	0.376
Equipment market constraint index (sum of the above two variables)	Count	0.576	0.463	0.561
Indebtedness (owe loans to dealers/banks)	Yes = 1	0.488	0.599	0.522
Do not receive an extension on the current loan payment	Yes = 1	0.397	0.461	0.273
More requests for late payment by customers	Yes = 1	0.738	0.710	0.385
Imminent risk of financial asset exhaustion	Yes = 1	0.463	0.401	0.443
Financial constraints index (sum of the above four variables)	Count	2.086	2.171	1.623
Rainfall percentile	Percentile (1 = 100%)	0.260	0.326	0.314
Time-invariant variables				
Selling four-wheel tractor (4wt)	Yes = 1			0.591
Franchise	Yes = 1			0.448
Regions				
Ayeyarwady	Yes = 1	0.156	0.704	
Bago	Yes = 1	0.107	0.165	
Magway	Yes = 1	0.559	0.033	

TABLE 3 (Continued)

Variables	Unit	TSP	CSP	MER
Mandalay	Yes = 1	0.051	0.031	
Sagaing	Yes = 1	0.114	0.049	
Yangon	Yes = 1	0.006	0.018	
Delta zone (proxied by Ayeyarwady, Yangon, and Bago)	Yes = 1			0.491
Year of establishment		2015.6	2016.3	2009.6
Number of full panel observations (combined)		904	447	330
Average numbers of panel rounds		3.5	2.9	3.3

Source: Authors.

Note: 4wt, four-wheel tractors; CSP, combine-harvester service providers; MER, mechanization equipment retailers; TSP, tractor service providers.

Magway. On average, MSPs have been in business since 2015 or 2016, while MERs have been in business since 2009.

4 | RESULTS

4.1 | Static effects of COVID-19 restrictions on perceptions by MSP and MER

Tables 4 to 8 summarize the results of COVID-19 restrictions on the outcomes of MSPs. Similarly, Tables 9 to 13 summarize the results for MER. Note that standard errors reported account for potential serial correlation across respondents and township clusters through the multiway clustering method in panel data analyses (Cameron et al., 2011).[3]

As described earlier, we primarily focus on the collective effects of three types of constraints: movement restrictions, equipment market constraints, and financial constraints. For three types of outcomes—revenues, financial challenges, and business challenges—while still distinguishing statistically significant coefficients from insignificant ones, it is also important, as is shown, that all statistically significant coefficients have positive signs and thus these three types of constraints have broadly negative effects across various outcomes in a consistent manner. Coefficients on movement restrictions can be insignificant if certain financial or business challenges can be resolved without significant physical movement (e.g., if information and communications technology is effective) or if alternative customers (with similar willingness to pay) can be found easily nearby. Coefficients on equipment market constraints can be insignificant if, for example, MSPs or MERs purchase equipment or services infrequently so that short-term market conditions do not affect them. Coefficients on financial constraints can be insignificant if they have the ability to find alternative finance sources in a timely manner.

As for the other outcomes, coping mechanisms and policy preferences (Tables 7, 8, 12, and 13), there may also be significant negative coefficients because, for these outcomes, we asked respondents to indicate the most important coping mechanisms among various options and up to two most preferred policies among multiple options. Coefficients in Tables 7, 8, 12, and 13, therefore, capture "relative" rather than "absolute" effects.

4.1.1 | Mechanization service providers

Movement restrictions

Mechanization services constrained to movement within the state/region or further within the village tracts had significantly negative effects. These included a greater likelihood of having prospects for revenue losses (Table 4), financial challenges like loan repayment and invoice payments (Table 5), and business challenges like logistic disruptions (Table 6). Effects are sometimes insignificant for certain outcomes, partly for tractors that generally tend to operate in smaller geography in the first place (e.g., Takeshima et al., 2015). However, the effects are often more significant for CSPs who tend to have greater mobility in developing countries (e.g., Diao et al., 2020; Zhang et al., 2017). For example, movement restrictions significantly raised the likelihood that CSP will face financial challenges (Table 5). Overall, the negative effects are significant for a range of outcomes, suggesting that movement restrictions imposed as COVID-19 containment measures still had substantially large economic effects on MSP.

TABLE 4 Effects of COVID-19-related restrictions on revenue perceptions (MSP)

Variables	Holds prospect of lower revenue in 2020 than in 2019		Holds prospect that drops in revenue more than the drop in cost	
	TSP	CSP	TSP	CSP
Movement restricted within village tracts	.100***	.202*	.026	−.043
Movement restricted within state/region	.139**	.185*	−.078	−.009
Equipment market constraints index	.065***	.068*	.091***	.040
Financial constraints index	.068***	.051*	.010	.116***
Rainfall percentile		Included		
Round dummy		Included		
Round dummy × time-invariant variables		Included		
Constant		Included		
Number of observations	904	447	904	447
p-Value (H0: variables jointly insignificant)	.000	.000	.000	.000

Source: Authors.

Note: CSP, combine-harvester service providers; MSP, mechanization service providers; TSP, tractor service providers. *10%; **5%; ***1%.

TABLE 5 Effects of COVID-19-related restrictions on financial challenges (MSP)

Variables	Face challenges in loan repayment		Face challenges in payment of invoices		Face increased financial problems	
	TSP	CSP	TSP	CSP	TSP	CSP
Movement restricted within village tracts	−.037	.176*	.018	.106*	−.012	.132
Movement restricted within state/region	.122	.147*	.050	.126*	.086	.061
Equipment market constraints index	.050*	.043	.047*	.125***	.003	−.062
Financial constraints index	.051***	.140***	−.006	.051*	.087***	.154***
Rainfall percentile			Included			
Round dummy			Included			
Round dummy × time-invariant variables			Included			
Constant			Included			
Number of observations	904	447	904	447	904	447
p-Value (H0: variables jointly insignificant)	.000	.000	.000	.000	.000	.000

Source: Authors.

Note: CSP, combine-harvester service providers; MSP, mechanization service providers; TSP, tractor service providers. *10%; **5%; ***1%.

TABLE 6 Effects of COVID-19-related restrictions on business challenges (MSP)

Variables	Cannot deliver existing orders		Face disruption to logistics	
	TSP	CSP	TSP	CSP
Movement restricted within village tracts	−.002	−.070	−.069	.230*
Movement restricted within state/region	−.011	−.006	.361***	−.064
Equipment market constraints index	.029*	.148***	.027	.057
Financial constraints index	.040***	−.005	−.013	−.038
Rainfall percentile			Included	
Round dummy			Included	
Round dummy × time-invariant variables			Included	
Constant			Included	
Number of observations	904	447	904	447
p-Value (H0: variables jointly insignificant)	.000	.000	.000	.000

Source: Authors.

Note: CSP, combine-harvester service providers; MSP, mechanization service providers; TSP, tractor service providers. *10%; **5%; ***1%.

Higher price or reduced machines availability, attachments, and spare parts

Increased prices and/or reduced availability of machines, attachments, and spare parts, as a result of indirect outcomes of COVID-19 restrictions, had negative effects on many of these outcomes as well. These included a greater likelihood of lower revenue and profit prospects (Table 4), financial challenges like loan repayment and invoice payments (Table 5), and greater business challenges, including the inability to deliver existing orders (Table 6).

Financial constraints due to exogenous factors

The intensity of exogenous or predetermined financial constraints, too, had negative effects on a broader range of outcomes. These included perceptions of revenue and profit losses (Table 4), all types of financial challenges (Table 5), and business challenges like the inability to deliver existing orders (Table 6). The broadly significant effects on financial challenges suggest that the breakdown of financial capacity by agents linked with MSP can easily incapacitate MSP's own financial transactions.

Coping mechanisms

MSPs pursued different types of major coping mechanisms, depending on the type of restrictions (Table 7). MSPs, particularly CSPs facing movement restrictions, generally resorted to seeking loans from the formal sector, including government and commercial banks, or through asset sales. This may be because MSPs expected that governments or the formal sector might offer compensation for movement restrictions that were imposed as COVID-19 mitigation measures. In contrast, MSPs facing reduced availability or higher prices of machines and equipment

TABLE 7 Effects of COVID-19-related restrictions on coping mechanisms (MSP)

Variables	Obtain loans from the government		Obtain loans from commercial banks		Obtain loans from private individuals		Liquidate assets		Use other incomes	
	TSP	CSP	TSP	CSP	TSP	CSP	TSP	CSP	TSP	CSP
Movement restricted within village tracts	.007	.176*	.007	.043*	.092*	−.021	−.040	.198*	−.040	.084
Movement restricted within state/region	.026	.188***	.006	−.072	−.003	−.109	.174*	.181*	.174*	−.077
Equipment market constraints index	−.052**	−.078**	−.049**	−.046*	.086***	.040	.024*	.141***	.024*	.081*
Financial constraints index	−.009	−.053**	−.017*	−.020*	.058***	.038*	.047***	.062**	.047***	.075***
Rainfall percentile					Included					
Round dummy					Included					
Round dummy × time-invariant variables					Included					
Constant					Included					
Number of observations	904	447	904	447	904	447	904	447	904	447
p-Value (H0: variables jointly insignificant)	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000

Source: Authors.

Note: CSP, combine-harvester service providers; MSP, mechanization service providers; TSP, tractor service providers. *10%; **5%; ***1%.

in the market pursued loans from private individuals, possibly because these loans would not require additional compensations (i.e., interest payments). Those facing greater financial constraints were more likely to seek loans from private individuals, asset sales, or diversion of other incomes. Interestingly, those facing financial constraints or unfavorable machine/equipment market conditions were relatively less likely to seek formal sector finance. This is possibly because the formal sector, which assesses borrowers more rigorously, regarded the presence of these constraints by MSPs as a greater risk for loan recovery. Overall, the findings suggest that the combinations of movement restrictions effects on machine markets and other types of financial challenges have led to significant heterogeneity in coping mechanisms pursued by MSPs, although the patterns were generally consistent between TSPs and CSPs.

Policy preferences

MSPs expressed preferences for different policies depending on the types of restrictions and challenges they face (Table 8). MSPs facing greater movement restrictions generally prefer financial-support policies focusing on the reduction of taxes/fees or rent/utilities, which can generally reduce financial burdens or financial support that involves an extension of current loan payment periods or the provision of additional loans. MSPs facing movement restrictions also prefer policies that allow nonfarm use of machines, which may be restricted in particular local communities. These MSPs usually do not prefer policies for keeping machine parts/shops open because these policies are less relevant to addressing the movement restrictions.

MSPs facing higher prices or reduced machines availability and equipment also generally prefer policies for reducing taxes/fees, financing/loan extension/debt relief, or rent/utilities, which may ease financial burdens for machine acquisitions. They also prefer policies that allow greater movement of machines across regions or keep machine shops open. Some of the statistically significant negative preferences may also reflect that respondents wanted relatively less of those policies as they recognize that these policies have opportunity costs or are simply not as preferable as other policies.

Other factors

All of the aforementioned effects hold when controlling for the survey-round dummy, their interactions with time-invariant factors (MSPs' home states/regions, whether operating tractors for service provisions, years of establishment of MSP business), and rainfall relative to the historical norm.

4.1.2 | MER

Movement restrictions

Similar to MSP, restrictions on movement or sales have had negative effects on various outcomes for MER. MERs that were constrained in machines' movement within townships or within states or regions significantly raised the likelihood of reduced revenue and profit prospects (Table 9). Overall, movement restrictions broadly shifted MER's financial prospects downward. These effects on revenues are broad, consisting of reduced sales, particularly on combine harvesters, or the increased likelihood that the sales of at least some equipment handled by MER dropped. The perceived effects could typically be more than a 20% drop in sales. Movement restrictions also negatively affected business activities, including the likelihood of facing general business issues like disruptions in logistics.

TABLE 8 Effects of COVID-19-related restrictions on preferred policies (MSP)

Variables	Reduce taxes/fees		Reduce financing/ extend loans/ debt relief		Allow movement of machines across regions		Keep machine/ parts shops open		Reduce rent/ utilities		Additional loans for small enterprises	
	TSP	CSP	TSP	CSP	TSP	CSP	TSP	CSP	TSP	CSP	TSP	CSP
Movement restricted within village tracts	.102***	.124*	.193***	.323***	.072**	.173*	−.056*	−.136*	−.170	−.433	.263***	.354***
Movement restricted within state/region	.140**	.029	−.005	−.204	.080	−.070	−.106*	−.007	.228**	.326***	−.129	−.134
Equipment market constraints index	.051***	−.043	.083***	.052	−.044**	−.008	.021	−.004	.037*	.099*	.012	.043
Financial constraints index	−.048***	−.074***	.060**	.059*	.051***	.007	.040***	.037*	−.033*	.018	−.026	.020
Rainfall percentile					Included							
Round dummy					Included							
Round dummy × time-invariant variables					Included							
Constant					Included							
Number of observations	904	447	904	447	904	447	904	447	904	447	904	447
p-Value (H0: variables jointly insignificant)	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000

Restrictions in sales in-store, at storefront, or through delivery

The effect of sales bans at various locations, including inside stores, at the storefront, or through deliveries on revenue prospects, conditional on movement restrictions, is somewhat insignificant. This may be because sales of equipment are sometimes made on an individual basis, where buyers make purchasing decisions based on the brand and other specifications rather than if they are sold in the store or at the storefront.

Nonetheless, these restrictions on sales practices still led to more significant challenges. In particular, to a greater extent, sales restrictions led to a substantial reduction in sales (by more than 20% compared to the same period in the previous year) of certain equipment, including combine harvesters, spare parts, or other equipment compared to 4wt. This holds even after controlling for restrictions on geographical boundaries on movement that MERs face, possibly because, even in areas where movements are allowed, any additional disruptions may affect equipment deliveries (Table 10). More intense sales restrictions also led to reduced ability to deliver existing orders, possibly because these might have prevented MERs from physically handing over equipment to buyers (Table 11).

Higher price or reduced availability of equipment, attachments, and spare parts

Compared to the case of MSPs who are mostly buyers of equipment, MERs are both buyers and sellers of equipment. On balance, similar to the case for MSPs, higher prices and/or reduced availability of equipment lowered revenue prospects of MERs (because reduced availability may indicate reduced sales, even when prices per equipment are high) (Table 9). Such revenue prospects seem particularly driven by reduced sales of 4wt (Table 10). Higher prices and/or reduced availability of equipment also led to not only increased business challenges, such as reduced ability to deliver existing orders, but also greater disruption in their logistics (especially dealing with a higher purchase price of equipment) (Table 11).

TABLE 9 Effects of COVID-19-related restrictions on revenue perceptions (MER)

Variables	Holds prospect of lower revenue in 2020 than in 2019	Holds prospect that drops in revenue more than the drop in cost
Movement restricted within township	.132*	.154**
Movement restricted within state/region	.098**	.037
Sales restriction index	.044	.069*
Equipment market constraints index	.152***	.010
Financial constraints index	.074***	.058*
Rainfall percentile	Included	
Round dummy	Included	
Round dummy × time-invariant variables	Included	
Constant	Included	
Number of observations	330	
p-Value (H0: variables jointly insignificant)	.000	.000

Source: Authors.

Note: MER, mechanization equipment retailers. *10%; **5%; ***1%.

TABLE 10 Effects of COVID-19-related restrictions on financial challenges (MER)

Variables	Sales drop by more than 20% (4wt)	Sales drop by more than 20% (combine harvesters)	Sales drop by more than 20% (spare parts)	Sales drop (any equipment handled)	Sales drop by more than 20% (any equipment handled)
Movement restricted within township	−.083	.060	.068	.050	.083
Movement restricted within state/region	.108	.265*	−.096	.126**	.176**
Sales restriction index	.071	.097**	.083*	.023	.069*
Equipment market constraints index	.083*	.038	−.035	.034	.024
Financial constraints index	−.031	.065*	.002	−.019	−.017
Rainfall percentile			Included		
Round dummy			Included		
Round dummy × time-invariant variables			Included		
Constant			Included		
Number of observations	190	105	247	330	330
p-Value (H0: variables jointly insignificant)	.000	.000	.000	.000	.000

TABLE 11 Effects of COVID-19-related restrictions on business challenges (MER)

Variables	Cannot deliver existing orders	Face disruption to logistics
Movement restricted within township	.022	.237***
Movement restricted within state/region	−.038	.118*
Sales restriction index	.125***	.003
Equipment market constraints index	.116***	.082*
Financial constraints index	.080**	−.013
Rainfall percentile		Included
Round dummy		Included
Round dummy × time-invariant variables		Included
Constant		Included
Number of observations	330	
p-Value (H0: variables jointly insignificant)	.000	.000

Source: Authors.

Note: MER, mechanization equipment retailers. *10%; **5%; ***1%.

Financial constraints

Similar to the case for MSPs, financial constraints had negative effects on a broader range of outcomes for MER. Facing broader dimensions of financial constraints led to more pessimistic revenue and profit prospects (Table 9), which may be driven particularly by reduced sales of combine harvesters (Table 10) due particularly to business challenges like the inability to deliver existing orders (Table 11).

Coping mechanisms

Similar to MSPs, major coping mechanisms used by MERs varied somewhat depending on the types of restrictions they faced (Table 12). MERs facing movement restrictions tend to seek more loans from the government, while they are less likely to pursue other coping mechanisms like obtaining loans from private individuals, liquidating assets, or using other incomes. Similar to MSPs, this may be because MERs expect that the governments may offer compensation for movement restrictions that they imposed while thinking these movement restrictions are rather temporary and thus keeping their asset inventory. However, the effects of facing bans in sales mode (bans sales in-store, at storefront, or through deliveries), conditional on these movement restrictions, often had the opposite effects from movement restrictions. This may be because these restrictions directly limit the stock of equipment. Intuitively, when facing higher prices and reduced availability of equipment in the market, MERs resort primarily to selling their inventory. Similar to MSPs, when facing financial constraints, MERs seek more loans from private individuals rather than the government or commercial banks because the formal sector may consider the presence of these financial constraints by MERs as a greater risk for loan recovery.

Preferred policies

Preferred policies expressed by MERs also vary, depending on the types of restrictions and constraints they face (Table 13). Those facing movement restrictions were relatively more likely to

TABLE 12 Effects of COVID-19-related restrictions on coping mechanisms (MER)

Variables	Obtain loans from the government	Obtain loans from commercial banks	Obtain loans from private individuals	Liquidate assets	Use other incomes
Movement restricted within township	.117***	.096*	.081	−.098*	−.053*
Movement restricted state/region	.104***	.107*	−.045*	−.016	.015
Sales restriction index	−.040*	−.036*	−.026	.103*	−.040**
Equipment market constraints index	−.029*	.008	−.042*	.074***	.030*
Financial constraints index	−.063***	−.015	.050*	−.014	.007*
Rainfall percentile			Included		
Round dummy			Included		
Round dummy × time-invariant variables			Included		
Constant			Included		
Number of observations	330				
p-Value (H0: variables jointly insignificant)	.000	.000	.000	.000	.000

Source: Authors.

Note: MER, mechanization equipment retailers. *10%; **5%; ***1%.

prefer policies that allow greater movement of machines across regions or extend the current loan repayment period, while they were relatively less likely to prefer policies to expand the provision of additional loans, which may simply put MERs in greater debt. MERs who are banned from sales in some format are more likely to prefer policies that keep machines/parts shops open and policies that reduce rent/utility for warehouses and shops where they have to keep their stocks longer, while less preferring policies to extend current loan repayment period or to allow greater movement of machines across regions as these policies may be ineffective as long as sales are banned. MERs facing greater financial constraints prefer policies for loan extensions or debt relief, possibly because these MERs consider that these measures can directly help address their financial constraints. In contrast, these MERs prefer less the policies that focus on reducing taxes or fees, rent, or utilities, possibly because of concerns that these policies do not directly or sufficiently mitigate their financial constraints.

Other factors

All of the aforementioned effects hold when controlling for the existing financial challenges faced by MERs, such as the challenges in receiving loan payment deferment, whether customers were asking for more late payments than the previous year, or whether customers currently owe loans from MER. They also hold controlling for the survey-round dummy variables, their interactions with time-invariant factors (whether the MER is based in one of the Ayeyarwady, Yangon, or Bago regions that are characterized more as delta zone, whether selling 4wt, or whether franchise dealers) and rainfall relative to the historical norm.

4.2 | Dynamic effects of pessimistic revenue perspectives among MSP

Table 14 presents the estimated dynamic effects of revenue perspectives on subsequent periods, estimated through dynamic-panel estimation methods (2).[4],[5] Consistent with the hypotheses discussed earlier, we find robust evidence that negative revenue prospects for MSPs result in persistent effects and a vicious cycle of negative revenue in subsequent periods. Specifically, the ranges of estimated coefficients on revenue prospects at $t-1$ suggest that having negative revenue prospects in the previous survey round raises the likelihood of similarly negative revenue prospects in the current survey round by 15%–20% points. This holds even after controlling for the effects of other potentially negative factors at t, such as reduced availability and/or higher price of machines and equipment and the extent of financial constraints. The effects also hold after controlling for rainfall, and the survey-round dummy interacted with time-invariant variables. The estimated effects are robust and hold broadly across different subsamples, including samples from summer 2020 only, samples of TSP only, and different estimation methods (one-step GMM or two-step GMM).

It is important to note that, as we described earlier, the prospects are for the final revenue that would be earned by the end of 2020 compared to the revenue earned in 2019, held at each round of survey in 2020. This point also clarifies the reviewer's second question, as we respond later in this chapter. The "lower prospects" at t conditional on observed variables X_{it} (all the shocks and constraints) are both further affected by respondent-specific factors (c_i in Equation 2), which may include personalities and by idiosyncratic errors (ε_{it} in Equation 2), which further affect the respondent's prospects randomly due to factors that are observable to respondents but not to researchers. Our findings do not simply say that respondents were correct about their revenue prospects in the next round, but, rather, the prospects in a particular round are explicitly affected by the prospects in the previous round, or, in other words, there are dynamic relations in the prospects. If the persistence in negative prospects is simply reflecting that the respondent is "correct" about their prospects, it may be more likely to be captured in variations in c_i in Equation 2, while the prospect in t is not affected by the prospect in $t-1$. This would be contrary to our findings in Table 14.

Table 15 further shows some evidence of the possible causes of the observed persistence of negative revenue prospects by MSP. Again, as is consistent with the hypotheses discussed earlier, having prospects in the previous period that the revenue for the year 2020 would be lower than the revenue earned in 2019 statistically significantly increases the number of "desperate" business practices that may be suboptimal, used by MSPs at the current period with the hope of recovering sunk costs on machines. These effects hold after controlling for other factors, for both all MSPs and TSPs specifically, and across different estimation methods.

Importantly, financing sources for the acquisition of machines can also affect the patterns of these dynamics. For example, if MSPs had purchased the machine outright, they may have a different optimal level of service provision in the short run than MSPs who own machines through a hire purchase agreement with bank finance and may face repossession if they do not meet the loan repayment schedule. It is not possible in this paper to test this directly as we do not have the information on the financing source of machine acquisition. Significantly positive coefficients of the index of the financial constraint in Tables 14 and 15, however, broadly suggest that facing greater indebtedness (e.g., having bought a machine through a hire purchase agreement with bank finance rather than having bought it outright) further aggravates the negative revenue perceptions and makes desperate service provisions more likely.

TABLE 13 Effects of COVID-19-related restrictions on preferred policies (MER)

Variables	Reduce taxes/fees	Reduce financing / extend loans/ debt relief	Allow movement of machines across regions	Keep machine/ parts shops open	Reduce rent/utilities	Additional loans for small enterprises
Movement restricted within township	.055	.126*	.058*	.058	.034	−.229**
Movement restricted within state/region	.031	−.043	.055	.055	.120*	−.165*
Sales restriction index	−.035	−.061*	−.060*	.066**	.088***	−.037
Equipment market constraints index	.054*	.056*	.016	−.060*	.055	−.045
Financial constraints index	−.093**	.072**	.058	.016	−.057*	.021
Rainfall percentile			Included			
Round dummy			Included			
Round dummy × time-invariant variables			Included			
Constant			Included			
Number of observations	330					
p-Value (H0: variables jointly insignificant)	.000	.000	.000	.000	.000	.000

Source: Authors.

Note: MER, mechanization equipment retailers. *10%; **5%; ***1%.

TABLE 14 Dynamics of revenue prospects (MSP)

Variables	All One-step GMM	All Two-step GMM	All (summer) One-step GMM	All (summer) Two-step GMM	TSP One-step GMM	TSP Two-step GMM	TSP (summer) One-step GMM	TSP (summer) Two-step GMM
Lagged value of negative revenue prospect	.148**	.149*	.179**	.179*	.175**	.160**	.178**	.191*
Movement restricted within village tracts	.139***	.140***	.145***	.139***	.132***	.119***	.138***	.130**
Movement restricted within state/region	.025	.022	−.053	−.063	−.051	−.045	−.028	−.039
Equipment market constraints index	.061**	.057*	.062*	.062*	.076**	.076*	.070*	.072*
Financial constraints index	.094***	.109***	.098***	.107***	.103***	.117***	.097***	.105***
Rainfall percentile					Included			
Round dummy					Included			
Round dummy × time-invariant variables					Included			
Constant					Included			
Sample size	835	835	531	531	564	564	484	484
Sample size of the panel	464	464	308	308	288	288	275	275
Number of instruments	52	52	31	31	50	50	30	30
p-Value								
Arellano–Bond test: AR(1)	.692	.761	.680	.757	.831	.718	.700	.865
Arellano–Bond test: AR(2)	.869	.848			.601	.703		
Arellano–Bond test: AR(3)	.997	.998			.876	.922		
Not overidentified (Sargan)	.292		.206		.607		.545	
Not overidentified (Hansen)	.238		.139		.771		.506	
Exogeneity of instrument subsets (Hansen test)	.488		.701		.928		.927	

Source: Authors.

Note: In both Tables 14 and 15, standard errors were adjusted using Windmeijer's (2005) finite-sample correction for the two-step covariance matrix. Excluded instruments include the first differences of dependent variables $\Delta y_{i,t-1} = y_{i,t-1} - y_{i,t-2}$ and $\Delta y_{i,t-2} = y_{i,t-2} - y_{i,t-3}$, which seem to satisfy the validity of instrumental variables based on a range of specification tests shown in the table. GMM, generalized methods of moment; MSP, mechanization service providers. *10%; **5%; ***1%.

TABLE 15 Effects of revenue prospects on the number of seemingly desperate service provisions in the next season (MSP)

Variables	All		All (summer)		TSP		TSP (summer)	
	One-step GMM	Two-step GMM	One-step GMM	Two-step GMM	One-step GMM	Two-step GMM	One-step GMM	Two-step GMM
Lagged value of negative revenue prospect	.234**	.269**	.277**	.262**	.287***	.238**	.311**	.311***
Movement restricted within village tracts	.202***	.193***	.200***	.194**	.219***	.231***	.206***	.207***
Movement restricted within state/region	.100	−.028	−.005	.014	−.028	−.108	−.035	−.008
Equipment market constraints index	.100**	.098**	.149***	.133***	.140***	.103*	.150***	.139***
Financial constraints index	.144***	.144***	.131***	.131***	.122***	.124***	.126***	.122***
Rainfall percentile					Included			
Round dummy					Included			
Round dummy × time-invariant variables					Included			
Constant					Included			
Sample size	835	835	531	531	564	564	484	484
Sample size of the panel	464	464	308	308	288	288	275	275
Number of instruments	52	52	31	31	50	50	30	30
p-Value								
Arellano–Bond test: AR(1)	.685	.556	.337	.322	.311	.236	.305	.308
Arellano–Bond test: AR(2)	.118	.131			.125	.175		
Arellano–Bond test: AR(3)	.777	.735			.418	.441		
Not overidentified (Sargan)	.549		.858		.425		.934	
Not overidentified (Hansen)		.681		.772		.858		.905
Exogeneity of instrument subsets (Hansen test)		.199		.284		.861		.401

Overall, results showcase insights that are somewhat unique to MSPs, who engage in capital-intensive service provisions. For these agents, shocks at the beginning of the business season can have dynamic effects throughout the season, possibly aggravating the overall damages. The results suggest that the timing of effective policy interventions is important. For example, it is important to provide sufficient support to mitigate negative business prospects for the coming season at the beginning of the production season.

5 | CONCLUSIONS

COVID-19, and policy responses against it, have affected economic activities in countries around the world, including the agrifood sector in Myanmar (Boughton et al., 2021). Some aspects of these effects can be particularly severe depending on the type of agrifood sector agents, given their unique characteristics. This paper aims to provide some insights for MSPs and MERs based on multirounds of phone surveys administered in Myanmar between May 2020 and January 2021.

The analyses generally revealed negative but also potentially complex effects on MSPs and MERs of direct restrictions imposed as COVID-19 responses, indirect changes in machine and equipment markets, and financial constraints. Restrictions on movements generally had negative effects on revenue prospects, sales of various types of machines and equipment, and various financial and business challenges. These generally applied to a range of restrictions, whether the movement was restricted to within region/state, township, or village tract. These negative effects were in addition to the damaging effects caused by the indirect outcomes of COVID-19, including higher costs and reduced machine availability, equipment, and repair services in the market, as well as a range of financial challenges already faced by MSPs and MERs.

The results also suggest that the combinations of movement restrictions, effects on equipment market constraints, and other various types of existing financial constraints led to significant heterogeneity in coping mechanisms pursued and supporting policies preferred by MSPs and MERs. These patterns relate to the heterogeneity in the exposure and the effects felt by the movement restrictions imposed under COVID-19. These patterns also appear to be associated with the heterogeneity in exposures to indirect outcomes of COVID-19, including market conditions, and individual-specific preexisting financial constraints, among others.

Lastly, the rare high-frequency, multiround interviews of MSPs originally intended for frequent monitoring during COVID-19 also allowed us to gain important insights into the changes in the dynamics of revenue prospects among MSPs. Importantly, we find that negative revenue prospects in the early part of the season can lead to a vicious cycle of suboptimal, desperate use of machines and further aggravation of revenue prospects in later periods. This is consistent with the hypotheses that may be unique to agents like MSPs, whose short-term decision making can be irrational and affected by the presence of large sunk costs made on machines. Consequently, for agents like MSP in Myanmar, mitigating negative business prospects at the beginning of the production season is particularly important.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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ENDNOTES

[1] We define sales reduction of more than 20% compared to the previous year as "severe," based on the interactions with several mechanization sector stakeholders in Myanmar.

[2] Other equipment handled by MERs included combine harvesters, power tillers, attachments like disc plow/rotary tillers, reapers, threshers, water pumps, and spare parts.

[3] We also estimated separate models accounting for cross-sectional dependence using xtscc command in STATA (Driscoll & Kraay, 1998; Hoechle, 2007). These estimates generally lead to more statistically significant results. Therefore, our main results presented here are more conservative estimates in terms of statistical significance.

[4] We also tested unit root for samples with sufficient length of panels (responding in three rounds or more). We used the Fisher-type panel unit-root test (Choi, 2001), which can be implemented in panel data that both are unbalanced and contain gaps like ours, which can be implemented with the STATA command xtunitroot. Appendix 0: Table A1 shows the results, suggesting that at least one panel is stationary, which ensures that our dynamic-panel analyses are not capturing a spurious relationship between our dependent variable and its lagged value.

[5] As is shown in Tables 14 and 15, all specification tests (*p*-values of various null hypotheses) suggest that estimates are consistent, given the level of autocorrelation, orthogonality of excluded instrumental variables, and orthogonality and exogeneity of appropriately lagged dependent variables that are also used as excluded instrumental variables.

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APPENDIX A: Additional results

TABLE A1 Panel unit-root tests of revenue prospect variable for panels of MSP with three rounds of more periods

Test statistics	Number of lag = 1		Number of lag = 2		Number of lag = 3	
	Statistics	*p*-Value	Statistics	*p*-Value	Statistics	*p*-Value
Inverse χ^2	660.7115	.000	803.1750	.000	922.1867	.000
Inverse normal	−10.3996	.000	−14.9320	.000	−17.6178	.000
Inverse logit t	−20.3288	.000	−27.0248	.000	−35.5315	.000
Modified inverse χ^2	4.5758	.000	9.0191	.000	12.7310	.000
Number of panel respondents	291		291		291	
Average number of periods	3.53		3.53		3.53	

Note: p-Values are based on Philips–Perron tests and correspond to the null hypothesis that all panels contain unit roots. *p*-Values close to 0 suggest the rejection of this hypothesis, which support the alternative hypothesis that at least one panel is stationary. Panel respondents are those with at least three rounds of responses, which is necessary for testing unit root.
Source: Authors.