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Abstract

The COVID-19 outbreak has had severe economic consequences across the globe. The crisis emanating from the pandemic has caused demand and supply side shocks, which are more far reaching than any crisis in living memory. We use a new data set from the 2020/21 Egyptian Industrial Firm Behavior Survey (EIFBS) to examine determinants of firms' resilience during the COVID-19 pandemic. Crisis present the opportunity for what Schumpeter (1934) called creative destruction. Have manufacturing firms been all hit by the crisis equally, or were less efficient firms more likely to exit or downsize their activities thereby 'cleansing' the market? Two sets of factors affect firm dynamics and survival: 1) firms' innate characteristics, such as formality and export status, sector, ownership, age, size and location and; 2) firm behavior which captures the extent to which good managerial practices, innovation, the adoption of advanced technologies and worker training have provided an opportunity for firms to adapt their business models and show greater resilience in coping with the crisis. Our main findings illustrate the vulnerability of private, smaller, informal firms and those that are not located in industrial zones. Also, as expected, pre-COVID behavioural characteristics matter for firm dynamics. The food sector and sectors identified as 'COVID sectors' show more resilience. More nuanced results show that the effect of some behavioral traits vary by sector and are more influential depending on firm size.

Keywords: COVID-19, pandemic, firm survival, firm dynamics, manufacturing sector, Egypt.
JEL Classifications: D22, L10, L25, L29.

ملخص

كان لتفشي كوفيد-19 عواقب اقتصادية وخيمة في جميع أنحاء العالم. وقد تسببت الأزمة الناجمة عن الجائحة في صدمات بجانبي العرض والطلب، وهي أبعد مدى من أي أزمة في الذاكرة الحية. نستخدم مجموعة بيانات جديدة من مسح سلوك الشركات الصناعية المصرية 2020/21 (EIFBS) لدراسة محددات مرونة الشركات خلال جائحة كوفيد-19 تمثل الأزمة الفرصة لما أسماه شومبيتر (1934) "Schumpeter " التدمير الخلاق. هل تضررت جميع شركات التصنيع من الأزمة على قدم المساواة، أم أن الشركات الأقل كفاءة كانت أكثر عرضة للخروج من أنشطتها أو تقليصها وبالتالي "تنظيف" السوق؟ هناك مجموعتان من العوامل تؤثران على ديناميكيات الشركة وبقائها: 1) الخصائص الفطرية للشركات، مثل وضعها الرسمي ووضع التصدير، والقطاع، والملكية، والعمر، والحجم، والموقع؛ و 2) سلوك الشركة الذي يجسد مدى توافر الممارسات الإدارية الجيدة والابتكار وتبنى التكنولوجيات المتقدمة وتدريب العمال فرصة للشركات لتكييف نماذج أعمالها وإظهار مرونة أكبر في التعامل مع الأزمة. توضح النتائج الرئيسية التي توصلنا إليها ضعف الشركات الخاصة والأصغر حجما وغير الرسمية وتلك التي لا تقع في المناطق الصناعية. أيضا، كما هو متوقع، فإن الخصائص السلوكية لما قبل كوفيد-19 مهمة لديناميكيات الشركة. يظهر قطاع الأغذية والقطاعات المحددة باسم "قطاعات الكوفيد" مزيدا من المرونة. تظهر النتائج الأكثر دقة أن تأثير بعض السمات السلوكية يختلف حسب القطاع ويكون أكثر تأثيرا بناءً على حجم الشركة.

1. Introduction

The COVID outbreak has had severe economic consequences across the globe. Most countries have instituted full or partial lock-down measures to save lives during the pandemic. However, protecting human life has an economic cost. The measures have resulted in a global economic crisis, which has been both a demand shock, and a supply side shock. Substantial numbers of businesses have been forced to exit the market or to temporarily close.

Global supply chains have been substantially disrupted resulting in increased supply costs limiting in turn firms' ability to enforce the quality and timeliness of contracts (Demertzis, and Maslloren 2020 and Ayadi et al. 2021). Sharma et al. (2020) use twitter data from NASDAQ to show that US firms are facing grave difficulties in sustaining their supply chains. Consequently, numerous firms have suffered lower productivity, lost previous productivity gains and have seen their sales and profits shrink (Bloom et al. 2021).

Firms have adopted various strategies to cope with the pandemic such as reducing input costs through worker layoffs and salary adjustments, or upgrading their business model through increased remote work and expanding e-commerce platforms. Some firms have also diversified their products. It is thus important to assess the impact of COVID-19 on firm survival and dynamics so as to identify appropriate measures of support during the pandemic to strengthen firm resilience in the face of future shocks.

A central question in this paper is whether firm dynamics have only been affected by demand and supply side conditions, or have they been also mediated by how firms respond to changing market conditions? Crisis presents the opportunity for what Schumpeter (1934) called creative destruction. During economic distress, less efficient firms are more likely to exit or to downsize their activities, thereby 'cleansing' the market. Do the Egyptian data support this hypothesis? Is firm survival positively associated with productivity? Are exporting, innovative, high tech firms and those that undertake good management practices more likely to maintain operations, or even just survive? Will such firms exhibit better dynamics, or has the COVID-19 crisis hit all firms equally hard as argued by Bosio et al. (2020)?

The empirical literature on the impact of COVID-19 on firm dynamics mainly discusses the experience in developed economies. There are some exceptions on Latin America for example (Guerrero-Amezaga et. al 2022). In Japan, Miyakawa et al. (2020) show that pandemic increased firm exit by around 20% compared to the previous year due to firm expectations regarding sales prospects. Bachas (2020) find that, while over half of firms will remain profitable by the end of 2020, the likelihood of exit will double. Using firm-level data for 31 economies, Muzi et al. (2020), find that less productive firms have a higher likelihood of permanently closing during the crisis, though it varies by the extent of innovation and digitalization. However, using administrative

corporate tax records from ten low- and middle-income countries (Sub-Saharan Africa, Eastern Europe and Latin America), firms in poorer countries are shown to be more resilient because these join the informal sector rather than exit altogether (Bachas 2020). For most developing countries the informal sector is a buffer to shocks which acts as a survival sector (El-Haddad and Zaki, forthcoming for the case of Egypt).

Existing literature on firm survival and performance emphasized the significant role that investing in R&D and the adoption of advanced technology play.[4] Firms build resilience by using both innovation and technology which entrepreneurs interact with firm characteristics and strategic behavior to adapt to unfavorable market changes (George and Bock 2011). Hall (1987) argues that R&D activities enhance the firm's stock of knowledge, increasing the firm's market value and so its likelihood of survival. Similarly, investing in innovation increases firm-specific assets and so the competitive position of firms (Esteve-Perez and Manez-Castillejo 2008). Cefis and Marsili (2005) stress the positive impact of innovation on firm survival. Survival probability is 11% higher for innovative firms compared to their non-innovative counterparts. This probability is 25% higher for those innovating in processes rather than production (*ibid.*). Giovannetti et al. (2011) show that being a large firm combined with technology adoption is a sufficient condition for firm survival. Cefis and Marsili (2019) demonstrate that new firms innovating within two years from founding enjoy a long-term adaptive survival premium during and after a crisis. More recently, Cucculelli and Peruzzi (2020) have shown that adaptive business models have influenced post-crisis firm survival by reducing the probability of default.

Grover and Karplus (2021) have shown that good management practices such as target-setting, monitoring, incentives and operational practices are also associated with a higher likelihood of survival for manufacturing firms, though is not the case for firms in services. As Pansiri and Temtime (2008) put it, 'managerial effectiveness could by definition have avoided or at least minimized [problems'] impact on firm survival' (p. 252).

Yet, while the literature is rich for the advanced and emerging economies it is rather scant when it comes to the Middle East and North Africa (MENA) region. This paper helps rectify this gap by presenting data for Egypt. In fact, the case of Egypt is of particular interest for three reasons. First, on a macroeconomic level, Egypt's economy was one of the most resilient across the MENA region. Indeed, Egypt was among the few economies that experienced a positive growth rate in 2019/2020 (Eldeep and Zaki 2021; El-Haddad 2020a). But at the social level the negative consequences of the crisis were more pronounced. Descriptive analysis of the data (El-Haddad and Zaki forthcoming) illustrates the counter cyclicality of the relation between the formal and the

[4] For example, Hall 1987; Esteve-Perez and Manez-Castillejo 2008; Damanpour 1996; Wolfe 1994; Gopalakrishnan and Damanpour 1997; Helmers and Rogers 2010; Bourletidis and Triantafyllopoulos 2014 for SMEs; Giovannetti et al. 2011; Suarez and Ulterback 1995; and more recently Muzi et al. 2020 with evidence from Europe in Wagner 2021.

informal sector as the latter is the only alternative way to earn a living. As a 'survival sector', it has provided 'helping hand employment' in the course of the current pandemic. There are no accurate official figures on the evolution of informality, inequality and poverty in the wake of the pandemic, but they should be expected to have increased with the lay-offs that have taken place. As shown by El-Haddad and Gadallah (2021), private sector informality is the largest contributor to increased inequality in Egypt. Second, despite being one of the most diversified economies in the MENA region, Egypt's manufacturing sector is still suffering from several longstanding bottlenecks which undermine its competitiveness. Foreign direct investment (FDI) is concentrated in the oil and real estate sectors and Egyptian markets exhibit limited competition. In addition, there is very limited contribution of the private sector in the green economy (Zaki 2021) so the manufacturing sector maybe less able to cope with external shocks. Finally, it is important to take a closer look at Egyptian SMEs. SMEs dominate the sector comprising 90% of all firms, but larger firms, both public and private, dominate the market in terms of performance and profitability.

We use unique and recently collected data from the 2020/21 Egyptian Industrial Firm Behavior Survey (EIFBS) of 2,383 Egyptian manufacturing firms.[5] The objective of this paper is to examine determinants of firm resilience and firm dynamics during the COVID-19 crisis. We distinguish between 'status variables' or 'innate characteristics' and those which are shaped by the behavior of the industrial firm such as managerial practices, investment in innovation or worker training and the adoption of advanced technology. In contrast, 'innate characteristics' such as being informal, solely catering to the domestic market or being in the private sector are less endogenous. We also introduce a shock variable and address the problem of endogeneity in our data using an instrumental variable approach.

Our main findings highlight the vulnerability of private, smaller, informal firms and those that are not located in industrial zones. Moreover, consistent with the literature, pre-COVID behavioral characteristics matter for firm dynamics. In terms of sector, the food sector and sectors identified as COVID sectors show more resilience. More nuanced results show that some behavioral traits matter more depending on sector and are more influential depending on size. Overall, our findings support Schumpeter's (1934) creative destruction theory.

The remainder of the paper is organized as follows. The next section describes sample and survey design and presents some stylized facts in the data. Section 3 is dedicated to the methodology and econometric specification. Section 4 analyses our empirical findings and section 5 concludes.

[5] Data will be placed in the public domain during the course of the coming year.

2. Sampling and Survey Design Data and Stylized Facts

We use a recently collected dataset of 2,383 manufacturing firms, namely the 2020/21 Egyptian Industrial Firm Behavior Survey (EIFBS). The data were collected at the beginning of the second wave of COVID-19 extending to the height of it.[6] EIFBS firms comprise a multistage stratified sample drawn from the 2017 economic census sample of 33,331 establishments, which is itself drawn from a sample of 117,149 establishments, the latter covering three other censuses, namely the population, housing and establishments' census.

The EIFBS sample design is based on three parameters to ensure that the sample produces representative and precise estimates at the national level. These parameters are number of employees, region (urban governorates, lower and upper Egypt) and economic activity level (2 digits). The sample frame, however, excludes firms with less than 5 employees and thus is only representative of small, medium and large enterprises (SMEs). This also implies that informal firms – albeit present – are underrepresented in our sample.

We oversampled by selecting a sample of 3,149 establishments in order to be sure to obtain the target number of 2,200. First, the sample was allocated proportionally among the three regions (urban governorates, lower Egypt, and upper Egypt), which cover 99.2% of industrial establishments in Egypt. A systematic random sample was drawn to select three governorates from each region using Probability Proportional to Size (PPS). The industrial establishments in each region were allocated among governorates proportional to their size (measured by employment). Next, a systematic random sample was used to select the establishments in each governorate after sorting the establishments according to the number of employees and economic activity at the 4 digits level. Two questionnaires were administered, one for firms that are still in operation, and another, very similar one[7], for firms that have exited the market or have temporarily shut down operations. The response rate is 75%, meaning that we successfully interviewed 2,383 establishments of which 2338 are in operation and 45 firms that either have exited the market or are temporarily closed. Of the 766 firms we could not interview, an unknown number, and presumably a much higher proportion, have also exited the market. The questionnaire has 14 modules: basic firm identification data, firm size, firm expectations on recovery and potential exit, changes in firm performance, pandemic transmission channels, ownership and management characteristics, innovation, management practices and use of IT, production costs, obstacles to operation, exports and global value chains, obstacles to exports, worker training and government support.

[6] Precisely between November 19th 2020 and the 5th of February 2021.

[7] Only four modules are slightly different. The main difference is that for temporarily closed or closed firms there are no values for current variables such as production, exports, employment or revenues.

A note on Egyptian bakeries is warranted. Bakeries are to be found on nearly every street in residential areas in Egypt, representing about 30% of all industrial firms. Unlike other micro and small enterprises, bakeries in Egypt have an incentive to formalize in order to be able to collect the bread subsidy from the government. Given protection afforded by the subsidy and the nature of their product which is an inferior good (i.e. demand goes up as income falls), bakeries likely exhibit different behavior to their non-bakery food sector counterparts, as well as other micro and small enterprises and formal counterparts. Their inclusion in the sample therefore strongly affects firm dynamics in the manufacturing sector as captured by a number of behavioral and performance variables. We report below if they are included in the analysis or not.

To measure firms' dynamics, we focus on two main variables. The first measures the operational status of firms, precisely is the firm partially or fully functioning in the wake of the COVID-19 crisis. The second variable documents firm closure based on the following question "Has the establishment been temporarily closed for any period since the beginning of the COVID crisis?". We distinguish between two possible determinants of firm dynamics: 1) innate firm characteristics such as formality and export status, sector, ownership, age, size and location; and 2) firm behavior, such as good managerial practices, innovation (R&D), the adoption of advanced technologies and investing in worker training. Table 1 summarizes the main descriptive statistics of the used variables.

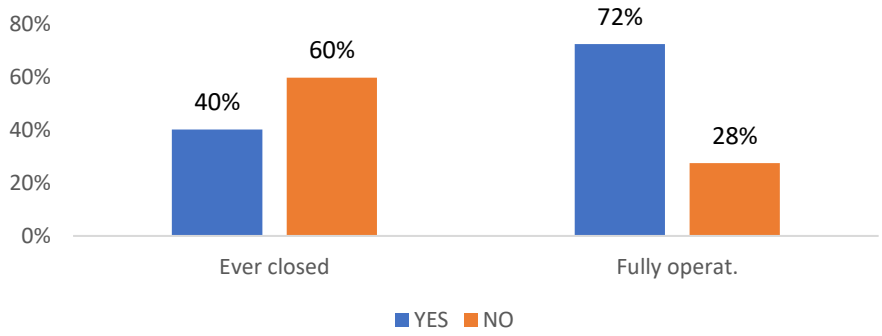
Table 1: Descriptive statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
Fully functioning	2190	0.77	0.42	0	1
Ever closed	2198	0.35	0.48	0	1
Formal	2196	0.98	0.14	0	1
Export Status Before COVID	2190	0.29	0.45	0	1
Private	2198	0.93	0.26	0	1
Ln(Emp. BC)	2193	4.43	1.53	0	9.6
Ln(Age)	2189	2.96	0.78	0	5.3
Industrial Zones	2197	0.53	0.50	0	1
Technology	2195	0.50	0.50	0	1
R and D	2196	0.30	0.46	0	1
Good Managerial Practices	2196	0.65	0.48	0	1
Training	2194	0.77	0.42	0	1

Source: Authors' elaboration using EIFBS.

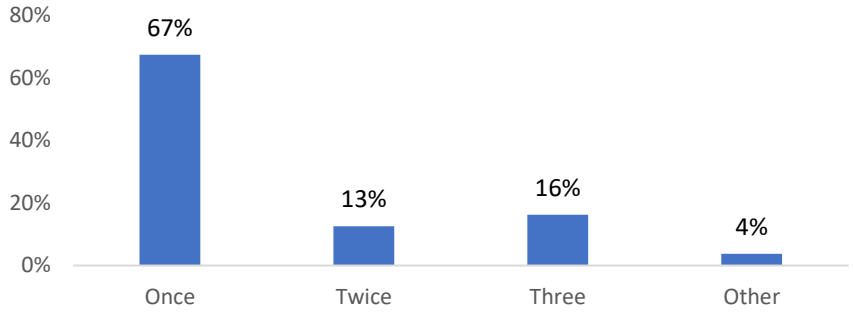
Just under a third of all Egyptian manufacturing firms were fully functioning at the time of interview (Figure 1). Moreover, 60% of firms have never closed. Indeed, since the start of the pandemic around 40% of all firms have at least once been temporarily closed – of those 67% once, 13% twice and 16% three times, Figure 2).

Figure 1: Firm dynamics



Source: Authors' own elaboration using EIFBS.

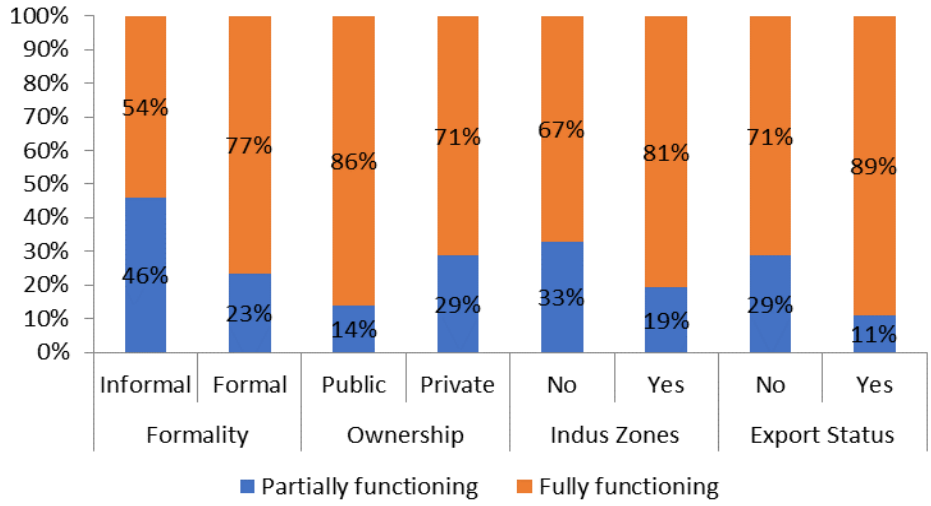
Figure 2: Number of closures since start of the COVID-19 crisis



Source: Authors' own elaboration using EIFBS.

The sample covers 82% of SMEs, 3.4% public firms, 7.2% informal firms and 2.7% exporting firms. Firms are more likely to be fully functioning if they are formal, public, located in an industrial zone or had been exporting prior to the COVID-19 crisis (Figure 3). While the share of formal firms that are fully functioning is 77% that share declines to 54% for their informal counterparts. Similarly, the share of firms in the public sector (86%), in industrial zones (81%) and exporters (89%) that are fully functioning are higher than their private (71%), non-zone (67%) and non-exporting (71%) counterparts.

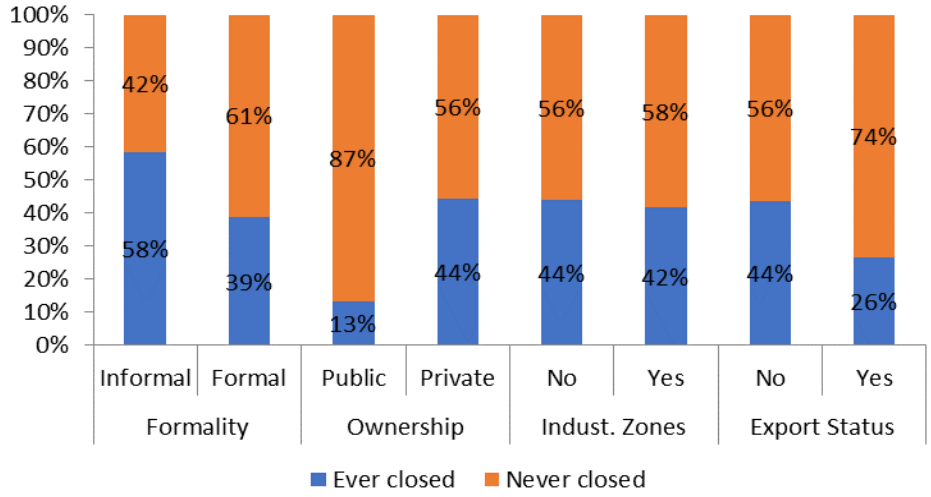
Figure 3: Operational status by firms' characteristics



Source: Authors' own elaboration using EIFBS.

Similar patterns are observed for firm closure. Formal, exporting, public firms and those located in an industrial zone are less likely to witness closures since the start of the COVID-19 crisis (Figure 4).

Figure 4: Closure by firms' characteristics

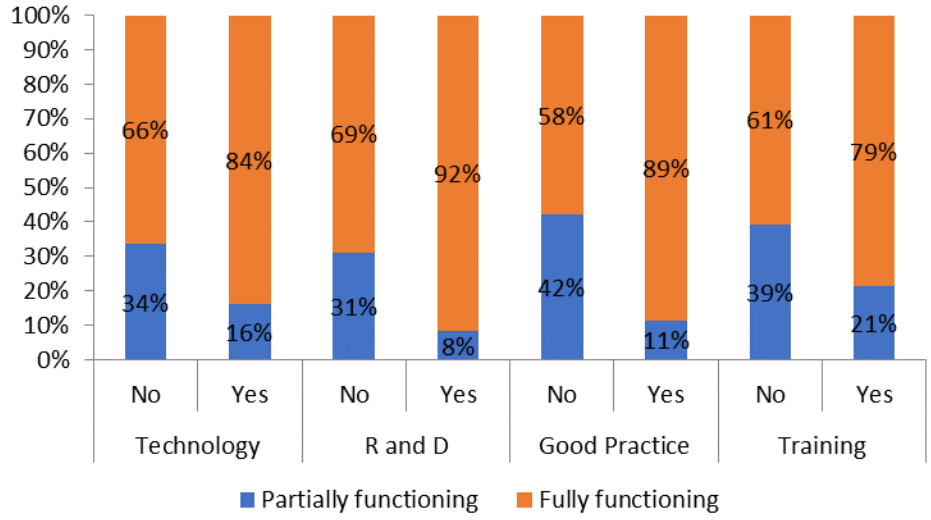


Source: Authors' own elaboration using EIFBS.

In terms of firm behavior: firms whose managers have adopted advanced technologies prior to the COVID-19 crisis (84% of those firms), innovated (92%), embraced good managerial practices such as monitoring performance indicators or setting production targets (89%) and those who have provided worker training (79%) are more likely to be fully functioning compared to their counterparts (Figure 5). They are also less likely to have ever been closed since the start of the

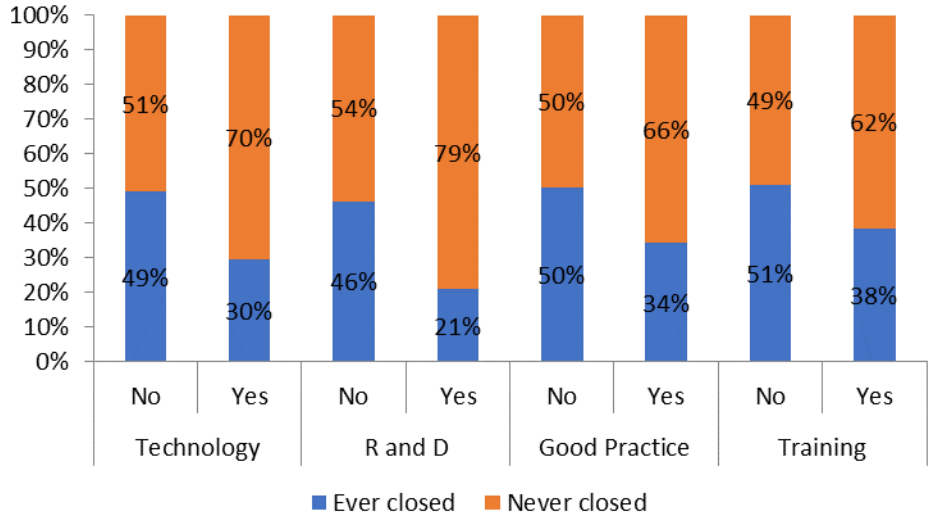
COVID-19 crisis (30%, 21%, 34% and 38% respectively) compared to their counterparts (49%, 46%, 50% and 51% respectively; Figure 6).

Figure 5: Operational status by firm behavior



Source: Authors' own elaboration using EIFBS.

Figure 6: Closure by firms' behavior



Source: Authors' own elaboration using EIFBS.

3. Methodology

We run the following econometric specification to examine the effect of the COVID19 crisis on firms' dynamics.

$$Y_{ikg} = \alpha_0 + \alpha_1 X_{ikg} + \alpha_2 Z_{ikg} + \mu k + \delta g + \eta_{ikg} \qquad (1)$$

where Y is the dependent variable of firm i in sector k and governorate g with separate equations estimated for (i) the operational status of the firm, which takes the value of one if the firm is fully functioning and zero otherwise; and (ii) the ever closed status, which takes the value of one if the firm has been temporarily closed for any period since the start of the COVID-19 crisis, and 0 otherwise. δg and μk are governorate and sector dummies respectively to control for governorate and sector unobversables, and η_{ikg} is the error term. The sectors are classified according to the ISIC Rev. 4 at the 2-digit level.

Two vectors of explanatory variables are included. The first measures firm innate characteristics including:

- *Ln(age$_{ikg}$)* is the age of firm i operating in sector k and governorate g. While older firms might be more resilient given their experience and financial health, younger firms might be more innovative.
- *Private* is a dummy variable that takes the value of 1 if the firm is privately owned and zero if it is publicly owned. Egypt preserves many features of its earlier state-led development model, including that public firms operate under a 'soft budget constraint'. The state provides cheap credit and bails out public companies in crisis (El-Haddad 2015). Hence publicly owned companies may appear more robust with better dynamics.
- *Ln(Emp BC)* gives firm size, measured by the number of employees before COVID. Given their resilience, larger firms are more likely to be fully operational. On the other hand, large firms are mostly also formal and so more likely to have had to fully observe lock-down measures
- *Formal* is a dummy variable that takes the value of one if the firm is formal. We employ a strict definition of formality. A firm is formal if it has a commercial registry, an operating license and a tax record. Firms are more likely to be fully functioning and less likely to have ever closed if they are formal.
- *Exp Status BC* is a dummy variable that takes the value of 1 if the firm was exporting before COVID.
- *Industrial Zone* is a dummy variable that takes the value of 1 if the firm is located in any industrial zone. This variable shows to what extent agglomeration economies might help firms sustain their activities. The zones may mitigate the negative effects of the shock. However, firms in the zones can also be the most hit on account of the disruptions to their value chains of which they are a part.

In terms of firm behavior, we control for four main dimensions:

- *Training* is a dummy variable taking the value of 1 if the firm provides training for its workers.
- *Technology* is a dummy variable that takes the value of 1 if the firm's manager utilizes technology such as computers, the internet, internal information link networks, distributed machine control systems, and quality control systems. Technology measures the ability of the firm to adapt to unfavorable market changes and to cope with the new normal by adapting their business models.

- *R and D* is a dummy variable that takes the value of 1 if the firm had spent on R&D other than market research surveys prior to COVID. Both, whether undertaken by the firm directly or by companies it contracted with. Both innovation and technology show how entrepreneurs interact firm characteristics and strategic behavior to adapt to unfavorable market changes, thus building greater resilience over time.
- *Good Practice* is a dummy variable that takes the value of 1 if the firm's manager has either specified any performance indicators or production targets; or has monitored these performance indicators.

This baseline regression is extended in three ways. First, we examine the extent to which firm size matters when interacted with the firm's behavioral variables. In other words, we examine whether large firms are more likely to make use of good management practices, innovation or technology, affecting in turn the probability of the operational status favorably. Second, we further analyze research and development (R&D), technology and good management practices to identify which dimension within each of these categories matters the most. Research and development, which is proxy for innovation, is broken down into devoting financial resources to improving products, machines, design, marketing and production processes. Moreover, while technology covers computers, internet, internal information link networks, distributed machine control systems, and quality control systems, good managerial practices cover setting performance indicators or production targets and monitoring them.

Third, the nature of the shock –- especially its demand side has led in particular to an increase in the demand on computers, pharmaceuticals and food products. Given the nature of the shock, firms operating in these sectors might be more resilient to the crisis. Accordingly, we distinguish between four sectors: traditional sectors (including textiles, garments, leather…etc.), COVID sectors, which cover computers; chemicals; and pharmaceuticals; food; and non-traditional sectors (machinery, electronics, and electrical equipment). We had also experimented some more by interacting innate characteristics with firm behavior. Finally, some of our firm characteristics and behavioral variables are potentially endogenous with respect to the firm's operational status (ever closed or fully functioning). We proceed with an instrumental variables approach to address the problem of endogeneity.

4. Empirical Results

4.1. Baseline Regressions

Table 2 presents results of the baseline regression. First, in terms of the firms' innate characteristics, firms are more likely to be fully functioning if they are public, large or located in an industrial zone. Second, formality matters for the ever being closed probability but not for the operational status. This is probably because, like informal firms, formal firms have significantly reduced their capacity utilization. However, they have reduced working hours significantly more

compared to their informal counterparts.[8] This implies that formal firms are less likely to close but that similar to their existing informal counterparts they are equally functional. Indeed, being formal helps firms access post-COVID-19 government designed support programs such as tax deferrals, loans postponements, COVID financial support…etc. Such support is likely to prevent firms from closing during times of crisis.

The results also show that private firms suffer an increased likelihood of closing and a reduced probability of being fully functioning. Public firms have for years enjoyed greater protection compared to their private sector counterparts through the provision of cheap state credit and a soft budget constraint resulting in the bailing out of public companies in crisis. Public firms are also relatively more concentrated in the more resilient sector, food: 40% of all public firms are in the food sector (excluding bakeries) but only 19% of private firms. The findings here echo the fact that the private sector in Egypt continues to face a number of institutional and competition-related barriers that hinder its expansion (World Bank, 2020). Plenty of the nascent literature suggests that politically connected firms in Egypt are mostly large in size, and that State-owned enterprises are more likely to enter the exports market than private sector firms, due to privileged connections and superior access to information (cf. Eibl and Malik 2016; Aboushady and Zaki 2019; El-Haddad 2020b).

Exporting is not statistically significant neither for the operational status variable nor for the ever being closed variable. The positive effects of exporting are likely diluted by the presence of the sectoral/economic activity dummies. In fact, both exporting (61% of all exporting firms) and non-exporting firms (56%) have reported similar reductions in demand in the wake of the COVID-19 shock.

There is broad agreement in the trade literature that exporting firms have higher productivity than non-exporting ones (Melitz 2003; Fernandes and Isgut 2005, Greenaway and Kneller 2008; Feng et al. 2016). This fact is chiefly attributed to a self-selection process: firms taking up exporting are already the most productive ones and are able to afford the high fixed-costs of entering foreign markets. An alternative explanation is the learning-by-exporting theory, where firms become more productive through exporting. The literature is not conclusive on the expected effects of the pandemic on exporters. A first strand argues that the international exposure of exporting firms increases their vulnerability and makes them more likely to be affected by external shocks. A second strand shows that they are less affected as they are, on average, more productive and more able to sustain their activities in times of crisis. Our results support the first view, that other things being equal, the demand shock hit firms serving the domestic market and those serving the export market equally hard, especially after controlling for economic activity.

[8] Results available from the authors upon request.

The effect of age is not conclusive in the literature (Rossi 2016). While older firms can be more resilient due to their experience and financial stability, younger ones are more innovative and thus can also be as resilient (Krammer 2021).

While age reduces a firm's likelihood of being fully functioning (columns 1-3), it significantly reduces its probability of closing (columns 4-6). This result is due to the fact that older firms might have more experience, larger stocks, and more resources in order to sustain their activities despite the decrease in sales or exports. The effect of being located in an industrial zone differs also across the two independent variables. While it increases the probability of being fully operational, it does not affect the probability of closure. This can be due to the fact that industrial zones, with their incentives and preferential treatment, can help firms benefit from existing externalities and thus sustain their operation.

Second, in terms of firm behavior, results in Table 2 (columns 3 and 6) show that, worker training, innovation through investing in R&D and implementing good managerial practices increase the probability of being fully operational, whereas the same is not true for technology. Note that we use the combined technology variable and it is likely that certain aspects of technology adoption are more influential than others.

The result on innovation is consistent with a large body of literature (cf. Hall 1987; Esteve-Perez and Manez-Castillejo 2008; Damanpour 1996; Wolfe 1994; Gopalakrishnan and Damanpour 1997; Helmers and Rogers 2010; Garg et al. 2003). Similarly, it is standard in the literature that good managerial practices are essential in boosting firm survival and performance (cf. Delaney and Huselid 1996; Verbeeten 2008; Lakhal et al. 2006). Krammer (2021) shows that, for more than 11,000 firms from 28 countries both before and after COVID-19, firms with better management practices exhibit greater ability to adapt to the crisis. Additionally, the literature has long confirmed the crucial role of technology in firm survival (cf. Suarez and Ulterback 1995, and more recent evidence from Europe in Wagner 2021). We are yet to observe the results when we disentangle the combined technology variable and add other variations on technology.

Table 2: Baseline Regression

	Fully functional			Ever closed		
	(1)	(2)	(3)	(4)	(5)	(6)
Formal	0.0313	0.0229	-0.0310	-0.214***	-0.216***	-0.216***
	(0.0358)	(0.0359)	(0.0347)	(0.0411)	(0.0413)	(0.0416)
Export Status BC	0.0800	0.0732	0.0315	-0.0639	-0.0648	-0.0392
	(0.0546)	(0.0546)	(0.0526)	(0.0626)	(0.0627)	(0.0630)
Private	-0.0771*	-0.0869*	-0.106**	0.150***	0.149***	0.159***
	(0.0453)	(0.0454)	(0.0435)	(0.0520)	(0.0522)	(0.0522)
Ln(Emp BC)	0.0211***	0.0165**	-0.0232***	-0.0221**	-0.0227**	-0.00945
	(0.00761)	(0.00781)	(0.00846)	(0.00872)	(0.00896)	(0.0101)
Ln(Age)	-0.0313***	-0.0311***	-0.0335***	-0.0258**	-0.0258**	-0.0230*
	(0.0108)	(0.0108)	(0.0104)	(0.0124)	(0.0124)	(0.0124)
Indus. Zone		0.0544**	0.0497**		0.00730	0.0121
		(0.0219)	(0.0212)		(0.0251)	(0.0253)
Technology			0.00435			0.0149
			(0.0237)			(0.0284)
R and D			0.0518*			-0.121***
			(0.0299)			(0.0357)
Good Practice			0.180***			-0.0264
			(0.0204)			(0.0244)
Training			0.131***			-0.00936
			(0.0193)			(0.0231)
Constant	1.112***	1.140***	1.118***	0.344***	0.348***	0.334***
	(0.0680)	(0.0689)	(0.0665)	(0.0780)	(0.0791)	(0.0796)
Gov. dum.	YES	YES	YES	YES	YES	YES
Eco. act. dum.	YES	YES	YES	YES	YES	YES
Observations	2,172	2,172	2,172	2,179	2,179	2,178
R-squared	0.302	0.306	0.337	0.215	0.215	0.220

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1.

4.2. Extensions

We extend the previous analysis in three ways. First, we examine how behavioral effects on firm dynamics vary by firm size. Second, we analyze the different aspects of technology and good management practices to identify which of these aspects matter the most for firm resilience. Third, different sectors have been hit to varying degrees by both demand and supply side shocks. We therefore examine the different extent to which shocks have been transmitted by sector.

Table 3 interacts our behavioral variables of interest with pre-COVID firm size to investigate to what extent their effect varies by firm size. R&D and technology exert a larger positive effect on the likelihood of being fully operational the larger the firm size. On the other hand, while training and good managerial practices exercise a positive impact on the probability of being fully operational, their effect is independent of firm size. This result is plausible since larger firms are more likely to be able to incur the high fixed cost associated with investing in R&D and

technology[9], but there are not such comparable high costs for management practices. In this variation, formality significantly reduces the likelihood of ever closing.

A closer look at management practices shows that setting performance indicators or production targets increases the probability of being fully operational, but it does not affect that of closure. However, monitoring these indicators significantly increases the likelihood of being fully functional *and* reduces that of ever being closed, thus setting targets and indicators per se is not as effective as taking the further step of ensuring those indicators are actually being met (Table 4). Monitoring implies assessing risks and factors that affect outcomes the most resulting in updated objectives and production targets, allowing adjustments in product scope to build resilience.

Regressions (1-8) in Tables 5 and 6 present the details of the combined technology variable (e.g. use of computers, the internet, internal information link networks…etc.). While some variables are insignificant and others are counter-intuitive, quality control in Egyptian manufacturing is the most important determinant. Quality control ensures streamlining production and guarantees that final products meet market requirements.

The effect of different components of R&D are shown in Tables 7 and 8. These components can be divided into two groups (Aboushady and Zaki, 2021). The first group relates directly to production innovation, which includes firm expenditure on R&D related to machines, products, and production processes. The second group pertains to auxiliary services related to the production process such as design and marketing. While R&D related to production is more important than auxiliary services, it requires more time and involves a much higher fixed cost to be effective. The majority of Egyptian firms in manufacturing cannot afford such high costs, and those who can have no incentive to make such investments, especially as they import the majority of their capital goods.

Our results show that all R&D components increase the likelihood of being fully functional (Table 7). However, in contrast to some existing studies (e.g. Cefis and Marsili, 2005), investing in auxiliary services is more effective in times of pandemic than R&D spending on products, processes and machines. That is, firms' past adoption of new designs and innovative marketing strategies has potentially assisted them to better reach their consumer base and perhaps even engage with new potential consumers during crises (cf. Rangarajan et al., 2021). R&D in auxiliary services is, however, not significant for the probability of closure (Table 8).

Regressions (1-6) of Tables 9 and 10 address our third extension of results. Here, we place food in a separate category on account of being the most resilient sector by far as shown in the data. We categorize the manufacture of pharmaceuticals, chemicals and computers as COVID-19 sectors. We believe that demand on these sectors has been favorable or has at worst remained stable since

[9] Such as long-term expenditure on hardware depreciation, new equipment, new software…etc.

the start of the pandemic. We classify the manufacture of electrical equipment, machinery and equipment, motor vehicles and other manufacturing as non-traditional sectors. The remaining sectors are the traditional ones (e.g. textiles and clothing, leather…etc.).

The results show that the food and COVID sectors are more likely to be fully functioning post-COVID-19 compared to the reference category of traditional sectors[10]; the latter is largely hit by both the demand and the supply shock. The same result is less conclusive for non-traditional sectors, which contain a mix of sectors that differ in shock exposure. The second main finding is that some behavioral variables matter for some sectors more than others do. For the non-traditional sectors, investing in innovation and adopting technology makes a significant contribution to firm dynamics. Non-traditional sectors with enhanced adoption of technology and investments in R&D are more likely to be fully functioning and less likely to have ever closed compared to traditional sectors, which rely relatively less on technology compared to their non-traditional counterparts. The effect of innovation and technology adoption in the food sector is counterintuitive (column 3 in tables 7 and 8), possibly reflecting the non-technology intensive nature of that sector in Egypt.

As an exercise, we have also extended the analysis to interact the innate characteristics of the firm with its behavioral ones. An interesting result indicated that private firms that invest in innovation are more likely to be fully functional and less likely to have ever closed, and those that have provided worker training are also less likely to have ever closed (Table A1 and A2 in Appendix 1). Additionally, private firms are less likely to have ever closed when we use the aspect of setting performance indicators and production targets rather than the combined good management practice variable (Table A3 in Appendix 1).

[10] Traditional sectors are the reference category.

Table 3: Firms' size and Resilience

	Fully functional				Ever closed			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Formal	-0.0232	-0.0151	-0.0231	-0.0346	-0.213***	-0.218***	-0.207***	-0.184***
	(0.0348)	(0.0349)	(0.0354)	(0.0356)	(0.0418)	(0.0419)	(0.0423)	(0.0425)
Exp. Status. BC	0.0144	0.0150	0.0257	0.0335	-0.0454	-0.0370	-0.0461	-0.0563
	(0.0530)	(0.0527)	(0.0528)	(0.0528)	(0.0635)	(0.0632)	(0.0633)	(0.0630)
Private	-0.105**	-0.0979**	-0.103**	-0.106**	0.160***	0.158***	0.164***	0.160***
	(0.0435)	(0.0435)	(0.0436)	(0.0435)	(0.0522)	(0.0522)	(0.0523)	(0.0520)
Training	0.133***	0.137***	0.132***	0.152***	-0.00895	-0.0101	-0.00873	-0.188***
	(0.0193)	(0.0193)	(0.0193)	(0.0472)	(0.0231)	(0.0232)	(0.0231)	(0.0562)
Ln(Emp BC)	-0.0319***	-0.0439***	-0.0337***	-0.0181	-0.0126	-0.00672	-0.0218	-0.0545***
	(0.00914)	(0.0102)	(0.0123)	(0.0138)	(0.0109)	(0.0122)	(0.0147)	(0.0164)
R and D	-0.150*	0.0313	0.0463	0.0532*	-0.194*	-0.118***	-0.127***	-0.133***
	(0.0864)	(0.0303)	(0.0302)	(0.0300)	(0.104)	(0.0364)	(0.0362)	(0.0358)
Technology	0.00577	-0.187***	0.00315	0.00403	0.0154	0.0403	0.0135	0.0176
	(0.0237)	(0.0577)	(0.0237)	(0.0237)	(0.0284)	(0.0693)	(0.0284)	(0.0283)
Good Prac.	0.184***	0.180***	0.128***	0.181***	-0.0249	-0.0264	-0.0882	-0.0322
	(0.0204)	(0.0203)	(0.0494)	(0.0204)	(0.0245)	(0.0244)	(0.0590)	(0.0244)
Ln(Age)	-0.0332***	-0.0328***	-0.0329***	-0.0334***	-0.0229*	-0.0231*	-0.0223*	-0.0235*
	(0.0104)	(0.0104)	(0.0104)	(0.0104)	(0.0124)	(0.0124)	(0.0124)	(0.0124)
Indus. Zone	0.0520**	0.0512**	0.0500**	0.0505**	0.0129	0.0119	0.0122	0.00478
	(0.0212)	(0.0212)	(0.0212)	(0.0213)	(0.0254)	(0.0253)	(0.0253)	(0.0253)
R and D*Ln(Emp BC)	0.0452**				0.0165			
	(0.0181)				(0.0217)			
Technology*Ln(Emp BC)		0.0531***				-0.00703		
		(0.0146)				(0.0175)		
Good Prac.*Ln(Emp BC)			0.0169				0.0199	
			(0.0145)				(0.0173)	
Training*Ln(Emp BC)				-0.00694				0.0614***
				(0.0148)				(0.0176)
Constant	1.132***	1.147***	1.134***	1.107***	0.339***	0.330***	0.352***	0.430***
	(0.0667)	(0.0668)	(0.0679)	(0.0705)	(0.0799)	(0.0802)	(0.0812)	(0.0840)
Observations	2,172	2,172	2,172	2,172	2,178	2,178	2,178	2,178
R-squared	0.339	0.342	0.338	0.338	0.220	0.220	0.220	0.224

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Governorate and economic activities dummies are included.

Table 4: Management Practices and Firms' Resilience

	Fully functioning	Ever closed	Fully functioning	Ever closed	Fully functioning	Ever closed
	(1)	(2)	(3)	(4)	(5)	(6)
Formal	-0.0310	-0.216***	-0.0256	-0.219***	-0.0333	-0.214***
	(0.0347)	(0.0416)	(0.0348)	(0.0416)	(0.0346)	(0.0416)
Exp. Status. BC	0.0315	-0.0392	0.0302	-0.0406	0.0245	-0.0367
	(0.0526)	(0.0630)	(0.0527)	(0.0630)	(0.0525)	(0.0630)
Private	-0.106**	0.159***	-0.104**	0.159***	-0.107**	0.160***
	(0.0435)	(0.0522)	(0.0436)	(0.0522)	(0.0434)	(0.0521)
Training	0.131***	-0.00936	0.138***	-0.0168	0.132***	-0.00539
	(0.0193)	(0.0231)	(0.0192)	(0.0230)	(0.0191)	(0.0230)
Ln(Emp BC)	-0.0232***	-0.00945	-0.0226***	-0.0104	-0.0244***	-0.00864
	(0.00846)	(0.0101)	(0.00848)	(0.0101)	(0.00844)	(0.0101)
Ln(Age)	-0.0335***	-0.0230*	-0.0341***	-0.0237*	-0.0349***	-0.0223*
	(0.0104)	(0.0124)	(0.0104)	(0.0124)	(0.0104)	(0.0124)
Indus. Zone	0.0497**	0.0121	0.0514**	0.0106	0.0555***	0.0116
	(0.0212)	(0.0253)	(0.0213)	(0.0253)	(0.0211)	(0.0253)
Technology	0.00435	0.0149	0.00877	0.00363	0.00209	0.0214
	(0.0237)	(0.0284)	(0.0238)	(0.0284)	(0.0236)	(0.0283)
R and D	0.0518*	-0.121***	0.0534*	-0.130***	0.0433	-0.114***
	(0.0299)	(0.0357)	(0.0300)	(0.0358)	(0.0299)	(0.0358)
Good Practice	0.180***	-0.0264				
	(0.0204)	(0.0244)				
Perf. Indic.			0.166***	0.00877		
			(0.0202)	(0.0241)		
Monit. Indic.					0.198***	-0.0493**
					(0.0207)	(0.0248)
Constant	1.118***	0.334***	1.115***	0.336***	1.126***	0.330***
	(0.0665)	(0.0796)	(0.0667)	(0.0796)	(0.0664)	(0.0795)
Gov. dum.	YES	YES	YES	YES	YES	YES
Eco. act. dum.	YES	YES	YES	YES	YES	YES
Observations	2,172	2,178	2,172	2,178	2,172	2,178
R-squared	0.337	0.220	0.334	0.220	0.341	0.221

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1.

Table 5: Technology and Firms' Resilience I

	Fully functioning					
	(1)	(2)	(3)	(4)	(5)	(6)
Formal	-0.0310	-0.0237	-0.0275	-0.0248	-0.0268	-0.0433
	(0.0347)	(0.0346)	(0.0348)	(0.0346)	(0.0347)	(0.0348)
Exp. Status. BC	0.0315	0.0266	0.0312	0.0337	0.0329	0.0302
	(0.0526)	(0.0524)	(0.0526)	(0.0524)	(0.0525)	(0.0524)
Private	-0.106**	-0.101**	-0.106**	-0.109**	-0.104**	-0.101**
	(0.0435)	(0.0434)	(0.0435)	(0.0434)	(0.0434)	(0.0433)
Training	0.131***	0.138***	0.134***	0.139***	0.134***	0.131***
	(0.0193)	(0.0192)	(0.0194)	(0.0193)	(0.0193)	(0.0192)
Ln(Emp BC)	-0.0232***	-0.0115	-0.0200**	-0.0154*	-0.0191**	-0.0299***
	(0.00846)	(0.00859)	(0.00854)	(0.00845)	(0.00846)	(0.00841)
Ln(Age)	-0.0335***	-0.0316***	-0.0339***	-0.0330***	-0.0336***	-0.0303***
	(0.0104)	(0.0103)	(0.0104)	(0.0103)	(0.0104)	(0.0104)
Indus. Zone	0.0497**	0.0608***	0.0545**	0.0540**	0.0515**	0.0453**
	(0.0212)	(0.0212)	(0.0215)	(0.0212)	(0.0212)	(0.0211)
R and D	0.0518*	0.0560*	0.0534*	0.0613**	0.0561*	0.0508*
	(0.0299)	(0.0295)	(0.0296)	(0.0296)	(0.0297)	(0.0295)
Good Prac.	0.180***	0.197***	0.188***	0.201***	0.188***	0.158***
	(0.0204)	(0.0199)	(0.0203)	(0.0205)	(0.0201)	(0.0205)
Technology	0.00435					
	(0.0237)					
Computer		-0.0899***				
		(0.0211)				
Internet			-0.0248			
			(0.0209)			
Internal Net.				-0.0767***		
				(0.0226)		
Machine Cont.					-0.0377*	
					(0.0223)	
Qual. Cont.						0.0742***
						(0.0206)
Constant	1.118***	1.109***	1.115***	1.105***	1.118***	1.088***
	(0.0665)	(0.0662)	(0.0665)	(0.0663)	(0.0664)	(0.0666)
Gov. dum.	YES	YES	YES	YES	YES	YES
Eco. act. dum.	YES	YES	YES	YES	YES	YES
Observations	2,172	2,172	2,172	2,170	2,170	2,170
R-squared	0.337	0.343	0.338	0.342	0.339	0.342

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1.

Table 6: Technology and Firms' Resilience II

	Ever closed					
	(1)	(2)	(3)	(4)	(5)	(6)
Formal	-0.216***	-0.215***	-0.215***	-0.216***	-0.218***	-0.228***
	(0.0416)	(0.0416)	(0.0417)	(0.0416)	(0.0416)	(0.0417)
Exp. Status. BC	-0.0392	-0.0393	-0.0389	-0.0385	-0.0396	-0.0397
	(0.0630)	(0.0630)	(0.0630)	(0.0630)	(0.0630)	(0.0629)
Private	0.159***	0.159***	0.159***	0.158***	0.157***	0.161***
	(0.0522)	(0.0522)	(0.0521)	(0.0522)	(0.0521)	(0.0521)
Training	-0.00936	-0.00798	-0.00834	-0.00854	-0.0101	-0.00999
	(0.0231)	(0.0231)	(0.0232)	(0.0232)	(0.0231)	(0.0230)
Ln(Emp BC)	-0.00945	-0.00698	-0.00787	-0.00801	-0.0107	-0.0148
	(0.0101)	(0.0103)	(0.0102)	(0.0101)	(0.0101)	(0.0101)
Ln(Age)	-0.0230*	-0.0228*	-0.0231*	-0.0232*	-0.0230*	-0.0205*
	(0.0124)	(0.0124)	(0.0124)	(0.0124)	(0.0124)	(0.0124)
Indus. Zone	0.0121	0.0142	0.0136	0.0145	0.0121	0.0118
	(0.0253)	(0.0254)	(0.0256)	(0.0254)	(0.0254)	(0.0252)
R and D	-0.121***	-0.118***	-0.118***	-0.118***	-0.121***	-0.120***
	(0.0357)	(0.0355)	(0.0355)	(0.0356)	(0.0356)	(0.0354)
Good Prac.	-0.0264	-0.0212	-0.0222	-0.0213	-0.0273	-0.0425*
	(0.0244)	(0.0239)	(0.0243)	(0.0246)	(0.0241)	(0.0246)
Technology	0.0149					
	(0.0284)					
Computer		-0.00925				
		(0.0254)				
Internet			-0.00248			
			(0.0251)			
Internal Net.				-0.00313		
				(0.0272)		
Machine Cont.					0.0258	
					(0.0268)	
Qual. Cont.						0.0665***
						(0.0247)
Constant	0.334***	0.331***	0.332***	0.334***	0.332***	0.310***
	(0.0796)	(0.0795)	(0.0795)	(0.0796)	(0.0795)	(0.0799)
Gov. dum.	YES	YES	YES	YES	YES	YES
Eco. act. dum.	YES	YES	YES	YES	YES	YES
Observations	2,178	2,178	2,178	2,175	2,175	2,175
R-squared	0.220	0.220	0.220	0.220	0.220	0.223

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1.

Table 7: R&D and Firms' Resilience II

	Fully functioning				
	(1)	(2)	(3)	(4)	(5)
Formal	-0.0331	-0.0340	-0.0321	-0.0331	-0.0343
	(0.0346)	(0.0347)	(0.0346)	(0.0346)	(0.0347)
Exp. Status. BC	0.0292	0.0308	0.0259	0.0290	0.0284
	(0.0525)	(0.0525)	(0.0525)	(0.0525)	(0.0527)
Private	-0.102**	-0.102**	-0.101**	-0.102**	-0.100**
	(0.0435)	(0.0435)	(0.0434)	(0.0434)	(0.0435)
Training	0.130***	0.130***	0.130***	0.130***	0.131***
	(0.0193)	(0.0193)	(0.0193)	(0.0193)	(0.0193)
Ln(Emp BC)	-0.0227***	-0.0224***	-0.0235***	-0.0229***	-0.0217***
	(0.00832)	(0.00832)	(0.00831)	(0.00831)	(0.00828)
Ln(Age)	-0.0344***	-0.0343***	-0.0353***	-0.0347***	-0.0338***
	(0.0104)	(0.0104)	(0.0104)	(0.0104)	(0.0104)
Indus. Zone	0.0489**	0.0493**	0.0505**	0.0492**	0.0497**
	(0.0212)	(0.0212)	(0.0212)	(0.0212)	(0.0212)
Technology	0.00633	0.00785	0.00611	0.00613	0.00487
	(0.0236)	(0.0236)	(0.0235)	(0.0236)	(0.0236)
Good Prac.	0.181***	0.181***	0.180***	0.181***	0.183***
	(0.0202)	(0.0202)	(0.0201)	(0.0202)	(0.0201)
Products	0.0915**				
	(0.0382)				
Machines		0.0809**			
		(0.0380)			
Design			0.124***		
			(0.0406)		
Marketing				0.109***	
				(0.0417)	
Processes					0.0932**
					(0.0443)
Constant	1.124***	1.124***	1.128***	1.126***	1.120***
	(0.0666)	(0.0667)	(0.0666)	(0.0666)	(0.0665)
Gov. dum.	YES	YES	YES	YES	YES
Eco. act. dum.	YES	YES	YES	YES	YES
Observations	2,172	2,172	2,172	2,172	2,172
R-squared	0.338	0.338	0.339	0.339	0.338

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1.

Table 8: R&D and Firms' Resilience II

	Ever closed				
	(1)	(2)	(3)	(4)	(5)
Formal	-0.208***	-0.207***	-0.207***	-0.208***	-0.208***
	(0.0416)	(0.0416)	(0.0416)	(0.0416)	(0.0416)
Exp. Status. BC	-0.0564	-0.0611	-0.0593	-0.0545	-0.0503
	(0.0631)	(0.0631)	(0.0631)	(0.0631)	(0.0632)
Private	0.151***	0.152***	0.151***	0.151***	0.149***
	(0.0522)	(0.0522)	(0.0522)	(0.0522)	(0.0522)
Training	-0.00876	-0.00945	-0.00918	-0.00869	-0.00862
	(0.0232)	(0.0232)	(0.0231)	(0.0231)	(0.0231)
Ln(Emp BC)	-0.0164	-0.0175*	-0.0171*	-0.0158	-0.0158
	(0.00998)	(0.00998)	(0.00998)	(0.00997)	(0.00993)
Ln(Age)	-0.0246**	-0.0254**	-0.0251**	-0.0242*	-0.0241*
	(0.0124)	(0.0125)	(0.0125)	(0.0124)	(0.0124)
Indus. Zone	0.00947	0.00854	0.00886	0.00973	0.00995
	(0.0254)	(0.0254)	(0.0254)	(0.0254)	(0.0254)
Technology	0.00361	0.00242	0.00274	0.00418	0.00630
	(0.0283)	(0.0282)	(0.0283)	(0.0283)	(0.0283)
Good Prac.	-0.0400*	-0.0425*	-0.0415*	-0.0389	-0.0386
	(0.0242)	(0.0242)	(0.0242)	(0.0242)	(0.0241)
Products	-0.0256				
	(0.0459)				
Machines		0.0139			
		(0.0457)			
Design			-0.00111		
			(0.0488)		
Marketing				-0.0478	
				(0.0501)	
Processes					-0.0722
					(0.0532)
Constant	0.345***	0.350***	0.348***	0.342***	0.342***
	(0.0799)	(0.0800)	(0.0799)	(0.0799)	(0.0798)
Gov. dum.	YES	YES	YES	YES	YES
Eco. act. dum.	YES	YES	YES	YES	YES
Observations	2,178	2,178	2,178	2,178	2,178
R-squared	0.216	0.216	0.216	0.216	0.216

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1.

Table 9: Sectoral Characteristics and Behavior I

	Fully functioning					
	(1)	(2)	(3)	(4)	(5)	(6)
Formal	0.0108	0.0121	0.00954	0.0153	0.00916	0.0106
	(0.0339)	(0.0339)	(0.0338)	(0.0339)	(0.0338)	(0.0339)
Exp. Status. BC	0.0281	0.0230	0.0316	0.0298	0.0332	0.0290
	(0.0534)	(0.0534)	(0.0532)	(0.0533)	(0.0534)	(0.0533)
Private	-0.114**	-0.118***	-0.117***	-0.110**	-0.116***	-0.118***
	(0.0441)	(0.0444)	(0.0440)	(0.0441)	(0.0441)	(0.0441)
Training	0.137***	0.137***	0.141***	0.138***	0.139***	0.180***
	(0.0195)	(0.0195)	(0.0195)	(0.0195)	(0.0195)	(0.0231)
Ln(Emp BC)	-0.0382***	-0.0369***	-0.0351***	-0.0372***	-0.0364***	-0.0390***
	(0.00802)	(0.00914)	(0.00805)	(0.00801)	(0.00804)	(0.00802)
Ln(Age)	-0.0269**	-0.0274***	-0.0276***	-0.0279***	-0.0281***	-0.0251**
	(0.0104)	(0.0105)	(0.0104)	(0.0104)	(0.0104)	(0.0104)
Indus. Zone	0.0603***	0.0646***	0.0656***	0.0524**	0.0623***	0.0586***
	(0.0207)	(0.0208)	(0.0207)	(0.0208)	(0.0207)	(0.0207)
Technology	-0.00195	-0.00214	0.0179	-0.00227	-0.00424	-0.00293
	(0.0232)	(0.0232)	(0.0258)	(0.0232)	(0.0232)	(0.0232)
R and D	0.0805***	0.0767**	0.0727**	0.0825***	0.0840**	0.0820***
	(0.0298)	(0.0299)	(0.0299)	(0.0299)	(0.0358)	(0.0298)
Good prac.	0.185***	0.184***	0.179***	0.225***	0.184***	0.186***
	(0.0203)	(0.0203)	(0.0203)	(0.0239)	(0.0203)	(0.0202)
Food	0.214***	0.260***	0.245***	0.257***	0.224***	0.286***
	(0.0197)	(0.0458)	(0.0219)	(0.0256)	(0.0206)	(0.0291)
Corona sectors	0.119***	-0.0515	0.0987	0.180***	0.116**	0.226***
	(0.0430)	(0.122)	(0.0655)	(0.0680)	(0.0526)	(0.0781)
Non-Trad.	0.0833**	-0.00211	0.00834	0.192***	0.0259	0.112
	(0.0397)	(0.115)	(0.0549)	(0.0645)	(0.0489)	(0.0899)
Food*Ln(Emp BC)		-0.0163				
		(0.0142)				
Corona sec.*Ln(Emp BC)		0.0411				
		(0.0282)				
Non-Trad.*Ln(Emp BC)		0.0209				
		(0.0271)				
Food*Tech			-0.163***			
			(0.0484)			
Corona sec*Tech			0.0209			
			(0.0862)			
Non-Trad.*Tech			0.137*			
			(0.0788)			
Food*Good prac.				-0.104***		
				(0.0386)		
Corona sec*Good prac.				-0.109		
				(0.0869)		
Non-Trad.*Good prac.				-0.183**		
				(0.0815)		
Food*RD					-0.133*	
					(0.0703)	
Corona sec.*RD					0.00306	

	Fully functioning					
	(1)	(2)	(3)	(4)	(5)	(6)
					(0.0907)	
Non-Trad.*RD					0.148*	
					(0.0847)	
Food*Training						-0.129***
						(0.0382)
Corona sec.*Training						-0.155*
						(0.0927)
Non-Trad.*Training						-0.0468
						(0.0999)
Constant	0.882***	0.883***	0.868***	0.850***	0.885***	0.848***
	(0.0662)	(0.0670)	(0.0663)	(0.0669)	(0.0664)	(0.0667)
Gov. dum.	YES	YES	YES	YES	YES	YES
Eco. act. dum.	YES	YES	YES	YES	YES	YES
Observations	2,172	2,172	2,172	2,172	2,172	2,172
R-squared	0.307	0.309	0.313	0.311	0.310	0.312

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1.

Table 10: Sectoral Characteristics and Behavior II

	Ever closed					
	(1)	(2)	(3)	(4)	(5)	(6)
Formal	-0.224***	-0.225***	-0.222***	-0.223***	-0.238***	-0.223***
	(0.0413)	(0.0410)	(0.0410)	(0.0412)	(0.0410)	(0.0414)
Exp. Status. BC	-0.0189	-0.00921	-0.0193	-0.0271	-0.0179	-0.0190
	(0.0650)	(0.0647)	(0.0645)	(0.0649)	(0.0645)	(0.0651)
Private	0.144***	0.171***	0.155***	0.146***	0.133**	0.144***
	(0.0538)	(0.0538)	(0.0534)	(0.0537)	(0.0534)	(0.0539)
Training	-0.0113	-0.0115	-0.0136	-0.0109	-0.0160	-0.00610
	(0.0237)	(0.0236)	(0.0236)	(0.0237)	(0.0236)	(0.0282)
Ln(Emp BC)	0.000325	-0.0177	-0.00537	-0.00274	-0.000745	0.000139
	(0.00977)	(0.0111)	(0.00975)	(0.00979)	(0.00970)	(0.00979)
Ln(Age)	-0.0257**	-0.0240*	-0.0253**	-0.0236*	-0.0223*	-0.0246*
	(0.0127)	(0.0126)	(0.0126)	(0.0127)	(0.0126)	(0.0127)
Indus. Zone	0.0187	0.00764	0.00694	0.0154	0.0288	0.0184
	(0.0252)	(0.0251)	(0.0250)	(0.0251)	(0.0251)	(0.0252)
Technology	-0.0567**	-0.0616**	-0.120***	-0.0567**	-0.0470*	-0.0564**
	(0.0283)	(0.0281)	(0.0312)	(0.0282)	(0.0281)	(0.0283)
R and D	-0.132***	-0.127***	-0.131***	-0.191***	-0.118***	-0.130***
	(0.0363)	(0.0362)	(0.0363)	(0.0436)	(0.0362)	(0.0364)
Good prac.	0.00927	0.0144	0.0191	0.0137	-0.0641**	0.0104
	(0.0247)	(0.0245)	(0.0245)	(0.0247)	(0.0289)	(0.0247)
Food	-0.293***	-0.540***	-0.362***	-0.319***	-0.408***	-0.283***
	(0.0239)	(0.0554)	(0.0265)	(0.0249)	(0.0309)	(0.0354)
Corona sectors	-0.0665	0.164	0.0211	-0.0580	0.0268	0.0124
	(0.0524)	(0.148)	(0.0795)	(0.0641)	(0.0824)	(0.0955)
Non-Trad.	-0.139***	-0.0112	-0.181***	-0.142**	-0.107	-0.213*
	(0.0480)	(0.139)	(0.0656)	(0.0588)	(0.0782)	(0.110)
Food*Ln(Emp BC)		0.0852***				
		(0.0172)				
Corona sec.*Ln(Emp BC)		-0.0512				
		(0.0342)				
Non-Trad.*Ln(Emp BC)		-0.0276				
		(0.0329)				
Food*Tech			0.352***			
			(0.0586)			
Corona sec*Tech			-0.103			
			(0.105)			
Non-Trad.*Tech			0.120			
			(0.0948)			
Food*Good prac.					0.271***	
					(0.0467)	
Corona sec*Good prac.					-0.142	
					(0.105)	
Non-Trad.*Good prac.					-0.0323	
					(0.0982)	
Food*RD				0.313***		
				(0.0856)		
Corona sec.*RD				0.0259		

	Ever closed					
	(1)	(2)	(3)	(4)	(5)	(6)
				(0.110)		
Non-Trad.*RD				0.0535		
				(0.103)		
Food*Training						-0.0169
						(0.0465)
Corona sec.*Training						-0.113
						(0.113)
Non-Trad.*Training						0.0873
						(0.122)
Constant	0.607***	0.639***	0.644***	0.617***	0.665***	0.598***
	(0.0807)	(0.0811)	(0.0804)	(0.0808)	(0.0810)	(0.0815)
Gov. dum.	YES	YES	YES	YES	YES	YES
Eco. act. dum.	YES	YES	YES	YES	YES	YES
Observations	2,178	2,178	2,178	2,178	2,178	2,178
R-squared	0.155	0.168	0.171	0.161	0.171	0.156

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1.

4.3. Robustness Checks

We test the robustness of our results in two ways: 1) by introducing a shock variable to our regressors and; 2) by addressing potential endogeneity of the behavioral variables. Although all behavioral variables are pre-COVID variables and thus already partially deal with endogeneity.

First, in order to test the robustness of our results, we observe whether the results of our individual and behavioral characteristics hold even after we introduce a sector shock. Since the COVID-19 crisis has induced demand and supply side shocks that have transmitted differently depending on sector, it is important to learn whether the effect of the shock overshadows the effect of our behavioral variables on firm dynamics. Or instead, whether those variables remain significant thus pointing to the importance of adopting these practices in order to curb the negative effect induced by the COVID-19 pandemic.

To analyze the effect of the shock on our results, we construct a dummy variable that takes the value of one if the firm is in a sector, which has witnessed a negative production shock due to the COVID-19 crisis. For this, we use responses from the question: “By how much has your production changed on average compared to the last completed financial year prior to the pandemic”. The results show that the *shock* variable is significant with the effect in the expected direction. The bigger the shock the less likely is the firm to be fully functioning and the more likely it is to have closed at some earlier point (Table 11). Investing in R&D, adopting good managerial practices, and providing worker training continue to be more or less effective. R&D spending still has a negative and significant effect on the probability of closure, and both good management practices and providing worker training remain positive and significant for the probability of being fully functioning.

Second, to control for endogeneity of the behavioral variables (technology, R&D, training, and good management practices), we instrument these variables by the share of the firms in the same industry and the same governorate (less the firm in question) which adopt that behavior. So in total there are four instruments, one for each of these four endogenous variables. In addition to that, we use a fifth instrument: the share of firms that are fully functioning (or, in the second model, that of those that have ever closed) in the same industry and the same governorate. The rationale behind these instruments is that in the same agglomeration (measured by the industry in a specific region), each firm has an incentive to adopt similar technologies and strategies because of fiercer competition from surrounding firms. A competitor's action or status creates an externality (cf. Romer 1986) inducing similar behavior by the other firms. For instance, if all neighboring firms adopt a new technology or type of innovation, the firm in question follows them in response to the pressure, in turn affecting its current and future operational status and survival. These instruments follow the principle that a valid instrument induces changes in the explanatory variables but has no 'independent' effect on the dependent variable. Its effect may be entirely through the other regressors.

While the results for investing in R&D and adopting good managerial practices continue to hold, those for the use of technology and worker training are counter-intuitive (Table 12). Yet, both Sargan and Basmann tests show that the null hypothesis that all overidentifying restrictions are jointly valid, cannot be rejected, since the p-value is greater than the significance levels (e.g. 0.1 or 0.05) for the likelihood of fully functioning, but to a lesser extent than for the likelihood of ever having closed.

Table 11: Demand Shock and Firm Dynamics

	Fully functioning	Ever closed
Formal	-0.0498	-0.190***
	(0.0339)	(0.0404)
Exp. Status. BC	0.0561	-0.0727
	(0.0514)	(0.0611)
Private	-0.0630	0.101**
	(0.0427)	(0.0508)
Ln(Emp BC)	-0.0247***	-0.00743
	(0.00826)	(0.00980)
Ln(Age)	-0.0344***	-0.0223*
	(0.0101)	(0.0120)
Indus. Zone	0.0544***	0.00597
	(0.0207)	(0.0245)
Technology	-0.00678	0.0303
	(0.0232)	(0.0275)
R and D	0.00911	-0.0624*
	(0.0294)	(0.0350)
Good practices	0.185***	-0.0329
	(0.0199)	(0.0236)
Training	0.116***	0.0109
	(0.0189)	(0.0224)
Shock	-0.186***	0.252***
	(0.0179)	(0.0213)
Constant	1.205***	0.218***
	(0.0655)	(0.0777)
Gov. dum.	YES	YES
Eco. act. dum.	YES	YES
Observations	2,172	2,178
R-squared	0.369	0.268

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1.

Table 12: Controlling for the Endogeneity of Behavioral Variables

	Fully func.	Ever closed
Formal	0.131	-0.134
	(0.232)	(0.206)
Exp. Status. BC	-0.388**	0.423**
	(0.191)	(0.167)
Private	-0.256*	0.362***
	(0.133)	(0.121)
Ln(Emp BC)	-0.123	0.166*
	(0.0984)	(0.0917)
Ln(Age)	-0.106***	0.0611**
	(0.0342)	(0.0302)
Indus. Zone	-0.119	0.146**
	(0.0803)	(0.0708)
Technology	-1.214**	0.873**
	(0.497)	(0.411)
R and D	1.756**	-2.063***
	(0.770)	(0.617)
Good prac.	1.969***	-1.443***
	(0.491)	(0.454)
Training	-0.866**	0.502
	(0.427)	(0.367)
Constant	1.532***	-0.237
	(0.236)	(0.206)
Gov. dum.	YES	YES
Eco. act. dum.	YES	YES
Sargan Test P value	0.3952	0.0435
Basmann P value	0.3995	0.0453
Observations	2,140	2,146

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1.

5. Conclusion

We use data from the 2020/21 Egyptian Industrial Firm Behavior Survey (EIFBS) to examine determinants of firm resilience during the COVID-19 crisis. The COVID-19 crisis induced both demand and supply side shocks which are more far reaching than any crisis in living memory.

In this analysis, we distinguish between ‘status variables’ or ‘innate characteristics’ and those which are shaped by the behavior of the industrial firm such as managerial practices, investment in innovation or worker training and the adoption of technology. In contrast, ‘innate characteristics’ such as being informal, solely catering to the domestic market or being in the private sector are less endogenous.

Overall, our results are in line with Schumpeter’s (1934) creative destructive theory in contrast to post-pandemic results from Bosio et al. (2020). The market shows signs of ‘self-cleansing’,

whereby the less efficient are more likely to close or downsize their activities in response to the crisis. The details are as follows:

In terms of innate characteristics, private sector firms are at a clear and consistently disadvantaged position in terms of firm dynamics. They are less likely to be fully functional and more likely to have ever closed since the start of the COVID-19 crisis. Equally, but less consistently, larger, formal and firms in industrial zones exhibit greater resilience to the shock compared to their counterparts. For larger firms this is true until we control for the behavioral factors that larger firms are more likely to adopt, which we find are driving the results we observe for size. These findings support the argument that public firms face a soft budget constraint, and that formal and larger firms are able to sustain their activities in times of crisis on account of their demonstrated resilience.

The existing literature suggests that the ability to adapt to market conditions is a crucial determinant of firm survival. Consistent with this literature, our results confirm that pre-COVID behavioral characteristics matter for firm dynamics. The adoption of good managerial practices, investment in innovation and in worker training lead to greater resilience and firm ability to adapt more effectively and thus better cope with the shock.

In terms of sectors, the manufacture of food and the 'COVID sectors' – pharmaceuticals, chemicals and the manufacture of computers and electronics - show much more resilience compared to the traditional sectors (e.g. textiles and clothing). The latter have been strongly hit by the crisis; in contrast, 'COVID sectors' experienced increased demand on their products, manifesting itself in a positive shock. Food is the most resilient sector of all.

There are some nuances pertaining to firm size and sector. The first is that the larger the firm size the larger the positive effect of R&D and technology. In contrast, while worker training and good managerial practices exercise a positive impact on firm dynamics their effect is independent of firm size which. This is plausible as larger firms are more likely to incur the high fixed cost associated with investing in R&D and technology whilst there aren't such comparable high costs for management practices. The second is that some behavioral variables matter for some sectors more than others. For the non-traditional sectors, investing in innovation and adopting advanced technology makes a significant contribution to firm dynamics compared to traditional sectors, which rely relatively less on technology.

Finally, controlling for the shock and addressing the potential endogeneity of the behavioral variables' only slightly mute the main findings. That is, behavioral characteristics exert a significant positive effect on firms' ability to adapt to changing market conditions and thus cope with the crisis.

From a policy perspective, the results presented in this paper illustrate the fact that the private sector in Egypt continues to face a number of institutional and competition-related barriers that hinder its expansion (World Bank, 2020). More generally, the results demonstrate the pre-existing fragilities of the private, smaller, informal and, more generally of the lower productivity firms of the manufacturing sector. There is a dire need for reforms across the Egyptian manufacturing sector to address the underlying structural constraints that limit firms' productivity. Such reforms include an effective competition policy, eliminating the 'soft budget constraint' as well as proper investment in education and in health and effectively addressing taxation and the business environment.

This paper also points to clear conclusions as to buffers of firm survival in the presence of shocks. Improving the digital infrastructure—including coverage and outreach – will improve resilience and ability to withstand shocks. Moreover, it is important to increase R&D spending at both the national level and at the level of the firm. Bianchini et al. (2019) show that public support for R&D can help private sector firms, especially when they are constrained by lower quality institutions. Such support lowers the uncertainty firms face, thus encouraging them to invest more in innovation, worker training and in technology. It is also important for government to support the private sector through reskilling programs that promote the complementarity between labor skills and technologies (Ndung'u and Signé 2020; Ramzy and Zaki 2021).

Finally, firms in industrial zones have done better. The Egyptian government aims to attract foreign investment in and develop industries on a "Cluster Based Policy". These clusters may indeed enable industries to achieve higher productivity by establishing R&D centers and the creating of efficient sectoral clusters. The latter will generate externalities and increase firms' resilience for future shocks.

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Appendix

Table A1: Innate characteristics with behavioral traits I

	Fully functional			
	reg (1)	reg (2)	reg (3)	reg (4)
Formal	-0.0409	-0.0332	-0.0267	-0.0521
	(0.0348)	(0.0348)	(0.0365)	(0.0394)
Export Status BC	0.0487	0.0609	0.116	0.131
	(0.0986)	(0.0751)	(0.140)	(0.162)
Private	-0.100*	-0.143***	-0.184***	-0.262***
	(0.0601)	(0.0484)	(0.0681)	(0.0834)
Ln(Emp BC)	-0.0246***	-0.0231***	-0.0236***	-0.0207**
	(0.00845)	(0.00848)	(0.00849)	(0.00849)
Ln(Age)	-0.0349***	-0.0340***	-0.0322***	-0.0336***
	(0.0104)	(0.0104)	(0.0104)	(0.0104)
Indus. Zone	0.104***	0.0555**	0.0842***	0.113***
	(0.0257)	(0.0228)	(0.0291)	(0.0316)
Technology	0.0641	0.00208	0.00803	-0.00119
	(0.0848)	(0.0238)	(0.0238)	(0.0238)
R and D	0.0618**	-0.0927	0.0594**	0.0594**
	(0.0299)	(0.106)	(0.0300)	(0.0299)
Good practices	0.177***	0.179***	0.208	0.181***
	(0.0204)	(0.0204)	(0.137)	(0.0204)
Training	0.131***	0.133***	0.134***	-0.0398
	(0.0192)	(0.0193)	(0.0193)	(0.125)
Formal*Technology	-			
	-			
Export Status BC *Technology	-0.0129			
	(0.114)			
Private*Technology	0.00629			
	(0.0851)			
Indus. Zone*Technology	-0.147***			
	(0.0393)			
Formal*R and D		-		
		-		
Export Status BC *R and D		-0.0490		
		(0.103)		
Private*R and D		0.182*		
		(0.105)		
Indus. Zone*R and D		-0.0409		
		(0.0521)		
Formal* Good Practice			-0.134	

	Fully functional			
	reg (1)	reg (2)	reg (3)	reg (4)
			(0.108)	
Export Status BC*Good Practice			-0.0930	
			(0.150)	
Private*Good Practice			0.128	
			(0.0872)	
Indus. Zone*Good Practice			-0.0679*	
			(0.0376)	
Formal*Training				0.00142
				(0.0814)
Export Status BC *Training				-0.101
				(0.170)
Private*Training				0.210**
				(0.0961)
Indus. Zone*Training				-0.100***
				(0.0377)
Constant	1.113***	1.153***	1.169***	1.260***
	(0.0766)	(0.0697)	(0.0824)	(0.0974)
Gov. dum.	YES	YES	YES	YES
Eco. act. dum.	YES	YES	YES	YES
Observations	2,172	2,172	2,172	2,172
R-squared	0.342	0.339	0.340	0.341

Robust standaR and D errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A2: innate characteristics with behavioral traits II

	Ever closed			
	reg (1)	reg (2)	reg (3)	reg (4)
Formal	-0.221***	-0.214***	-0.225***	-0.280***
	(0.0417)	(0.0416)	(0.0437)	(0.0472)
Export Status BC	-0.0382	-0.0933	-0.0760	-0.0743
	(0.118)	(0.0897)	(0.168)	(0.193)
Private	0.187***	0.214***	0.254***	0.158
	(0.0722)	(0.0580)	(0.0817)	(0.0999)
Ln(Emp BC)	-0.0103	-0.00997	-0.00979	-0.00657
	(0.0101)	(0.0101)	(0.0102)	(0.0102)
Ln(Age)	-0.0237*	-0.0222*	-0.0238*	-0.0237*
	(0.0124)	(0.0124)	(0.0124)	(0.0124)
Indus. Zone	0.0402	0.0101	-0.00415	0.0879**
	(0.0307)	(0.0272)	(0.0347)	(0.0377)
Technology	0.0921	0.0187	0.0113	0.0104
	(0.102)	(0.0284)	(0.0285)	(0.0284)
R and D	-0.115***	0.112	-0.126***	-0.118***
	(0.0359)	(0.126)	(0.0359)	(0.0358)
Good practices	-0.0283	-0.0249	-0.0366	-0.0294
	(0.0244)	(0.0244)	(0.164)	(0.0245)
Training	-0.00895	-0.0105	-0.0116	-0.170
	(0.0231)	(0.0231)	(0.0232)	(0.149)
Formal*Technology				
Export Status BC*Technology	0.00470			
	(0.137)			
Private*Technology	-0.0471			
	(0.102)			
Indus. Zone*Technology	-0.0735			
	(0.0471)			
Formal*R and D				
Export Status BC*R and D		0.0968		
		(0.123)		
Private*R and D		-0.269**		
		(0.126)		
Indus. Zone*R and D		0.0203		
		(0.0624)		
Formal* Good Practice			0.155	
			(0.129)	
Export Status BC*Good Practice			0.0405	
			(0.180)	

	Ever closed			
	reg (1)	reg (2)	reg (3)	reg (4)
Private*Good Practice			-0.156	
			(0.105)	
Indus. Zone*Good Practice			0.0345	
			(0.0450)	
Formal*Training				0.210**
				(0.0975)
Export Status BC *Training				0.0494
				(0.203)
Private*Training				0.00179
				(0.115)
Indus. Zone*Training				-0.122***
				(0.0450)
Constant	0.308***	0.281***	0.265***	0.361***
	(0.0920)	(0.0833)	(0.0987)	(0.117)
Gov. dum.	YES	YES	YES	YES
Eco. act. dum.	YES	YES	YES	YES
Observations	2,178	2,178	2,178	2,178
R-squared	0.221	0.222	0.222	0.224

Robust standaR and D errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table A3: innate characteristics versus behavioral traits (setting performance indicators BC)

	Ever closed				
	reg (1)	reg (2)	reg (3)	reg (4)	reg (5)
Formal	-0.231***	-0.276***	-0.228***	-0.241***	-0.297***
	(0.0418)	(0.0440)	(0.0418)	(0.0438)	(0.0475)
Export Status BC	-0.0412	0.0186	-0.102	-0.0449	-0.0875
	(0.0629)	(0.190)	(0.0897)	(0.150)	(0.192)
Private	0.160***	0.195*	0.217***	0.259***	0.160
	(0.0521)	(0.109)	(0.0579)	(0.0789)	(0.0997)
Ln(Emp BC)	-0.0157	-0.0144	-0.0161	-0.0164	-0.0138
	(0.0101)	(0.0101)	(0.0101)	(0.0101)	(0.0101)
Ln(Age)	-0.0216*	-0.0191	-0.0207*	-0.0230*	-0.0220*
	(0.0124)	(0.0124)	(0.0124)	(0.0125)	(0.0124)
Indus. Zone	0.00974	0.110***	0.00854	-0.0184	0.0917**
	(0.0253)	(0.0354)	(0.0271)	(0.0334)	(0.0375)
Quality control	0.0551**	-0.0178	0.0571**	0.0581**	0.0627**
	(0.0247)	(0.186)	(0.0248)	(0.0248)	(0.0248)
R and D	-0.131***	-0.116***	0.110	-0.139***	-0.129***
	(0.0355)	(0.0357)	(0.126)	(0.0356)	(0.0355)
Performance	-0.00551	-0.0138	-0.00366	-0.0407	-0.0112
	(0.0244)	(0.0244)	(0.0245)	(0.163)	(0.0245)
Training	-0.0184	-0.00667	-0.0193	-0.0214	-0.171
	(0.0229)	(0.0230)	(0.0229)	(0.0230)	(0.149)
Formal* Quality control		0.170			
		(0.142)			
Export Status BC * Quality control		-0.0604			
		(0.199)			
Private* Quality control		-0.0358			
		(0.123)			
Indus. Zone* Quality control		-0.179***			
		(0.0456)			
Formal*R and D			0		
			(0)		
Export Status BC *R and D			0.110		
			(0.123)		
Private*R and D			-0.277**		
			(0.126)		
Indus. Zone*R and D			0.0172		
			(0.0624)		
Formal* Performance				0.186	
				(0.129)	
Export Status BC * Performance				0.000741	

	Ever closed				
	reg (1)	reg (2)	reg (3)	reg (4)	reg (5)
				(0.163)	
Private* Performance				-0.173*	
				(0.103)	
Indus. Zone* Performance				0.0624	
				(0.0448)	
Formal*Training					0.204**
					(0.0973)
Export Status BC *Training					0.0625
					(0.202)
Private*Training					0.00151
					(0.115)
Indus. Zone*Training					-0.133***
					(0.0451)
Constant	0.318***	0.263**	0.262***	0.250**	0.341***
	(0.0799)	(0.122)	(0.0838)	(0.0971)	(0.117)
Gov. dum.	YES	YES	YES	YES	YES
Eco. act. dum.	YES	YES	YES	YES	YES
Observations	2,175	2,175	2,175	2,175	2,175
R-squared	0.221	0.228	0.224	0.224	0.226

Robust standaR and D errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1.