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Abstract

This study looks at the impact of the Covid-19 pandemic on Tunisian SMEs and their strategic management during the first lockdown. We analyze three shocks using Tunisia's national firm census: labor supply, demand, and material supply shocks. We show that the demand shock induced by the pandemic was the major shock to firm revenue in 2020, while the lockdown was the main source of formal job losses. The shortage of material supplies was relatively mild due to decreased demand and limited customer access. Using our own firm survey, we highlight the importance of firms' strategic management in mitigating the shocks, which depends on the level of shock exposure: changes in selling/production process were more important for firms in the industries that were kept open during the lockdown, while the ability to work from home and trade credit were equally important for all firms.

Keywords: Crisis, Covid-19, lockdown, SME, adaptation
JEL Classifications: D22 , L25 , O14 , O16

ملخص

تبحث هذه الدراسة في تأثير جائحة كوفيد-19 على الشركات الصغيرة والمتوسطة التونسية وإدارتها الاستراتيجية خلال الإغلاق الأول. نحلل ثلاث صدمات باستخدام التعداد الوطني للشركات في تونس: عرض العمالة والطلب وصدمات العرض المادي. نظهر أن صدمة الطلب التي أحدثها الوباء كانت الصدمة الرئيسية لإيرادات الشركة في عام 2020، بينما كان الإغلاق هو المصدر الرئيسي لفقدان الوظائف الرسمي. كان النقص في الإمدادات المادية معتدلاً نسبيًا بسبب انخفاض الطلب ومحدودية وصول العملاء. باستخدام استطلاع الشركة الخاص بنا، نسلط الضوء على أهمية الإدارة الاستراتيجية للشركات في التخفيف من الصدمات، والتي تعتمد على مستوى التعرض للصدمة: وكانت التغييرات في عملية البيع/الإنتاج أكثر أهمية بالنسبة للشركات في الصناعات التي ظلت مفتوحة خلال فترة الإغلاق، في حين كانت القدرة على العمل من الائتمان المنزلي والتجاري مهمة بنفس القدر بالنسبة لجميع الشركات.

1. Introduction

Understanding the nature of an economic shock is the key feature to mitigate its con- sequences and prepare for the recovery and handle future shocks. The demand/supply nature of the Covid-19 crisis and the channels through which it is transmitted to the whole economy entail different policy implications [1]. This crisis challenged economists and policy makers to an unprecedented level of complexity of shocks, including various initial and high-order supply and demand shocks. The labor supply shock resulted from the mandatory closure, social distancing implementation, disease infection or fear of infection. The shortage of intermediate inputs is the consequence of the reduction in labor witnessed by in intermediate-input industries. Meanwhile, the demand shock came from the intersectoral and intertemporal shift in households' expenditure composition. Households reduced demand for high contact-intensive goods such as dining-out, entertainment, travelling and increase demand for non-perishable food, sanitary products and healthcare services. Furthermore, they preferred to postpone their consumption at the present, which is called by Baldwin and Tomiura [2] the wait-and-see effect, which also resulted from the income loss due to the lockdown and other containment measures.

In this paper, we are interested in the impacts of three shocks on SMEs: labor supply shock, demand shock and intermediate input shock. Our key variables are the variation of these shocks across industries. Labor supply shock captures exposure to the risk of closure, using a dummy variable which takes the value 1 if a firm operates in a non-essential industry. Demand shock captures the decrease in households' purchasing power and is proxied by the industrial mean of changes in US firms' annual earnings forecast before and after the Covid-19 outbreak. Finally, intermediate input shock captures the potential disruptions in input provision and is measured as the industrial share of firms having intermediate input constraints from the World Bank's

Enterprise Survey Follow-up on Covid-19. We run our Difference-in-Differences model on the panel data drawn from the Tunisia's national firm census. While demand and supply shocks are the fundamental hazards, other factors may have a hand by amplifying or mitigating these hazards. We identify three sources of amplification/mitigation: technological adaptation, credit constraint and firm heterogeneity. We first examine these sources using the national census. More precisely, we add a triple interaction of the shock measures with firm or industry characteristics to the baseline model. Firm characteristics include size, export status and foreign ownership whereas technological adaptation and credit constraint are proxied respectively by the industrial teleworkability and external finance dependence indices. To further investigate SMEs' actual adaptations in terms of technology and finance, we ran a survey on Tunisian SMEs right after the first lockdown. Three firms' prominent kinds of adaptations were examined: workplace adaptation, process adaptation and the use of trade credit.

Overall, we find that the demand shock was the major shock to SME revenue in 2020. The labor supply shock induced by the lockdown was less critical for SME revenue but the main reason of formal job losses. The effect of intermediate input shock on firm revenue was relatively small and alleviated by the contraction of demand. We also find that small enterprises were less exposed than medium firms to the intermediate input shocks while partially exporting and foreign firms were more resilient to the demand shock. Finally, it is shown that all three forms of adaptations - process, workplace and trade credit - mitigated the effect of the

lockdown on SMEs. However, the effects of each type of adaptation were different: the process adaptation was more helpful for firms in essential industries while the workplace adaptation and trade credit were equally important for firms in both essential and non-essential industries.

Our paper contributes to the literature on the impacts of "negative shocks" on SMEs in three ways. Firstly, it is among a small number of papers that look at these impacts at the firm level in developing countries. The uniqueness of our data set makes it possible to estimate the effects of the Covid crisis on the entire SME population and control for time-invariant unobservable heterogeneity. Furthermore, this paper quantifies the impact of various simultaneous shocks induced by the pandemic. From the technical point of view, we provide a comprehensive set of measures of shocks at the industry level. These measures neither limit themselves to the Tunisian context nor to the Covid context. Other measures of economic shocks can be constructed in the same spirit for other countries or other crises. From the practical point of view, being informed about which firms are more sensitive to certain shocks than others is substantial for a better timing and targeting of public support. Finally, with our own survey on SMEs carried out after the first lockdown, we are able to provide evidence on the actual adaptation strategies of SMEs and how these strategies helped SMEs to cope with the pandemic.

The rest of the paper is structured as follows. Section 2 reviews the relevant literature. Section 3 provides the context of the first lockdown and Tunisia's economy in 2020. The data and methodology are described in Section 4. Section 5 presents our results. Finally, Section 6 concludes our findings.

2. Literature Review

Our paper relates to several strands of literature. The first one seeks to decompose shocks at the macroeconomic level. Given the vastness and prevalence of this literature, we only cite here the Covid-19 related papers. del Rio-Chanona et al. [3] were among the first authors who predicted the first-order supply and demand shocks on sectoral output, employment and wage. They estimate that the Covid-19 crisis and containment measures reduced by one fifth the aggregate output, by one quarter total employment and by nearly one fifth the total income wage. The aggregate effects were dominated by the supply shocks. Brinca et al. [4] measure the shifts in labor supply and demand curves using structural-vector-autoregression model and monthly sectoral data. They also found that more than two thirds of the aggregate drop in working hours' growth rate during the lockdown could be attributed to the labor supply shock. Baqaee and Farhi [5] and Barrot et al. [6] focus on the first-order and second-order supply effects of social distancing measures and suggested that the nonlinearities of the production network, together with the heterogeneity of the shocks, could make the second-order shock very costly to the output. Guerrieri et al. [7] examine the demand shock triggered by the negative supply shocks and find that this secondary shock could be larger than the initial shock if the intersectoral elasticity of substitution was less than the intertemporal one. Baqaee and Farhi [1] incorporate nominal frictions into the disaggregate Keynesian model with multi-sector and factor. In the presence of complementarities, negative supply shocks out weight negative demand shocks in terms of output loss and generate Keynesian spillovers as well as further output loss. Lastly, Pichler et al. [8] extend the traditional input-output model to account for simultaneous demand and supply shocks and added various firm rationing to obtain the bottom-up impact estimates. They affirm the important amplification effects of the production network which were even much larger in the presence of micro-level

coordination failures. The common findings of this literature are that (i) labor supply supply shocks predominated during the lockdown; (ii) demand and supply shocks var- ied substantially across industries; (iii) the higher-order shocks were much larger than the initial shocks and (iv) nonlinearities, complementarities and market frictions, in most of the cases, amplified the shocks.

The literature that studies more specifically the impact of COVID-19 at the firm level shows a heterogeneous impact depending mainly on firm size and the level of development of their country of operation. Based on a US survey of 28,000 firms Alekseev et al. [9] find that larger and older firms are more likely to operate during the crisis and that they were more concerned about the demand than the supply shock. Apedo-Amah et al. [10] confirm the disproportionate impact on small firms with a survey on 51 countries and 100,000 businesses. Using a survey on 35,000 small businesses in Latin America, Guerrero-Amezaga et al. [11] predict a substantial impact on the medium term on small firms, due to the low assistance that these firms benefited from. Drawing on firm surveys in 38 countries, Aga and Maemir [12] show that Sub- Saharan African firms are disproportionately impacted by the health crisis, due to structural pre-pandemic characteristics. The authors also find a higher propensity to adapt to the shock in Sub-Saharan Africa, despite lower financial and technological resources. Using a 5,000 UK firm panel survey, Bloom et al. [13] highlight the large contraction of less productive firms in 2020-21, which partly offsets the large reduction in within-productivity on overall total factor productivity. Drawing on firm-level data on 34 countries, Muzi et al. [14] also find a higher probability of exit of unproductive firms, characterized by low digitalization and innovation. New significant contributions to this literature also draw attention to the resilience factors. For instance, Barry et al. [15] study how three forms of corporate flexibility - workplace, investment and finance- affect firm employment and investment plans. Notably, high workplace flexibility was not only important for planned employment growth but also boosted planned capital spending when coupled with high investment flexibility. Using the domain/website density and data on small business performance aggregated at the metropolitan level, Mossberger et al. [16] highlight the role of the digital economic activity in the resilience of small businesses in the US metropolitan regions. Meanwhile, Aristei and Gallo [17] conclude that sound environmental management practices relieved the impacts of the Covid-19 and pre-crisis credit constraints acted as an amplifier of the negative impacts.

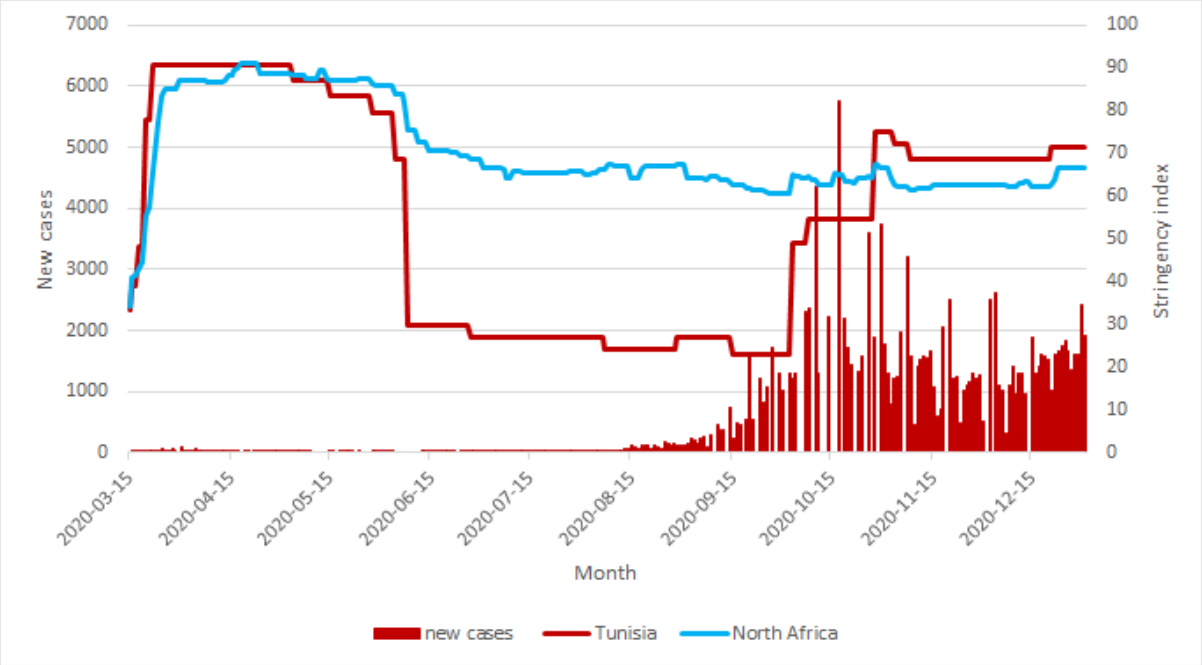
Finally, our paper is also close to a third strand of the literature that looks at the effects and the responses to other shocks (financial crisis, terrorist attacks, etc.) at the firm level. These studies exploit the exogenous variation in the shocks or in the predisposition to shocks across industries or economies. For instance, Tong and Wei [18] and Isyuk [19] use the variation in sectoral demand sensitivity and firm financial constraints to isolate the effect of the demand shock and credit supply shock on firm stock price during the 2007-2009 financial crisis. The index of demand sensitivity was constructed by Tong and Wei [18] based on the response of the consumer confidence, proxied by firm stock prices, to the September 11 attacks. They find that firms were more affected by the credit contraction than the reduction in consumer confidence. Calomiris et al. [20] study the change in equity returns of firms around the world during the financial crisis. They find a lower equity returns in firms that were sensitive to the global demand shock, the credit crunch and the equity selling pressure. Claessens et al. [21] compile firm-level data from 42 countries to study the three transmission channels of the financial crisis: credit supply, domestic demand and trade. They conclude that firms in higher demand- and trade- sensitivity industries experienced more output loss. Nguyen and Qian [22] use a survey on Eastern European firms and reached the same conclusion that the demand

shock was more damaging to firm sales and employment than the credit shock. In the same spirit, Coviello et al. [23] examine firm responses to a persistent adverse demand shock using a quasi-experiment: the 2008 law on fiscal rule that affected only Italian municipalities with population greater than 5,000. They show that firms responded to a persistent demand shock by cutting capital rather than labor.

3. First lockdown and Tunisia economy in 2020

Following the trauma caused by the explosion in the number of infected persons by Covid-19 in Italy and France, the main economic partners of Tunisia and the privileged destination for its migrants, Tunisia imposed one of the strictest lockdowns in the world (stringency index of 91) from March 2020 (after the detection of the first infected case) to the beginning of May 2020. Borders and schools were closed, internal movements forbidden and only workplaces of essential industries (food, public utilities, etc.) were kept open [24].

Figure 1: Number of daily covid cases and Stringency of restrictions in Tunisia in 2020



Source: Author's creation using data by Hale et al. [25]

The success in terms of low infections and the high economic cost (GDP decreased by 21% in the second quarter of 2020) led the Government to lift almost all restrictions in the 2020 summer as shown by Figure 1. However, the resurgence of cases in Fall 2020 led the authorities to reimpose high restrictions, particularly harmful for service sector which represent a high share in Tunisia economy, resulting in a total GDP loss of 9% at the end of 2020. The cost was particularly high for SMEs given the weak financial capacity of support of the Government. Only 25% of SMEs applied for or received any form of state support to overcome the crisis [26].

4. Data and Methodology

4.1 Methodology

4.1.1 Shock evaluation

As mentioned above, the supply and demand shocks induced by the lockdown and the Covid-19 were aggregate shocks but their effects were very heterogeneous across industries. We deploy these sectoral variations of the shocks to decompose their effects on Tunisian SMEs. As the baseline model, we apply the traditional two-way-fixed-effect (TWFE) DID specification. The model is set up as follows:

$$y_{ijrt} = \gamma_1 LS_j \cdot Post + \gamma_2 DS_j \cdot Post + \gamma_3 IS_j \cdot Post + \beta X_{ijr(t-1)} + \alpha_j + \eta_r + \lambda_t + \epsilon_{ijrt} \quad (1)$$

where y_{ijrt} is the annual sales/employment of firm i in industry j and district r. The dummy variable *Post* takes the value 1 if a firm is observed in 2020 and the value 0 otherwise. α_j and η_r capture time-invariant industry-specific and district-specific effects while λ_t accounts for the time trend. A set of firm covariates $X_{ijr(t-1)}$ controls for pre-crisis time-varying firm-level characteristics, including firm age (in logarithm), square of age, size, foreign ownership and export status. The labor supply shock, LS_j, measures exclusively the direct effect of the mandatory shutdown in April and May 2020. The demand shock, DS_j, is a proxy for the demand shifts induced by the Covid-19. The intermediate input shock, IS_j, measures the sectoral exposure to intermediate input shocks. Details on the identification of these shocks are presented in the section 4.2. Except for the labor supply shock, which is a dummy, other shocks are standardized. We expect the estimations of γ_1, γ_2 and γ_3 to be negative, meaning that the shocks have negative impacts on firm sales and employment.

To examine which firms were hit harder by the shocks, we interact the measures of shocks with firm characteristics as follows:

$$\begin{aligned} y_{ijrt} = {} & \gamma_1 LS_j \cdot Post + \rho_1 Covariate_{ij(t-1)} \cdot Post + \pi_1 LS_j \cdot Covariate_{ij(t-1)} \\ & + \delta_1 Covariate_{ijr(t-1)} \cdot LS_j \cdot Post \\ & + \gamma_2 DS_j \cdot Post + \gamma_3 IS_j \cdot Post + \beta X_{ijr(t-1)} + \alpha_j + \eta_r + \lambda_t + \epsilon_{ijrt} \quad (2) \end{aligned}$$

where $Covariate_{ijrt}$ is a dummy variable indicating firm size, foreign ownership, off- shore status and partial export status. $X_{ijr(t-1)}$ is the set of time-varying covariates. We also interact the measures of shocks with sectoral indicators of financial and technological characteristics (in this case $Covariate_{ijr(t-1)}$ is replaced by $Covariate_j$), since this information is not covered by the Tunisian firm census. The construction of these two variables is also presented below in section 4.2.

4.1.2 Firm adaptation to shocks

Facing the strict mandatory closure, a firm in a non-essential industry can adjust its workplace by shifting all its activities online to allow its employees to work from home. Meanwhile, a firm in an essential industry, facing the mobility restrictions, can adapt its working process and products to reduce the physical contact among employees and with clients. Both firms, however, experienced a sudden loss in their revenue, requiring a fast financing alternative to survive through the great lockdown. In this paper, we study the mitigation effect of firm prominent adaptations to the direct shock generated by the lockdown. Three adaptations are examined: workplace adaptation, process adaptation and the use of trade

credit. The identification of these three adaptation is presented in section 4.2.3. We interact the labor supply shock with adaptations dummies as follows:

$y_{ijg} = \alpha + \beta X_{ijg} + \gamma_1 LS_j + \gamma_2 ADAPT_{ijg} + \gamma_3 ADAPT_{ijg} \times LS_j + \alpha_j + \eta_r + \epsilon_{ijg}$ (3) where y_{ijg} is the percentage changes in sales of firm i in industry j and region g during the lockdown compared to the same month of the previous year. $ADAPT_{ijg}$ is one of the three adaptation dummies. X_{ijg} is the set of control variables, including firm and managers' characteristics. α_j and η_r capture the unobserved industry- and region-specific effects. We adjust the standard errors by clustering them at the 2-digit NAT[5] industry level.

4.2 Data and variable construction

4.2.1 Sectoral variables

Labor supply shock: The mandatory closure during the lockdown manifested itself mainly as a labor supply shock to non-essential industries of which stores and plants were suddenly forced to close, thousands of workers were suddenly not allowed to leave their houses for work. As Tunisia experienced a low infection rate during most of the year 2020, the main source of labor supply shock in 2020 came from the strict lockdown policy. We constructed our own list of essential (or non-essential) industries for Tunisia by gathering information from announcements of government agencies. We end up with a list of non-essential industries at the 4-digit NAT level. Our measure of the direct shock induced by the lockdown is a dummy which takes on the value 1 if the firm operated in a non-essential 4-digit industry, and 0 otherwise.

Demand shock: Following Barry et al. [15] and Hong et al. [27], we compute the demand shock as the industrial mean of changes in US firms' annual earnings forecast before and after the Covid-19 outbreak. Given that February 20 is the starting date of the pandemic in the US, we choose January 2020 as the most recent non-pandemic forecast period and May 2020 as the revision accounting for the pandemic. The data are provided by the Institutional Brokers' Estimate System (IBES).[6] We compute the firm-level change in predicted revenue between January and May 2020, then take the average value at the 3-digit-NAICS (North American Industry Classification System) level. Finally, the measure is mapped from the 3-digit NAICS to the 3-digit NAT codes. The demand shock is multiplied by −1 before being standardized so that the increase in a negative demand shock is negatively associated with firm performance.

The use of a US proxy of certain industry characteristics has been widely practiced in applied economics (see the survey by Ciccone and Papaioannou [28]), as the US measure is deemed to have less distortions compared to less developed economies. For instance, the US demand sensitivity to the September 11 terrorist attacks [18] has been deployed in various papers to estimate the effects of the financial and sovereign debt crises on firms across the world [21, 22, 29].

Despite the extensive literature based on this practice, it still requires our caution because of

[5] 2009 Tunisian Nomenclature of Activities 2009

[6] The earnings forecast are firstly adjusted to account for the fact that a certain fraction of the fiscal year has already been realized before the pandemic.

the underlying assumption: the pattern of sectoral demand contraction is analogous across countries. This is a strong assumption, given the differences in technological availability, consumer preference, and the range of substitute products between the two countries. First of all, to rule out the fact that US firms might adapt better to the Covid shock, we use the US firms' annual earnings forecast instead of the real earnings. In addition, we construct an equivalent measure of demand shock using the real change in Tunisian stock prices before and after the lockdown. Tunisia's stock market in 2020 was composed of the 60 largest companies of Tunisia, many of which from the financial sector. Thus, the demand shock computed from these data is at best considered as an indicator for a limited part of the economy. We plug the two data sets to the firm data and calculate the correlation coefficient. It varies between 0.29-0.58 depending on the choice of the time window.

Intermediate input shock: While the intermediate supply shortage was an aggregate problem due to the interruption of the global value chain, a large part of it is still industry-specific [30]. We calculate a survey-based measure of intermediate input shortage from the World Bank's Enterprise Survey Follow-up on COVID-19. These cross-section surveys follow the baseline Enterprise Survey and are designed to pro- vide quick information on the impact and adjustments that COVID-19 has brought about in the private sector. The questionnaire contains a question on firm's produc- tion during the last month before the survey. Specifically, firms are asked to compare their supply of inputs, raw materials, or finished goods and materials purchased to resell for the last completed month with the same month in 2019, whether it increased, remained the same, or decreased. If firms answer "decreased", then it is classified as input constrained. We aggregate the share of firms having a reduced material supply at the 3-digit-ISIC industrial level across 33 countries surveyed from 2020 to 2020 around the world. This measure, hence, captures industry-specific rather than country-specific intermediate constraints. Similar to the demand shock, the intermediate supply shock is also mapped to the 3-digit-NAT codes and standardized.

Teleworkability (Telework): Studies on firm responses to the Covid-19 suggest that teleworkability is the key to the resilience of firms. To quantify this feature, we use the classification of teleworkable jobs developed by Dingel and Neiman [31]. Their classification covers the questions on work context and generalized work activity in O*NET,[7] a US survey database on the nature of occupations and their task composition. The authors define a list of statements that excludes the possibility of telework. If none of these statements are true, the occupation can be performed from home and takes the value 1, otherwise it takes the value 0. The index is available at the 5-digit SOC[8] level. We map it to the NNP-14[9] codes then aggregate it at the 3-didit NAT level.

External finance dependence (EFD): We proxy firm sensitivity to financial shocks by the external finance dependence [32] of US firms over the period 2010-1019 in the Compustat data base. To smooth temporal fluctuations and reduce the effects of outliers, we sum firm use of external finance and investment over 2010–2019 and then take the ratio of these sums. We then take the industry median at the 3-digit SIC code level and map it to the 3-digit NAT level.

[7] US's Occupational Information Network
[8] US's Standard Occupational Classification
[9] Tunisia's 2014 National Occupational Classification

4.2.2 RNE panel data

Our main data set comes from the national firm census (RNE) of the Tunisian National Institute of statistics (INS). This database provides information on formal firm activity code, characteristics (age, size, ownership and export status) and performance (sales and employment). For this study, we restrict the data set to the SMEs in the period 2015-2020. Table 1 reports the average outcomes and characteristics of firms in our control and treatment groups. The treatment groups include non-essential industries, industries with demand shocks above the 2020 sample median (high demand shock) and industries with intermediate input shocks above the median (high intermediate input shock). Conversely, the control groups include essential industries, industries with demand below the median (low demand shock) and industries with intermediate shocks below the median (low intermediate shock).

Table 1: Average outcomes and characteristics of firms in control and treatment groups- RNE data (2015-2020)

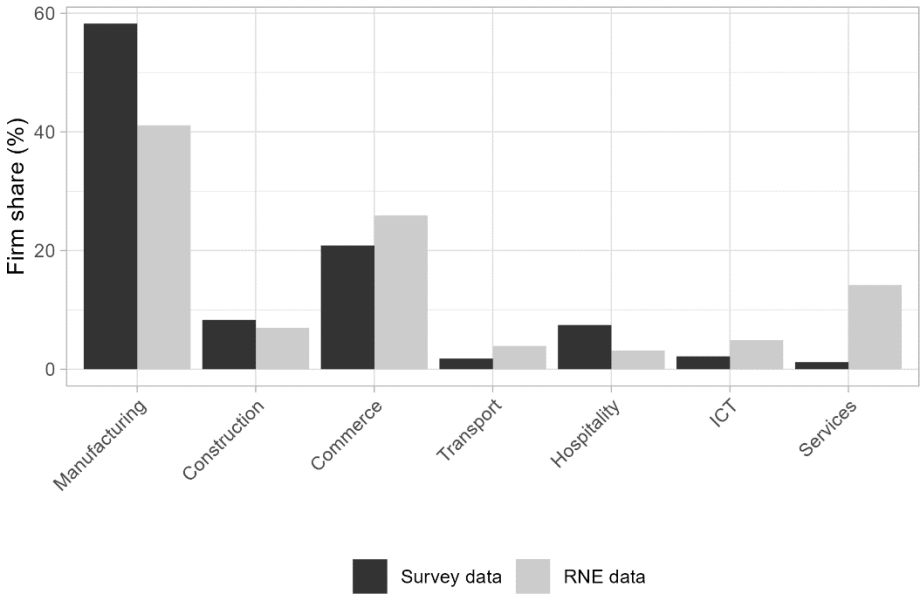
	All		Labor supply shock		Demand shock		Intermediate input shock	
			Yes	No	Low	High	Low	High
	N	Mean	Mean		Mean		Mean	
Firm outcome								
Log sales	64,838	13.90	14.04	13.85	13.87	13.89	14.24	13.73
Log employment	64,838	2.86	2.63	2.94	2.72	3.03	2.83	2.95
Firm characteristics								
Log age	64,409	2.47	2.60	2.42	2.44	2.49	2.54	2.38
Sq. Log age	64,409	6.81	7.47	6.59	6.68	6.88	7.12	6.41
Medium	47,430	0.17	0.11	0.19	0.12	0.22	0.16	0.20
Partial Export	50,025	0.15	0.12	0.17	0.15	0.15	0.17	0.15
Offshore	50,025	0.19	0.03	0.24	0.13	0.27	0.11	0.30
Foreign	50,025	0.10	0.01	0.12	0.08	0.12	0.06	0.14
Industry's characteristics								
Telework	64,830	0.24	0.23	0.24	0.30	0.15	0.22	0.27
EFD	63,829	-0.05	-0.09	-0.03	0.11	-0.21	0.14	-0.20

4.2.3 COVID-19 survey data and SME adaptation

To investigate SME adaptation, we run a firm survey conducted after the first lock- down in 2020. The survey provides us with firms' and managers' characteristics, including firm age, size, import status, export status (non, partial, total exporter) and ownership (local or foreign); manager's experience and education. It also covers strategic management questions containing details about the firm performance as well as the strategies adopted for coping with the pandemic. Firm performance during the lockdown is proxied by change in sales in May 2020 with respect to sales in May 2019.

Table 2 describes the data from this firm survey and the sectoral variables used in this study. Figure 2 and Figure 3 compare firms' distribution and average sales growth in the RNE panel data set and the survey data set. Manufacturing firms and hotel/restaurants are over-represented in the survey data set. Furthermore, the average variation in sales in May 2020 (regarding to May 2019) is much larger than that of the entire year 2020 (regarding to the entire year 2019) due to the fact that most of firms were completely shut down during April and the first half of May 2020.

Figure 2: Firm distribution across sectors (%)



Firm adaptations are constructed as follows. Firms are identified as having a process adaptation if they responded yes to any of the following questions:

1. Did your company start selling online to reduce the proximity to clients?
2. Did your company start selling over the phone to reduce the proximity to clients?
3. Did your company change your product to reduce the proximity to clients?
4. Did your company change its mode of transportation due to mobility restrictions?
5. Did your company change its imported/exported products to cope with the pandemic?

Firms are identified as having a workplace adaptation if all or some of their employees were able to work from home. Firms that could sell online or over phone did not necessarily have their employees work from home. Indeed, among 12% firms that were able to turn their storefront into an online business, only 65% of these firms had their employees work from home.

Figure 3: Sales change across sectors (%)

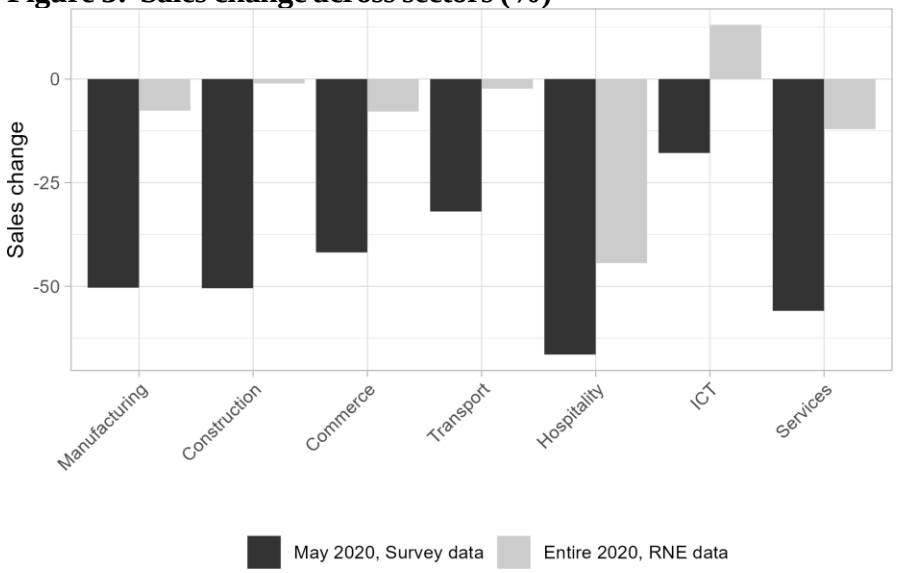


Table 2: Average outcomes and characteristics of firms in control and treatment groups - Survey data

		All	Labor supply shock		Demand shock		Intermediate input shock	
			Yes	No	Low	High	Low	High
	N	Mean	Mean		Mean		Mean	
Firm outcome								
Sales change (%), May 2020	831	-48.80	-26.43	-55.70	-39.60	-57.56	-42.42	-55.20
Firm adaptations								
Workplace adapt., April	831	0.17	0.27	0.14	0.22	0.13	0.16	0.19
Use of trade credit	831	0.19	0.19	0.19	0.19	0.20	0.15	0.23
Process adapt., April	830	0.23	0.26	0.22	0.28	0.18	0.24	0.21
Firm characteristics								
Log age	826	2.43	2.44	2.42	2.44	2.41	2.51	2.33
Sq. Log age	826	6.57	6.73	6.52	6.62	6.49	6.94	6.17
Medium	831	0.25	0.15	0.28	0.18	0.30	0.24	0.27
Import	831	0.52	0.46	0.54	0.47	0.56	0.51	0.54
Partial Export	831	0.11	0.12	0.11	0.10	0.11	0.14	0.09
Offshore	831	0.19	0.08	0.23	0.09	0.30	0.12	0.26
Foreign	831	0.13	0.08	0.14	0.09	0.16	0.12	0.14
Mng's experience	820	12.34	11.20	12.70	11.89	12.68	13.28	11.32
Mng having a college degree	831	0.66	0.61	0.68	0.66	0.66	0.70	0.62
Industry's characteristics								
Telework	831	0.17	0.22	0.16	0.25	0.10	0.18	0.15
EFD	819	-0.06	0.01	-0.08	0.13	-0.23	0.09	-0.22

5. Results

5.1 Effect of the shocks on firm performance

Figures 4 and 5 plot the linear trends of the sales and employment over time for our control and treatment groups. Despite the different levels, the two groups had roughly similar pre-trends in most shocks and outcomes. Furthermore, there is a clear divergence in firm performance when the Covid-19 broke out in 2020. One exception is the widening difference between the non-essential and essential groups before 2020 that might cause an overestimation of our treatment effect. This difference is, however, expected to be ruled out once the industry-specific effects are controlled for.

Figure 4: Sales trends (2015-2020)

Figure 5: Employment trends (2015-2020)

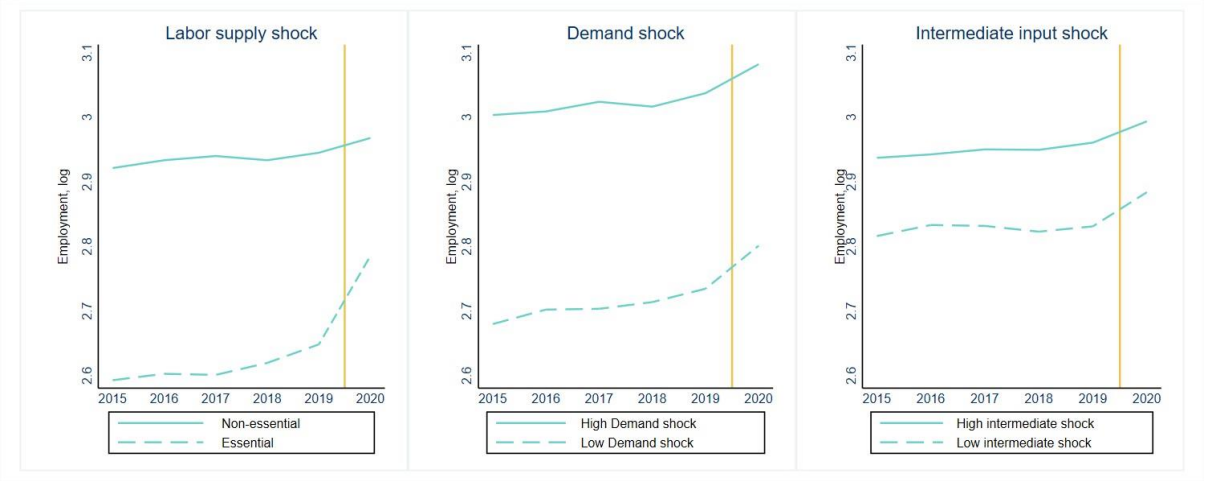


Table 3 displays the results of the baseline model (1) for SME sales. The model is estimated using the national firm census (RNE) data provided by the National Institute of Statistics. Column (1) shows that the effect of the labor shock due to the lockdown on SME sales is significant and negative. Firms in non-essential activities experienced 11.3 percent lower sales than those in essential activities. Column (2) exposes a negative association between the demand shock and SME sales: one standard deviation increase in our industrial measure of demand shock is associated with 9.1 percent loss in sales. Finally, Column (3) shows that Tunisian SMEs also suf- fered a negative impact from the intermediate input shock, although the magnitude is much lower than that of the demand shock: one additional standard deviation in our industrial measure of intermediate input shock is associated with 4.8 percent loss in firm sales. When we introduce the three shocks at the same time in Column (4), the demand shock becomes the greatest hazard to SME sales. The coefficient on the intermediate input shock is not significant anymore, that is to say, it is much less important than the labor supply and demand shocks. The fall in demand as well as the limited access to clients, even when firms were not closed, indeed alleviated the pressures on input supply.

Table 3: Effects of the shocks on SME's sales

	(1)	(2)	(3)	(4)
Labor supply shock *Post	-0.113***			-0.062***
	(0.027)	-0.091***		(0.023)
Demand shock*Post				-0.079***
		(0.027)		(0.027)
Intermediate input shock*Post			-0.048**	-0.015
			(0.019)	(0.013)
Log age	0.079	0.078	0.080	0.079
	(0.061)	(0.061)	(0.061)	(0.061)
Sq. Log age	-0.007	-0.007	-0.007	-0.007
	(0.014)	(0.014)	(0.014)	(0.014)
Medium	1.513***	1.513***	1.513***	1.513***
	(0.063)	(0.063)	(0.063)	(0.063)
Partial exporter	0.383***	0.383***	0.384***	0.383***
	(0.038)	(0.038)	(0.038)	(0.038)
Total exporter	0.127*	0.127*	0.128*	0.127*
	(0.074)	(0.074)	(0.074)	(0.074)
Foreign	0.315***	0.315***	0.315***	0.315***
	(0.060)	(0.060)	(0.060)	(0.060)
Observations	45826	45826	45826	45826
R2	0.534	0.534	0.534	0.534

Note: This table examines the effects of the shocks on SME's sales in 2020. All models apply the two-way fixed-effect estimator and control for year, 4-digit industry and district fixed effects. Standard errors are clustered at the 4-digit industry level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

As a placebo test, instead of interacting the shocks with a dummy indicating the post-crisis period, we interact the shock with year dummies to investigate the effects of the shocks in the years before the Covid-19 event. Figure 6 plots the pre-trend coefficients (before 2020) and the treatment effects (2020). 2019 serves as the base year. Once the industry-fixed effects are controlled for, it turns out that the average sales level of non-essential industries is larger than that of essential industries, which is contrary to the suggestion by Figure 4. Our measures of the labor supply shock and demand shock do have negative effects on firms sales. Given the positive pre-trend, our estimates of the shock effects might be underestimated, especially in the case of the demand shock.

Figure 6: Differences in sales trends

In Table 4 we present the results of the re-estimation of Equation (1) but substituting employment to sales as the dependent variable. The results are different from those exposed in Table 3 since only the labor supply shock is significantly, and negatively, associated with employment. This result is consistent with the fact that the lockdown of some firms directly affected their capacity to hire and employ people, while the demand and input shocks took some time to affect firm employment, since this effect required a decrease in sales at first. At the end of the first year of pandemics, the potential impact of these two shocks on employment of formal firms in Tunisia was not yet perceptible. As for sales, Figure 7 suggests that the difference, before treatment in the treated and control groups, are not significant.

5.2 Heterogeneous effects of the shocks

According to their characteristics and activity, the impact of the COVID-19 crisis may have varied. To examine this question, we estimate Equation (2) on the same sample of firms. In this model, we interact the effect of the three shocks with some firm/industry-level characteristics that may influence how hard was the impact on the firm. The results are displayed in Tables 5 and 6. If a characteristic (covariate) alleviates a shock, the coefficient of the triple interaction should have a positive sign. We firstly distinguish medium firms from small ones (Column 1). We also examine whether outward-looking firms were more strongly impacted by the shocks since they are more involved in global value chains. We notably examine whether firms exporting part of their production (Column 2) and firms which production was entirely exported (the so-called offshore firms) (Column 3) were more harshly hit by the shocks. We also examine whether firms which capital is partly foreign-owned were hit in a distinct way as other firms (Column 4). In Columns 5 and 6, we investigate the case of firms belonging to the activities that structurally need more external financing (hence more

vulnerable to shocks) and those in which it is easier to implement work from home (hence less vulnerable to the shocks).

Table 4: Effects of the shocks on SME's employment

	(1)	(2)	(3)	(4)
Labor supply shock *Post	-0.029**			-0.029**
	(0.014)			(0.014)
Demand shock*Post		-0.012		-0.012
		(0.010)		(0.010)
Intermediate input shock*Post			-0.000	0.007
	-0.153***	-0.154***	(0.006)	(0.005)
Log age			-0.154***	-0.154***
	(0.025)	(0.025)	(0.026)	(0.026)
Sq. Log age	0.044***	0.044***	0.044***	0.044***
	(0.006)	(0.006)	(0.006)	(0.006)
Medium	1.558***	1.558***	1.558***	1.558***
	(0.029)	(0.029)	(0.029)	(0.029)
Partial exporter	0.136***	0.136***	0.136***	0.136***
	(0.014)	(0.014)	(0.014)	(0.014)
Total exporter	0.237***	0.237***	0.237***	0.237***
	(0.038)	(0.038)	(0.038)	(0.038)
Foreign	0.064***	0.064***	0.064***	0.064***
	(0.015)	(0.015)	(0.015)	(0.015)
Observations	45826	45826	45826	45826
R^2	0.658	0.658	0.658	0.658

Note: This table examines the effects of the shocks on SME's employment in 2020. All models apply the two-way fixed-effect estimator and control for year, 4-digit industry and district fixed effects. Standard errors are clustered at the 4-digit industry level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Figure 7: Differences in employment trends

Table 5 shows that in most of the specifications, the labor supply shock and the demand shock remain significantly negative and quite similar in terms of magnitude to those displayed in Table 3. Little heterogeneity was found among firms exposed to the labor supply shock. This is not surprising because the first lockdown was strictly imposed to all non-essential activities. While both small and medium firms were equally affected by the lockdown and the demand shock, medium firms were more hit by the intermediate supply shock (Column 1). One explanation might be the input complexity of larger firms. Larger-scale firms tend to use more various and complex intermediate inputs than smaller-scale firms. In addition, they are also more likely to import inputs which are hard to substitute in times of border closure. The F-test for the joint significance of the coefficients of interaction terms *Intermediate shock*Post* and *Intermediate shock*Medium*Post* rejects the null hypothesis at $p - value = 0.01$. Interestingly, partial exporters appear to be the most resilient compared to offshore and domestic firms

when it comes to the demand shock (Column 2). As the former suffered from the interruption of the global supply chains and the latter were more constrained both financially and technologically, the hybrid SMEs stood out thanks to their flexibility to respond to market demand. Finally, it comes as no surprise that foreign firms were less affected by the demand shock (Column 4).

Table 5: Heterogenous effects of the shocks on firm sales

	(1)	(2)	(3)	(4)	(5)	(6)
	Medium	Partial export	Offshore	Foreign	EFD	Telework
Panel A: Labor supply shock						
Labor supply shock *Post	-0.035	-0.074***	-0.051*	-0.061**	-0.068***	-0.071**
	(0.029)	(0.023)	(0.027)	(0.024)	(0.023)	(0.028)
Covariate*Post	0.107	-0.043	0.126	-0.022	-0.001	0.020
	(0.092)	(0.069)	(0.154)	(0.203)	(0.014)	(0.034)
Labor supply shock *Covariate*Post	-0.181*	0.081	-0.156	0.010	-0.007	-0.042
	(0.099)	(0.083)	(0.158)	(0.207)	(0.020)	(0.040)
Observations	45826	45826	45826	45826	45119	45821
R^2	0.535	0.534	0.534	0.534	0.536	0.534
Panel B: Demand shock						
Demand shock*Post	-0.067**	-0.091***	-0.081***	-0.087***	-0.045**	-0.084***
	(0.031)	(0.027)	(0.030)	(0.027)	(0.018)	(0.028)
Covariate*Post	-0.027	0.023	-0.025	-0.028	-0.015	-0.020
	(0.031)	(0.027)	(0.029)	(0.040)	(0.017)	(0.019)
Demand shock*Covariate*Post	-0.061	0.099**	0.017	0.135***	-0.062	-0.016
	(0.042)	(0.042)	(0.041)	(0.044)	(0.047)	(0.037)
Observations	45826	45826	45826	45826	45119	45821
R^2	0.535	0.535	0.534	0.535	0.536	0.534
Panel C: Intermediate shock						
Intermediate shock*Post	0.004	-0.020	-0.014	-0.025*	-0.015	-0.015
	(0.019)	(0.013)	(0.020)	(0.014)	(0.013)	(0.014)
Covariate*Post	-0.024	0.025	-0.022	-0.042	-0.010	-0.013
	(0.037)	(0.027)	(0.028)	(0.029)	(0.016)	(0.015)
Intermediate shock*Covariate*Post	-0.074**	0.028	0.002	0.059*	-0.007	-0.007
	(0.034)	(0.029)	(0.028)	(0.030)	(0.014)	(0.012)
Observations	45826	45826	45826	45826	45119	45821
R^2	0.535	0.534	0.534	0.534	0.536	0.534

Note: This table examines the heterogenous effects of the shocks on SME sales. The columns reports the interaction terms of the shocks and the covariate. All models apply the two-way fixed-effect estimator and control for year, 4-digit industry and district fixed effects. Standard errors are clustered at the 4-digit industry level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 6 reveals a slightly different pattern of resilience in terms of employment. Medium firms experienced more employment loss than small firms both during and in the months following the lockdown (Column 1). Offshore firms turn out to be the most resilient in terms of employment, regardless of facing a greater demand shock (Column 4). Foreign firms were also more able to keep employment (Column 5).

5.3 Adaptations and firm resilience

Before looking into firm adaptations to the labor supply shock, we run a regression of firm sales change in May 2020 with respect to May 2019 on firm characteristics, managers' characteristics and the three shocks. The model controls for region fixed effects and 2-digit-NAT industry fixed effects. Standard errors are clustered at the 2-digit-NAT industry level. The result of this specification is reported in Table 7. Only the coefficient of the labor supply shock is significant. It means that firms in non-essential industries experienced roughly 32 percentage points lower in sales lower than firms in essential industries during the lockdown. Since the labor supply shock was dominant throughout the lockdown, we focus on the mitigation effect of firm adaptations to this shock only.

Table 6: Heterogenous effects of the shocks on firm employment

	(1) Medium	(2) Partial export	(3) Offshore	(4) Foreign	(5) EFD	(6) Telework
Panel A: Labor supply shock						
Labor supply shock *Post	-0.015	-0.030*	-0.029**	-0.029**	-0.030**	-0.029**
	(0.016)	(0.016)	(0.015)	(0.014)	(0.014)	(0.014)
Covariate*Post	0.027	0.009	-0.159**	-0.209	-0.003	-0.005
	(0.038)	(0.031)	(0.074)	(0.135)	(0.005)	(0.016)
Labor supply shock *Covariate*Post	-0.092**	0.003	0.125	0.180	-0.003	-0.002
	(0.038)	(0.038)	(0.079)	(0.137)	(0.009)	(0.017)
Observations	45826	45826	45826	45826	45119	45821
R^2	0.658	0.658	0.658	0.658	0.658	0.658
Panel B: Demand shock						
Demand shock*Post	-0.005	-0.014	-0.020*	-0.014	-0.011	-0.014
	(0.010)	(0.011)	(0.011)	(0.011)	(0.008)	(0.009)
Covariate*Post	-0.041**	0.012	-0.054***	-0.037*	-0.007	-0.004
	(0.017)	(0.016)	(0.015)	(0.021)	(0.007)	(0.007)
Demand shock*Covariate*Post	-0.035**	0.013	0.059***	0.019	-0.015	0.012
	(0.015)	(0.018)	(0.023)	(0.033)	(0.021)	(0.013)
Observations	45826	45826	45826	45826	45119	45821
R^2	0.658	0.658	0.658	0.658	0.658	0.658
Panel C: Intermediate shock						
Intermediate shock*Post	0.014*	0.005	0.003	0.003	0.006	0.007
	(0.008)	(0.006)	(0.009)	(0.006)	(0.005)	(0.005)
Covariate*Post	-0.043**	0.013	-0.053***	-0.049***	-0.010	-0.005
	(0.019)	(0.016)	(0.015)	(0.017)	(0.007)	(0.006)
Intermediate shock*Covariate*Post	-0.026**	0.013	0.023	0.028*	-0.010	-0.005
	(0.013)	(0.014)	(0.017)	(0.015)	(0.007)	(0.005)
Observations	45826	45826	45826	45826	45119	45821
R^2	0.658	0.658	0.658	0.658	0.658	0.658

Note: This table examines the heterogenous effects of the shocks on SME employment. The columns reports the interaction terms of the shocks and the covariate. All models apply the two-way fixed-effect estimator and control for year, 4-digit industry and district fixed effects. Standard errors are clustered at the 4-digit industry level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 7: Effects of the shocks on SME's sales change between 5/2019-5/2020 (%)

	(1)	(2)	(3)	(4)
Labor supply shock	-33.599***			-32.430***
	(4.401)			(4.261)
Demand shock		-4.458		-5.124
		(3.933)		(4.025)
Intermediate input shock			-8.212	-5.106
			(5.189)	(3.534)
Log age	-2.279	-4.022	-4.636	-3.053
	(7.899)	(8.303)	(7.757)	(7.709)
Sq. Log age	1.992	2.376*	2.520*	2.230*
	(1.256)	(1.383)	(1.282)	(1.237)
Medium	3.612	2.761	2.271	3.436
	(3.406)	(3.436)	(3.444)	(3.409)
Importer	10.931***	10.095***	10.372***	10.986***
	(3.278)	(3.579)	(3.500)	(3.290)
Partial exporter	13.476*	14.717*	13.536*	13.045
	(7.717)	(7.575)	(7.695)	(7.823)
Offshore	8.580*	9.667**	9.381**	8.076*
	(4.812)	(4.405)	(4.276)	(4.773)
Foreign	-3.230	-1.719	-1.707	-3.530
	(4.175)	(4.546)	(4.607)	(3.980)
Experience	-0.569**	-0.598**	-0.594**	-0.587**
	(0.239)	(0.242)	(0.238)	(0.233)
Having a college degree	3.470	3.968	3.655	3.423
	(3.671)	(3.448)	(3.385)	(3.570)
Observations	816	816	816	816
R^2	0.204	0.175	0.179	0.207

Note: This table examines the effects of the shocks on SME's sales changes between 5/2019 and 5/2020. All models control for 2-digit industry and region fixed effects. Standard errors are clustered at the 2-digit industry level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Tables 8, 9 and 10 report the results obtained from equation (3) for workplace adaptation, process adaptation and trade credit. For the sake of interpretation, we set as baseline the group of firms in non-essential industries and having had no adaptation (Labor supply shock = 1, Adaptation = 0). This is the most vulnerable group, so we expect other groups to have a lower loss of revenue in comparison to the base group.

Table 8 presents the results for the workplace adaptation, i.e., firms' capacity to work from home. For firms in non-essential industries, the workplace adaptation had a mitigation effect of 10.8 percentage points on May's sales change, as reported in Column 1. We then consider how this effect varied across industries with high- and low- teleworkability. It is expected that workplace adaptation will have a more pronounced effect on firms in non-essential and ex-ante high-teleworkability industries. Indeed, column 2 and 3 show that the effect of workplace adaptation is significant for firms in non-essential and ex-ante high-teleworkability industries, but not for firms in non-essential and ex-ante low-teleworkability industries.

Table 8: Mitigation effect of workplace adaptation on SME's sales change between 5/2019-5/2020 (%)

		All	High telework	Low telework
Labor supply shock(= 0)		32.453***	36.577***	12.220*
		(3.872)	(3.903)	(6.660)
Adaptation(= 1)		10.817**	19.498***	3.495
		(4.123)	(5.052)	(5.898)
Labor supply shock(=0)*Adaptation(=1)	1.212		-11.119	14.963**
		(9.677)	(10.962)	(6.065)
Observations		815	409	406
R2		0.212	0.243	0.163

Note: The base group consists of firms in non-essential industries and having had no adaptation (Labor supply shock = 1, Adaptation = 0). All models apply the OLS estimator and control for 2-digit industry and region fixed effects. Standard errors are clustered at the 2-digit industry level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 9 reports the estimates of the effect of process adaptation. SMEs' capacity to adjust their sales/production process was more helpful for essential industries than for non-essential industries. More precisely, among firms in non-essential industries, those having had a process adaptation experienced a 10.5-percentage-point difference. Meanwhile, among firms in essential industries, those having had a process adaptation experienced a 30.7-percentage-point difference. Since the lockdown was strict and sudden, firms in non-essential industries were hardly able to make any process adjustment. Those in essential industries were not completely free from the impact of the lockdown, thus, they also needed to adjust their sales/production process to cope with the mobility restrictions. When we examine firms in ex-ante high- versus low- teleworkability industries, we found process adaptation was a mitigation factor only for firms in essential and low-teleworkability industries.

Table 9: Mitigation effect of process adaptation on SME's sales change between 5/2019-5/2020 (%)

	All	High telework	Low telework
Labor supply shock(= 0)	29.640***	32.347***	15.134*
	(4.329)	(5.255)	(8.230)
Adaptation(= 1)	10.487**	13.196	8.779
	(4.846)	(8.220)	(5.954)
Labor supply shock(=0)*Adaptation(=1)	20.265**	10.827	37.362***
	(7.949)	(9.271)	(6.867)
Observations	816	410	406
R^2	0.224	0.239	0.189

Note: The base group consists of firms in non-essential industries and having had no adaptation (Labor supply shock = 1, Adaptation = 0). All models apply the OLS estimator and control for 2-digit industry and region fixed effects. Standard errors are clustered at the 2-digit industry level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

We proceed to the capacity to mobilize trade credit in Table 10. Having trade credit is also an important mitigator for SMEs during the lockdown. We replicate the same regression to the high- and low-external-financial-dependence (EFD) subsets to see whether the effect of trade credit is more pronounced in ex-ante credit constrained firms. Our results confirm this prediction. For firms in essential industries, the effect of trade credit is only significant for credit-constrained SMEs. For firms in non-essential industries, this effect is greater for credit-constrained SMEs.

Table 10: Mitigation effect of trade credit on SME's sales change between 5/2019-5/2020 (%)

	All	High EFD	Low EFD
Labor supply shock(= 0)	29.861***	31.831***	-25.076*
	(4.160)	(5.078)	(12.005)
Adaptation(= 1)	13.443***	17.639**	10.620**
	(4.251)	(6.477)	(4.522)
Labor supply shock(=0)*Adaptation(=1)	3.750	0.615	4.763
	(8.516)	(16.313)	(6.871)
Observations	816	463	353
R^2	0.217	0.249	0.207

Note: The base group consists of firms in non-essential industries and having had no adaptation (Labor supply shock = 1, Adaptation = 0). All models apply the OLS estimator and control for 2-digit industry and region fixed effects. Standard errors are clustered at the 2- digit industry level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

6. Conclusions

In this paper, we estimate the effects of the Covid-19 shock on SMEs in Tunisia, using the DID specification. We also identify different sources of shock amplifi- cation/mitigation, including teleworkability, external finance dependence and firm heterogeneity. Lastly, we evaluate the role of firms' actual adaptations, including workplace adaptation, process adaptation and the use of trade credit.

We find that the demand shock caused the greatest damage to SME revenue in the entire year 2020. The labor supply shock induced by the lockdown turned out not to be as harmful to SME revenue as expected. Nevertheless, it was still the main source of formal job losses, which were mild in 2020. Lastly, the effect of the intermediate input shock on firm revenue was alleviated by the contraction of demand and the limited access to clients. This is in line with the prediction of the macroeconomic literature. Our results suggest that in the context of a short and strict lockdown, once it is finished, the government should redirect its support from firms exposed to the labor supply shock to firms exposed to the demand shock.

The heterogeneity analysis using the national firm census shows that the effect of the lockdown shock was quite homogeneous across firms. We find that small firms turned out to be less exposed to the intermediate inputs' shock, while partially exporting and foreign firms were more resilient to the demand shock.

Last but not least, using our firm survey, we show that all three forms of adaptations - process, workplace and financial - mitigated the effect of the lockdown on SMEs. However, the effects of each type of adaptation were different: the process adaptation was more helpful for firms in essential industries while the workplace adaptation as well as the ability to mobilize trade credit were helpful for firms in both essential and non-essential industries.

We acknowledge that this work, in spite of our efforts, has certain limitations. First, we estimate the effects of the Covid-19 on SMEs within almost one year since the first lockdown. This period in most of developing countries is characterized by a strict border closure, a strict but short national lockdown and a low infection rate. Hence, any analyses that go beyond this specific context might have to consider other factors, such as the real conformity to the mobility restrictions when the enforcement became less strict in the following years. Second, a missing piece from our picture is an analysis of the Covid-19's impact on the informal sector. This sector does not only account for a significant part of the private sector[10] but is also its most vulnerable component. Further research is hence needed to provide more evidence on this sector.

[10] Informal employment accounted for 26.8 percent of Tunisia's employment in 2020 according to a report of ILO and UNDP [33].

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