Effect of COVID-19 lockdown on the profitability of firms in India

Abstract

We examine the effect of COVID-19 induced lockdown on the profitability of listed firms in India. With restrictions on labor mobility, repressed supply and weakened demand condition, we hypothesize that firms lose profitability due to lockdown. We also explore the role of external factors such as lockdown stringency and pace of COVID-19 spread (in areas where the firm operates) as conditioning factors in influencing the effect of lockdown. We use the earliest available financial information of 4062 listed firms for the June 2020 quarter and compare their financial data with previous quarters (2017-2019). Using a difference-in-difference estimation framework and various measures of profitability, we find that the COVID-19 lockdown has reduced profits by around 15% for listed firms in India. We find evidence of firms losing revenues more than expenses, thus validating our main hypothesis. We also find that the impact is higher for firms operating in states with more stringent lockdown and in states with rapid COVID-19 spread. Finally, the effects of lockdown were more severe for smaller, older and firms that did not belong to any business group affirming the role of external factors and pre-existing firm specific factors in shaping the effect of interventions on firm performance.

Keywords: COVID-19, Firm Performance, lockdown, India

JEL: L25, G38, D22

1. Introduction

On March 11, 2020, after two months since the first case was reported in China, the World Health Organization (WHO) declared COVID-19 as a global pandemic. WHO urged countries to adopt strict social distancing and quarantine measures to contain the spread of the virus. Various economies implemented measures ranging from stay-at-home orders to extended lockdowns. This led to a collapse of economic activity reeling with an unprecedented situation of repressed demand and severe supply shortages. With weak institutional factors, huge informal sector and high persistent inequality, the cost of lockdowns in developing economies is beyond the revival of repressed demand and supply.

Moreover, some of these economies had already been exhibiting a slowdown in economic growth. For instance, the Indian economy grew by 5% in 2019 dipping to a decade low. Negative growth rates in consumption in the rural economy, unemployment reaching a record high in the past four decades and the industrial sector stagnating, the pre-COVID 19 India loomed all signs of a weak economic situation, to begin with (Nagaraj, 2019; Nagaraj, 2020; Kannan, 2020)[1]. Consequently, a lockdown may have acted as a brake to industrial output leading to a collapse of economic activity. It is against this background that this paper examines how the COVID-19 induced lockdown impacted firms' profitability in India.

We build on the strand of literature that focuses on how COVID-19 lockdowns affect firm performance. Since getting data related to operations is too early, most of the existing papers have focused on the effect of COVID-19 and lockdowns on the stock market performance of firms. For

[1] Among other factors, the decision of demonetizing its higher denomination currencies (leading to a sharp drop of 86% of currency in circulation) and replacing the indirect taxes with the Goods and Services Taxes (with inefficient implementation) contributed to the contraction of output.

instance in the context of US stock market, Ding et al. (2020), Alfaro et al. (2020) and Fahlenbrach et al (2020) find that pre-existing firm specific factors determine the extent of COVID-19 impact on stock prices and returns. In the context of India, Mishra et al. (2020) focus on the Indian financial market and find that compared to the two recent events of demonetization and the introduction of the Goods and Services Tax system, the COVID-19 outbreak had a higher impact on the financial market. Mathur and Sengupta (2020) also document a drop in returns for Indian stocks that were more vulnerable to COVID-19. However, an interesting feature of the Indian stock market experience was its quick recovery since April and continued boom until August.

Despite IMF declaring the COVID-19 economic crisis as "The Great Lockdown" and the worst economic downturn since the great depression of the 1930s, the stock market has reached and even exceeded the pre-COVID-19 level. This stands in stark contrast with the grim reality of shut factories, unemployed workers and repressed demand. Moreover, it emphasizes the need for examining the effect of lockdown on operational performance indicators. Few studies have studied the effect of COVID-19 and lockdowns on operational indicators. Papanikalaou and Schmidt (2020) use data from the American Time Use Surveys and find that sectors that did not have a significant portion of workers possessing the ability to work remotely suffered the greatest reduction in employment, performance and a higher probability of default. Shen et al (2020) use data on predicted return on assets for Chinese companies for 2020 based on 2014-2019 data and find that COVID-19 has a higher effect on firms operating in industries and areas that were not functional and were in complete lockdown, respectively. In North India, Rathore and Khanna (2020) use a primary survey of micro, small and medium enterprises to examine the effect of lockdown find evidence of considerable financial stress.

The current paper aligns closely with the latter strand of literature since we use operational indicators of firm performance. It uses the only, as of now, available data source, the Prowess database, that provides financial performance of listed firms in India for the June 2020 quarter. We extract data for all 4062 firms that had disclosed their quarterly financial statements for the June 2020 quarter and then compare their performance with the past three years. Since the data pertains to the income statement of these firms, we limit our performance indicators to a set of profitability measures. We hypothesize that a lockdown hurts firm profitability as it leads to a spiraling demand and supply crunch due to restrictions on labor mobility, logistic bottlenecks and future uncertainty. Consequently, firms struggle to continue operations and lose profitability.

We use a difference-in-difference estimation framework to ensure causal inference of the lockdown restriction on firm performance. We use industry and state-specific location identifiers for firms to design our empirical strategy. We identify our treatment and control group of firms for the estimation model using an exogenous approach of identifying industries that were exempted from the lockdown. The Government of India (GoI) had released an official order before the commencement of lockdown in the country that deemed certain industries as essential and hence were exempted from the lockdown. This is similar to the approach used by Shen et al. (2020)

We also recognize the role of institutions and the external environment in shaping firm performance. For instance, spatial variation in lockdown stringency at the subnational level determines the extent of labor mobility and hence the ability to sustain production and continue operations. We use daily data on workplace mobility, from the Google Community Reports and take explicit account of mobility patterns at the state level during the entire June quarter. We use interactions within the difference-in-difference model to examine if lockdown stringency conditions affects firm profitability. While using the mobility measures for the state where the firm

operates, we account for multiple locations and compute a measure of mobility at the firm level based on reported locations. We follow a similar methodology for examining the effect of COVID-19 spread across various states.

We find that lockdowns reduced profitability of firms in India. All measures of profitability- real profit after tax, return on sales, real earnings per share and profit growth exhibited a decline of around 15%. Our results are robust to different model specifications and falsification tests. As expected, we find that while both expenses and revenue suffered due to the lockdown, the decline in revenues is more than that of the expense, thus leading to profit loss. This affirms our basic hypothesis that the effect of the lockdown has indeed led to a spiraling demand and supply shock at the firm level.

Another important result of the paper is related to the heterogeneity of COVID-19 effects. We find that lockdown has a higher effect on firm profitability if the external environment of a firm has a lesser workplace mobility vis-à-vis a firm that operates in an environment with a relaxed lockdown. Similarly, the effect of the lockdown is higher in firms that are located in areas that witnessed a rapid rise in COVID-19 infection. These results highlight the critical influence of external environment in shaping firm performance. Finally, we find that lockdown effects are more pronounced for firms that are smaller, older and not part of any business group.

2. Hypotheses

2.1 Lockdowns and profitability

A key determinant of firm performance is the state of the business environment such as governance, regulatory constraints, property rights, policies and institutions (Commander and Svejnar, 2011; Bhaumik et al., 2012). In developed countries, well-functioning markets for labor, capital and credit shape a business environment that is conducive for performance. In contrast, emerging

economies face market failure due to agency problems, a huge informal sector and weaker governance. These barriers make it costly for firms in emerging markets to continue smooth business operations.

The COVID-19 pandemic was a unique shock to the global economy that led to most governments resorting to measures ranging from social distancing to strict lockdowns. Lockdowns are similar to negative shocks similar to any natural disaster, but the scale of which was humongous spanning across most countries, sectors and time. An immediate effect of lockdowns is the closing down of businesses that require employees to be physically present at the workplace and work in close proximity with each other. Some sectors have been affected more adversely than others depending on the ability to continue operating remotely. We examine the effect of lockdown by theorizing the impacts on the supply and demand side of the manufacturing and services sector separately.

On the supply side of the manufacturing sector, due to strict restrictions on labor mobility and the opening of factories and offices, production drops drastically. Initially, distributors may view this supply shortage as an opportunity to spike prices and hence may carry on sales but with probably deferred and delayed payments. With extended lockdowns, shortage of labor expands thereby affecting production volumes further. Consequently, transporters and dealers also struggle to continue operations due to the inability to arrange necessary logistics for transporting goods. Finally, distributors also feel the pressure and start revising their expected sales accordingly. These events disrupt the supply of manufacturing goods which may also lead to extreme actions such as shutdowns and layoffs. In contrast, supply in service-oriented sectors will be driven by the extent of information and communication technology (ICT) compatibility of the business and the proportion of employees working from home (Papanikolaou and Schmidt, 2020). For instance, information technology, consultancy and financial services are well equipped to continue business

if employees have the necessary infrastructure to work remotely. However, certain service sectors that require personal contact with customers and other employees, such as hotels, tourism, restaurants and entertainment will suffer significantly.

Another important factor while examining supply disruptions is the list of industries deemed as 'essential' services by the government. These 'essential' services were exempted from the lockdown as these were considered to be critical for the basic sustenance of the economy. There was significant variation across economies on the identification and implementation of 'essential' service operations. For instance, in the US various state governments were responsible for deeming certain industries as 'essential' in their respective states. In contrast, Sweden had a softer approach by allowing work from home and encouraging people to practice social distancing when stepping out (Fischer, 2020). The GoI had released an official order before the commencement of lockdown that exempted a set of industries and services from it. Since this was an order released by the central government, the list of essential services was uniform at the subnational level. Thus, any attempt to focus on the supply disruptions due to COVID-19 restrictions need to take explicit account of the COVID exposure, as Papanikolaou and Schmidt (2020) describe it, of the industry and the governments' approach to exempting some industries from the lockdown. Simultaneously, extended lockdowns and the high spread of the virus create fears of a deep recession and thus have dampened demand as well.

On the demand side, a key concern is whether the demand response will be a spillover of the supply shock or will COVID-19 have a direct effect on demand. Bekaert et al (2020) describe that a massive lockdown of the economy directly reflects a large demand slump. Commencing a sudden lockdown leads to a rise in income uncertainty followed by drastic income cuts. Buyers respond with spending cuts but this response may largely be driven by the nature of supply shocks.

Guerrieri et al (2020) describe that with the lockdown disrupting supply in some sectors more than others (for instance, restaurants), consumers redirect their spending to other substitutable goods and services (spending more on ingredients and packaged food for cooking at home). In contrast, in certain other cases if the customers are spending on, say travel more before the lockdown will reduce their fuel usage during the lockdown. Thus, the demand impact will be driven by complementarity between goods and services with sectors that face a strong supply shock. These complementarity effects may be stronger and weaker in certain cases, but in the presence of incomplete markets and weak institutional setting, it will unravel an adverse demand shock across most sectors.

To summarize, lockdowns lead to an intertwined demand and supply shocks that affect both revenue and expenses of firms in sectors that are more prone to be hard hit by physical distancing. However, revenue shortfalls are rapid and instantaneous with sudden lockdowns due to suppressed demands. In contrast, cost reduction is more structural and delayed. For instance, hotel owners may face no customers soon after the lockdown is imposed, but has to continue paying rent, wages and salaries for some time in the future. Based on these arguments we frame the following hypothesis-

Hypothesis I: Lockdowns reduce firm profitability

2.2 External factors and the impact of lockdown on profitability

Adverse economic shocks that are limited to a particular region or industry can have substantial impacts on the forward and backward linked industries and regions (Inoue and Todo, 2019). This feature was subdued in the argument by Lucas (1977) whose idea based upon the law of large numbers suggested that if shocks across various industries and regions are idiosyncratic, they would cancel out on aggregating the sectors. Recent theoretical literature developed by Gabaix

(2011), Acemoglu et al. (2012), Acemoglu et al. (2015), Acemoglu et al. (2016) extend this argument by suggesting that the input-output linkages between sectors that are hit and those that are not may compensate the action of the law of large numbers and may cause an aggregate shock.

Acemoglu and Robinson (2008) discuss that economic institutions matter for economic outcomes as they are instrumental in shaping the incentives of economic actors in society. Economic institutions not only determine the aggregate growth but also affect the redistribution of resources and affects economic and political development. Along similar lines, the economic consequences of announcing a lockdown and its impact on firm performance also needs to be contextualized using the role of institutions. Ferraresi et al. (2020) argues that institutional quality has a bearing on how lockdowns affect firm performance. For instance, in regions with better law enforcement by the police force, lockdowns will be implemented in a more stringent manner as compared to regions with weak law enforcement. The disproportionate degree of lockdown stringency across various regions will have a differential impact on the mobility of workers and products. Using mobility patterns as a proxy for the stringency of lockdown, we hypothesize

Hypothesis 2(a): The effect of lockdown on profitability will be higher in regions with weaker law enforcement implementation as measured by lower mobility

Hypothesis 2(b): The effect of lockdown on profitability will be higher in regions with higher risk of COVID-19 infections

2.3 Firm specific factors and the impact of lockdown on profitability

The absence of strong financial intermediary institutions such as well functioning product and labor markets, access to credit and technology in developing economies makes firm level pre-existing factors important in the current context. Firms' resilience and ability to recover from unexpected shocks will moderate the effect of lockdown on firm profitability. For instance, larger

firms have better safety nets such as economies of scale, capacity building and managerial capabilities that may enable them to withstand external shocks better than smaller firms. We also focus on firm age as a second pre-existing factor. While older firms have better experience and have existed through self-selection, ageing of firms may lead to inflexibility and inertia in adapting to sudden changes in the external environment.

Khanna and Palepu (2000) argue that group affiliation may be beneficial in developing economies since group firms can utilize on their reputation from established business to gain credibility in other areas of business. Similarly, since the scope of operations of these group firms spreads beyond single industry groups and regions, they are better placed in diversifying the external risk and mitigate market failures using these internal institutions. Group firms also have better cost management since the internal capital market can be used to tide over cost fluctuations in various industry or product groups. While there may be some costs associated with group membership such as the risk of misallocation of capital, conflicting interest between controlling and minority shareholders, the potential benefits in the context of emerging economies will outweigh these costs. Based on the above discussion, we formulate the following hypotheses

Hypothesis 3(a): Impact of lockdown on firm profitability will be higher for smaller firms

Hypothesis 3(b): Impact of lockdown on firm profitability will be higher for older firms

Hypothesis 3(c): Group firms will have a weaker impact of lockdown on firm profitability

3. The Indian Context

India recorded its first COVID-19 infection on January 30, 2020. By March 24, India had 618 confirmed cases of COVID-19. As a response, the GoI announced a 21-day nationwide lockdown from the following day as a steep measure to control the spread of the virus. According to the

COVID Government Stringency Index, India scored a full score of 100 in late March indicating a high level of stringency[2]. This lockdown was extended twice until May 31, when the Ministry of Human Affairs issued an order announcing a phased reopening that lifted most prohibitory orders barring containment zones. There are two striking and unique features of the Indian lockdown- the lockdown was a sudden surprise event with a lot of future uncertainty about opening up and extension. Second, its commencement coincided with the beginning of the June quarter lasting for almost two of the three month quarter. This provides us with an interesting opportunity to examine the effect of this nationwide event on the Indian industries.

Firm performance is driven by firm-specific internal factors and external institutional factors that shape the environment in which the firm functions. India in its enormity provides a huge spatial variation on ease of mobility during the lockdown period. According to the Google Community Reports, workplace mobility declined sharply in Maharashtra (which harbors two economic hubs Mumbai and Pune) and Delhi. In contrast, states such as Telangana (that harbors Hyderabad, another commercial city), Andhra Pradesh and Karnataka (that harbors Bangalore) went lax. The effect on business and operations is closely associated with mobility restrictions in the local environment of the firm. In fact for firms having a presence in more than one state, we incorporate the mobility restrictions in all the reported locations.

A second important dimension to this study is the non-uniform spread of COVID-19 across different Indian states. The rise of COVID-19 cases was fast-paced in states like Maharashtra and New Delhi whereas it was slow in Rajasthan and Kerala. The inter-state coefficient of variation of

[2] The COVID-19 Government Stringency Index collects information on how governments responded to the pandemic by imposing stringency measures on fourteen indicators ranging from school closure to travel restrictions. Source: https://www.bsg.ox.ac.uk/research/research-projects/coronavirus-government-response-tracker

cases between April and June 2020 has remained high and fairly stable in India[3]. Unusual spikes in case spread may also affect mobility across states, consequently inhibiting smooth business operations. Thus, we account for state wise variation in mobility and infection growth in moderating the effect of the lockdown. To the best of our knowledge, this is one of the first attempts to take account of these features and examine the heterogeneous effect on the basic hypothesis of the paper.

4. Data and variables

4.1 Data Source

To test the hypothesis presented in Section 2, the data have been collated from multiple sources. We extract all firm-level information from the Prowess database owned by the Center for Monitoring India Economy. Firms covered in the database account for more than three-fourth of the economic activity in the organized industrial sector in India (Goldberg et al, 2010). Prowess provides audited financial data on all listed and selected unlisted firms in India. It also provides data on the location of firm offices, ownership groups and industry categories of firms. We also use the GoI order dated March 24, 2020, that exempted certain industries and services from closing during a complete lockdown of 21 days in the country[4]. We use this order as an exogenous method to classify all the selected firms into essential (exempted industries) and non-essential categories by mapping the industry information.

The lockdown had imposed severe restrictions on people's movement. To account for labor mobility during the lockdown, we use Google Community Mobility (GCM) dataset at the state level. Based on GPS location, GCM records changes in mobility trends across various categories

[3] Based on authors' calculations using COVID-19 data. Source of the data- www.Covid19india.org
[4] The lockdown was extended twice till May 31st beyond which states were given the flexibility of imposing local lockdowns according to case load.

including the workplace. Using the five weeks of January 3-February 6, 2020, the GCM dataset uses the median value of mobility for each day of the week as a reference point. Based on this reference point, each data point compares the percentage change in mobility on a particular date. Finally, we also use daily data on the spread of COVID-19 in India at the state level from http://www.COVID19india.org, a crowdsourced initiative that curates and verifies data related to COVID-19 cases in India from state bulletins and official handles.

4.2 Variables

To examine the effect of COVID-19 on firm performance, we use measures of profitability. We use the (i) natural log of real profits after tax (PAT), excess of income over expenses, (ii) the log of return on sales (ROS), ratio of profit after tax to operating income, (iii) the log of real earnings per share (EPS), ratio of profit after tax to the total number of outstanding shares and (iv) the growth in profit after tax (GP), quarter-on-quarter proportionate change in real profit after-tax. We convert the nominal value of PAT and EPS into real value by using quarterly WPI from the Reserve Bank of India website. Following the previous studies on factors affecting firm performance, we include a set of control variables such as age, leverage, growth of revenue and research and development expenses. The definition of these variables has been presented in Annexure I.

Besides these financial variables, we also control for firm ownership, industry group and location identifiers. To control for ownership, we create dummy variables based on the ownership code available in the ProwessIQ, which categorize firms into group, state-owned, foreign and private firms. To account for the change in concentration at the industry level, we compute the concentration ratio for the top four firms at the three-digit NIC code level for every period. This variable also controls for time-variant changes in industry competition that may affect firm performance. To map our firm-level data with state-level external factors, we identify the states in

which the firm has headquarters, registrar's office, corporate office and registered office[5]. Thus, our final dataset provides information on firm-specific factors, industry-level factors and state-specific factors. Descriptive statistics of the important variables along with their definition is presented in Annexure I.

5. Identification strategy

According to the Securities and Exchange Board of India (SEBI) guidelines, all listed firms are required to disclose their quarterly financial statement within forty-five days of the end of each quarter[6]. However, as a response to the pandemic, SEBI had relaxed the deadline for filing the financial report for the quarter ending June 2020 to September 15. These reported financial statements are the earliest available large scale data for financial information of firms in India after the pandemic[7].

Our analysis covers all firms that have disclosed their income statement for the April-June quarter. We construct a panel data using these 4060 firms and tracing them for the past few years. To avoid the impact of demonetization announcement of November 2016, we start our period from the quarter ending June 2017 to the quarter ending June 2020. We drop firms that have not reported their financial data for more than two years. We also winsorize profitability measures at 1% to avoid estimation bias due to the presence of outliers. The final dataset is a panel of 3560 firms across thirteen quarters.

[5] All firms may not have four offices. Depending on the number of offices reported in Prowess database, we use the relevant states for the particular firm. For instance, if Firm A has only reported one registered office in State X and no other offices, we consider the specific variable for state X. In contrast if Firm B has reported all four types of offices in states X, Y, Z and W- the location specific variable is constructed as a simple arithmetic mean of states X, Y, Z and W.

[6] According to clause 41 of the guidelines, a company may submit audited or unaudited quarterly financial report. If the financial results are unaudited, it will be subjected to a limited review by the statutory auditors of the issuer. Source: https://www.bseindia.com/downloads1/claause41.pdf

[7] The data was downloaded on Oct 1, 2020

Our main empirical strategy is a difference-in-difference (DD) regression framework to examine the effects. We define the nationwide lockdown announcement of March 25 as the event. Since the countrywide lockdown started from March 25 and continued till May 31, it provides us a natural advantage of considering quarterly data. We define the quarter ending June 2020 as the post-event period and all the prior quarters as the potential pre-event period. However, it may not be viable to include all pre-event quarters in the analysis. Differences in demand conditions, business decisions and fund allocation across quarters within the same year may cause seasonality across quarters in the same year. Hence, to provide a reasonable comparison of the pre-event period with the post-event period (April-June 2020), we examine the same quarter (April-June) of all years between 2017 and 2019 as the pre-event period[8].

To identify our treatment and control firms, we use the GoI order. The order mentioned that public utilities such as petroleum, CNG, LPG, PNG, power generation and transmission units, post offices, electricity, water and sanitation corporations would not remain closed. Additionally, hospitals and related medical establishments ranging from manufacturing, distribution, transportation, shops, laboratories and hospital support services are to be permitted. Even within commercial and private establishments, ration shops, all food and food products, dairy products, meat, groceries and so on were to remain functional. Importantly, the order also specifies that the manufacturing of all essential units and production units that require continuous process was to remain open. This implies basic industrial sectors such as chemicals, coal and minerals would not be disrupted.

The non-essential category of firms is our treatment group and the essential category is our control unit for lockdown. For firms producing multiple products, we use the industry group that generates the highest share of revenues as identified by the main product. This approach has been followed

[8] As a comparison to the baseline model, we present the results for the pre-event period with all quarters.

by Shen et al (2020). Using data on Chinese listed firms, they identify sectors (such as tourism, retail, entertainment and transportation sectors) that are more likely to be hard hit by the outbreak of the virus. We employ a better approach by using an exogenous GoI order for the identification of our treatment and control groups. Finally, we estimate the effect of lockdown in the following DD regression framework

$$y_{ijsgt} = \alpha_0 + \alpha_1 D_{2020,t} + \alpha_2 NE_{treat,j} + \alpha_3 D_{2020,t} NE_{treat,j} + \alpha_4 x_{ijsgt} + \alpha_5 z_{jt} + \alpha_6 I_j + \alpha_7 O_g + \alpha_8 S_s + \alpha_9 T_t + \varepsilon_{ijsgt} \quad \text{---------- (1)}$$

where y_{ijsgt} denotes the profitability measure of firm *i*, operating in industry *j*, located in state *s*, owned by entity g in quarter *t*[9]. $D_{2020,t}$ is a dummy variable that takes a unit value for the year 2020 and zero otherwise. α_1 measures the difference in average profitability between the pre-event and post-event period. $NE_{treat,j}$ takes a value one if the industry is categorized as non-essential and zero otherwise. α_2 measures the time-invariant difference between the treatment and control group. The effect of lockdown is denoted by the product $D_{2020,t} NE_{treat,j}$ and we, therefore, focus on the coefficient α_3. If α_3 is negative, it implies that the lockdown hurts the profitability of the enterprises in India. x_{ijsgt} and z_{jt} are vectors of confounding firm-specific and industry-specific characteristics respectively. Finally, we use dummy variables at the industry, state, year and ownership level.

6. Results

6.1 Main model

The DD model gives precise causal estimates only if the parallel trends assumption is satisfied. The parallel trends assumption requires for the treatment and control groups to follow a similar

[9] In our analysis, *t* refers to the April- June quarter of each year and not the entire year.

trend before the announcement. This would ensure that differences across control and treatment groups are time-invariant. Figure 1 presents profitability trends followed by our treatment and control groups during the pre-treatment period of 2017-20. The red vertical line indicates the date of lockdown announcement.

<Figure 1 here>

Figure 1 indicates a quarter-specific seasonality pattern in profitability measures before 2020. Fluctuations in profitability within a year may be driven by systematic changes in demand. Additionally, spending patterns across different quarters within a financial year may also be different. To ensure a fair comparison between our pre-event and post-event period, we present the same information by examining only the April-June quarter of each year (Figure 2).

<Figure 2 here>

Figure 2 shows the pre-event values for the June quarters of 2017, 2018 and 2019 (left side of the vertical red line)[10]. The treatment and control groups follow a parallel trend before 2020 and then diverge. Next, we test the parallel trends assumption formally by re-estimating equation (1) for the period before the lockdown announcement. Table 1 compiles the results of the parallel trend assumption. We report only the coefficient of treatment with a year trend for the pre-event period (for 2018-20 and 2017-20).

<Table 1>

We find that the interaction of our time trend with treatment for the 2018-20 and 2017-20 samples is insignificant, thus validating the parallel trend assumption. The treatment variable for 2019-20

[10] The red vertical line does not indicate the date of announcement of the lockdown. Instead it separates the pre-event period from the post event period.

is also insignificant. After validating the parallel trends assumption, we examine the impact on all four measures of profitability by estimation equation (1). Table 2 compiles the results.

<Table 2>

Table 2 presents the results of 2019-20, 2018-20 and 2017-20 June quarters in the top, middle and bottom panels respectively. We present the regression coefficient of DD for each of the profitability measures in separate columns. We find that the coefficient of our DD estimate is negative and significant (at 1% level) for all three sample periods. This is similar to Shen et al. (2020). The top panel indicates that PAT declined by 15.2% due to lockdown. Similarly, ROS and EPS plunged 13.2% and 16.8% respectively[11]. PG rate plummeted 18% due to the lockdown. The other two panels also indicate a similar pattern. The detailed regression result with firm-specific variables and other controls have been discussed in Annexure-II of the paper. As a robustness check, we re-estimate this model for all quarters since 2018 using quarter level fixed effects and compare the effect size (Table 3).

<Table 3>

The effect sizes in Table 3 are similar to those in Table 2 (except for profit growth rate) affirming that the lockdown is a strong blow to the Indian corporate sector. This validates our hypothesis that lockdown has hurt profitability. It is important to evaluate the effect size in detail. According to official statistics, India's GDP faced a worst-ever contraction, falling by 23.9% in the June 2020 quarter. Our sample consists of firms that are listed on the stock market and that have managed to disclose their financial information at the end of the quarter even under lockdown. It is reasonable to assume that these firms are the least vulnerable group of firms and hence, are less affected as

[11] Since our dependent variable is in log terms, the coefficient is converted into effect size by using [1-exponential (coefficient size)].

compared to firms that are facing a complete collapse of production activity. Thus, a decline of 15% in real profits is a reasonable estimate against the 23.9% decline in overall economic activity in the country for the same quarter.

6.2 Robustness tests

6.2.1 Effect of lockdown on control firms

To empirically establish that the firms in our control group were not affected by the lockdown, we re-estimate our models by using the previous quarters to forecast profitability measures for the June 2020 quarter. We use these forecasted values only for the control group in the June 2020 period. For instance, our alternate outcome variable of PAT has forecasted values of the control group firms in 2020 instead of the original values. This constructs the trend that the control group would've followed in the absence of lockdown. Table 4 compiles results of the 2018-20 period.

<Table 4>

Table 4 shows that the effect size of our constructed measures of profitability is similar to Table 2. Specifically ROA2, ROS2, EPS2 and PG2 record 15.8%, 14.4%, 14.5% and 14.6% decline due to the lockdown. This affirms our findings from Table 2. Hence, we deduce that the control group firms did not experience any significant change in their trend due to the lockdown.

6.2.2 Falsification tests

To re-instate our causal effect of lockdown on profitability, we implement two sets of falsification tests. We generate a pseudo-treatment indicator taking values zero and one, as a random assignment to all firms and we re-estimate our models. If our true models indeed capture the effect of the lockdown, the placebo models with pseudo treatment indicator should not indicate any effects. For the second falsification test, we assume that our event (lockdown) was announced in

2019 instead of 2020. As mentioned earlier, we expect this pseudo-2019 event to show no effect on any of the profitability measures. We present the 2018-20 results in Table 5.

<Table 5>

Table 5 presents the results of the two falsification tests in the top and bottom panel respectively. The results indicate that the DD variable is insignificant in all the specifications. Thus, our models capture the causal impact of lockdown in India.

6.3 Potential channels

In line with the main hypothesis of the paper, we attempt to test whether the lockdown has indeed spiraled a demand and supply shock to the Indian economy. Total expenses of a firm encompass the supply side of the firm i.e., costs associated with the production inputs including labor, capital, raw material, energy and so on. On the other hand, total revenue is the value of sales made by the firm which reflects the demand pattern of the firm. We particularly focus on the effect of the lockdown on expenses and revenue. We use the log of real expenses and the growth rate of real expenses as compared to the previous quarter to capture the supply side. Similarly, we use the log of real operating income and the growth rate of real operating income to capture demand. Table 6 compiles the results.

<Table 6>

Table 6 indicates that for the 2019-20 period, expenses of firms have plunged by 17.3% due to the lockdown. Revenue of firms has declined by 44.8%, which indicates that the effect of lockdown has impacted both disruptions in the supply chain and a sharp slump in demand. Growth rate of both expenses and revenue has also exhibited a sharp downturn. Moreover, revenues exhibited a sharper decline as compared to expenses incurred. With sharper declines on the demand side, firms

struggle to continue operations and lose money. Hence, we find strong validation of the channels driving our main hypothesis that demand slumps are instantaneous. In contrast, reducing business expenses is more structural in nature.

6.4 Effect of external factors on the main relationship

Hyotheses 2(a) and 2(b) postulate that the effect of lockdown on profitability is moderated by a set of external variables. We explore these extensions by employing an interaction of these moderating variables with the difference in difference variable in the regression framework from eq. (1). The equation to be estimated is

$$y_{ijsgt} = \beta_0 + \beta_1 D_{2020,t} + \beta_2 NE_{treat,j} + \beta_3 H_{het,f} + \beta_4 D_{2020,t} NE_{treat,j} +$$

$$\beta_7 D_{2020,t} NE_{treat,j} H_{het,f} + \beta_8 x_{ijsgt} + \beta_9 z_{jt} + \beta_{10} I_j + \beta_{11} O_g + \beta_{12} S_s + \beta_{13} T_t + \varepsilon_{ijsgt} \quad \text{--------- (2)}$$

where all notations are similar to equation (1). Here, $H_{het,f}$ is a dummy variable that takes a unit value for a particular heterogeneous effect and zero otherwise. f indicates the dimension of heterogeneity at the location level. We use the state with the registered office as the location identifier and the state-level averages of all indicators for firms with multiple reported locations. In this framework, we focus on β_7 to capture the heterogenous lockdown impact. To examine heterogeneous effect of COVID-19 of firm profitability, we mainly consider two types of heterogeneous effect- lockdown stringency and COVID-19 spread.

6.4.1 Lockdown stringency and labor mobility

Since India is a large country with a diverse population, we observe spatial variation in the stringency of lockdown at the sub-national (state) level using the GCM data. We use the state-level daily data for India that provides the percentage change in mobility on that day as compared

to the same day of the week in the reference period (median value for five weeks between January and February 2020).

We consider workplace mobility on the first day of the post-event quarter (April 1, 2020) and on the last Wednesday of the quarter (June 24, 2020, since April 1, 2020 was also a Wednesday). Using the national workplace mobility on the respective dates, we group states under more stringent lockdown and less stringent lockdown on both the dates. As a next step, we construct our "strict lockdown" indicator variable if the state is under a strict lockdown on both dates. We observe that since some firms have multiple locations in different states, workplace mobility data varies across firms. Results of estimating (3) is presented in Table 7.

<Table 7>

Table 7 indicates that firms firms that were under a stricter lockdown, experienced 13% (approximately) lower PAT as compared to firms operating in a less strict lockdown environment in our sample. Similarly, these firms also recorded lower ROS, EPS and PG as compared to their counterparts. These results highlight the significance of institutions and external factors in shaping the profitability of firms. Thus, we find evidence in support of Hypothesis 2(a).

6.4.2 COVID-19 spread

There is a huge variation on the pace of COVID-19 at the state-level in India. We use data on growth in COVID-19 cases between April 1 and June 30 for each state and merge it with our main dataset using location identifier(s). We estimate model (2) and examine the effect of the COVID-19 interaction term with our DD variable. Table 8 compiles the results.

<Table 8>

Table 8 confirms that firms that have seen rapid growth in infections have experienced lower PAT, EPS, ROS and PG as compared to firms that are operating in states with a lower spread of COVID-19. This validates Hypothesis 2(b).

6.4.3 Firm resilience and the main effect

We also explore the effect of certain firm level characteristics (size, age, indicators for group ownership and being listed on the stock market) in driving our main result. We define small (old) as a dummy that takes a unit value if the total asset in the last financial year (incorporation year) was below (earlier than) the industry mean asset size (year of incorporation) and zero otherwise. Similarly, we use no-group (not a NIFTY-500) dummy variable if the firm is part of a business group (part of NIFTY-500) and zero otherwise. We discuss our results in Annexure III. We find that the effect of lockdown is more severe for firms that are more vulnerable - smaller, older, not part of a business group or NIFTY-500 index. These results validate Hypotheses 3(a), 3(b) and 3(c) and emphasize the role of pre-existing firm specific conditions in influencing the effect of lockdown on profitability.

7. Conclusion

While lockdowns are essential for inhibiting the spread of COVID-19 infections and hence human lives, it costs the economy both on the social and economic front. We document the economic cost by characterizing the effect of lockdown on the profitability of firms in India. We use the earliest available data on firm operations after the lockdown and employ a DD regression framework to evaluate the impact. We observe a dramatic drop in all profit measures which are driven by both demand and supply-side shocks to the firm.

The decline in profitability is higher in firms which are operating in an environment with higher stringency of lockdowns and higher COVID-19 exposure. These results strongly highlight the role

of external/ institutional factors in shaping firm performance. Moreover, it also links to supply chain management and diversification in location while setting up plants. Even though a concentrated production line might lead to better coordination amongst different branches but it also suffers from high risks associated with labor strikes, political changes in the given state and disruptions due to adverse climate changes.

This analysis pertains to firms that are listed on the stock market who were able to publish the quarterly financial report. Based on the effect size of lockdown for these firms, one can assert that the adverse effects of the more vulnerable set of firms will be even higher. These adverse effects on profitability will deepen in the future quarters as the demand and supply shocks due to the pandemic continue to expand. These results point towards a crisis in the Indian industrial sector that requires the immediate attention of the policymakers. The paper pushes for government stimulus packages to be more focused on the vulnerable group of firms such as the MSMEs, and firms in stressed sectors such as aviation, construction and so on. The government also needs to provide income support to boost demand to avoid the deepening of these effects. With the historically highest contraction in economic activity in the Indian economy, the government must ensure a quick, easy and effective implementation method to avoid a spiraling crisis to widen.

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Annexure I

Table 9 indicates the definition and summary statistics of the important variables of our analysis.

Variable	Measure	Mean	Std. Dev.	Min	Max
Firm profitability					
PAT	Log (real profit after tax)	7.16	1.30	-5.53	8.88
ROS	Log (profit after tax to income)	-0.53	0.70	-2.44	0.03
EPS	Log (earnings per share)	2.78	0.83	-5.23	3.11
Profit growth	Growth rate of profit from previous quarter	-0.55	2.07	-5.93	4.10
Covariates					
Treatment	Dummy with unit value if the firm is in non-essential category	0.50	0.50	0	1
Lockdown stringency	Dummy with unit value if lockdown is more stringent	0.58	0.49	0	1
COVID-19 case growth	Dummy with unit value if case growth is high	0.48	0.49	0	1
Firm level characteristics					
Size	Log (sales)	5.05	2.66	-4.61	13.97
Age	Log (years since establishment)	3.45	0.51	0	5.06
Leverage	Ratio of debt to size	1.43	0.44	-5.15	10.10
Income growth	Quarterly growth rate in income	-0.06	0.90	-9.28	8.50
R&D investment	Log (R&D expenses)	0.02	0.34	0	11.10

Table 9- Summary statistics of the main variables

Annexure-II

The detailed regression results of the main model (Table 2) for the period 2018-2020 is presented in Table 10.

	PAT	**ROS**	**EPS**	**PG**
Difference-in-difference estimate				
Non-essential industries	-0.163***	-0.145***	-0.166***	-0.143***
x post lockdown ($D_{2020,t}NE_{treat,j}$)	(0.054)	(0.028)	(0.038)	(0.046)
Firm-level controls				
Firm age	-0.023	0.026*	-0.076***	-0.009
	(0.034)	(0.014)	(0.023)	(0.022)
Firm size	0.028***	0.087***	0.018***	-0.003
	(0.007)	(0.004)	(0.004)	(0.006)
Leverage	0.380***	-0.541***	-0.118**	-0.110
	(0.144)	(0.097)	(0.058)	(0.131)
Growth in income	0.048***	0.248***	0.096***	0.058**
	(0.014)	(0.015)	(0.015)	(0.015)
R&D expenses	0.117***	0.014	0.011*	0.050
	(0.022)	(0.012)	(0.016)	(0.004)
Other controls				
Lockdown indicator	0.007	0.033	-0.006	-0.048
	(0.029)	(0.020)	(0.024)	(0.037)
Non-essential industries indicator	-0.010	-0.015	-0.024	0.104
	(0.043)	(0.021)	(0.053)	(0.099)
Industry level concentration ratio	0.620*	0.157	0.395**	0.142
	(0.377)	(0.127)	(0.189)	(0.274)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes
Ownership FE	Yes	Yes	Yes	Yes
No. of observations	9219	9218	9043	9131
R- squared	0.19	0.54	0.14	0.11
Note: Same as Table 1				

Table 10- Detailed regression result for the effect of lockdown on firm performance for the period 2018-2020

Annexure III

Annexure III presents the heterogeneity of the effect of lockdown on profitability measures according to various firm specific factors. We have compiled the results for 2018-20 in Table 11.

	PAT	**ROS**	**EPS**	**PG**
Firm size				
Non-essential industries x post lockdown x small	-0.559*** (0.149)	-0.169*** (0.040)	-0.518*** (0.095)	-0.063 (0.056)
All controls	Yes	Yes	Yes	Yes
No. of observations	9219	9218	9043	9131
R- squared	0.20	0.35	0.15	0.11
Firm age				
Non-essential industries x post lockdown x old	-0.191*** (0.064)	-0.125*** (0.031)	-0.282*** (0.058)	-0.134** (0.057)
All controls	Yes	Yes	Yes	Yes
No. of observations	9219	9218	9043	9131
R- squared	0.19	0.34	0.14	0.11
Group ownership				
Non-essential industries x post lockdown x no-group	-0.025 (0.044)	-0.118*** (0.030)	-0.109*** (0.041)	-0.106** (0.051)
All controls	Yes	Yes	Yes	Yes
No. of observations	9219	9218	9043	9131
R- squared	0.19	0.34	0.14	0.11
NIFTY-500				
Non-essential industries x post lockdown x unlisted	-0.163*** (0.054)	-0.145*** (0.028)	-0.166*** (0.038)	-0.143*** (0.046)
All controls	Yes	Yes	Yes	Yes
No. of observations	9219	9218	9043	9131
R- squared	0.20	0.34	0.14	0.11
Note: Same as Table 1				

Table 11- Effect of lockdown on firm profitability conditioned on firm specific factors

List of Tables

Table 1- Results for the parallel trends assumption

	2019-20	**2018-20**	**2017-20**
PAT			
Non-essential industries	-0.023	–	–
	(0.033)		
2018-19 trend* Non-essential industries	–	-0.002	–
		(0.046)	
2017-19 trend* Non-essential industries	–	–	-0.005
			(0.023)
Other controls	Yes	Yes	Yes
No. of observations	3115	6059	9086
R- squared	0.29	0.21	0.18
ROS			
Non-essential industries	-0.087	–	–
	(0.086)		
2018-19 trend* Non-essential industries	–	-0.001	–
		(0.024)	
2017-19 trend* Non-essential industries	–	–	0.020
			(0.014)
Other controls	Yes	Yes	Yes
No. of observations	3114	6058	9366
R- squared	0.28	0.29	0.28
EPS			
Non-essential industries	-0.030	–	–
	(0.104)		
2018-19 trend* Non-essential industries	–	0.026	–
		(0.030)	
2017-19 trend* Non-essential industries	–	–	0.025
			(0.015)
Other controls	Yes	Yes	Yes
No. of observations	3074	5947	8903
R- squared	0.23	0.16	0.20
PG			
Non-essential industries	0.015	–	–
	(0.164)		
2018-19 trend* Non-essential industries	–	0.073	–
		(0.050)	
2017-19 trend* Non-essential industries	–	–	0.038
			(0.025)
Other controls	Yes	Yes	Yes
No. of observations	3088	6005	8994
R- squared	0.20	0.14	0.13

Note: Estimates from regressions are presented with robust standard errors in parentheses. All regressions use clustered standard errors at the industry-state-year level. Non-essential

industries is a dummy variable that takes value 1 if the industry is non-essential and 0 otherwise. All regression models include firm-specific variables such as age, leverage, growth of revenue, rent, labor expenses, power and fuel expenditure, raw material expenses, research and development expenses. Industry-level concentration ratios are also used. The models also control for industry, state, year and ownership fixed effects.
*, ** and *** indicate significance at 10%, 5% and 1% respectively
– indicates not relevant.

Table 2- Effect of lockdown on firm profitability in India

	PAT	**ROS**	**EPS**	**PG**
2019-20				
Non-essential industries x post lockdown ($D_{2020,t}NE_{treat,j}$)	-0.165*** (0.057)	-0.143*** (0.032)	-0.185*** (0.040)	-0.189*** (0.052)
Other controls	Yes	Yes	Yes	Yes
No. of observations	6275	6274	6170	6214
R- squared	0.24	0.37	0.18	0.14
2018-20				
Non-essential industries x post lockdown ($D_{2020,t}NE_{treat,j}$)	-0.163*** (0.054)	-0.145*** (0.028)	-0.166*** (0.038)	-0.143*** (0.046)
Other controls	Yes	Yes	Yes	Yes
No. of observations	9219	9218	9043	9131
R- squared	0.19	0.35	0.14	0.11
2017-20				
Non-essential industries x post lockdown ($D_{2020,t}NE_{treat,j}$)	-0.170*** (0.052)	-0.148*** (0.027)	-0.160*** (0.037)	-0.125*** (0.044)
Other controls	Yes	Yes	Yes	Yes
No. of observations	12246	12244	11999	12120
R- squared	0.17	0.31	0.12	0.11
Note: Same as Table 1				

Table 3- Effect of lockdown on firm profitability with all quarters as the pre-event period

	PAT	**ROS**	**EPS**	**PG**
Non-essential industries	-0.130***	-0.164***	-0.190***	-0.110**
x post lockdown	(0.050)	(0.035)	(0.040)	(0.047)
Quarter FE	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes
No. of observations	30808	30806	30234	30413
R- squared	0.15	0.27	0.10	0.09
Note: Same as Table 1				

Table 4- Effect of lockdown on alternate measures of profitability

	PAT2	**ROS2**	**EPS2**	**PG2**
Non-essential industries	-0.172***	-0.155***	-0.157***	-0.146***
x post lockdown	(0.045)	(0.018)	(0.029)	(0.032)
Other controls	Yes	Yes	Yes	Yes
No. of observations	9219	9219	9124	9182
R- squared	0.23	0.48	0.20	0.23
Note: Same as Table 1				

Table 5- Robustness tests for examining the effect of lockdown on firm profitability

	PAT	**ROS**	**EPS**	**PG**
Falsification test 1- pseudo treatment indicator				
Pseudo treatment	-0.081	0.018	-0.061	-0.068
x post lockdown	(0.053)	(0.027)	(0.039)	(0.046)
	Yes	Yes	Yes	Yes
Other controls				
No. of observations	9219	9218	9043	9131
R- squared	0.19	0.34	0.14	0.12
Falsification test 2- 2019 lockdown				
Non-essential industries	-0.002	-0.001	0.026	0.073
x 2019 lockdown	(0.046)	(0.024)	(0.030)	(0.050)
Other controls	Yes	Yes	Yes	Yes
No. of observations	6059	6058	5946	6005
R- squared	0.21	0.29	0.15	0.14
Note: Same as Table 1				

Table 6- Effect of lockdown on demand and supply indicators

	Supply indicators		**Demand indicators**	
	Ln (real expenses)	Expense growth rate	Ln (real income)	Income growth rate
2019-20				
Non-essential industries x post lockdown	-0.191* (0.101)	-0.288*** (0.039)	-0.595*** (0.099)	-0.457*** (0.043)
Other controls	Yes	Yes	Yes	Yes
No. of observations	6592	6297	6661	6278
R- squared	0.54	0.22	0.51	0.27
2018-20				
Non-essential industries x post lockdown	-0.172** (0.044)	-0.315*** (0.034)	-0.598*** (0.085)	-0.481*** (0.038)
Other controls	Yes	Yes	Yes	Yes
No. of observations	9612	9250	9739	9222
R- squared	0.54	0.20	0.51	0.24
2017-20				
Non-essential industries x post lockdown	-0.155* (0.084)	-0.338*** (0.034)	-0.584*** (0.082)	0.497*** (0.039)
Other controls	Yes	Yes	Yes	Yes
No. of observations	12733	12286	12899	12249
R- squared	0.55	0.18	0.52	0.21
Note: Same as Table 1				

Table 7- Effect of lockdown on profitability conditioned on lockdown stringency

	PAT	**ROS**	**EPS**	**PG**
2019-20				
Non-essential industries x post lockdown x strict lockdown	-0.142*** (0.046)	-0.127*** (0.034)	-0.213*** (0.048)	-0.223*** (0.059)
Other controls	Yes	Yes	Yes	Yes
No. of observations	6275	6274	6170	6214
R- squared	0.24	0.37	0.17	0.14
2018-20				
Non-essential industries x post lockdown x strict lockdown	-0.135** (0.062)	-0.128*** (0.030)	-0.203*** (0.046)	-0.182*** (0.054)
Other controls	Yes	Yes	Yes	Yes
No. of observations	9219	9218	9043	9131
R- squared	0.19	0.34	0.14	0.11
2017-20				
Non-essential industries x post lockdown x strict lockdown	-0.138** (0.061)	-0.126*** (0.029)	-0.191*** (0.046)	-0.160*** (0.051)
Other controls	Yes	Yes	Yes	Yes
No. of observations	12246	12244	11999	12120
R- squared	0.17	0.31	0.12	0.11
Note: Same as Table 1				

Table 8- Effect of lockdown on profitability conditioned on COVID-19 spread

	PAT	**ROS**	**EPS**	**PG**
2019-20				
Non-essential industries x post lockdown x high COVID-19	-0.170** (0.075)	-0.158*** (0.038)	-0.145*** (0.050)	-0.185*** (0.060)
Other controls	Yes	Yes	Yes	Yes
No. of observations	6275	6274	6170	6214
R- squared	0.24	0.37	0.17	0.14
2018-20				
Non-essential industries x post lockdown x high COVID-19	-0.156** (0.072)	-0.157*** (0.035)	-0.118*** (0.048)	-0.134** (0.054)
Other controls	Yes	Yes	Yes	Yes
No. of observations	9219	9218	9043	9131
R- squared	0.19	0.34	0.14	0.12
2017-20				
Non-essential industries x post lockdown x high COVID-19	-0.166*** (0.071)	-0.156*** (0.035)	-0.112** (0.047)	-0.117** (0.051)
Other controls	Yes	Yes	Yes	Yes
No. of observations	12246	12244	11999	12120
R- squared	0.17	0.31	0.13	0.11
Note: Same as Table 1				

Figure 1: Trend followed by profitability measures between 2017 and 2020

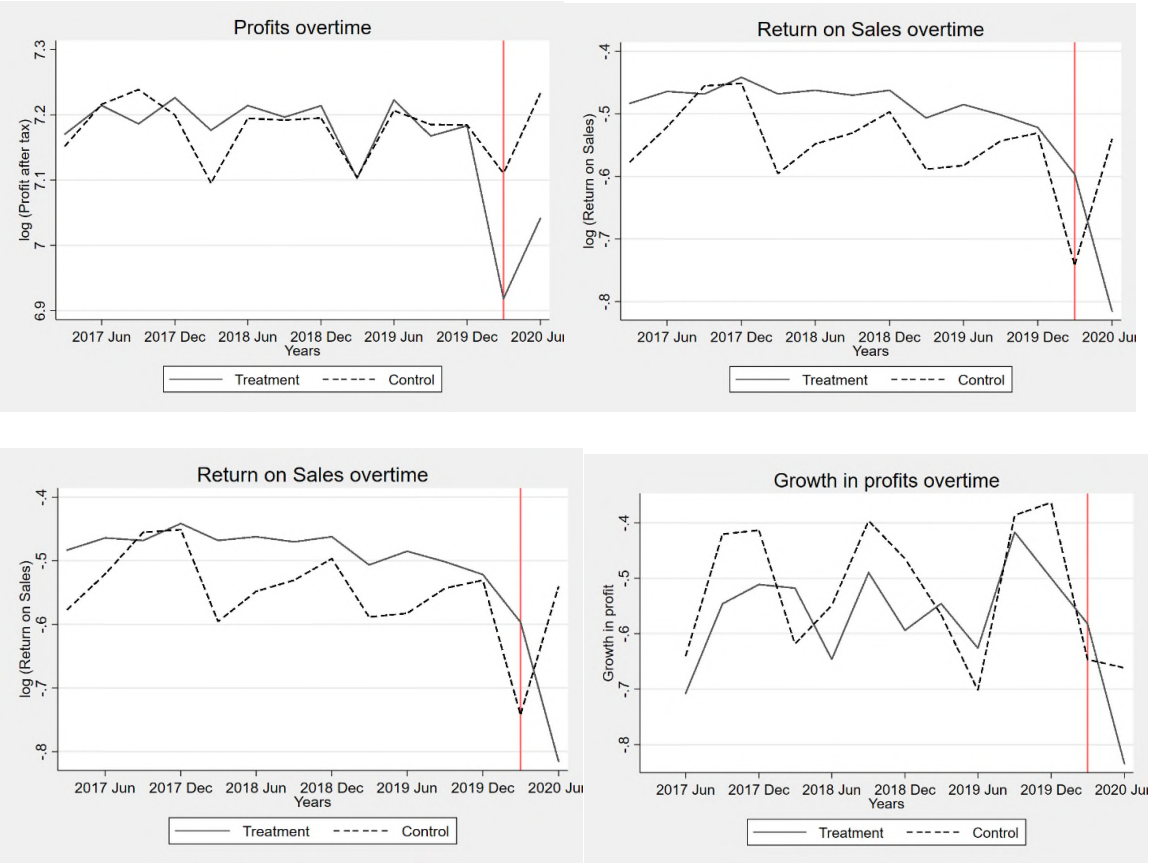

Figure 2: Parallel trends assumption by the treatment and the control group