The role of geographic proximity in the context of the COVID-19 pandemic

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by

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TITLE: THE ROLE OF GEOGRAPHIC PROXIMITY IN THE CONTEXT OF THE COVID-19 PANDEMIC

SUPERVISOR: Dr. Megha Mukim

The purpose of this paper is to explore the role of geographic proximity during the COVID-19 pandemic. The study investigates the extent to which the performance of firms has been affected by the COVID-19 pandemic, and the role played by economic geography factors in mitigating or exacerbating the impact. To do this, I build upon the conceptual frameworks from the existing literature and introduce a model to help explain performance as driven by specific firm characteristics. The study draws data from the World Bank Group's Enterprise Survey (ES). The dataset used for analysis comprises of 1097 South African firms of which 329 are from the Gauteng province. The study finds that firm size, sector, and market demand have a significant impact on the performance of private sector enterprises during the COVID- 19 pandemic. The results of the empirical analysis are inconclusive with regards to the effects of location and export collaboration in determining firm success.

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1 Introduction

The coronavirus outbreak resulted in a health catastrophe and further brought on a global economic crisis. Indeed, interest has skyrocketed in understanding how the COVID-19 pandemic has impacted economic growth (Chaudhary et al., 2020; Inegbedion, 2021; Ashraf and Goodell, 2021) The shocks have been felt through the appalling death toll, effects through the stock market, closure of businesses, changes in market structure and more. Geography – which has always played an important role in economic development – has again been put at the forefront, as the pandemic swept through different countries and cities over time. This essay investigates the extent to which the characteristics of an economic agent's geography affects their performance. Put simply, does location amplify or minimize the impact of the pandemic on firm performance?

In his First Law of Geography, Tobler (1970) states "*Everything is related to everything else, but near things are more related than distant things*." This is the fundamental assumption used in spatial analysis. There can be two identical economic agents who differ only by geographic proximity, and their objective or subjective performance differ completely. Hence, he emphasizes the importance of understanding the competitive advantages provided by geographic proximity. Geographic proximity is defined as the physical distance between agents (Howells, 2002). Economic geographers have accumulated evidence that geographic proximity has positive effects on growth through agglomeration economies[1]. Although technology allows the flow of ideas across space with decreasing costs and frictions, the importance of such agglomeration economies have become increasingly important. The shorter the geographical distance between participants, the less the cost of exchanging knowledge and information and the faster communication between actors (Doloreux, 2002). Proximity to customers, markets, suppliers, competitors, governments, jobs, and amenities is an important ingredient to fuel economic growth. Such economic growth is fueled by agglomeration economies – i.e. the spillovers that arise when economic agents are in close proximity, driving productivity growth. Physical distance and accessibility influence the ease with which economic agents can coordinate decisions.

[1] These agglomeration economies arise through a variety of matching, sharing, and learning mechanisms that have been well-described both in the academic literature (see, in particular, Duranton and Puga, 2004).

Indeed, as Kolko (2000) demonstrates, using data across the United States, the spread of internet usage only strengthens the advantages of agglomeration across cities.

This study will contribute to the existing literature by evaluating the impact of geographic proximity on firm performance in South African cities. A study of the private sector in South African cities is of particular interest to public policy – especially so given that the sector lags other middle-income countries in boosting economic growth and creating employment opportunities. In addition, South Africa's history of colonialism and apartheid has shaped how cities were formed, which continues to have implications for the economic benefits for urban residents in the present time. Cities in South Africa also continue to grapple with challenges related to liveability and lack of structural transformation in the labour markets, challenges common to cities in sub-Saharan Africa, further affecting productivity. In addition, they are relatively costly, negatively impacting capital investment by firms.

The objective of this study is to understand the effect of geographic proximity on the performance of South Africa firms in an environment that was disrupted by the coronavirus outbreak. We conceptualise a performance model for firms located in three major South African cities. Given South Africa's high unemployment rate, it is important now more than ever, to find strategies for small businesses to adapt to and withstand the impact of economic shocks in the future. This is a relevant topic for a country with a poor job market, where both – structural and spatial issues are important factors.

The study uses from the World Bank Group's Enterprise Survey, comprising of 1097 South African firms. The study confirms finds that firm size, sector, and market demand have a significant impact on the performances of companies. However, the data is inconclusive regarding the importance of location and export collaboration in determining firm success.

The remainder of this report is structured as follows: section 2 provides the literature review and hypothesis formulation, while section 3 discusses data and methodology. Section focuses on the econometric specification and section 5 presents the results. Finally, section 6 concludes with policy implications.

2 Literature review and hypothesis formulation

2.1 Existing literature

As new industries emerge, it becomes increasingly important for businesses to know factors that are good predictors of success for their industrial activity. A considerable amount of geographic proximity literature stems from historical theories formed during the time of digital revolution. The few scholars who have since revisited this body of literature in relation to firm performance have mixed findings. Some studies emphasized the importance of geographic proximity in knowledge creation and firm performance (e.g., Capaldo & Petruzzelli (2014), Leten at al. (2014)) while others point to the geographic diversity and coverage as contributors to firm performance (e.g., Kafouros et al., 2018). This controversy encourages enthusiasm to study this topic focusing on a narrower scope. We will accompany the foundational concepts with the empirical investigation and hard evidence.

Drawing upon the above, we will commence with a popular approach that used gravity models to evaluate the elasticity of trade. Venables (2006) indicated that for African regions where the distance between trading partners is thousands of kilometers, trade will be 90% lower compared to partners within 1000 kilometers. More than a decade later, Mehl (2019) finds that an increase in the physical distance between two countries by one standard deviation decreased trade in goods by 23% during the Great Trade Collapse. Transport infrastructure allows firms to access inputs cheaply and sell their products to a wider market, using economies of scale to cut costs and drive profits. The lack of geographic proximity between economic agents in Africa makes investment and productivity growth more expensive than elsewhere (Naudé, 2009). Have improvements in information technology

and transport helped to mitigate these challenges? Rietveld and Vickerman (2004), noted that the idea that physical transport would be replaced by electronic communication, thus making distance insignificant, was premature. While IT and transport innovation have improved interaction among the economic agents of different countries, there are too many underlying challenges in local markets and connective infrastructure that the challenges remain. Africa remains the poorest continent in the world.

Another concept we lay our foundation on is the invention of the telephone. The telephone was invested to bring about new ways of information distribution and exchange. Since the invention of the telephone, the Internet became an important technological innovation and brought one of the most fundamental changes in information production (Moss and Townsend, 2000). As the Internet became more popular in society, the relevance of geography and the role of distance in the information age became a big topic among scholars. Cairncross (2001) discussed how the communication revolution was impacting our lives in her book titled *The Death of Distance*. According to Cairncross, the cost of electronical communication would no longer be determined by distance. Such seminal papers explain theories that have been influential in developing this field of study. Many scholars ((Townsend (2001); Gorman and Malecki (2002)) presented evidence that supported the "death of distance" hypothesis.

The anything-anywhere-anytime paradigm argues that when more and more human activities are being conducted online and via transportation technologies, physical places no longer offer the same advantages. However, after revisiting the death of distance hypothesis, Wang et al. (2003) found that geographic proximity was still an important factor in shaping the spatial pattern of Internet activities. Several studies have suggested that innovation is a localised phenomenon and geographic proximity matters in knowledge transfer (for example Fioravanti et al (2021)). Audretsch and Feldman (1996) argue that short distances facilitate communication and knowledge exchange through face-to-face interaction, personal relations, causal and unintended meetings. Kantor and Whalley (2014) found that local firms and workers benefit from spillovers created by adjacent universities' activities. In this case, geographic proximity to firms may be conducive to increased knowledge transfer.

In between the extreme ends which are either for or against the significance of geographic proximity, lies a group of scholars who believe in the power of multidimensional proximity. Letaifa & Rabeau (2013) suggest that the role played geographic proximity is mostly realized when it facilitates other important proximities, namely social, cognitive, institutional and organizational. Social proximity includes the analysis of trust and

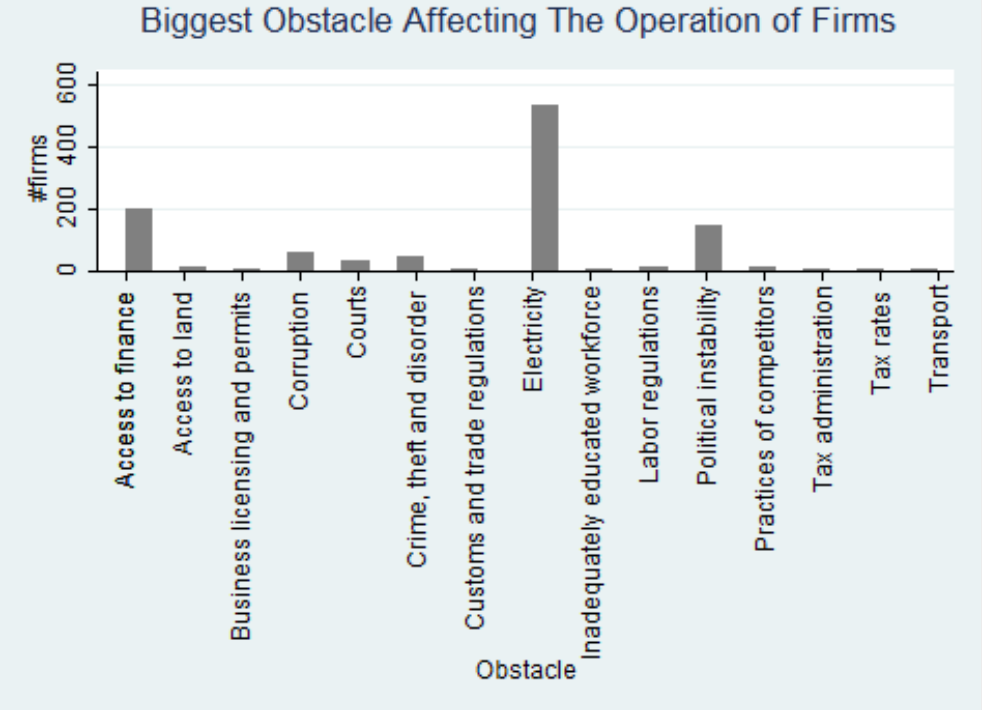
experience, while cognitive proximity refers to knowledge fields. Spatial effects have a crucial impact on economic growth. Countries can have strong links through channels such as trade, technological diffusion, capital inflows, and common political, economic and social policies. Thus, externalities can infringe country boundries, influencing the explanation of growth (Amidi & Majidi (2020)). In the context of corporate finance, the benefits of geographic closeness have been well recognized in financial decisions (John et al., 2011; El Ghoul et al., 2013), firms' innovation activities (Zhang et al., 2020; Hu et al., 2021) and investment management (Baik et al., 2010; Opie et al., 2019). These studies generally confirm that the cost of information acquisition and supervision rises as the geographical distance between agents increases.

2.2 Contextual motivation

The COVID-19 pandemic has once again made the study of distance of interest. Early in the pandemic small businesses' proximity to one another was viewed as an advantage that provided sufficient market density to attract customers from nearby neighbourhoods and facilitate delivery services to adapt to new business operations (Powe and Love, 2020). It remains unclear if these advantages hold for businesses located in less densely populated communities and small towns. In particular, smaller businesses have been strongly and negatively affected by the lockdown and other restrictions imposed during the pandemic. Powe and Love (2020) suggest that the variation in business owner experience indicates the promise for proximity and density in facilitating recovery.

The South African economic climate has not been favourable to small and medium- sized businesses owing to the obstacles affecting operations of these firms. During the first year after the coronavirus outbreak was declared a global pandemic, 1081 South African firms reported the biggest obstacles that affected their operations as shown in Figure 1. Electricity, access to finance and political instability came up as the top three obstacles. The negative impact of these challenging factors has been exacerbated by the crisis. African businesses continue to struggle as productivity slows down, demand and supply are shifted, restrictions are imposed on certain industries etc.

Figure 1 Biggest obstacle affecting the operation of firms



Data source: World Bank Enterprise Survey _ South Africa 2020 full data

The disruptions created by the COVID-19 outbreak had a sudden shock of unforeseen magnitude on the business environment. South Africa's lockdown was one of the strictest in the world. As a consequence of the lockdown restrictions, many corporate firms adapted a remote working approach. While this was effective for some economic agents, some struggled with challenges related to liveability, nature of the goods and service they provide, and costs associated with technological transformation. Measuring the impact of the pandemic on the economy will depend heavily on information and related facts provided by businesses. Hence the use of business surveys. The crisis is ongoing and so are its ripple effects. Understanding the dynamics of such shocks is essential to revive the South African business climate. There is an urgent need for empirical evidence that uses data close to real time rather than waiting for the pandemic to end.

2.3 Hypotheses

This essay will test two separate hypotheses, linking it to the economic geography literature and providing a valuable addition to the understanding of the effects of the COVID-19 pandemic on economic performance.

H1: Geographic proximity and firm specific characteristics impacts positively the performance of South African firms.

Theoretically, proximity can mitigate information asymmetry for a subset of investors, customers, potential employees or suppliers. Coval and Moskowitz (2001) suggest that local investors possess an informational advantage when trading local assets. When a company is located in a South African urban area, closer to educational institutions, R&D collaborations are easier to facilitate and chances of attracting best candidates for employment are much better. They are able to expand their offerings to accommodate a larger customer base. Being close to competitors will increase environmental adaptation. Organisations engaged more in firm-to-firm collaboration networks may likely gain benefits such as reduced transaction cost (Somaya, 2012).

H2: Firms with better economic geographies were less affected by the COVID-19 pandemic.

This hypothesis relies on the observed relations between companies' exposure to different geographic regions of operation, companies' size and type of industry in which they operate, and the media coverage of the COVID-19 outbreak. Organisations often face crises, but the COVID-19 pandemic may be unique given its speed of change and the scale of its impact on both private and public segments of the economy (Kelly, 2020). However, companies that are agile and able to change production and sales proactively, will arguably have higher chances of thriving.

3 Data and methodology

3.1 Data

The data used in this study is drawn from the World Bank Group's (WBG) Enterprise Survey. The Enterprise survey has two main objectives: *first*, to benchmark the investment climate of individual economies across the world and, *second*, to conduct firm performance analyses focusing mainly on how investment climate constraints affect productivity and job creation in selected sectors. The Enterprise Survey provides a wide array of qualitative and quantitative information based on a representative sample of a country's private sector. It is conducted at the firm level to measure factors that shape private sector response to the business environment. For the period under study, the data was collected via Computer Assisted Telephone Interviews (CATI).

The questionnaires are designed to capture information that connects the business environment of a country with the productivity and performance or firms. The ES uses a global sampling methodology to generate sample sizes that are appropriate to achieve the above-mentioned goals. In the context of the COVID-19 pandemic, this survey is a key diagnostic tool of the private sector, measuring the day- to-day experiences of firms. The dataset provided by the ES is suitable for investigating policies and the economic environment of an emerging country such as South Africa.

The selected dataset is subject to some limitations. Given that the data for South Africa is available for one point in time during the pandemic, any temporal analysis (via panel regressions) is not possible and thus causal inference is limited.

Table 1: Survey information

Survey status	The ES covers a representative sample of South Africa's private sector. The World Bank collects data on firm characteristics, performance, and on various business environment topics.
Selection criteria	Registered establishments with five or more employees functioning within several industries in South Africa.
Number of responding businesses	1097 (South Africa) 329 (Gauteng province)
Reference period	December 2019 – February 2021

3.2 Methodology

According to Saunders (2015) there are three available approaches that can be used to conduct research, namely qualitative, quantitative, or mixed methods. I will utilize the quantitative method paradigm for this study. I will utilize the quantitative method paradigm for this study. Quantitative methods use quantifiable data to articulate facts and reveal patterns in research The statistics will help derive results and conclude the response to the research problem. The chosen technique is deemed appropriate for this study because it will capture accurate in-depth insights of the topic while allowing for complete utilization of data.

The analysis is conducted in two stages outlined below.

Stage I

The first stage of the analysis uses data on the Enterprise Survey to understand the extent to which economic geography variables (i.e. local agglomeration, density, business environment, amenities etc) affect the performance of firms. The sample size is 1097 South African firms from Gauteng, Western Cape, KwaZulu Natal and Eastern Cape. I will conduct correlations that control for basic characteristics such as sector and location to allow for some descriptive understanding.

Stage II

In the second stage of the analysis the focus is narrowed to 329 firms from Gauteng. We employ the follow up data to understand the impact of COVID- 19 on various aspects of firm performance in Gauteng and the extent to which these may be associated to the economic geography of the location. The hypothesis is that firms with access to better agglomeration economies and advantages of geography, those in Gauteng, should be less affected by the effects of the pandemic.

4 Empirical analysis

4.1 Model specification

The selection of explanatory variables has proven to be a challenge given the uncertainties that exist in the business environment during the reference period. Unlike other past global shocks whose effects could be measured and understood within a short period of time, the COVID-19 pandemic setting does not have many reliable determinants.

The ultimate choice of variables was arbitrary but largely reflects the most frequently discussed firm characteristics as determinants of firm performance. The outcome variable under study is the performance of a given firm. A firm's performance can be measured by a series of outcomes, including total outputs, revenues, profits, labour, capital or total factor productivity. This study uses two dependent variables to measure firms' performance. The first dependent variable is the operational status (*Op_status*) of the firm. This answers the question whether a firm is permanently closed (code 0), temporarily closed (code 1) or open (code 2) because of the COVID-19 pandemic. The second dependent variable is the change in sales for the last month compared with the same month in 2019 *(SALESimp*). The use of these variables may reflect the sustainability of business models much better than traditional performance measurements such as those listed above in the context of the COVID-19 outbreak.

Industrial organization literature (as explored below) suggests that several firm-specific characteristics can affect firm performance. The independent variables are the characteristics of the firms which consist of both continuous and dummy variables. Categorical responses from the survey have been coded into dummy variables. The independent variables are described in Table 2 in the Appendix.

Results from multiple scholars suggest that there is a positive relationship between the size of a firm and profitability. One of the concepts that may be used to support this view is economies of scale. Highly efficient firms reap cost advantages. In their paper, Ichev and Marinc (2018) argue that big firms have more competitive power compared to small firms because of the larger market share, better access to capital, experience, and operational efficiencies they possess. The size indicator deployed in this study is the number of employees in the establishment. There are small (5-19 workers), medium (20-99 workers) and large (100+) firms. This study considers the number of permanent, full-time workers end of December 2019 in all categories.

The South African dataset includes selected regions that represent the largest centres of production and business enterprise. These are namely: Gauteng, KwaZulu Natal, Eastern Cape and Western Cape. Hassan et al (2020) found evidence that the COVID-19 pandemic impacted certain sectors in the economy more than others. The lockdown regulations in South Africa imposed restrictions on firms not considered as essential businesses. This meant the sector or industry in which the business operates as well as its ability to convert production or services in response to COVID-19 influenced its performance. To account for this reality, I incorporate the sector and adjustment variables. A popular feature of economic crises is exports.

There are different dimensions of proximity. While all of them play a role in the performance of businesses, for the purpose of this study the focus is geographical proximity. Location is an instrument to facilitate cognitive, social, and cultural proximity. Shorter geographic distance helps ease coordination and communication, increases the rate

and effectiveness of technological transfers, and reduces information asymmetries. Closer firms are in a more similar context, thus the need for a region-specific variable. Furthermore, my analysis will incorporate an export variable and a related export collaboration variable. An exporter is a business with at least ten percent of sales exported directly. Otherwise, the business is a non-exporter. Exporting to Southern Africa Development Community (SADC) member state is the nearest collaboration, followed by Other Sub-Saharan African (SSA) countries while Asia and Europe are most distant.

Literature on capital structure elaborates several theories on companies' financing decisions. The coronavirus pandemic has demonstrated that private enterprises depend strongly on the wider environment, including governmental support. The financial source variables include access to new credit and the support provided by the South African government in response to the crisis. The COVID-19 outbreak is not only a health crisis, but also an economic crisis with undeniable demand and supply shocks across different markets. I introduce a variable that captures the changes in demand for the goods and services offered by firms under study. Changes in demand have led to a surge in e-commerce and accelerated digital transformation. Technology is a key tool that can be used to mitigate difficulties businesses encounter to get their goods and services to the market. Utilization of convenient technologies has become significantly important during this period where social and physical distancing are required to lessen the coronavirus impact. Thus, I incorporate an online activity and delivery services variable.

The model specification for the baseline regression is as follows:

$$Performance_i = \beta_0 + \beta_{1*}(firm) + \beta_{2*}(finance) + \beta_{3*}(digital\_solns) + \beta_{4*}(region) + \beta_{5*}(demand) + \varepsilon_i$$

where the subscript i denotes each firm. $Performance_i$ is the dependent variable measuring a firm's performance. This variable is proxied by two variables: *SALESimp* and *Op_Status*. β_0 is a constant; $\beta_1 - \beta_5$ are the coefficient vectors of the parameters we want to estimate; ε is the disturbance term; *finance* represents various finance sources; *firm*

includes size, sector, adjustment, delivery, and export.

Op_Status is a categorical dependent variable. Thus, I will use the logistic regression technique to estimate the model when this left-hand side variable is used.

4.2 Descriptive statistics

Descriptive statistics for the South African Full dataset are summarised in Table 3 below.

Table 3 Descriptive Statistics for SA full data

Variable	***N***	***Mean***	***Std. Dev.***	***Min***	***Max***
SALESimp	1070	-37.525	30.167	-100	86
Sector	1097	2.093	.845	1	3
Region	1097	2.593	1.014	1	4
Size	1093	64.853	261.979	2	7000
Demand	1086	2.797	.503	1	3
Exporter	1074	.088	.284	0	1
digital_solns	921	.654	.476	0	1
trade_co	119	1.966	1.255	1	4
Gvt_supp	991	.427	.495	0	1
Loan	909	.047	.212	0	1
Equity	909	.02	.139	0	1

Note: The above variables are described in Table 2 found in the Appendix

From the 96% of the respondents, change is sales ranged from a 100% decrease to 86% increase. On average, sales decreased by 38%. Firms interviewed were from three sector categories and four provinces. The average number of fulltime employees for a firm is 65. The smallest firm has two workers and the largest, 7000 workers. The demand for a particular firm's product in the covered period does not increase on average. More than 50% of the firms have online business activity. On average, 119 of the firms have at least one exporting collaboration.

Descriptive statistics for the Gauteng follow-up survey dataset are summarised in Table 4 below. This dataset contains additional characteristics which will be useful for the analysis. Of the 329 firms in the Gauteng province, the operational statuses of only 205 firms are known. About 50% of the respondents experienced a change in sales ranging from a 100% decrease to a 70% increase. The number of fulltime employees for a firm at the end of December 2019 ranges from zero to 25,000. Permanent, full-time workers are defined as all workers that work for a term of one or more fiscal years and/or have a guaranteed renewal of their employment and that work a full shift. None of the firms interviewed had received government funding. In a group of 70 firms, an average of 6.4% of their sales were direct exports.

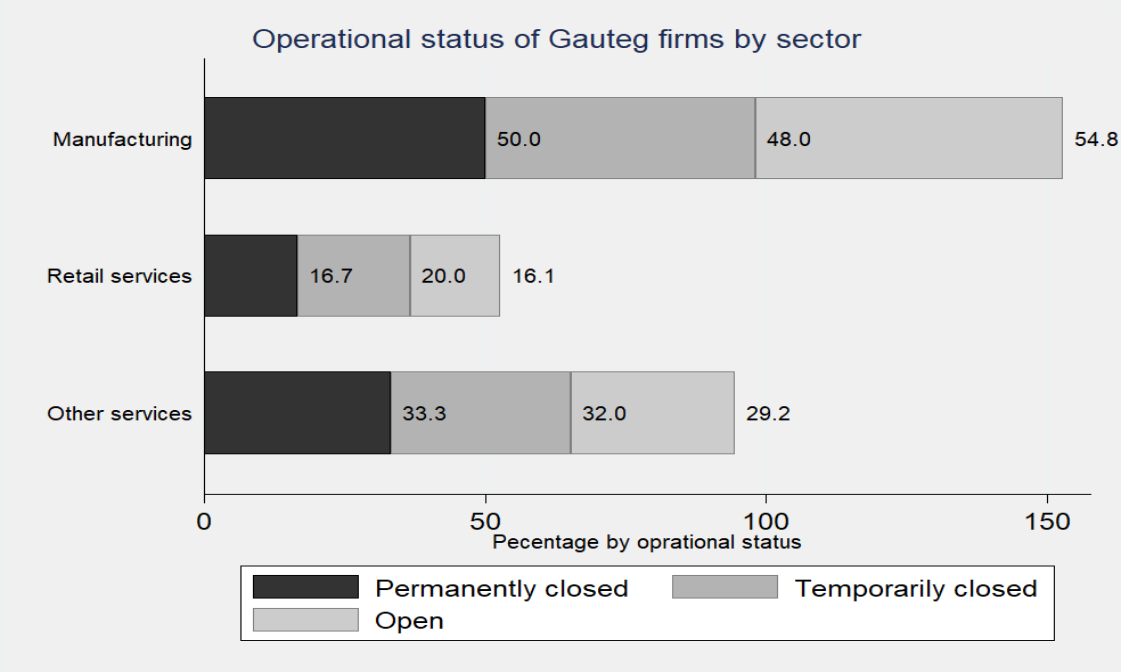
Table 4 Descriptive Statistics for Gauteng follow-up data

Variable	***N***	***Mean***	***Std. Dev.***	***Min***	***Max***
SALESimp	166	-33.554	33.789	-100	70
Op_status	205	0.819	0.385	0	1
Sector	205	1.761	0.884	1	3
Size	124	265.77	2251.034	0	25000
Demand	188	2.612	0.623	1	3
Export	70	6.414	16.577	0	100
digital_solns	322	0.205	0.404	0	1
Delivery	324	0.185	0.389	0	1
Adjustment	326	0.288	0.454	0	1
Gvt_supp	329	0	0	0	0
Loan	136	0.073	0.262	0	1
Equity	136	0.066	0.25	0	1

Note: The above variables are described in Table 2 found in the Appendix

Only 62% of the firms in the Gauteng follow-up dataset reported their operational status (the options being either permanently closed, temporarily closed or open). Since the first lockdown, business disruptions experienced by small and medium businesses started to signal a strong decline in revenue and profitability. Few months down the line, the proportion of firms that had closed was shocking. Figure 2 presents the operational status of 205 firms across the three sector categories.

Figure 2



Data source: World Bank Enterprise Survey _ South Africa 2020 full data

5 Results and discussion

This section presents the results of correlations and regressions.

Tables 5 presents the Pearson correlation coefficients, while Table 6 presents the Spearman rho correlation results. Pearson correlation coefficients measure the linear relationship between the variables while Spearman correlation coefficients measure only monotonic relationships.

The coefficients of the correlation among variables in this study range between -0.701 and 0.697 for Pearson and between -0.618 and 0.697 for Spearman. Majority of the correlation coefficients are generally below the typical concern threshold of the multicollinearity indication level, implying that multicollinearity will not be a major problem in the estimated regressions. *SALESimp*, size, region- and sector- variables show significant correlation coefficients. For instance, the small to moderate Spearman correlation observed between size and *SALESimp* is 0.197 and is statistically significant at 0.1% level of significance. This implies that there is enough evidence to reject the null hypothesis and accept the alternate hypothesis that there is some relationship between the two variables.

The coefficients between market demand and *SALESimp* have a high positive correlation. When the demand for the firms' goods and services increased the change in sales moved in the opposite direction i.e., there was less deviation (increase or decrease) of sales volumes from the levels recorded before COVID-19. GP AND SADC have a low positive correlation. Firms in Gauteng are more likely to have more trading partnerships with member states of the SADC as Gauteng is closest to these states.

Stratified random sampling was deployed to select the sample from the contacts available in frame. The sample target for the ES in South Africa in 2020 was 1100 firms. Of these 1 097 firms were able to complete interviews, making the target completion rate equal to 99.7% (World Bank, 2020). The attrition rate represents the loss of study units from a sample before its completion. The percentage of firms who were eligible in process but did not complete the interview is only 0.2%. This low rate suggests little bias. Hence, the correlation results obtained are representative of the population.

Table 5 Coefficients of the Spearman correlation

Variables	SALESimp	size	manuf	retail	GP	KZN	WC	Exporter	digital_solns	Gvt_sup	loan	equity	SADC	SSA	EU	Asia	demand
SALESimp	1.000																
size	0.087***	1.000															
manuf	0.112***	0.154***	1.000														
retail	0.070**	-0.053*	-0.42***	1.000													
GP	0.106***	0.022	0.057*	-0.027	1.000												
KZN	-0.027	-0.011	0.017	0.030	-0.428***	1.000											
WC	-0.072**	-0.009	-0.043	-0.003	-0.436***	-0.324***	1.000										
Exporter	0.088***	0.041	0.204***	-0.011	0.024	-0.062**	0.058*	1.000									
digital_solns	-0.037	0.003	0.119***	-0.049	0.150***	-0.056*	-0.110***	0.000	1.000								
Gvt_sup	-0.036	0.047	-0.036	0.007	-0.453***	0.135***	0.203***	-0.023	-0.068**	1.000							
loan	-0.056*	-0.008	0.026	-0.012	-0.109***	-0.033	0.09***	-0.006	-0.054	0.108***	1.000						
equity	-0.008	0.001	0.012	-0.053*	-0.088***	0.027	0.042	0.052	-0.005	0.019	-0.032	1.000					
SADC	0.062	-0.044	0.239***	-0.111	0.312***	-0.007	-0.212***	0.069	0.250***	-0.066	-0.162*	-0.134	1.000				
SSA	0.128*	0.072	0.099	-0.012	-0.073	0.060	0.010	0.125	0.046	0.150*	0.047	0.066	0.144*	1.000			
EU	0.128*	-0.117	0.056	0.101	-0.097	0.030	0.085	0.287***	-0.076	0.002	-0.120	-0.025	0.042	0.372***	1.000		
Asia	0.023	-0.073	0.050	0.006	-0.119	0.112	0.037	0.204**	-0.058	0.135*	-0.030	-0.017	0.042	0.438***	0.697***	1.000	
demand	-0.701***	-0.030	-0.077**	-0.007	-0.066**	0.055*	0.041	-0.054*	0.023	0.021	0.017	0.011	-0.103	-0.093	-0.050	0.045	1.000

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

Table 6	Coefficients of the Spearman correlation																
	SALESimp	size	manuf	retail	GP	KZN	WC	Exporter	digital_solns	Gvt_supp	loan	equity	SADC	SSA	EU	Asia	demand
SALESimp	1																
size	0.197***	1															
manuf	0.113***	0.269***	1														
retail	0.0785*	-0.0320	-0.420***	1													
GP	0.119***	0.108***	0.0566	-0.0274	1												
KZN	-0.0235	-0.0456	0.0168	0.0301	-0.428***	1											
WC	-0.0747*	-0.0559	-0.0434	-0.00294	-0.436***	-0.324***	1										
Exporter	0.0800**	0.149***	0.204***	-0.0112	0.0239	-0.0624*	0.0582	1									
digital_solns	-0.0381	0.0494	0.119***	-0.0490	0.150***	-0.0563	-0.110***	0.000214	1								
Gvt_supp	-0.0392	0.00591	-0.0359	0.00737	-0.453***	0.135***	0.203***	-0.0228	-0.0684*	1							
loan	-0.0714*	-0.0206	0.0258	-0.0117	-0.109***	-0.0333	0.0926**	-0.00577	-0.0541	0.108**	1						
equity	-0.000405	0.0229	0.0116	-0.0533	-0.0877**	0.0271	0.0419	0.0519	-0.00472	0.0188	-0.0317	1					
SADC	0.0739	0.112	0.239**	-0.111	0.312***	-0.00656	-0.212**	0.0695	0.250**	-0.0664	-0.162	-0.134	1				
SSA	0.118	0.0208	0.0995	-0.0119	-0.0735	0.0599	0.00960	0.125	0.0456	0.150	0.0474	0.0660	0.144	1			
EU	0.115	0.0106	0.0564	0.101	-0.0967	0.0300	0.0855	0.287***	-0.0764	0.00240	-0.120	-0.0255	0.0416	0.372***	1		
Asia	0.0262	0.0748	0.0499	0.00632	-0.119	0.112	0.0374	0.204*	-0.0584	0.135	-0.0303	-0.0171	0.0417	0.438***	0.697***	1	
demand	-0.618***	-0.116***	-0.0849**	0.00145	-0.0703*	0.0543	0.0489	-0.0597	0.0328	0.0315	0.0179	0.0116	-0.0699	-0.0787	-0.0178	0.0633	1

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 7 presents the estimation results concerning the influence of various characteristics on firm performance during the COVID-19 pandemic for the full South African dataset. Four models are presented where *SALESimp* is the dependent variable.

Model 1: Basic model.

Model 2: A model that controls for regional differences.

Model 3: This model controls for trade partnership between the SA firms and international regions, i.e. export collaboration.

Model 4: Includes all the independent variables, controlling for both region and export collaboration. I make use of dummy variables for each province as well as dummy variables for each trade partnership.

Table 8 presents regression estimates using the Gauteng follow-up data.

Model 1: Uses Ordinary Least Squares (OLS) technique where *SALESimp* is the dependent variable.

Model 2: Estimation using logit regression where the operational status of the firm is the dependent variable.

The study found that three of the explanatory variables - size of the firm, sector and decrease in market demand - all have a significant impact on firm performance in the period of interest. This supports the findings suggested by early literature on the importance of firm size and sector on company performance. Interestingly, none of the export or trade collaboration indicators have been confirmed as significant. Furthermore, financial indicators seem to have little or no impact on business performance during the coronavirus crisis.

Using data related to the COVID-19 pandemic, I am also unable to confirm the importance of geographic proximity in the performance of South African firms. There

is insufficient evidence to corroborate my two fundamental hypotheses outlined with a high degree of confidence – however, the results do provide some indication of the processes at work.

In particular, it would seem that larger firms and firms in particular sectors (manufacturing and retail) are more likely to weather the pandemic crisis. An ex-post explanation might suggest that since international trade was strongly and negatively affected by the crisis, given its global nature, this would explain that exporters were not protected by their international links. The effect of the location variable is also not significant – which indicates that location at the provincial level is less likely to drive changes in firm performance. With finer grained data on the geographical location within urban regions, the model may have been able to pick up the effects of economic geography variables more clearly. It is, however, surprising that the financial indicators have no discernible effect, as one would have assumed that access to finances would have helped steady firm performance. Nonetheless, it could be hypothesized that these effects might have been better captured with the use of longer-term panel data.

The study has had to work around certain limitations of data and methodology. Having multiple data points would allow researchers to keep track of firms over time, taking into considerations the effects of the crisis at different points in time. Monetary and governance variables are confounding factors that may be useful in reconciling the contrasting results to previous literature findings.

6 Conclusion

The COVID-19 outbreak, and the measures implemented to contain its spread have resulted in major disruptions to the economic system worldwide. For businesses in developing economies like South Africa, this comes on top of existing structural challenges facing the private sector. Whether COVID-19 is truly an inflection point for countries and firms is yet to be seen but there is no doubt that the pandemic has challenged core premises of several theoretical foundations in ways that have important implications for the future. The main contribution of this study is the development of a performance model that amalgamates a traditional measurement approach with the testing of relatively novel variables such as business closures during COVID-19 and whether firms respond to the pandemic by adjusting their business activities. This study joins the growing body of understanding the impact of COVID-19 on firm performance. Given that COVID-19 might have a long-term effect, the study can serve as a building block for further research into the subject. Specifically, this essay encourages future researchers to apply multiple theories and examine their relevance to company performance.

The limitations of this paper offers opportunities for further research to extend findings. One limitation of this study is that the effects of the COVID-19 pandemic are still unfolding and there have been additional waves of the outbreak after the data was collected. Further research is required in at least three directions. *Firstly*, more substantial data is needed to quantify the impact of geographic proximity on business performance. Currently, there is a lack of comparable, cross-location and time-series data on important determinants of firm performance in developing countries. *Secondly*, additional studies are required with the application of various metrics and cross-sectional data. For example, it is currently impossible to conclude whether the operational status of a firm is a relevant indicator in business studies in the long run when we have not considered the existing relationships that might have provided a competitive edge during the Covid-19 outbreak. Thirdly, Extending the research to other regions in South Africa to test the model would also be a valuable exercise. A larger sample size in the future could also yield more interesting and definitive

results. Furthermore, the vulnerability of some private firms, industry sectors and provinces to infectious diseases such as COVID-19 should be recognised and managed by policymakers.

In conclusion, it seems that firm-specific characteristics seem to be the best at determining their ability to survive the pandemic. However, those linked to the larger business and economic geography environment seem mostly irrelevant. This is suggestive that firms in South Africa, although linked to and dependent on their external environment including public institutions, have also been more or less pushed to depend on their own circumstances to respond to and be resilient to economic shocks.

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8 Appendix

Table 2: Description of variables

Variable	Description	Relevant survey code
Dependent variables		
Op_status[*]	Operational status of the firm; Is the firm permanently closed (code 0), temporarily closed (code 1) or open (code 2)	COVb0
SALESimp	Percentage increase or decrease in sales for the last month compared with the same month in 2019	COVb2b & COVb2c
Explanatory variables		
size	Number of permanent workers; As of December 2019, how many full-time employees did the firm have?	COVd0a
sector	1-manufacturing; 2-retail; 3-other services	a0
exporter	Takes value of 1 if at least 10 percent of sales are directly exported; Otherwise– nonexporter	COVb3c
digital-solns	Online business activity	COVc4a
demand	The demand for this establishment's products and services	COVc2b
Adjustment[*]	This establishment converted its business operations in response to COVID-19 (yes=1; no=0)	COVc3

[*] Data for these variables was only available in the Gauteng follow-up survey

Delivery[*]	Delivery or carry out of goods or services	COVc4b
Region	1-Gauteng; 2-KwaZulu Natal; 3- Eastern Cape; 4-Western Cape	a2
Gvt_supp	Government support	COVf1
Loan	Loans from commercial banks	COVe2
Equity	Equity finance (increase contributions or capital from existing owners/shareholders or issuing new shares)	COVe2
trade_co	Exporting collaboration with: 1-SADC; 2-SubSaharan Africa; 3-Europe; 4-Asia	SAd1a-d

[*] Data for these variables was only available in the Gauteng follow-up survey

Table 7	Multiple regression results for the SA full dataset			
	1	2	3	4
size	0.0162**	0.0158**	0.0204	0.0167
	(0.00555)	(0.00551)	(0.0172)	(0.0191)
manuf	8.509***	8.542***	2.723	3.465
	(2.077)	(2.090)	(7.617)	(7.923)
retail	11.39***	11.27***	12.77	12.97
	(2.036)	(2.030)	(9.685)	(9.883)
Exporter	0.716	0.732	-1.303	-1.347
	(2.782)	(2.808)	(5.464)	(5.450)
digital_solns	-2.031	-2.697	3.269	2.222
	(1.778)	(1.775)	(6.072)	(6.028)
Gvt_supp	0.362	3.309	-6.509	-4.546
	(1.655)	(1.892)	(5.187)	(6.771)
loan	-3.134	-1.893	5.424	4.210
	(2.927)	(2.839)	(10.41)	(10.44)
equity	0.367	1.420	-6.397	-5.370
	(6.238)	(6.191)	(11.11)	(12.07)
demand	-21.73*	-21.54*	1.098	0.879
	(9.499)	(10.06)	(26.70)	(29.32)
GP		7.019*		2.959
		(2.884)		(8.899)
KZN		1.987		-4.554
		(2.533)		(7.646)
WC		0.0658		-1.846
		(2.540)		(7.500)
SADC			1.696	0.00669
			(5.126)	(5.885)
SSA			1.610	1.202
			(4.745)	(4.605)
EU			12.74	12.62
			(8.357)	(7.527)
Asia			-5.587	-5.057
			(8.127)	(7.149)
_cons	13.17	8.911	-54.51	-52.29
	(28.22)	(29.99)	(80.77)	(88.72)
R-squared	0.0803	0.0937	0.1223	0.1342
F-statistic	6.12	5.57	1.06	1
N	670	670	94	94

Standard errors in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 8	Model 1 (SALESimp as a dependent variable)		Model 2 (Op_status as a dependent variable)	
	Coefficients	Std errors	Coefficients	Std errors
size	0.000371	(0.000433)	0.000143	(0.0000957)
manuf	-19.30	(12.21)	0(.)	
retail	-5.565	(9.112)	-1.099	(0.956)
DExports	-0.193	(0.186)	0.0217	(0.0313)
digital_solns	12.48	(8.314)	2.702	(1.471)
loan	9.807	(15.05)	-2.079	(1.121)
equity	13.14	(7.383)	0	(.)
delivery	-13.11	(7.943)	-2.075	(1.236)
demand	-9.259	(15.01)	0	(.)
adjustment	-5.241	(9.894)	-0.379	(1.062)
_cons	-4.773	(46.02)	2.443*	(0.990)
	R-squared	0.1652	Wald Chi2(7)	24.65
	F-statistic	1.65	Pseudo R2	0.2086
N	50		44	

Standard errors in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$