Innovation as a driver of SMME performance in South Africa: a quantile regression approach

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Abstract

Purpose – Innovation is regarded as a crucial determinant of growth and development in South Africa, and small, medium and micro enterprises (SMMEs) have been earmarked as instruments for the achievement of the socio-economic goals and innovation as set out in the National Development Plan. The purpose of this study is to investigate the effect of innovation on SMME performance in South Africa.

Design/methodology/approach – The empirical analysis was conducted using the quantile regression technique to examine the effect of innovation on the performance of firms at different sales levels. Data from the World Bank's enterprise survey was used for the analysis.

Findings – The results of the empirical analysis showed that R & D expenditures have a positive and significant effect on performance for firms with higher sales (high growth or larger firms). There is evidence that the introduction of new products/services promotes performance for low growth/ smaller firms.

Practical implications – The empirical results imply that innovation is crucial for SMMEs' development and growth. However, smaller/low growth firms are not able to spend on R & D due to a lack of funds which could be the reason for their low survival rate. More support needs to be provided to smaller firms with lower sales growth, given the large financial outlay required for R & D expenditures. Despite the lack of funding for R & D expenditure, smaller firms are encouraged to introduce new products and methods of production that do not require major financial outlays.

Originality/value – There is scant empirical evidence on the impact of innovation on firm performance in South Africa. Most studies investigate the challenges faced by SMMEs and the different types of innovation approaches used by firms. Furthermore, the study employs the quantile regression approach which highlights the effect of innovation on firms of different sizes.

Keywords SMMEs, SMEs, Sales, Sales per worker, R & D expenditure, Quantile regression

Paper type Research paper

1. Introduction

Small, medium and micro enterprises (SMMEs) are crucial for the economic growth and development of any nation; however, sustaining their performance in the long term remains a considerable challenge (Bhorat *et al.*, 2018). The changing nature of the world economy which has become more knowledge based has necessitated that businesses be innovative in order to maintain growth and development, as well as achieving socio-economic goals. Innovation is referred to as the commercial or industrial application of something new or a new product, new process or method of production (Saunila, 2016). Despite its importance, innovation remains a challenge globally including South Africa. This is an area of concern, given the socio-economic challenges that are faced by several developing economies such as unemployment, inequality and poverty (Hausman, 2005; Lukhele and Soumonni, 2020).

SMMEs account for the great majority of firms and jobs in vast world economies (Dabic *et al.*, 2021). Their ability to adapt to innovation and digitalization ensures that

there is success if implemented in a practical manner and can compete in world markets (Dabic *et al.*, 2019). However, they lag behind larger firms in the economy. When it comes to digitalization and innovation, this has some negative impacts on the small and mid-sized enterprise (SME) firm performances (Parrilli *et al.*, 2020). The digital development of SMEs requires that they re-think and innovate their business models; however, they have limited time and resources to incorporate new strategies and innovative new business models (Bouwman *et al.*, 2019).

The literature has highlighted the importance of innovation and digitalization in the process of maintaining the development of SMMEs (Wong *et al.*, 2005; Van Stel *et al.*, 2005; Curraj, 2018). Without innovation or digitalization, businesses will find it difficult to adapt to the changing environment. The fourth industrial revolution (4IR) and the Covid-19 pandemic have accelerated the need for innovation and digitalization in SMMEs. As such, performance management models are also extending their scope beyond traditional functions such as finance and manufacturing to go deep into innovation, digitalization and R&D where intangibles such as information and knowledge play more of a role (Davila *et al.*, 2012). It is, thus, important to understand better the performance of SMMEs and how it relates to innovation and digitalization within SMMEs (Curraj (2018).

South Africa has been plagued by challenges such as high unemployment rate, inequality and poverty levels since the dawn of democracy in 1994 (World Bank, 2018). Furthermore, economic growth has been sluggish for the past decade due to the slow recovery from the 2008/2009 global financial crisis. SMMEs have been earmarked as instruments for the achievement of the socio-economic goals and innovation as set out in the National Development Plan (Bhorat *et al.*, 2018; Lukhele and Soumonni, 2020). SMMEs, however, continue to be in the shadow of larger businesses with regards to contribution to GDP and innovation. South Africa has identified innovation as a crucial determinant of growth and development, and thus developed policy frameworks to encourage both the public and private sectors to put innovation at the forefront. In 1996, South Africa has adopted the National System of Innovation (NSI) which includes Doing, Using and Interacting (DUI), and Science, Technology and Innovation (STI) for the purpose of addressing the innovation challenge faced by both small and large businesses and also strengthening South African technological capabilities (Lukhele and Soumonni, 2020). Due to the changing nature of the world economy, an updated White Paper on Science, Technology and Innovation was adopted in 2019. Despite these initiatives, the innovation levels of SMMEs remain inadequate to contribute to the growth and development of SMMEs (Furawo and Scheepers, 2018). Furaro and Scheepers (2018) argue that sustained innovation is critical for developing a firm's competitive advantage which, in turn, impacts its survival. According to Bushe (2019), over 70% of SMMEs fail in their first 5–7 years of inception. Therefore, the low survival rate of SMMEs in South Africa could be an indication of inadequate levels of innovation.

There is scant empirical evidence on the impact of innovation on firm performance in South Africa. There is growing literature on the nature of digitalization and innovation on SMMEs in South Africa, which has highlighted the lack of infrastructure, knowledge and skills in improving innovation levels (Afolayan and De la Harpe, 2015; Ndabeni *et al.*, 2016; Ndabeni *et al.*, 2019; Lukhele and Soumonni. 2020). Furthermore, recent studies such as those of Bhorat *et al.* (2018) and Lukhele and Soumonni (2020) investigate the challenges faced by SMMEs, as well the different types of innovation approaches used by firms, respectively. Therefore, the objective of this study is to fill this gap by investigating the impact of innovation on SMME performance in South Africa. The study is structured as follows: Section 2 discusses the empirical literature; Section 3 outlines the data and methodology; Section 4 presents and discusses the empirical results; and lastly, Section 5 provides a conclusion and recommendations.

2. Overview of SMMEs in South Africa

This section presents a brief overview of SMMEs in South Africa. As indicated by the National Development Plan (NDP), SMMEs are regarded as important vehicles for the achievement of socio-economic goals and innovation in South Africa (Bhorat *et al.*, 2018; Lukhele and Soumonni, 2020). Furthermore, SMMEs are envisioned to create 90% of jobs by 2030. The SMME sector in South Africa has performed poorly relative to other middle-income countries with regard to their contribution to employment and GDP. According to Bhorat *et al.* (2018), SMMEs in South Africa contributes 56% to employment and around 45–50% to GDP compared to 95% and 70%, respectively for other middle-income economies. According to Bowmaker-Falconer and Herrington (2020), in 36 countries in the Organisation for Economic Co-operation and Development (OECD), small and medium enterprises constitute 99% of all firms and contribute between 50 and 60% to total value-added.

The poor performance of SMMEs in South Africa as shown by the high failure rate can be attributed to the entrepreneurial environment which is not conducive to business growth and development (Bushe, 2019; Bowmaker-Falconer and Herrington, 2020). Furthermore, there is a lack of adequate innovation which often occurs as a result of the inability to source funding for R & D expenditures (Furawo and Scheepers, 2018). The business discontinuance rate as shown by the 2019/2020 Global Entrepreneurship Monitor (GEM) study was 4.9% while the established business ownership rate, is the percentage of the adult population that has owned or managed businesses for a period of more than 42 months, was 3.5%. This is an indication that the business failure rate is greater than the rate at which businesses are created. In 2019, South Africa was ranked 49 out of 54 participating countries in the GEM's National Entrepreneurship Context Index (NECI), which is a measure of the entrepreneurial environment for business start-ups and growth (Bowmaker-Falconer and Herrington, 2020). In realizing the continued challenges of financial access for SMMEs, the Minister of the Department of Small Business Development announced the creation of a Small Business Innovation Fund designed to provide loans and grants for SMMEs with high growth potential (Bowmaker-Falconer and Herrington, 2020). One of the objectives of the Fund is to encourage SMME's innovation and growth which are crucial for strengthening competitive advantages. Hence, this study examines the effect of innovation on SMME performance.

Figure 1 shows the region of the establishment of the SMMEs in South Africa. According to the World Enterprise Survey data which comprises of SMMEs in Gauteng, KwaZulu-Natal, Western Cape and Eastern Cape, the majority of the firms (37.19% out of the total of 917) are located in Gauteng. This is expected given that the province is the major economic hub of South Africa. Due to its large population size and high economic activity, Gauteng presents more opportunities for SMME growth and development. Figure 2 shows that most of the SMMEs (over 60%) are small which is encouraging, given the higher productivity scope for small firms compared to the medium and larger firms. Figure 3 highlights that most of the SMMEs are in the services industry. Bhorat *et al.* (2018) also showed that the majority of the SMMEs operate in the services sector with 30% being in the wholesale and retail trade industry, 23% being in the community and social services industry and 14%, in the financial services industry. This is as expected, given that the services sector is the largest contributor to output and employment in South Africa.

3. Literature review

This section presents a review of the theoretical and empirical literature on the effect of innovation on firm performance. The empirical literature comprises of a survey of studies that have investigated a similar topic to this study, with the aim of identifying gaps in the literature.
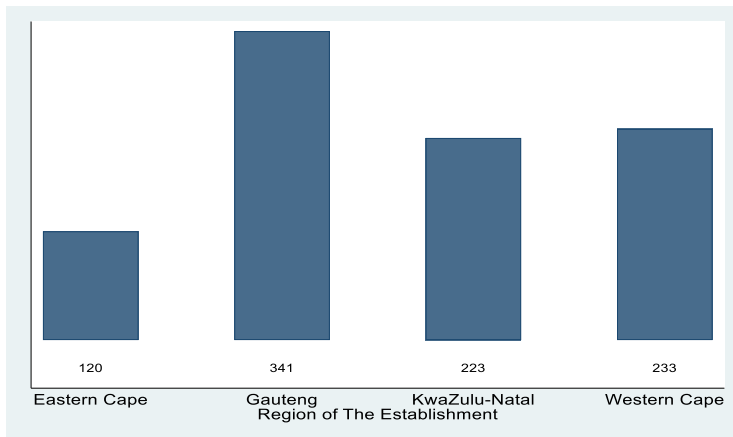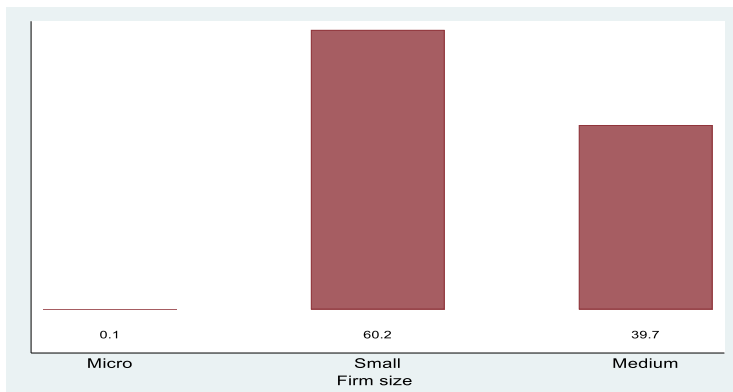
Figure 1.
SMMEs region of
establishment

| 120 | 341 | 223 | 233 |
| Eastern Cape | Gauteng | KwaZulu-Natal | Western Cape |

Region of The Establishment

Figure 2.
Firm size

| 0.1 | 60.2 | 39.7 |
| Micro | Small | Medium |

Firm size

3.1 Theoretical literature

According to Barney (1991), theories of competitive advantage (which could be an indicator of firm performance) include those that focus on internal strength and weaknesses, plus those that promote external factors such as opportunities and strengths. The former is referred to as the resource-based view (RBV), and the latter as environmental models of competitive advantage. The environmental models of competitive advantage assume that firms in an industry have identical resources, and any resource heterogeneity is expected to be a short-run phenomenon. The RBV theory describes the internal capabilities and resources that distinguish firms, and therefore relaxes the assumption of resource homogeneity (Peteraf, 1993). The theory was developed formerly by Wernerfelt (1984) and Barney (1991).

Resources are regarded as stocks of knowledge, machinery, workforce skills and a variety of tangible and intangible assets owned by firms (Wernerfelt, 1984 and Ramon-Jeronimo *et al.*, 2019). Barney *et al.* (2001) identified a comprehensive and concrete framework that focuses on the characteristics of business resources that are required to generate long-term competitive advantage. Invisible assets, entrepreneurship, functionally based distinct competencies, and a unique combination of business
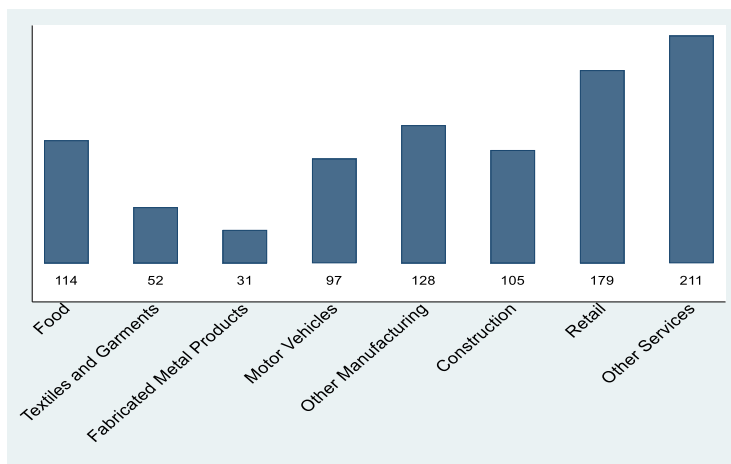
Figure 3.
SMME industry

experience and human resources are among the resources identified. RBV provides the theoretical explanation of the contribution made by resources to the development of a sustained competitive advantage and strategy formulation.

The resource-based theory is of relevance to this study because innovation is a resource that firms use to improve performance. Innovation is linked to stocks of knowledge and can be viewed as an intangible asset. According to Barney (1991), SMMEs adopt strategies based on the resources under their control to improve efficiency and effectiveness. The RBV model has been employed in the literature to explain planning capabilities (Shin *et al.*, 2009) and innovative capabilities (Diaz Villavicencio *et al.*, 2016).

3.2 Empirical literature
Several studies show that innovation has a positive and significant effect on the performance of SMMEs through social media and business plans that act as business tools for performance enhancement (see Seow *et al.*, 2020; Bleicher and Stanley, 2019; Pozo *et al.*, 2019). Various studies examined the impact of technology innovation on the performance of firms (see Esone and Tsambou, 2017; Chege *et al.*, 2020; Chege and Wang, 2020). The studies concluded that technology innovation impacts positively on SMME performance by encouraging employment creation. The effective use of information technology in small businesses also contributes to their competitiveness and access to international markets. However, Bleicher and Stanley (2019) warned that digitization can pose threats to existing organizations; therefore, understanding the strategic potential of digitalization and fostering strategic innovation are critical aspects in establishing maintainable business models that will ensure that SMEs develop and perform in the competitive market.

Several studies concluded that the effect of innovation on a firm's performance is dependent on variables such as firm strategy, access to capital, and the use of product differentiation (see Abdilahi *et al.*, 2017; Kijkasiwat and Phuensane, 2020; Guo *et al.*, 2018). Abdilahi *et al.* (2017) investigated the impact of innovation in Hargeisa, Somaliland, and found that innovation significantly affects the performance and development of SMEs. The study highlighted four types of innovations namely product, process, marketing, and organizational. The four types of innovations have a positive and significant in promoting SME's performance in terms of sales volume. However, the authors acknowledge the role of

strategizing the business model to ensure that product innovation, marketing innovation and organizational innovation are aligned to growth. Kijkasiwat and Phuensane (2020) found that product and process innovation promote the performance of SMEs in Eastern Europe and Central Asia by enlarging market share. However, the relationship is dependent on firm size and access to capital. Guo *et al.* (2018) are of the view that R & D spending enhances firm performance for firms that use product differentiation in Chinese manufacturing firms.

Studies by Nyoike (2019), Afriyie *et al.* (2019) and Tebourbi *et al.* (2020) showed that the effect of innovation on SMME performance is determined by leadership and management practices. Nyoike (2019) examined the influence of innovation practices on the performance of SMMEs in the manufacturing sector in Kenya. The study found that commercialization, organizational structure, R & D and creativity contributed positively to SMME's performance. Furthermore, entrepreneurial orientation is crucial for the innovative practices of a firm. Afriyie *et al.* (2019) examined the contribution of transformational leadership (TL) to the relationship between innovation and marketing performance in SME service firms. The findings suggested that product and process innovation have a positive effect on marketing performance. However, the relationship is determined by transformational leadership which is critical for improvements in innovation. Tebourbi *et al.* (2020) found that innovation, represented by expenditure on R & D, is positively related to a firm's performance. Managerial overconfidence and government ownership, however, are major determinants of R & D expenditures.

According to Begonja *et al.* (2016), the performance of SMEs also improves because of innovation targeted on improving marketing, financial and employee skills. The findings show that new product development, process innovation and social innovation have a significant effect on business performance. Market knowledge accumulated by doing business in foreign markets could lead to better identification of customer needs. Castillo-Vergara and García-Pérez-De-Lema (2021) found that creativity and product innovation are significant determinants of firm performance in Chilean Industrial SMEs. Product innovation plays a crucial role in the competitiveness of SMEs due to increased demand, higher revenues and increased market share. Expósito and Sanchis Llopis (2019) concluded that product, process and organizational innovation promote the financial and operational performance of SMEs in Spain by augmenting a firm's productive capacity and improving product/service quality. The findings contrast with those of Atalay *et al.* (2013), who reported that only technological innovation has a positive effect on a firm's performance in the automotive industry, while organizational and marketing innovation have no effect. Technological innovation has a significant effect on firm performance due to the capital-intensive nature of the automotive industry. On the other hand, the insignificant effect of marketing innovation on firm performance may be due to the fact that most of the automotive supplier firms in the sample do not have a corporate marketing department in their organizations; therefore, marketing innovation is not well recognized by these firms. The insignificance of organizational innovation on firm performance can similarly be explained by the fact that most of the firms in the sample which were family-owned and run are expected to have less need for re-organization.

Some studies report that the effect of innovation on firm performance is dependent on firm size or growth. Wong *et al.* (2005) examined the effect of entrepreneurship and innovation on economic growth and found that fast-growing small businesses contribute more to innovation, job creation and ultimately economic growth compared to low growth firms. Cucculelli (2013) and Coad and Rao (2008) used quantile regression and found that innovation promotes performance (profits and sales) in high-growth firms. The positive impact of new product development could be an indication that innovation propensity is a propelling factor for the growth of a firm due to innovators enjoying long-lasting competitive advantages. Similarly, Falk (2012) concluded that innovation, measured by R & D expenditures, is

significantly related to performance (employment and sales growth) for firms in the middle to upper growth distribution. The findings suggested that profits are an important determinant of innovation, and therefore, smaller firms with less profits require government subsidies to engage in R & D expenditures. Chen *et al.* (2019) concluded that R & D spending has a negative effect on a firm's performance in the Taiwan's semi-conductor industry in the year the investment was made due to the rise in operating expenses which impact negatively on firm performance. However, the lagged value of R & D expenditure is positively signed suggesting a U-shaped relationship. The impact of innovation on a firm's performance is positive in the long-run as efficiency reduces costs of production.

There is scant evidence on the effect of innovation on SMME performance in South Africa. Van Vollenhoven and André (2010) investigated the effect of innovation on a firm's performance in the automotive manufacturing industry. The results showed that the automotive manufacturing industry is more innovative than other manufacturing industries, and innovation made a significant contribution to a firm's performance. Naidoo and Muhammad (2018) found that innovation is positively related to a firm's performance, through IT resources and skills, IT capabilities, and product quality. While Naidoo (2019) found that innovation (R & D investment) has a positive impact on employment and export growth in South Africa Maziriri and Chinomona (2016) found that relationship marketing, green marketing and innovative marketing have a positive effect on the business performance of SMMEs in southern Gauteng, South Africa. These studies, however, do not distinguish amongst the firms according to size. SMMEs are earmarked as instruments for innovation in South Africa according to the NDP. Therefore, this study contributes to the literature in South Africa by investigating the role of innovation in driving the performance of firms. The study employs the quantile regression technique, which further differentiates SMMEs in this study according to a number of sales that can be used as a proxy for firm growth (see Falk, 2012 and Coad and Rao, 2008).

4. Data and methodology
The study utilizes data obtained from the World Bank's enterprise survey conducted in 2020. The survey is a database containing information on different attributes of enterprises in Gauteng, Western Cape, KwaZulu Natal (KZN) and the Eastern Cape. The focus of the study is on South African SMMEs. Table 1 presents the variables used in the study.

The empirical model is specified based on the available empirical literature on the determinants of firm performance, as follows:

$$y_i = \alpha_{1i} + \alpha_{2i}D_{2i}^{innov} + \alpha_{3i}D_{3i}^{reg} + \alpha_{4i}D_{4i}^{fin} + \alpha_{5i}D_{5i}^{cri} + \alpha_{6i}HC_i + \alpha_{7i}MS_i + \alpha_{8i}Age_i + \varepsilon_i \quad (1)$$

where y_i is a measure of firm performance, D_{2i}^{innov} is a dummy variable for innovation which is captured by R & D spending and new product. HC is human capital; MS is market share, and ε_i is the error term.

Firm performance variables are total sales and productivity (sales per worker) in line with Nguyen and Jaramillo (2014). The variables are used in logarithmic form to cater for the uneven distribution of the variables resulting from differences in size. The innovation measures are expenditure on R & D and the introduction of a new product. R & D expenditure is associated with the introduction of new products which contributes to firm performance (Guo *et al.*, 2018). R & D intensity has been used as a measure of innovation by Falk (2012) and Chen *et al.* (2019), who view investments in research as a means to promote the competitiveness of a firm's products. The introduction of new products is an indicator of product innovation which is regarded as an important determinant of firm performance (Cucculelli, 2013). Okumu *et al.* (2019) also utilized product innovation in their analysis of

Variable	Description
R & D spending	A dummy variable which represents a firm that invested in R & D in the previous fiscal year and 0 otherwise
Region	A dummy variable where 1 represents a firm in Gauteng and 0 otherwise
New product	A dummy variable where 1 represents a firm that has introduced a new product and 0 otherwise
Age	The number of years since the firm was established
Human capital	The percentage of workers who have completed high school
Market share	The establishment's market share
Total sales	Total sales made in the last fiscal year
Productivity	Sales per employee
Crime	The dummy variable where 1 represents a firm that stated that crime was an obstacle to business operations and 0 otherwise
Finance	The dummy variable where 1 represents a firm that stated that access to finance was an obstacle and 0 otherwise

innovation and employment growth. Product innovation was defined as the introduction of new or improved products. The control variables are selected based on their association with firm performance. Access to finance is expected to promote firm performance possibly by encouraging investments (Fowowe, 2017). Market share is expected to impact positively on a firm's sales and profits. Human capital is expected to promote firm performance by increasing labour productivity. The effect of age on firm performance is ambiguous to some extent. Pervan *et al.* (2017) showed that age has a negative effect on firm performance. However, it has been shown that the survival rate of younger SMMEs in South Africa is very low, thus indicating that older firms are more successful. Crime increases security costs and also could lead to property damage or theft of equipment which, in turn, hurts firm performance.

Equation (1) is estimated using quantile regression. Quantile regression developed by Koenker and Basset (1978) is a departure from the classical linear regression where the objective is to estimate the conditional mean function by minimizing the sum of squared residuals (Buhai, 2005). It involves the estimation of conditional median functions by minimizing the sum of asymmetrically weighted absolute residuals. The standard least-squares technique estimates the average effect of the explanatory variable on the dependent variable which may be inferior due to the omission of valuable information (Coad and Rao, 2008). Furthermore, the standard least-squares technique is based on the assumption of normality of the residuals which is violated in some cases. The mean regression approach is based on the Gaussian assumption which suggests that errors in a regression model are a sum of small and independently distributed errors (Koenker and Bassett, 1978). However, regression models with heavy-tailed distributions are a common occurrence. Quantile regression estimates parameters for different points on distribution and relaxes the assumption of identically and individually distributed errors (Cucculelli, 2013). Relaxing the assumption is an acknowledgment of the heterogeneity in firms selected for this study, there is a possibility that the effect of innovation on firm performance is dependent upon the size and growth of firms. Falk (2012) highlights that the effect of R & D intensity is significant for larger firms compared to smaller firms; therefore, it is necessary to employ a technique that caters for differences in firm growth. Quantile regression is robust to heavy-tailed distributions, heteroscedasticity and the presence of outliers. It is, therefore, the appropriate estimation technique for this study.

A quantile regression model can be specified as follows:

$$y_i = x_i \alpha_\rho + u \dot{p}_i$$

where y_i is the dependent variable, x_i is a vector of explanatory variables, α is vector of coefficient estimates associated with the ρth quantile for any $\rho \in (0, 1)$ and u is a vector of errors. The ρth quantile is estimated by minimizing the weighted absolute residual as follows:

$$\min_{\alpha^k} \sum_{t \in (t:\ y_i \geq x_i \alpha)} \rho |y_i - x_i \alpha| + \sum_{t \in (t:\ y_i < x_i \alpha)} (1 - \rho) |y_i - x_i \alpha|$$

5. Empirical results

Descriptive statistics are presented in Table 2. For dummy or binary variables, frequencies and percentages were reported instead. Sales and productivity have very high standard deviation and as such the variables will be used in logarithmic form. The average market share of the SMMEs is just over 11% which is an indication of the challenges of market access that continue to affect small businesses. The average age of the SMMEs is just over 24 years of age while the percentage of employees who have completed high school is 67% on average for all the SMMEs. Over 50% of SMMEs reported having challenges with both access to finance and crime. As shown earlier, over 37% of the SMMEs are based in the Gauteng province. The innovation dummy variables show that very few firms are involved in innovative activities. Just below 4% of the SMMEs have introduced new products, and only 25% of the firm have made R & D expenditures.

The empirical analysis involves regressing the logarithm of sales and sales per worker (productivity) on innovation and control variables.

Quantile regressions results for the 25th, 50th, and 75th percentiles are shown in Tables 2–5. Table 3 shows that innovation has a positive effect on sales for firms in the 50th and 75th percentile. The positive coefficient is supported by Guo *et al.* (2018) who found results that supported the notion that R & D spending promotes firm performance. Tebourbi *et al.* (2020) are of the view that expenditure on R & D contributes to firm performance by giving a firm a competitive advantage. Furthermore, R & D expenditure enables a firm to innovate and introduce new technologies or methods of doing business which promotes sales and profits. The result suggests that R & D expenditures are significant for firms with higher sales which

Variable	Mean	Std. Dev
Sales	1.65e + 07	6.59e + 07
Market share	11.1603	24.75305
Human capital	67.2790	27.9349
Productivity	831845.60	6831829
Age	24.0869	18.5224
Dummy variables		
Variable	Frequency	Percent
Finance	524 (393)	57.14 (42.86)
Crime	488 (429)	53.22 (46.78)
New product	36 (881)	3.93 (96.07)
R & D pending	232 (685)	25.30 (74.70)
Region	341 (576)	37.19 (62.81)

Table 2.
Descriptive statistics

supports the findings of Wong *et al.* (2005), Coad and Rao (2008), Falk (2012) and Cucculelli (2013). Wong *et al.* (2005) found that fast-growing small businesses contribute more to innovation, job creation and ultimately economic growth compared to low growth firms. Falk (2012) reported that R & D intensity has a positive and significant effect on employment growth for firms in the middle and upper quartiles (0.4–0.9). Coad and Rao (2008) utilized patents and R & D expenditure as measures of innovation and found that for fast-growing firms, innovation is positively related to firm performance. However, the coefficient for the average effect is small and insignificant. In line with Coad and Rao (2008), Cucculelli (2013) found that innovation impacts positively on firm performance for firms in the upper quartile compared to those in the 50% quartile. The results of the current study are, therefore, more in line with those of Falk (2012). The results contradict with those of Soares de Almeida *et al.* (2019) who found that R & D

Variable	Sales (25th)	Sales (50th)	Sales (75th)
Finance	0.1944 (0.9649)	0.4812** (2.5312)	0.9722*** (4.3491)
Crime	−0.0104 (−0.0556)	−0.0664 (−0.3777)	−0.1505 (−0.7282)
R & D spending	−0.099 (-0.5485)	0.6483*** (3.8053)	0.5567*** (2.7788)
Region	1.2561*** (8.6737)	1.0393*** (7.6055)	0.7747*** (4.8211)
Human capital	0.0031 (1.313)	0.0073*** (3.3074)	0.0116*** (4.459)
Age	−0.0001 (−0.2323)	0.0005 (1.3218)	0.00001 (0.102)
Market share	0.0093*** (3.4448)	0.012*** (4.7015)	0.0099*** (3.2875)
Constant	12.9293*** (58.1248)	13.477*** (64.2058)	14.1333*** (57.2585)
Note(s): *t*-statistics are in parenthesis. ** and *** indicate significance at the 5% and 1% levels, respectively			

Table 3.
R & D spending
and sales

Variable	Sales (25th)	Sales (50th)	Sales (75th)
Finance	0.1772 (0.9658)	0.0827 (0.4146)	0.6148*** (2.9359)
Crime	0.0458 (0.2549)	0.0596 (0.3054)	−0.1295 (-0.6319)
New product	0.8906** (2.5265)	0.0884 (0.2307)	0.784* (1.9491)
Region	1.2927***(9.2791)	1.031***(6.8051)	0.773*** (4.8622)
Human capital	0.0033 (1.4731)	0.0082*** (3.3366)	0.0117*** (4.5554)
Age	0.00001 (-0.1386)	0.0003 (0.7983)	−0.0002 (-0.5656)
Market share	0.0094*** (3.6369)	0.0089*** (3.1578)	0.0083*** (2.8151)
Constant	12.837*** (66.9915)	13.7481*** (65.9771)	14.4819*** (66.2269)
Note(s): *t*-statistics are in parenthesis. *, ** and *** indicate significance at the 10, 5 and 1% levels, respectively			

Table 4.
New product and sales

Variable	Prod (25th)	Prod (50th)	Prod (75th)
Finance	0.3477** (1.9937)	0.4918*** (2.6339)	0.4378** (2.3971)
Crime	0.0024 (0.0148)	−0.2446 (−1.4168)	−0.1092 (−0.6463)
R & D spending	0.193 (1.2347)	0.3833** (2.2908)	0.5571*** (3.4037)
Region	1.036*** (8.2644)	0.7182*** (5.3507)	0.4539*** (3.4577)
Human capital	0.0073*** (3.5845)	0.0081*** (3.6997)	0.0073*** (3.4044)
Age	−0.0005 (−1.5581)	−0.0005 (−1.5366)	0.0001 (0.4384)
Market share	0.0058** (2.4563)	0.0068***(2.7192)	0.0067*** (2.7223)
Constant	10.0465*** (52.1741)	11.0676*** (53.6845)	12.0264*** (59.6387)
Note(s): *t*-statistics are in parenthesis. ** and *** indicate significance at the 5 and 1% levels, respectively			

Table 5.
R & D spending and
productivity

expenditures have a larger effect on firms with lower sales. The insignificance of R & D expenditures for firms at the lower end of the sales distribution in this study could be an indication of limited expenditures which is common in South African firms due to lack of funds and uncertainty regarding the returns to investment in R & D (Lukhele and Soumonni, 2020). Fast-growing SMMEs or those with larger sales are able to spend more on R & D compared to those on the lower end of the growth distribution.

As highlighted in Table 4, the introduction of a new product promotes performance for firms with lower sales. New product development is insignificant at the 5% level for firms at the 50th and 75th quantile. This finding supports that of Booyens (2011) who reported that small firms have higher innovation rates measured by the introduction of new products and process innovation. Herstad (2018) also found that innovation measured by a turnover from new products has a positive impact on firm performance (employment growth) for firms at the lower part of the distribution. The findings contradict those of Coad and Ran (2008) and Cuculelli (2013) who found that new product innovation is negatively related to firm performance for firms with lower sales (low part of the distribution). These findings suggest that for South African firms, innovation-driven by the introduction of new products is an important determinant of firm performance for smaller firms.

Access to finance has a positive and significant effect on firm performance in the 50th and 75th quantile. Access to finance is a major determinant of investment in equipment which, in turn, promotes sales (Fowowe, 2017). The finding suggests that access to finance promotes firm performance for those with higher sales. Access to finance for the smaller firm is not a major determinant of high sales. Crime has a negative but insignificant effect on firm performance. As expected, SMMEs based in Gauteng are predicted to perform significantly better than those in other provinces. Gauteng has more business opportunities due to its population size and possibly due to a larger pool of skilled workers available. This finding suggests that SMME performance is determined to a large extent by economic activity. Higher economic activities provide more scope for sales growth and productivity due to larger markets for SMMEs. This finding is supported by the positive and significant coefficient of market share. Access to markets is one of the major hindrances to the growth and development of SMMEs mostly due to dominance by larger firms, high unemployment and the poor performance of the South African economy (Bhorat et al., 2018; Bowmaker-Falconer and Herrington, 2020).

Human capital is positively related to firm performance for the 50th and 75th percentile which is in line with theoretical expectations. As firms grow, the sophistication of goods/services provided is advanced which necessitates higher levels of human capital compared to smaller firms. Employees with higher levels of schooling are expected to be more productive and innovative which enhances firm performance. Fatoki (2011) found that human capital is crucial for SMME performance in South Africa. Furthermore, Muda and Rahman (2016) highlighted that human capital is vital for firm performance as economies become more knowledge-based. Age has an insignificant effect on SMME performance.

For robustness purposes, sales per worker (productivity) is used as a measure of firm performance. The results shown in Tables 5 and 6 also suggest that R & D sending is only significant for firms with higher sales. The introduction of new products has an insignificant effect on sales per worker for all firms (weakly significant for firms with lower sales). The reason for the insignificance could be that there are very few firms that introduce new products. However, it should be noted that the robustness results are largely similar to those of the main regressions.

5.1 Implications of the results
As indicated by the NDP, SMMEs are regarded as important vehicles for the achievement of socio-economic goals and innovation in South Africa (Bhorat et al., 2018; Lukhele and

Variable	Prod (25th)	Prod (50th)	Prod (75th)
Finance	0.3187** (1.9819)	0.3561* (1.8414)	0.2603 (1.2968)
Crime	−0.0236 (−0.1499)	−0.3213* (−1.6978)	−0.237 (−1.2065)
New product	0.5299* (1.7154)	0.2545 (0.6849)	−0.0405 (−0.1051)
Region	1.0043*** (8.2254)	0.7682*** (5.231)	0.3793** (2.4888)
Human capital	0.0078*** (3.9599)	0.0089*** (3.735)	0.0058** (2.3334)
Age	−0.0005* (−1.7316)	−0.0005 (−1.2393)	0.0001 (0.1561)
Market share	0.0051** (2.2615)	0.0045* (1.6611)	0.0039 (1.3685)
Constant	10.1039*** (60.164)	11.2143*** (55.5213)	12.5024*** (59.6389)

Note(s): *t*-statistics are in parenthesis. *, ** and *** indicate significance at the 10, 5 and 1% levels, respectively

Table 6.
New product and
productivity

Soumonni, 2020). Furthermore, SMMEs are envisioned to create 90% of jobs by 2030. The results of the study highlight the importance of innovation for firm performance which has a number of policy implications. According to Bushe (2019), over 70% of SMMEs fail in their first 5–7 years of inception. The low survival rate of SMMEs could be attributed to low levels of innovation which hinder firm performance and growth. According to Kijkasiwat and Phuensane (2020), innovation is vital for SMME survival, especially during economic recessions. As such, the growth and development of SMMEs, as well as their ability to create employment as set out in the NDP is dependent on innovation. Access to funding for R & D expenditures and the introduction of new products is of paramount importance. The results show that R & D expenditures have a positive and significant effect on sales and productivity for firms with higher sales (high growth or larger firms). However, the introduction of new products has a positive effect on firm performance only for firms with lower sales (low growth or smaller firms). The findings imply that smaller firms have the desire to innovate and produce new products. However, they might be constrained by a lack of financial resources to make the requisite investments. The findings also suggest that R & D expenditures by larger firms have not contributed significantly to the introduction of new products, given that new product innovation has an insignificant effect on firm performance. R & D expenditures seem to be focused on areas such as improving business processes or improving the current products.

The findings of the study have implications for future research. The findings highlight that the impact of firm innovation on firm performance is dependent upon the amount of sales made. Therefore, future research on SMME performance, in general, should distinguish firms according to size or number of sales in order to take into account the different challenges faced by firms at different levels. Future research should also be centred on investigating the constraints faced by smaller firms that seek to invest in R & D. Access to funding has been a major challenge for SMME owners, especially those with poor socio-economics characteristics as alluded to by Bhorat *et al*. (2018).

6. Conclusion
The purpose of the study was to investigate the effect of innovation on SMME performance in South Africa. The innovation indicators chosen for the analysis are R & D expenditures and the introduction of new products. The measure of firm performance was total sales and sales per worker. The World Bank's enterprise survey conducted in 2020 was used for the empirical analysis. Quantile regression analysis was the chosen technique for the purposes of estimating a regression model due to its ability to estimate coefficient estimates at different points of distribution.

The results of the empirical analysis showed that R & D expenditures have a positive and significant effect on performance regardless of the indicator for firms with higher sales levels. There is evidence that the introduction of new products/services promotes performance for smaller firms with lower sales. Expenditure on R & D seems to be confined to firms with larger sales which indicate that smaller firms lack the funds to make such investments. The findings have implications for South African policy makers.

The study recommends that policy makers create an environment conducive to investments in R & D, as well as the introduction of new products. Innovation is crucial for the success of SMMEs in South Africa who are earmarked as the vehicles to drive productivity, employment, GDP and the achievement of socio-economic goals such as poverty and inequality. The government has introduced measures such as R & D tax incentives and innovation funds for firms. However, such policies have been purported to favour larger firms or firms with larger profits (OECD, 2021). Furthermore, OECD (2021) is of the view that South Africa is still lagging behind other OECD countries with regards to R & D support to businesses. More support needs to be provided to smaller firms with lower sales growth given the large financial outlay required for R & D expenditures.

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