MATERIAL EFFICIENCY AND FINANCIAL PERFORMANCE: A CASE OF FIRMS LISTED ON THE JOHANNESBURG STOCK EXCHANGE, SOUTH AFRICA

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ABSTRACT

This study aimed to assess the link between material efficiency and financial performance of firms listed on the Johannesburg Stock Exchange. Existing empirical literature about material efficiency and its effect on firm success is seemingly sparse from both a developed country and developing countries' perspective. This study was quantitative in nature and it employed a case study research design. A longitudinal design was also used where secondary data spanning from 2011-2018 was collected from sustainability reports. The sample consisted of 16 firms listed on the FTSE/JSE Responsible Investment Index top 30. Data was analyzed using panel regression. Specifically, the feasible generalized least squares was used. Interestingly, the relationship between material efficiency and ROE was found to be significant at 5% significance level. The findings also showed that the relationship between material efficiency and the Tobin's Q was significant at 5% significance level. The findings of this paper can assist managers of listed firms to design corporate policies which promotes material efficiency and environmental protection. This paper adds new empirical evidence to the body of knowledge by linking material efficiency to both accounting and market based measures of financial performance which has been missing in extant literature.

Keywords: Circular economy, Financial Performance, Johannesburg Stock Exchange, Material Efficiency, Sustainability.

INTRODUCTION

To date, talks around the world have intensified towards encouraging nations to promote a circular economy. The circular economy helps to eliminate resource wasted by encouraging reuse of waste previously discarded at end of pipe. The circular economy can be attained by attaining material efficiency which is defined as the optimum and efficient use of resources in combinations, which allows a firm to produce more output with less resources waste in the production process (Milios, 2016). One of the major purposes of material efficiency is to create a circular material flows where economic activities are conducted while at the same time accounting for the environment. This is aimed at addressing the short falls of the linear economy where there is no consideration for sustainability. Moreover, the circular flow focuses on environmental protection, optimisation of resource use by emphasising the need for material reuse and elimination of processes, which creates negative externalities to the environment. Furthermore, the circular flow economy uses a variety of methods to attain material efficiency. Ideally, the circular flow economy is based on the idea to eliminate waste before production begins and the attachment of value to waste in the event that it was

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generated (Indo-German Expert Group, 2014; European Commission, 2015; Milios, 2016; Mendoza et al., 2017). This is because firms just focus on producing and selling without scope for reusing the product after it reaches its useful lifespan. On the other hand, the circular material flow economy is embedded in the sustainability agenda, where materials are sustainably sourced, processed efficiently and packaged in a manner that enables reuse (Indo-German Expert Group, 2014; Milios, 2016). To achieve the circular flow, firms need to change their old ways of production and consumption. This entails adopting green business models and systems to eliminate material wastage. Sustainable business models enable firms to eliminate material wastage by incorporating innovation in systems and materials handling. It is these sustainable business models that can make it easy for firms to adapt to new environmental demands. Sustainable business models also promote the circular flow by changing the way firms source out materials, produce and distribute products (Bocken, Short, Rana & Evans, 2014; Bocken et al., 2016; Geissdoerfer et al., 2016).

Existing empirical literature about material efficiency and its effect on firm success is seemingly sparse from both a developed country and developing countries' perspective. This area has been getting less attention as compared to other environmental sustainability variables, yet studies agree that material efficiency can allow a firm to excel in other environmental performance indicators (Bocken et al., 2016). This is because material efficiency can lead to energy efficiency, water efficiency, waste reduction and carbon emission reduction which enables a firm to attain excellent financial performance. As such, a knowledge gap exists in South Africa as no study has attempted to assess the effect of material efficiency on financial performance (Milios, 2016). This has reduced the effectiveness of plans to mitigate climate change (Allwood et al., 2013). Moreover, this derails theory and practice as there are limited empirical studies on the phenomenon. More studies are required to unpack this phenomenon from a developing country perspective, especially in Africa where fossil fuel use is still at its pick. Hence, this study aims to close this lacuna and add value to the ongoing role on the importance of environmental performance.

LITERATTURE REVIEW

Theoretical Framework

Dowling & Pfefeer (1975) define legitimacy as the way the society perceives an organisation as desirable or appropriate as determined by how it conduct business. For legitimacy to exist, there should be congruence between the values of the firm and that of the society. Any disparity between the two may result in conflicts between the two systems, which may create unfavourable operating conditions for the business. It follows that the expectations of the society are deep rooted in the social contract which, in most cases, is very delicate. The delicacy of the social contract emanates from the fact that social needs and expectations are not static but evolve over time. This entails that firms' activities and behaviour should always adjust to cater for the new social contract. Any breach of the social contract carries negative implications for the firm, which are difficult to resolve in the short run. This means the firm should operate within the norms and belief systems of the society less it risks business failure. Firms should also take certain actions to justify their existence. Such actions include; adhering and respecting the society's values and belief systems that in turn award the firm endorsement and positive publicity, which is essential for business sustainability. Noteworthy, it is imperative for a firm to keep itself abreast with changing society values, norms and beliefs as well as stakeholder needs so as to maintain a positive image and legitimacy (Burlea & Popa, 2013; Ching & Gerab, 2017; Wei et al., 2017).

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The legitimacy theory is highly applicable in this study. This is because it explains the social contract between listed firms and green stakeholders such as the community. In this case, due to environmental challenges such as water shortage, unmanaged dumping sites and pollution, communities have started perceiving only those firms which participate in environmental protection initiatives as legitimate. Moreover, the legitimacy theory remains one of the widely adopted theories in studies related to environmental sustainability. Essentially, unlike other theories, the legitimacy theory clearly outlines some innovative strategies that firms can use to gain trust from their stakeholders. To this end, most companies are involved in voluntary disclosures as an application of the Legitimacy theory. Such voluntary environmental disclosures are linked to enhanced environmental performance and superior corporate image. This makes the Legitimacy theory an important theory for this study. This theory has been used by a plethora of studies to explain what motivates firms to invest in sustainability initiatives and generally as a strategic tool for a firm to maintain key relations and gain a positive image from the society. One compelling idea derived from the legitimacy theory is that the society has a bearing on the demise or success of a firm. Hence, firms ought to act and operate within the legitimacy dictates prescribed by the society if they are to enhance their legitimacy (Guthrie et al., 2007; Mousa & Hassan, 2015; Reisig & Bain, 2016; Ching & Gerab, 2017; Maleka et al., 2017).

MATERIAL EFFICIENCY

Material efficiency is attained when the firm uses minimal inputs to produce more units of a product (Fischer, 2013). It can assist nations to be sustainable in other areas such as energy and water (International Resource Panel, 2019). It brings momentous benefits such as enhanced innovation, reduction in carbon emissions, and eliminates resource extinction risk. Hence, it is estimated that material efficiency can reduce natural resource extraction by 28%, reduce carbon emission by 15-20% and reduce the overall cost of climate change initiatives by 2050. More importantly, attaining material efficiency can allow nations to be resource self-sufficient and cut down the volume of imports. Based on this, material efficiency should form the cornerstone of all climate change policies if this phenomenon is to be successfully abated (Allwood et al., 2013; IRP, 2017). Material efficiency can be attained by attaining efficiency from the raw material source (IRP, 2017). This includes reducing the extraction of raw materials and environmental damage at source (Fischer & O'Brien, 2012; IRP, 2017).
Material efficiency can be a sustainable strategy for decoupling economic growth from environmental degradation without compromising people's wellbeing. Material efficiency aims at promoting sustainability in energy use, water and mitigating climate change. Such milestones are achievable in the long term but requires approval and participation by both suppliers and customers (Allwood et al., 2013; Fischer, 2013; International Resource Panel, 2018). Material efficiency is linked to resource decoupling (Indo-German Expert Group, 2014). Resource decoupling is defined as reducing the ratio between natural resources inputs and output (Indo-German Expert Group, 2014). On the other hand, decoupling is defined as lifting up the negative effect imposed on the environment by reducing resource uptake in the economic activities of a firm (United Nations Environmental Programme, 2011). To achieve material efficiency, it is crucial to assess the relative impact of material extraction for economic purposes on the environment. Essentially, material efficiency can be attained by decoupling economic activities from scarce natural resources and the environment (Indo-German Expert Group, 2014; Milios, 2016).

Existing literature points to the importance of investing in cutting edge technology and innovation to propel material efficiency (Alwood et al., 2013; Fischer, 2013). On that note, Fischer & O'Brien (2012) submit that information communication and technology can

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assist firms in attaining material efficiency. Innovation is key because it makes it possible to maintain or increase the production output without increasing carbon emissions. The argument for products innovation is to have products that are in support of the green economy agenda premised to mitigate environmental damage. New products innovation can add significantly towards environmental sustainability. This is because innovation makes it possible for the business to fully participate in environmental sustainability initiatives. Moreover, it enables a firm to achieve its overall sustainable development goals (Ar, 2012; Hsu et al., 2016; Milios, 2016).

HYPOTHESIS DEVELOPMENT

Relationship between Material Efficiency and Financial Performance

Material efficiency is one of the widely suggested strategies to cut cost in an organisation and attain superior financial performance (Greenovate, 2012; Vinayagamoorthi et al., 2015; Boakye, 2018). A significant number of firms in Europe which have adopted this strategy reported enhanced financial performance. Cutting costs through material efficiency is sustainable and can give a firm unmatched competitive advantage by reducing resource scarcity risk. For instance, with widely documented fear of possible resource scarcity in terms of water and energy supply, firms which attain material efficiency will require less of these resources hence, bracing themselves for these unfavorable conditions which will see most firms closing shop (Greenovate, 2012).

According to Allwood et al. (2013), attaining material efficiency helps a firm to cut costs of production significantly by reducing the amount of raw materials and inputs required in the production process. The major savings are noticeable in the areas of energy savings and amount of water required to produce a unit of a product. Since energy and other raw materials bills constitute a significant amount of a firm's cost, attaining material efficiency enables a firm to enjoy cost benefits (Allwood et al., 2013).

Fischer & O'Brien (2012) assessed the effect of material efficiency on financial performance. The study established that material efficiency positively influences financial performance. The effect was found to be high on return on sales. Fischer & O'Brien (2012) argued that material efficiency enables a firm to cut cost of raw materials and other related inputs. These cost savings are then passed to customers in form of low prices leading to high return on sales. More importantly, the study noted that investments in material efficiency may payback in approximately less than a year. Nevertheless, this may only hold in the context of "*low hanging fruits*" such as attaining material efficiency through material saving or recycling. The payback period for material efficiency maybe longer than a year in the context of more sophisticated strategies such as new light material designs.

A study by Unam (2012) reported that there is a strong positive link between material efficiency and profitability. "*The implication of this is that through efficient management of materials, a manufacturing firm can achieve significant cost saving, improvement in production efficiency, and increase in profitability*" (Unam (2012:50). This is because a significant amount of costs are hidden in materials. Hence, if a firm can attain efficiency through strict material handling, use of alternative materials and aligning the production process, it is guaranteed that such a business will record superior performance. According to Ong et al. (2014), firms with material efficiency policies and standards can manage their production systems well by ensuring that the material efficiency goal is shared in the entire supply chain. This enables the firm to eliminate costs associated with wasteful ways of production and be profitable (Unam, 2012).

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In their study on Indian firms, Vinayagamoorthi et al. (2015) found that attaining material efficiency can send a strong signal to the government on the firm's environmental responsibility behaviour. This can allow the firm to get subsidies and funding from the government and other organisations which fund green initiatives. To that effect, material efficiency enhances the firm's overall financial performance. More importantly, a firm is able to mitigate risks associated with scarcity of resource while at the same time gaining green trust from its key stakeholders. Moreover, operating with lower resource inputs reduces the economic vulnerability to price volatility at the global level (International Resource Panel, 2018).

A recent report by International Resource Panel (IRP) (2017) assessed the economic implications of material efficiency. The report found that material efficiency enables a firm to have sustainable revenue streams which far outweigh the cost associated in initiating the material efficiency strategies. Material efficiency strategies such as light-weight design can boost the firm's sales which translates into superior financial performance (IRP, 2017). For instance, 21st customers prefer portability over bulkiness. Hence, a firm which leverages on product modification using light material and new design will likely grow its profit with a significant margin. If well executed, material efficiency can be used to differentiate the firm from its competitors and increase its market.

Nevertheless, attaining material efficiency can be costly to a firm as it requires huge investments in technology and new product designs. These can come up with exorbitant costs, which negatively impact the financial performance of a firm. Additionally, there is scarcity of engineers worldwide. Hence, the few who are there are highly priced in the labour market making it difficult for a firm to secure their services for a long period of time.

This study advances the argument that material efficiency enhances financial performance. This argument draws from the existing studies which have empirically proved this hypothesis in other contexts. To that effect, given the pressing environmental challenges such as water scarcity, pollution, unmanaged waste dumping sites and pollution of water bodies with plastics, green stakeholders such as investors, the government and the community are likely to favour firms which actively participate towards environmental protection initiatives such as material efficiency. Material efficiency can enable firms to reduce raw material required to produce a product, which is a low hanging fruit strategy towards cutting costs. Hence, material efficiency initiatives such as use of lesser material, easily recycled material, use of biodegradable material and improved raw material handling can help a firm to enhance its return on capital. Additionally, firms which adopt measures to attain a circular economy can enhance their market value from the perspective of green consumers and investors. Based on this evidence, this study proposes to test the following hypotheses:

Ha_1: *There is a significant positive relationship between material efficiency and ROE of firms listed on the JSE.*

Ha_2: *There is a significant positive relationship between material efficiency and the Tobin's Q of firms listed on the JSE*

MATERIAL AND METHODS

The current study adopted a quantitative research method informed by a positivism research philosophy. This was because the researcher intended to critically test the hypothesised relationships using numerical data. The population of the study was all firms listed on the Johannesburg Stock Exchange. The sample consisted of 16 firms listed on the FTSE/JSE Responsible Investment Top 30 Index. The firms were assigned with a code to avoid renaming of the entity which could violate anonymity and confidentiality of these

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firms. The purposive sampling technique was adopted in this study. Therefore, using purposive sampling, the researcher deliberately chose to focus on 16 firms from telecommunications, banking, manufacturing, and retail. Panel data was collected from the firms' websites and sustainability reports. Particularly, secondary data was used. According to Amacha & Dastane (2017), secondary data obtained from sustainability reports is is critically audited to enhance transparency. Data related to ROE and the Tobin's Q was obtained from IRESS database. Due to inconsistencies regarding the reporting of material efficiency on the sample firms' sustainability reports, the researcher opted to use content analysis to collect the data. To that effect, a dichotomous scale ranging from between 0 and 1 was used following recommendations by Cooke (1989). Hence, 0 was allocated when the firm did not record or performed badly on material efficiency on that particular year. On the other hand, 1 was allocated when the firm recorded and performed well on any given material efficiency strategy.

MEASURES

Independent Variables

Material efficiency

In this study, material efficiency was measured based on the firm's use of lesser material, light weight designs, easily recycled material, use of biodegradable material and improved raw material handling. This information was obtained from the companies' sustainability reports. essentially, the guidelines are clearly outlined in the Global Reporting Initiative EN category.

Dependent variables

This study employed both accounting and market-based measures of financial performance as the dependent variable. This was done to deduce whether listed firms can enhance the ROE and the Tobin's Q from environmental investments such as material efficiency. Return on equity is well understood as profits divided by shareholders' equity (Kurniaty et al., 2018). On the other hand, "*The Q ratio is defined as the market value of a firm divided by the replacement cost of the firm's assets*" (Fu et al., 2016:1). In other words, it measures a firm's value. It is also used to measure a firm's long run financial performance. As such, the Tobin's Q is highly regarded as a key ratio that informs future investment decisions in existing literature (Al-Matari et al., 2014; Fu et al., 2016). A higher Tobin's Q signals investors that the firm value will appreciate in future, hence, guaranteeing them of future gains (Sethibe & Steyn, 2016; Manrique & Martí-Ballester, 2017). This is supported by the Signaling theory which explains that a positive Tobin's Q can help listed firms to send a positive signal to the market (Kurniaty et al., 2018; Wijayanto et al., 2019).

Dependent variable; Y: Financial performance

Dependent variable 1; Y: ROE
Dependent variable 2; Y: Tobin's Q

Independent variable; X: Material efficiency

Independent variable 1; X1: material efficiency

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Panel regression model

$$Y_{it}=\alpha+X_{1it}+X_{2it}+X_{3it}+\varepsilon$$

Where y=financial performance; x_1= material efficiency; x_2=firm size; x_3=Liquidity; + ε = error term; α= constant

Control variables

In this study, firm size and liquidity were used as control variables. This emanated from the understanding that it is vital to control other factors which may also influence the financial performance of listed firms (Bacon-Shone, 2013). Other studies have found that firm size and liquidity positively influence profitability (Marashdeh, 2014). In this study, market capitalization was used to measure the size of the firm. The size of the firm has an effect on the profitability of a firm (Al Shahrani & Tu, 2016). Liquidity was measured by compiling values from the current ratio of firms which were evaluated. These were compiled for the 8-year period considered in the study. These were obtained in the firm's annual financial statements and from the IRESS database. Existing studies assert that liquidity should be controlled because it also has an effect on profitability (Warra & Oqdeh, 2018).

RESULTS

Descriptive Statistics

Table 3
DESCRIPTIVE STATISTICS

Variable	Obs	Mean	Std. Dev.	Min	Max
Material efficiency	128	2.773438	1.228516	0	4
ROE	128	15.79004	34.4581	-422.65	107.64
Tobin's Q	128	1.673086	1.341552	0.22	7.05
Liquidity	128	1.425118	0.9830142	0	6.8176
Firm size	128	929723	47711.28	0	428668

Table 3 presents the descriptive statistics for the key variables considered in the study. The total number of observations was 128 derived from 16 Less Environmentally Sensitive firms observed for 8 years. The mean for material efficiency was 2.773438 with a standard deviation of 1.228516, with a minimum value of 0 and a maximum value of 4. In terms of material efficiency, it is only two firms which did not consistently report on this variable. The mean score for ROE was 15.79004 with a standard deviation of 34.4581. The minimum and maximum values for ROE were -422.65 and 107.64 respectively. Considering the Tobin's Q, the mean was 1.673086 and the standard deviation was 1.341552. The minimum and maximum values for Tobin's Q were 0.22 and 7.05, respectively. The findings show that the mean for liquidity was 1.425118 and the standard deviation was 0.9830142. The minimum value for liquidity was 0 and the maximum value was 6.8176. Considering firm size, the mean score was 929723 and the standard deviation was 47711.28. The minimum value was 0 and the maximum value was 428668.

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Correlation Analysis

Table 4
CORRELATION ANALYSIS

Variables	ROE	Tobin's Q	Material efficiency	Liquidity	Firm size
ROE	1				
Tobin's Q	0.4177	1			
Material efficiency	0.1033	0.1325	1		
Liquidity	0.2481	0.033	0.0089	1	
Firm size	0.2327	0.0151	-0.1132	0.0222	1

Table 4 shows correlation analysis results among variables. The results showed that material efficiency was positively correlated with ROE (0.1033) and share price (0.1325). The findings also showed a weak and positive relationship between material efficiency and liquidity (0.0089). On the other hand, a negative correlation was established between material efficiency and firm size (-0.1132).

Feasible Generalised Least Squares

Table 5
MODEL 1 FGLS REGRESSION -ROE

Cross sectional time series FGLS regression							
Coefficients: generalized least squares							
Panels:	heteroskedastic						
Correlation: no autocorrelation							
Estimated covariances		=	1		Number of obs	=	128
Estimated autocorrelation		=	0		Number of groups	=	16
Estimated coefficients		=	11		Time periods	=	8
Log likelihood		=	-524.6		Wald chi2 (10)	=	61.79
					Prob >chi2	=	0.0000
ROE	Coef.	Std.Err.	z	P>|z|	[95% confi.		Interval]
Material	3.93202	1.7131	2.30	0.022	0.5744066		7.289634
Liquidity	3.106693	1.1831	2.63	0.009	0.7878781		5.425507
Firm size	0.000082	0.0000	3.50	0.000	0.000036		0.000127
_cons	76.27957	26.644	2.86	0.004	24.05893		128.5002

t statistics in parentheses * p<0.1, ** p<0.05, *** p<0.01

Table 5 shows the findings on the relationship between material efficiency and financial performance as measured by ROE. Interestingly, the relationship between material efficiency and ROE was found to be significant at 5% significance level. To that effect, the alternative hypothesis stating that **t**here is a significant positive relationship between material efficiency and the ROE of firms listed on the JSE was supported. This implies that listed firms in sectors such as telecommunications, banking, manufacturing, and retail can benefit immensely from environmental investments such as material efficiency. Ideally, this means that listed firms in the above-mentioned sectors can benefit from moving towards the circular flow economy, where packaging strategies are designed in a manner that allows re-use and recycling of the material which is also biodegradable.

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Tobin's Q

Table 6
MODEL 1 FGLS REGRESSION – TOBIN'S Q

Cross sectional time series FGLS regression						
Coefficients: generalized least squares						
Panels:	heteroskedastic					
Correlation: no autocorrelation						
Estimated covariances		=	1		Number of obs =	128
Estimated autocorrelation		=	0		Number of groups=	16
Estimated coefficients		=	11		Time periods =	8
Log likelihood		=	-194		Wald chi2 (10) =	108.77
					Prob >chi2 =	0.0000
Tobin's Q	Coef.	Std.Err.	z	P>|z|	[95% confi.	Interval]
Material	0.2865477	0.129683	2.21	0.027	0.0323745	0.5407208
Liquidity	0.6379416	0.089561	7.12	0.000	0.4624061	0.8134771
Firm size	4.505e-06	1.7606	2.30	0.022	5.96e-07	7.51e-06
_cons	3.065867	2.01694	1.52	0.128	-0.887263	7.018997

t statistics in parentheses * p<0.1, ** p<0.05, *** p<0.01

Table 6 presents the findings on the relationship between material efficiency and financial performance as measured by the Tobin's Q. Interestingly, the relationship between material efficiency and the Tobin's Q was significant at 5% significance level. To that effect, the alternative hypothesis stating that there is a significant positive relationship between material efficiency and the Tobin's Q of firms listed on the JSE was supported. This implies that listed firms in sectors such as telecommunications, banking, manufacturing, and retail can enhance the market value from environmental investments such as material efficiency. Ideally, this means that stakeholders such as investors, the government and the community attach value to firms which account for resource scarcity and environmental protection. Hence, firms which excel in initiatives aimed at attaining a circular economy where material efficiency activities such as use of lesser material, easily recycled material, use of biodegradable material and improved raw material handling are prioritised are likely to enhance their brand loyalty. Based on the positive and significant Tobin's Q, this means investors highly regard firms which excel in material efficiency as they are likely to perform well in future.

DISCUSSION

Relationship between Material Efficiency and Financial Performance

Interestingly, the relationship between material efficiency and ROE was found to be significant at 5% significance level. To that effect, the alternative hypothesis stating that **t**here is a significant positive relationship between material efficiency and the ROE of firms listed on the JSE was supported. This implies that listed firms in sectors such as telecommunications, banking, manufacturing, and retail can benefit immensely from environmental investments such as material efficiency. Ideally, this means that listed firms in

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the above-mentioned sectors can benefit from moving towards the circular flow economy, where packaging strategies are designed in a manner that allows re-use and recycling of the material which is also biodegradable. On the other hand, the relationship between material efficiency and the Tobin's Q was found to be significant at 5% significance level. To that effect, the alternative hypothesis stating that there is a significant positive relationship between material efficiency and the Tobin's Q of firms listed on the JSE was supported. This implies that listed firms in sectors such as telecommunications, banking, manufacturing, and retail can enhance their market value from environmental investments such as material efficiency. Ideally, this means that stakeholders such as investors, the government and the community attach value to firms which account for resource scarcity and environmental protection. Hence, firms which excel in initiatives aimed at attaining a circular economy where material efficiency activities such as use of lesser material, easily recycled material, use of biodegradable material and improved raw material handling are prioritised are likely to enhance their brand loyalty from green stakeholders. Based on the positive and significant Tobin's Q, this means investors highly regard firms which excel in material efficiency as they are likely to perform well in future.

The findings of this study corroborate with other similar studies. For instance, there is an agreement among scholars that material efficiency is one of the widely suggested strategies to cut cost in an organisation and attain superior financial performance (Greenovate, 2012; Vinayagamoorthi et al., 2015; Boakye, 2018). A significant number of firms in Europe which have adopted this strategy reported enhanced financial performance. Cutting costs through material efficiency is sustainable and can give a firm unmatched competitive advantage by reducing resource scarcity risk. For instance, with widely documented fear of possible resource scarcity in terms of water and energy supply, firms which attain material efficiency will require less of these resources, hence, bracing themselves for these unfavorable conditions which will see most firms closing shop (Greenovate, 2012).

Other scholars such as Allwood et al. (2013) submit that attaining material efficiency can help a firm to cut costs of production significantly by reducing the amount of raw materials and inputs required in the production process. The major savings are noticeable in the areas of energy savings and amount of water required to produce a unit of a product. Since energy and other raw materials bills constitute a significant amount of a firm's cost, attaining material efficiency enables a firm to enjoy cost benefits (Allwood et al., 2013). Additionally, Fischer & O'Brien (2012) assessed the effect of material efficiency on financial performance. The study established that material efficiency positively influences financial performance. The effect was found to be high on return on sales. Fischer & O'Brien (2012) argued that material efficiency enables a firm to cut cost of raw materials and other related inputs. These cost savings are then passed to customers in form of low prices leading to high return on sales. More importantly, the study noted that investments in material efficiency may payback in approximately less than a year. Nevertheless, this may only hold in the context of "*low hanging fruits*" such as attaining material efficiency through material saving or recycling. The payback period for material efficiency maybe longer than a year in the context of more sophisticated strategies such as new light material designs.

A study by Unam (2012) reported that there is a strong positive link between material efficiency and profitability. "*The implication of this is that through efficient management of materials, a manufacturing firm can achieve significant cost saving, improvement in production efficiency, and increase in profitability*" (Unam (2012:50). This is because a significant amount of costs are hidden in materials. Hence, if a firm can attain efficiency through strict material handling, use of alternative materials and aligning the production process, it is guaranteed that such a business will record superior performance. According to

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Ong et al. (2014), firms with material efficiency policies and standards can manage their production systems well by ensuring that the material efficiency goal is shared in the entire supply chain. This enables the firm to eliminate costs associated with wasteful ways of production and be profitable (Unam, 2012).

In their study on Indian firms, Vinayagamoorthi et al. (2015) found that attaining material efficiency can send a strong signal to the government on the firm's environmental responsibility behaviour. This can allow the firm to get subsidies and funding from the government and other organisations which fund green initiatives. To that effect, material efficiency enhances the firm's overall financial performance. More importantly, a firm is able to mitigate risks associated with scarcity of resource while at the same time gaining green trust from its key stakeholders. Moreover, operating with lower resource inputs reduces the economic vulnerability to price volatility at the global level (International Resource Panel, 2018). A recent report by International Resource Panel (IRP) (2017) assessed the economic implications of material efficiency. The report found that material efficiency enables a firm to have sustainable revenue streams which far outweigh the cost associated in initiating the material efficiency strategies. Material efficiency strategies such as light-weight design can boost the firm's sales which translates into superior financial performance (IRP, 2017). For instance, 21st customers prefer portability over bulkiness. Hence, a firm which leverages on product modification using light material and new design will likely grow its profit with a significant margin. If well executed, material efficiency can be used to differentiate the firm from its competitors and increase its market.

CONCLUSION

Material efficiency remains one of the key strategies firms can use to enhance their financial performance. This study tested the link between material efficiency and financial performance. The current study adopted a quantitative research method informed by a positivism research philosophy. The population of the study was all firms listed on the Johannesburg Stock Exchange. The sample consisted of 16 firms listed on the FTSE/JSE Responsible Investment Top 30 Index. Panel data spanning from 2011-2018 was used. Data was analysed using panel regression. Particularly, the feasible generalised least squares was used. Interestingly, the relationship between material efficiency and ROE was found to be significant at 5% significance level. To that effect, the alternative hypothesis stating that **t**here is a significant positive relationship between material efficiency and the ROE of firms listed on the JSE was supported. This implies that listed firms in sectors such as telecommunications, banking, manufacturing, and retail can benefit immensely from environmental investments such as material efficiency. The findings also showed that the relationship between material efficiency and the Tobin's Q was significant at 5% significance level. To that effect, the alternative hypothesis stating that there is a significant positive relationship between material efficiency and the Tobin's Q of firms listed on the JSE was supported. This implies that listed firms in sectors such as telecommunications, banking, manufacturing, and retail can enhance the market value from environmental investments such as material efficiency. Ideally, this means that stakeholders such as investors, the government and the community attach value to firms which account for resource scarcity and environmental protection. Hence, firms which excel in initiatives aimed at attaining a circular economy where material efficiency activities such as use of lesser material, easily recycled material, use of biodegradable material and improved raw material handling are prioritised are likely to enhance their brand loyalty. The limitations of this study include that this study was limited to 16 firms considered to operate in less environmentally sensitive industries such as retail, telecommunications, manufacturing and the banking sector. Nevertheless, the

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findings of the study contribute new empirical evidence to the body of knowledge. the findings can also help managers of listed companies to design internal environmental policies which promote material efficiency. The author of this study suggest that further research can investigate the moderating role of industry type on the link between other environmental sustainability variables and financial performance.

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