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Principal component analysis of factors influencing pricing decisions of building materials in Ghana

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ABSTRACT

The key factors that greatly affect the selection of building materials are the cost and other related factors such as properties of the materials. The aim of this study was to identify the factors that influence the pricing decisions in determining the price level of building materials in Ghana. Self-administered questionnaires were sent to both construction practitioners and building material merchants to collect data in Kumasi metropolis, Accra metropolis and Sunyani municipal assembly in Ghana. Factor analysis was performed to identify the main factors that influence pricing decisions of building materials. Six main factors were identified: market-, producer-, production-, economic-, political- and environmental-related factors. It is recommended that the identified factors should be controlled by stakeholders who are concerned with the identified factors that contribute to prices of the building materials in order to prevent the increased prices of building material. The study contributes to the literature in the area of building materials management.

KEYWORDS

Building materials; cost; factor analysis; prices

Introduction

The price of building materials has been assuming a critical part in the construction industry globally, especially in developing countries. Researches have shown that between 50 and 60% of cost of buildings goes into the materials (Ugochukwu and Chioma 2015) and Danso (2015) observed that other variables such as insufficient infrastructural for storage, cost of transportation of materials and levies charge on the materials may increase the cost of the building materials. The increasing cost of building materials has been recognized as one of the significant issues militating against the construction industry in most developing countries (Danso and Manu 2013).

The major factors that greatly affect the selection of building materials are their costs and social requirements such as thermal comfort, good mechanical properties (strength and durability), aesthetic characteristics and an ability for speedy construction. Ideally, combination of the environmental, economic and social factors can give a clear description of a material, and thus help in a decision-making process regarding the cost of the materials suitable for buildings (Abeysundara et al. 2009).

The instability in the price of building materials is as a direct result of high taxes which in turn impacts on the cost of accommodation in major cities across developing countries. According to Idoro and Jolaiya (2010), there was a radical variance in the costs of key building materials such as cement, steel, blocks, sand and gravel. Contractors face critical misfortunes because of settled value development contracts, which are as a result of the unstableness of prices of building materials (Danso and Manu 2013).

One of the major constraints in the Ghanaian construction industry today has been the rapid inflation in the price of the building materials. As asserted by Oladipo and Oni (2012), the prices of building materials respond to market situation by an economic law of supply and demand, with imported materials such as cement, reinforcement and sanitary ware, prices fluctuate partly as a result of the effect of changing monetary policies, and partly as a result of changes in their supply. The interest for building materials prices is a determined interest for construction industry administration and management. This makes it important to consider the variables that influence the prices of building materials.

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Most literature (Danso 2013; Danso and Manu 2013; Oppong and Badu 2013; Acheampong et al. 2014) has concentrated on studying the effects of high cost of building materials in Ghana with little emphasis on the factors that influence pricing decisions. This study therefore, identifies the factors that influence the pricing decisions in determining the price level of building materials in Ghana.

Literature review

Amadi (2017) identified four main factors affecting cost of building construction in Nigeria, these include economics factors, environmental factors, government policies and issues of indigenes. All these factors have link with the cost of building materials which invariable affect the total cost of buildings. A study conducted in China indicated that building materials price, especially iron and steel prices continued to rise and have reached 60%, and the other building materials prices also continue to rise sharply (Huan and Jianhua 2013). Huan and Jianhua (2013) further identified six price influence factors of building materials, which are the value of building materials, supply–demand relationship, national macro policy, the value of money, notes circulation and the influence of the international market.

Windapo and Cattell (2012) in examining the trends in building material prices also reviewed some factors contributing to the increase in prices of building materials. The factors they identified are raw material cost, competition, transportation, energy cost, inflation, import duties and crude oil. According to Akanni et al. (2014), the three main factors that influence the price of building materials are government policies, the cost of fuel, power supply and exchange rate. Government policies and legislature play various roles in influencing pricing decisions. With reference to Mansfield et al. (1994) and Obadan (2001) (as cited in Akanni et al. 2014), government policies set the economic environment in which all elements of the economy operate including the building materials industry.

Another study by Rajaprabha et al. (2016) found design-, client-, contractor-, site-related factors, external factors, labour and equipment-related factors, market condition factors and overall material mismanagement factors as the main factors that affect the pricing of building materials. Dlakwa and Culpin (1990) also concluded that government fiscal policies also affect the cost of building materials. Cost of fuel and power supply also influence prices of building materials which are major factors that influence or contributes to the determination of prices of building materials. No company can totally avoid the impact of increasing costs, and most managers have learned to adjust to the effects that inflation has on current operating costs. The use of fuel and power as an operation element in production, and its consequences with respect to the cost of purchase cannot be ruled out as a factor that will determine prices of materials.

When the cost of raw materials and other inputs are on a higher level than the output, the final products price will bear the cost of the input cost in addition to price determinants (Gorin 2017). Lipsey and Chrystal (2007) indicated that demand and supply of building materials or scarcity in that sector can add to the patterns in the costs increase of building materials, where the law of free market activity can be connected. Ihuah (2015) indicated that over dependence on imported materials, rapid depreciation of national currency, increase in labour cost of production, lack of knowledgeable technical expertise, lack of consistent government policy and implementation, inadequate industrial production units, capacity and facilities available in the industry and lack or absence of indigenous technology for the production of building materials are all reasons for cost increase of building materials.

Research methodology

The research adopted a cross sectional survey approach. The population of the study was experts in the construction industry (building contractors and registered quantity surveyors) and building material merchants. These people constituted the population of the study because they are knowledgeable on issues related to pricing of building materials. Snowball and purposive sampling techniques were used to select the sample for collecting data. The snowball technique was adopted for selecting merchants of building materials to participate in the study. Glen (2015) explains snowball sampling as where research participants recruit other participants for a test or study. It is used where potential participants are hard to find. It is called snowball sampling because (in theory) once you have the ball rolling, it picks up more "snow" along the way and becomes larger and larger. Initially, three merchants of building materials were identified who aided in recruiting others for the study. Purposive sampling technique was used to select the contractors and quantity surveyors for the study. Contractors and quantity surveyors who were currently involved in construction project works were chosen from the study since they possessed enough information on the current prices of building materials.

Questionnaires were used to collect data on the factors that influence building material pricing decisions. A five-point Likert scale was used for the study; strongly disagree (1), disagree (2), neutral (3), agree (4) and strongly agree (5). The questionnaire contained items for demographic data and items on the causes of building materials price increase. The items on the causes of building materials price increase were adopted from previous studies as shown in Appendix I. The instrument was pilot tested and the reliability co-efficient (Cronbach's Alpha) determined was 0.93 which was above the recommended value of 0.7 (Straub et al. 2004). The questionnaires were administered to selected sample. 95 questionnaires were retrieved out of 120 administered, representing 79% response rate within a period of 3 months.

Factor analysis was performed to identify the factors that influence pricing decisions of building materials. Factor analysis is a statistical method which is used to analyze interrelationships among a large number of variables and to explain the variables in terms of their common underlying dimensions called components or factors. Data collected were presented in tables and analyzed using principal component analysis with International Business Machines Statistical Package for Social Sciences (IBM SPSS) version 21.

Results and discussion

Respondents' information

The respondents' information obtained is presented in Table 1. It could be seen that majority (80%) of the respondents were males, which indicates male dominant in the construction industry in Ghana as was also found by Danso (2012). 31% the respondents were <30 years of age. Those between 40 and 49 years also formed 29% of the overall respondents, whereas 30 and 39 years were 24% of respondents. Generally, it could be seen that majority of the respondents were <50 years with an overall percentage of 84% of total respondents. For Kumasi municipality, a total of 29 respondents were obtained with 10 quantity surveyors, 11 merchants and 8 contractors, whereas Accra had respondents of 49 with 18 quantity surveyors, 21contractors, and 10 merchants. Sunyani, had 2 quantity surveyors, 3 contractors and 12 merchants. Generally, the majority (68%) of respondents had 5 and more years of working experience.

Table 1. Respondents' information ($n = 95$).

	Merchants	Contractors	Quantity surveyors	Total	
	f	*f*	*f*	*f*	%
Gender					
Male	21	31	24	76	80
Female	12	1	6	19	20
Age					
<30 years	4	10	15	29	31
30–39 years	9	7	7	23	24
40–49 years	12	10	6	28	29
50–59 years	8	3	1	12	13
≥60	0	2	1	3	3
Municipality					
Kumasi	11	8	10	29	31
Accra	10	21	18	49	51
Sunyani	12	3	2	17	18
Experience					
<5 years	8	11	12	31	32
5–9 years	12	10	13	35	37
>10 years	13	11	5	29	31

Factors that influence pricing decisions of building materials

In order to identify the factors that influence pricing decisions of building materials, factor analysis was performed. From Table 2, the Chi-square = 948.330, df = 404, $p < .0001$ obtained, justified the use of factor analysis for the data. Sampling adequacy of the data was 0.703 per the Kaiser-Meyer-Oklin sampling adequacy test (KMO = 0.703) was more than the KMO threshold of 0.05. A value of 0.703, thus, confirmed that the data were satisfactory for factor analysis.

Extraction method: principal component analysis

It could be seen from Table 3 that the total variance explained was based on 5% variance, thus, six components passed this limitation even though eight components have had an eigenvalue of 1 or more. The total cumulative of these six components explained 62.87% of the variance with individual variance explaining 23.638, 12.394, 8.325, 7.385, 6.016 and 5.113% for components one, two, three, four, five and six, respectively. Each component had at least three variables (see Table 4) representing a factor. The other two components had variables less than three, and therefore eliminated from the factors.

Market-related factors

The first component obtained from the result is termed market-related factor as shown in Table 4.

Table 2. KMO and Bartlett's test.

KMO and Bartlett's test		
KMO of Sampling Adequacy		0.703
Bartlett's test of sphericity	Approximately Chi-Square	948.330
	df	406
	Sig.	0.000

Table 3. Initial matrix and rotated matrix.

	Extraction sums of squared loadings			Rotation sums of squared loadings		
Component	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1. Market-related factor	6.855	23.638	23.638	4.132	14.249	14.249
2. Producers-related factor	3.594	12.394	36.032	3.588	12.372	26.621
3. Production-related factors	2.414	8.325	44.357	3.321	11.452	38.073
4. Economic-related factors	2.142	7.385	51.741	2.123	7.319	45.392
5. Political-related factors	1.745	6.016	57.758	1.998	6.889	52.281
6. Environmental-related factors	1.483	5.113	62.871	1.978	6.822	59.104

Extraction method: principal component analysis.

Table 4. Factors influencing pricing decisions of building materials after rotated factor matrix (loading).

	Component					
Causes	1	2	3	4	5	6
Component 1. Market-related factor						
Fast growing demand due to high global economic growth	0.801					
Over dependence on imported building materials	0.774					
Declining supply or anticipated shortage in supply	0.705					
Purchase frequency	0.646					
Related product pricing	0.604					
Price skimming	0.597					
Component 2. Producers-related factor						
Interest rate and cost of finance		0.768				
Population growth		0.666				
Business cycles		0.653				
Producers' incentives		0.619				
Cost of fuel and power supply		0.608				
Cost of plant		0.574				
Knowledge and management skills		0.566				
Availability of substitute		0.564				
Component 3. Production-related factors						
High running cost			0.801			
High prices of raw materials			0.751			
Maximization of profit by manufacturers			0.719			
High tariffs			0.669			
Component 4. Economic-related factors						
Energy cost				0.795		
Crude oil prices				0.650		
High cost of labour				0.585		
Component 5. Political-related factors						
Local taxes and charges					0.734	
Government policies and legislature					0.536	
Cost of transportation					0.491	
Component 6. Environmental-related factors						
Lack or absence of indigenous technology for the production of building materials						0.611
Inadequate infrastructural facilities						0.536
Behaviour of financial market participants						0.504
Rapid depreciation of national currency						0.496

Extraction method: principal component analysis; rotation method: Varimax with Kaiser normalization.

The variables loaded under this factor are fast growing demand due to high global economic growth, over dependence on imported building materials, declining supply or anticipated shortage in supply, purchase frequency, related product pricing and price skimming. These were loaded unto the factor one which explained 23.638% of the variance.

Market-related determinants allow us to determine the attractiveness of pricing strategies under specific market conditions (Carricano 2014). The variables loaded under this factor are all critical in determining the prices of building materials relating to the market consideration. According to Schoell and Guiltinan (1995), in inelastic segments, e.g. the optimal strategic choice is skimming. Breitenfellner et al. (2009) emphasize fast growing demand due to high global economic growth and declining supply or anticipated shortage in supply as critical variables for market-related factor.

Producers-related factors

From Table 4, it can be seen that producers-related factor were the second component obtained from the result. Subsequently, variables such as interest rate and cost of finance, population growth, business cycle, producers' incentives, cost of fuel and power supply, the cost of the plant, knowledge and management

skills and availability of substitutes were loaded onto the factor two. This factor explained 12.394% of the variance.

Producer-related factors are central in defining the success of a firm. The level of price competition has a strong influence on a firm's pricing power. Differentiation also appears as the necessary condition for price discrimination (Geradin et al. 2005). The capability of a company to exploit in a flexible way the profit potentials of different market segments is also defined by the quality and the perceived value of a product offering (Rothaermel 2008). Happonen (2009) explained that producers' incentives and availability of substitute are critical variables for determining prices of goods. Akanni et al. (2014) also explained that variable such as interest rate and cost of finance, cost of fuel and power supply, and cost of plant are important in terms of identifying cost of goods. These therefore, make the producer-related factor an important in pricing decision dimension of building materials.

Production-related factors

The third factor had variables such as high running cost, high price of raw materials, maximization of profit by manufacturers, and high tariffs loading onto it (see Table 4). These were named production-related factors, which explained 8.325% of the variance. Production involves the processes to which a product is derived from the final output. Production-related factors are factors that influence the production process of building materials (Reynolds 2005). This factor is clearly related to the creation of building materials and in this manner, may change as the level of manufacture or arrangements changes. Mbugua (2016) emphasized that high running cost, high prices of raw materials and high tariffs are important variables for determining production-related factors. According to Ger (1999) companies pricing decision choices would be acted upon by factors as producers would inculcate the impacts of these variables on the price point of the final product.

Economic-related factors

Energy cost, crude oil prices, and high cost of labour were loaded on factor four which explained 7.385% of the variance. The factors were referred to as economic-related factors. In essence, pricing policies are fine-tuned to prevailing economic condition like energy cost, crude oil prices and high cost of labour (Windapo and Cattell 2012; Mbugua 2016). A firm changes cost-based pricing to market-oriented pricing that pays more attention to environmental dynamics in times of economic uncertainty, and when there is a need to break-even or penetrate into a new construction market. Economic factors are therefore important in determining the prices of building materials.

Political-related factors

Local taxes and charges, government policies and legislature, and cost of transportation loaded on the fifth factor as can be seen in Table 4. These explained 6.016% of the variance and were named political-related factors. Political factors appear to impact every single other variable. As indicated by Mansfield et al. (1994), political arrangements such as local taxes, government policies and legislature and cost of transportation set the financial condition in which all areas work, including the building materials segment. Dlakwa and Culpin (1990) identified government monetary strategies as one of the components influencing the price of building materials in the construction industry. Merchants need to be mindful of regulations that influence how the prices are set in the marketplaces in which their products are traded. This means that there may be legal consequences if the regulations are not observed. Price regulations can occur from any stratum of government and vary extensively in their necessities (Haron 2016).

Environmental-related factors

Lack or absence of indigenous technology for the production of building materials, inadequate infrastructural facilities, behaviour of financial market participants and rapid depreciation of national currency were loaded on factor six which explained 5.113% of the variance. The factors were referred to as environmental-related factors. Environmental factors determine the workload available for the manufacture. According to Akintoye and Skitmore (1990), turbulent environmental conditions characterized by lack or absence of indigenous technology for production of building materials, inadequate infrastructural facilities, the behaviour of financial market participants and rapid depreciation of national currency lead to the quick changes in firms' pricing policies.

Summary of the identified factors

The study identified six factors that influence pricing decisions of building materials in Ghana. The factors are market-, producers-, production-, economic-,

political- and environmental-related factors. Although the data on which this study are based are specific to Ghana, the results generally agree with earlier studies in developed countries. The findings of this study are similar to the study conducted in Nigeria by Amadi (2017), which also identifies economics factors, environmental factors, government policies and issues of indigenes. This can be attributed to similarities of conditions surrounding the two countries in terms of pricing decisions of building materials. These two countries are all in West African and are also developing countries; therefore, the factors that influence the pricing increase of building materials in Ghana are similar to those in Nigeria. Contrarily, a study conducted in China by Huan and Jianhua (2013) identified factors such as the value of building materials, supply–demand relationship, national macro policy, the value of money, notes circulation and the influence of the international market, which are different from the factors identified by the current study. The difference might be due to the different geographical areas and the level of economic development of the two countries. According to Huan and Jianhua (2013), building materials price change has a great influence on the project, so it is necessary to control the influence factors. This means that the stakeholders who are concerned with the identified factors that contribute to prices of the building materials have enormous task to ensure that the factors are controlled to prevent increase in the cost of building materials.

Limitations of the study

The study considered only contractors, quantity surveyors and building materials merchants in Ghana. There are other construction experts and clients who can also be useful in providing information for such study. The variable on the causes of building materials price increase used were adopted from previous studies, but might not be exhaustive due to that fact that other variables have been used in other studies that yielded different factors.

Conclusion

The aim of the study was to identify the factors that influence the pricing decisions in determining the price level of building materials in Ghana. With the help of principal component analysis, the following factors were identified: market related, producer related, production related, economic related, political related and environmental related. These six factors are said to be the main determinants that influence pricing decisions of building materials in Ghana. The factors will lead to either increase or decrease in prices of building materials on the Ghanaian construction market.

The factors could be related to internal or external conditions. Internal conditions are influenced by producer- and production-related conditions. These are company-related conditions that influence the choice of pricing decision to be adopted in determining the price level of building materials. Also, market conditions, environmental factors, economic conditions and political factors were identified to be under external conditions. The impact of these are not under the control of the companies producing the building materials as well as those determining the price levels of building materials but are rather dictated by factors that are outside their control.

The results of this study are expected to assistance researchers and construction industry practitioners to focus on how to handle the identified factors in order to take measures to control the prices of building materials from escalating. The implications of this study are not limited to researchers and construction industry practitioners alone. The Government of Ghana could adopt the results of this study to help in introducing measures that will check the factors so as to prevent rising cost of building materials which has the tendency of increasing the total cost of buildings.

The study therefore, recommends that the identified factors should be controlled by stakeholders who are concerned with the identified factors that contribute to prices of the building materials in order to prevent the increased prices of building material. It is also recommended that further research should be carried out to find out the trend of prices of building materials in Ghana.

Disclosure statement

No potential conflict of interest was reported by the authors.

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Appendix I. Summary of the causes of price increase of building materials.

No.	Variables	Sources
1	Government Policies and Legislature	Akanni et al. (2014)
2	Local taxes and Charges	
3	Season Changes	
4	Political Interference	
5	Interest rate and Cost of finance	
6	Cost of fuel and power supply	
7	Inadequate infrastructural facilities	
8	Cost of Transportation	
9	Cost of Distribution	
10	Cost of Plant	
11	Fast growing demand due to high global economic growth	Breitenfellner et al. (2009)
12	Declining supply or anticipated shortage in supply	
13	Coordinated action on the part of Building materials producers	
14	Behaviour of financial market participants	
15	Competition	Windapo and Cattell (2012)
16	Energy cost	
17	Crude oil prices	
18	Import duties	
19	Exchange rates	
20	Demand pull inflation	
21	Maximization of profit by manufacturers	
22	Over dependence on imported building materials	Ihuah (2015)
23	Rapid depreciation of national currency	
24	Increase in labour cost of production	
25	Lack of knowledgeable technical expertise	
26	Lack of consistent government policy and Implementation	
27	Lack or absence of Indigenous technology for the production of Building materials	
28	Inadequate industrial production units	
29	Capacity and facilities available in the industry	
30	High prices of raw materials	Mbugua (2016)
31	High running cost	
32	High cost of labour	
33	High Tariffs	
34	Monopoly	Baumol and Blinder (1979)
35	Direct competitor pricing	Haron (2016)
36	Related product pricing	
37	Purchase frequency	
38	Weight and technicality of product	
39	Price Skimming	Musonera and Ndagijimana (2008)
40	Distribution of income	
41	level of urbanization	
42	Culture	
43	Producers' incentives	Happonen (2009)
44	Availability of substitute	
45	Monetary policy	Tvaronavičienė and Michailova (2006)
46	Business cycles	
47	Knowledge and management skills	Timmerr (2008)
48	Panic or hoarding	
49	Speculation	
50	Population growth	