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Discovering Thoughts, Inventing Future

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Perception towards Cervical Cancer Insurance Policy: A Study on Women in Barishal City

By Rabeya Sultana Lata
University of Barishal

Abstract- The purpose of this research paper is to assess the perception of urban women towards having an insurance policy as a precaution against cervical cancer. Data required for the research have been collected from primary data source taking into consideration total 170female as respondents who have been living in Barishal city with at least 18 years old. Frequency distribution has been used to explain the response of 27 questions comprising demographic and financial aspect of the respondents. Reliability of the survey has been tested by Cronbach's Alpha with satisfied value of more than 0.705. Moreover, a regression analysis has been used for finding out the most significant factors influencing the willingness of purchasing cervical cancer insurance policy in near future covering 7relevant variables. Overall, it has been found that approximately 23% respondents from the surveyed sample has a history to be encountered with cervical problems like ovarian cyst, uterus infection etc. However, most of them neither had any screening nor have any health insurance policy as a precaution against cancer. Moreover, significant number of participants are willing to purchase a cancer insurance policy if it is with a very reasonable premium.

Keywords: *cervical cancer insurance policy, screening, social awareness, motivation.*

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Perception towards Cervical Cancer Insurance Policy: A Study on Women in Barishal City

Rabeya Sultana Lata

Abstract- The purpose of this research paper is to assess the perception of urban women towards having an insurance policy as a precaution against cervical cancer. Data required for the research have been collected from primary data source taking into consideration total 170female as respondents who have been living in Barishal city with at least 18 years old. Frequency distribution has been used to explain the response of 27 questions comprising demographic and financial aspect of the respondents. Reliability of the survey has been tested by Cronbach's Alpha with satisfied value of more than 0.705. Moreover, a regression analysis has been used for finding out the most significant factors influencing the willingness of purchasing cervical cancer insurance policy in near future covering 7relevant variables. Overall, it has been found that approximately 23% respondents from the surveyed sample has a history to be encountered with cervical problems like ovarian cyst, uterus infection etc. However, most of them neither had any screening nor have any health insurance policy as a precaution against cancer. Moreover, significant number of participants are willing to purchase a cancer insurance policy if it is with a very reasonable premium.

Keywords: cervical cancer insurance policy, screening, social awareness, motivation.

I. Introduction

Cervical cancer developed in a woman's cervix is the fourth most common cancer in women. In 2018, an estimated 5,70,000 women were diagnosed with cervical cancer worldwide and about 3,11,000 women died from the disease (WHO,2018). Each year, many countries from developed world publishes reports on early cancer detection; which is absolutely absent in most developing countries like Bangladesh. Very limited evidence is found on the role and acceptance of Pap test among the women of Bangladesh in determining cervical cancer. More research and updates are needed relating Pap test in early detection of cervical cancer (Mustari, S. 2017).

In the coming decades, cancer is foreseen to be a more significant cause of mortality in Bangladesh. The projected frequency of new cancer cases will be 21.4 million by 2030 (Hussain and Sullivan, 2013). However, women, their partners and families are often not aware of the disease and its consequences. (Ahmed T 2008) They come for diagnosis and treatment usually when it is too late. This is the reason why approximately 18,000 of Bangladeshi women reported new cases of cervical cancer on annual basis and out of which amounting to over 10,000 women die from it. "According to hospital records in Bangladesh, it constitutes about 22-29% of all female cancers". "Two-third (69.2%) of the women referred for cervical cancer screening aware of cervical cancer and half of the women (47.4%) know about prevention of the disease" (Nessa et al., 2013).

In the absence of health insurance, treatment of critical illnesses like cancer poses a formidable financial challenge to affected individuals, their immediate and extended family, and the society at large. Patients often fail to complete the course of treatment due to unaffordable costs and yet face the prospect of bankruptcy. Against this backdrop, we propose a two-tiered novel insurance scheme for cancer care, involving all the major stakeholders. (Hussain MZ 2016). Due to high premium, poor coverage, relatively few choices, lack of promotional activities and most importantly reluctance to screening cervical cancer demotivate women to adopt any health insurance products. However, weather plenty of social awareness programs and very convenient featured cervical cancer insurance policy can motivate the women to invest for this deadly diseases or not is the main concern of this project.

The paper aims to find out the perceptions of women towards their knowledge and sincerity of screening particularly cervical cancer along with willingness to purchase an insurance policy as a precaution against it hereafter. It has been organized as follows. Firstly, there is an introduction; second section consists of literature review, followed by a rational of the study as section three; section four consists of methodology; section five includes result and analysis; the last section concludes the paper with some recommendations.

II. Literature Review

Cervical cancer ranks as the most prevailing cancer among Bangladeshi females (Ahmed and Rahman, 2008). Despite advances in screening and treatment during the past several decades, cervical cancer remains a major health problem for Bangladeshi women. The reason is, many women have never undergone a Pap test procedure, or are not tested regularly. Like other less developed countries, low socio-economic status, poverty and lack of knowledge are considered as the reasons for the low test rates on Bangladeshi women (Austin et al., 2002).

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A questionnaire-based survey of 400 Bangladeshi urban women was evaluated by on their socio-demographic characteristics, knowledge and attitudes towards Pap testing. In general, the findings reveal that respondents have a good understanding of the purpose of Pap test screening with 3.92 (Mean score). With 3.54 Mean score, the respondents believed that Pap tests are recommended to women who are married and with 3.45 mean score women believed that Pap tests are recommended only to those who have children. Generally, respondents possess good knowledge of Pap test and its purpose (Mustarietel 2017).

Health, medical consumption, and on socio-economic characteristics like age, income, education and family size has been considered as a key factors can influence the purchasing decision health insurance policy. Health, medical consumption and income are found to have a significant influence on the decision with respect to the type of insurance. The result gives an indication of the degree of adverse selection that may take place if health insurance policies are offered with the option to take a deductible in exchange of a premium reduction. (Bernard and Van 1983) Advertising is positively correlated with the purchase decisions of unsought product while personal selling is statistically significant and positively correlated with the purchase decision of life insurance product. (Abdullah et el 2015).

Slattery (1989) puts the customer in the focus of insurance marketing. Integrity and trust are highly important to win over a customer‘s decision to buy a life insurance product. The perceived risk of the customer in buying a life insurance product is dependent on the service of the insurer and its personal equation with the customer. Gronroos (1984) pointed that insurance get influenced by the external aspects such as brand image while judging the service. The various causes outlined by Wells & Stafford (1995) and supported by Cooper & Frank (2001) are low quality of service, unawareness of specific needs of customers, inferior service design and very poor insurance service delivery process. Customer‘s expectation of the agent‘s service is the standard to be used by the insurers while evaluating their services (Walker & Baker, 2000).

There is a positive influence of certain socio-demographic characteristics on the decision to enroll and renew health insurance policy. Negative perceptions about the NHIS and the quality of care decreased the likelihood of enrolling in the scheme. It can be concluded that, improvement in the technical processes in the scheme management and the quality of care will stimulate voluntary enrollment and renewal rate of the health insurance policy. A health insurance policy is influenced by scheme factors (convenience, price and benefits), individual factors (gender, religion, marital status, perceived health status) and provider factors (quality of care, staff provider attitude) Daniel and Dadson (2013)

Asensoetel (1997) people are willing to pay higher premiums for health insurance. The reasons for the low enrolment are problems in ability to pay the premium, poor quality of health care, the rigid design in terms of enrolment requirements and problems of trust are other important reasons for people not to join. Logistic and OLS regressions are used by Liu and Chen (2002) to examine the factors influencing the probability and amount of private health insurance purchased. Higher income and education levels Married females, the employed and household heads working in state-run enterprises are more likely to purchase private insurance than their counterparts. The likelihood of private insurance purchase also tends to rise with advancing age and larger family sizes. The environment rating, residence, income, education, age, smoking and marital status variables were all found to have a statistically significant (at 95% confidence level) positive relationship with ownership of health insurance schemes. Contrastingly, the other covariates, namely: health rating, age squared, household size, occupation, employment, alcohol use and contraceptive use had a significantly negative relationship with health insurance ownership. Joses et el (2010).

There is a large and persistent association between education and health and we suggest that increasing levels of education lead to different thinking and decision-making patterns. David and Adriana (2008) Wealth status, age, religion, birth parity, marriage and ecological zone were found to have significantly predicted health insurance subscription among women in reproductive age in Ghana. Hubbard (1995) Demand effects are dominated by the marginal impacts from existing purchasers of insurance. Although income and number of earners are both positively related to the demand for insurance, the marginal effect from an increase in income is greater for single-earner households than for multi- earner households. Also, as either family size or age increases, the marginal increase in insurance expenditure diminishes. Showers & Shotick (1994) Anjali (2018) surveyed 50 respondents in Kerala, India. And she tried to know the perception of customers towards health insurance. The study finds out the awareness level of people regarding health insurance, sources of awareness, and the factors which influence people to select the health insurance company.

Bawa and Ruchita (2011) studied 563 people and found that a low level of awareness and willingness to purchase a health insurance policy among people. And also found seven key factors which create a barrier to have a health insurance policy. Besides these, they have found significant existed relationships among age, gender, education, employment, income of respondents with their preparedness to pay for health insurance.

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Panchal N (2013) found three factors that's why people have not any health insurance policy. These are low consciousness level among people, lack of efficient financial tools, and the high premium charged by the company. Nekmahmud, Shahedul and Ferdush (2017) they researched to know the perception of people regarding life insurance. They found a large number of people are aware of life insurance. It emphasized mass communication to raise awareness among people. Joshi and Shah (2015) try to know the perception of the customers to Health Insurance of different service providers and to find out customers purpose and numerous factors for buying Health Insurance policy.

III. Rationale of the Study

Cervical cancer is predicted to be an increasingly important cause of morbidity and mortality in Bangladesh in next few decades. Moreover, health insurance policy is not yet an effective measure to health and financial coverage for the people here. Most of the people are not concerned regarding the effectiveness of this cooperative service due to some personal, financial and social factors. As frequency and possibility of women being affected by the fatal diseases like cervical cancer, ovarian cancer and breast cancer is very high in South Asian region in recent years, it's very crucial to find out the attitude of women in our country to have cancer insurance policy as a precautions to face this types of unexpected situation in future. The paper would help to motivate further research to pick up the scenario from all over the country that would grow sincerity to the general women, the service provider and government as well to make cancer insurance policy as a common defensive tools for fighting against unanticipated future. Government could insist the insurance company to launce special policy for woman with convenient features.

IV. Methodology

The research is basically quantitative in nature and primary data has been used to prepare the project report The study was conducted in Barishal city where the data collection started in March 2023 and continued till mid of April 2023.A questionnaire with both structured and unstructured questions has been used to collect the data where 5-points Likert scale was also used to assess the opinions of the respondents regarding cancer insurance policy. In total, 170 women were surveyed ages between 18-60 years as sample from which finally 142 respondents were evaluated for the study. The analysis is based on data from cross sectional household sample. Frequency distribution of the collected sample have been prepared while Linear Regression, Chi Square test and Cronbach's Alpha has been run with the software SPSS to analyze the collected data. No experimental research has been conducted in the proceedings of this project. The model used for the analysis is given below.

$$\text{WILLINGNESS} = \alpha + \beta 1\text{MINPREMIUM} + \beta 2\text{SUSPECTION} + \beta 3\text{PENCOUNTER} + \beta 4\text{EDU} + \beta 5\text{TABILITY} + \beta 6\text{FINCOME} + \beta 7\text{INSUPOLICY} + \beta 8\text{MOTIVATION} + \beta 9\text{COST} + \varepsilon it$$

Where α represents constant. $\beta 1$, $\beta 2$,……$\beta 9$ indicates the regression coefficient for the independent variables, namely x_1= Minimum amount of Premium, $x_{2=}$ Suspection, $x_{3=}$ Previous occurrence history, $x_{4=}$ Education level, $x_{5=}$ Treatment ability , $x_{6=}$ Financial income per month, $x_{7=}$ Availability of insurance policy $x_{8=}$ Motivation to have insurance policy from the surroundings and $x_{9=}$ cost of the treatment.

V. Result and Analysis

a) Frequency Distribution of the Questionnaire

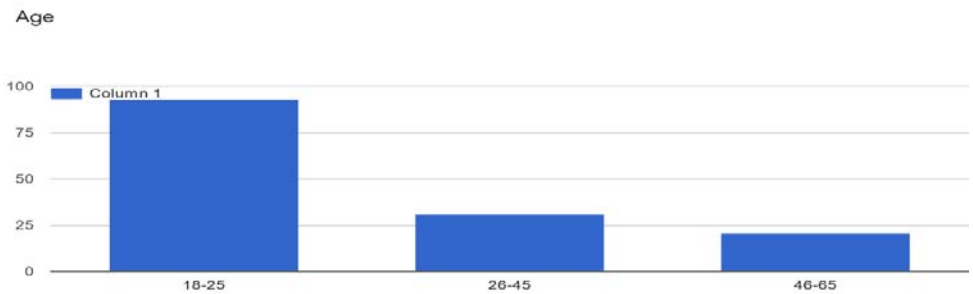

Figure No. 1: Source: Survey in Barishal, March –April 2023

From the above figure we can see that in total 127 response had been collected during the sampling study period among which more than75% are from ages between 18 years to 25 years old. Exactly 25% respondents are from ages in between 26-45 and a very few senior female responded the questionnaire regarding the research.

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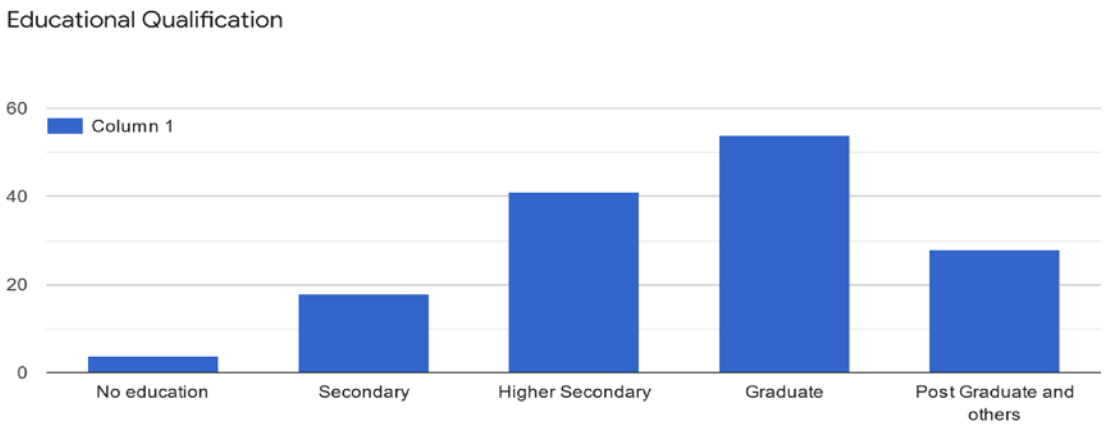

Figure No. 2: *Source:* Survey in Barishal, March –April 2023

Figure 2 shows that highest number of respondents are graduate that is almost 50% of the total sample whereas around 25% of them are from post graduate level of education. On an average 10% respondents have their education level up to higher secondary and a very insignificant portion are totally out of education.

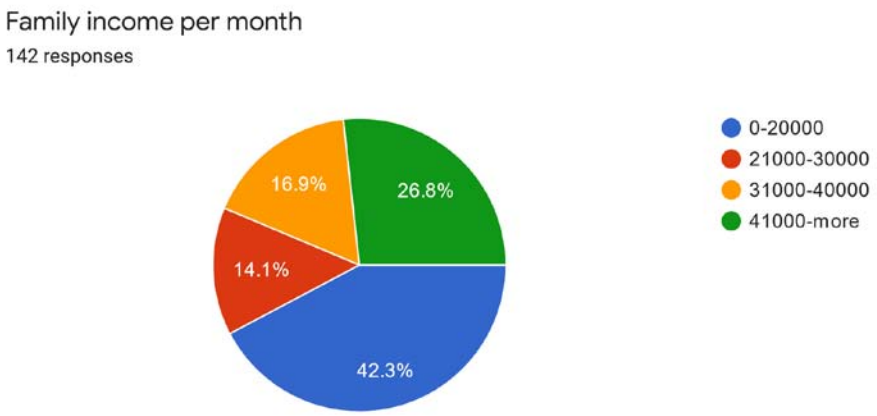

Figure No. 3: Source: Survey in Barishal, March –April 2023

The first pie chart above represents that 67.7% of the respondents are unmarried whereas 32.3% are married. The second diagram above shows the family income of the respondents within various categories. Highest proportion of female have their family income within 20,000 taka. On the other hand 25.4% have their family income level per month equal or more than 41,000 taka. However, the remaining two ranges have almost same number of respondents.

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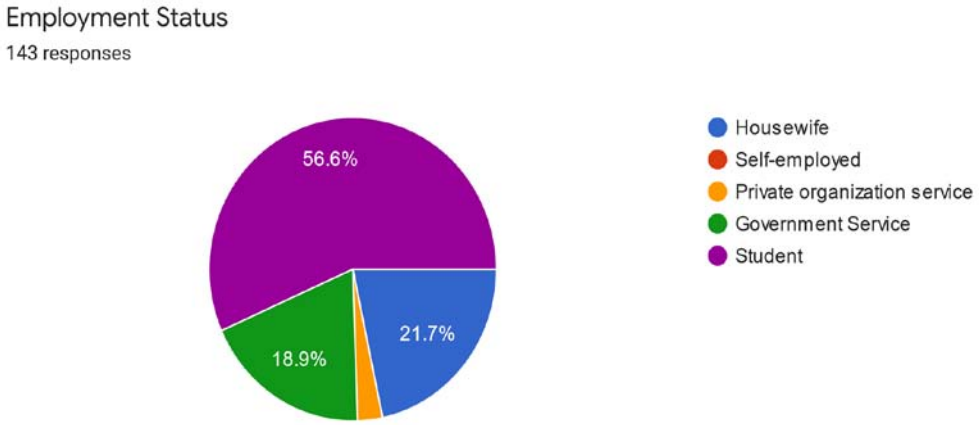

Figure No. 4: Source: Survey in Barishal, March –April 2023

Figure 4 shows that highest percentage of respondents having 63.8% of the total sample are students whereas there is no self-employed persons here. 17.3% of the sample are government employee and a very insignificant percentage are doing private organization service. Moreover, 15.7% of the collected responses are from housewives.

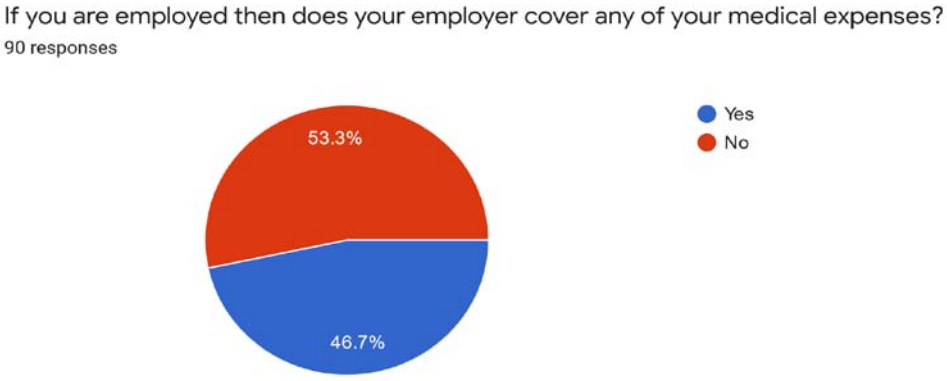

Figure No. 5: Source: Survey in Barishal, March –April 2023

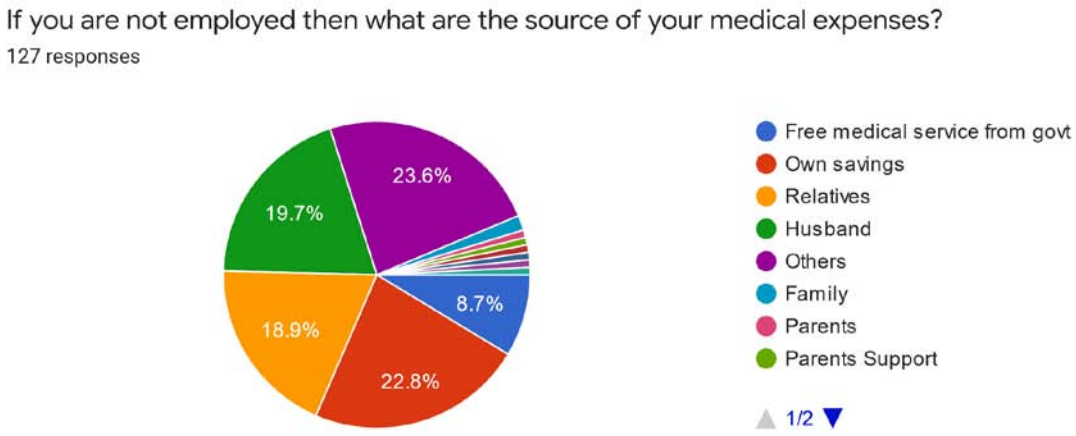

Figure No. 6: Source: Survey in Barishal, March –April 2023

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From figure 6 it can be clear that 56% of the respondents of the survey are employed but get no medical support from their employer whereas 44% of them are fortunate to have medical facilities from their employer. However, almost 24% of the correspondents arrange their medical expenses from their own savings while relatives and husband are the basis for the expense for around 17% of the respondents (figure 7).

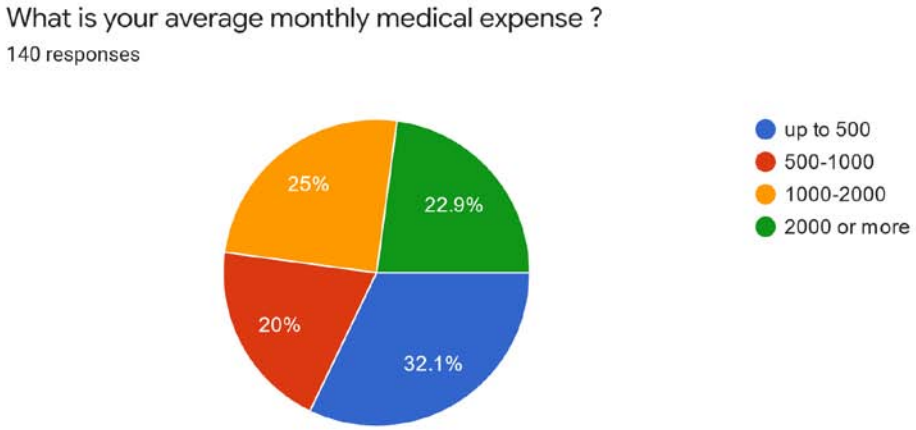

Figure No. 7: Source: Survey in Barishal, March –April 2023

The above graph show that around 32% of the respondents out of 140 have their medical expense up to 500 taka while approximately 25% of the sample have to spend 1000 -2000taka per month for their treatment purpose. On an average the remaining two groups have almost same number of samples in each (Figure 6).

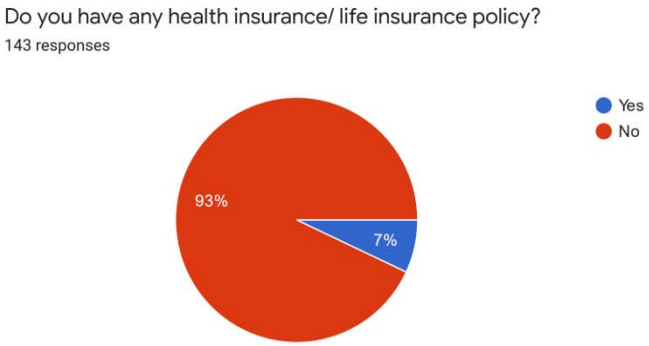

Figure No. 8: Source: Survey in Barishal, March –April 2023

Only a very few female from our sample have health insurance policy and their precaution against fatal diseases covering 7% of the total alternatively 93% of the respondents don't have any health insurance policy. Although a significant number participants of our survey are educated they are not even still conscious regarding health insurance policy.

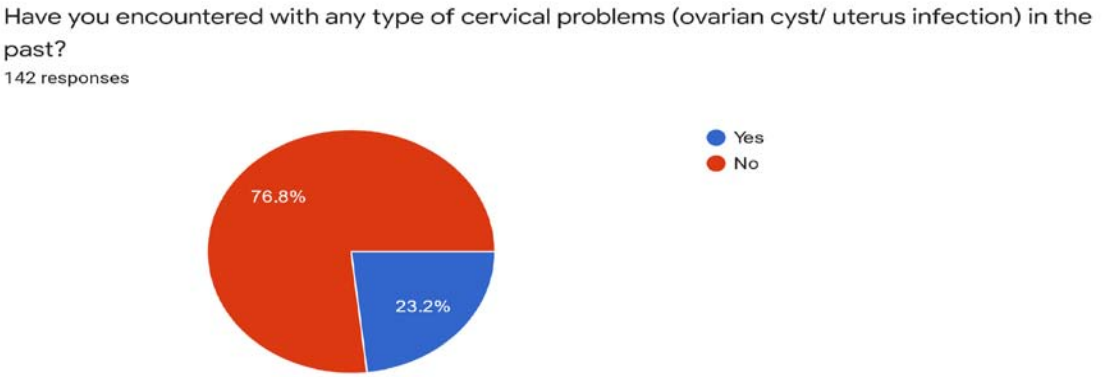

Figure No. 9: Source: Survey in Barishal, March –April 2023

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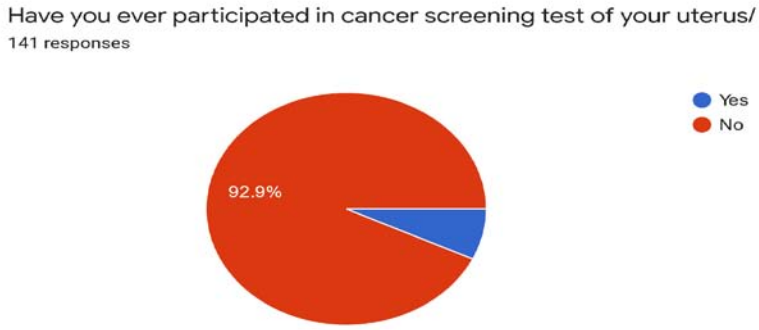

Figure No. 10: Source: Survey in Barishal, March –April 2023

Figure 9 indicates that approximately 23% respondents from the surveyed sample have a history to be encountered with cervical problems like ovarian cyst, uterus infection etc. From the categorical review of the sample it has been found that married women have greater possibility of being affected by these above mentioned complexities. However, only 7% of the total sample went through cancer screening test that means in spite of being affected by cervical problem they are not even serious of that issue.

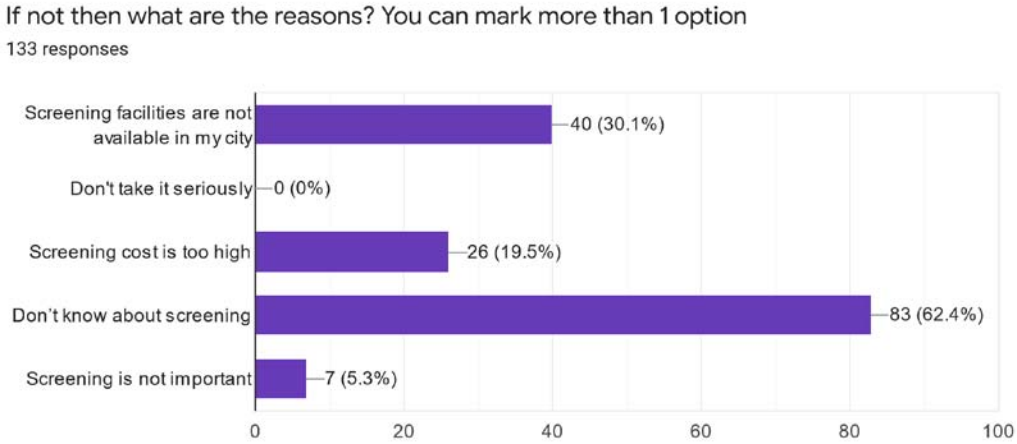

Figure No. 11: Source: Survey in Barishal, March –April 2023

Firstly, figure 11 reveals the major causes of their reluctance on screening issue and found that almost 63% of the respondents don't know about screening. Secondly, screening facilities are not available in their city is claimed by 30% of the sample. Thirdly, 26% of the respondents accused high cost as their reason of not participating in cervical screening test. In addition, around 5% of the respondents don't feel it important to test.

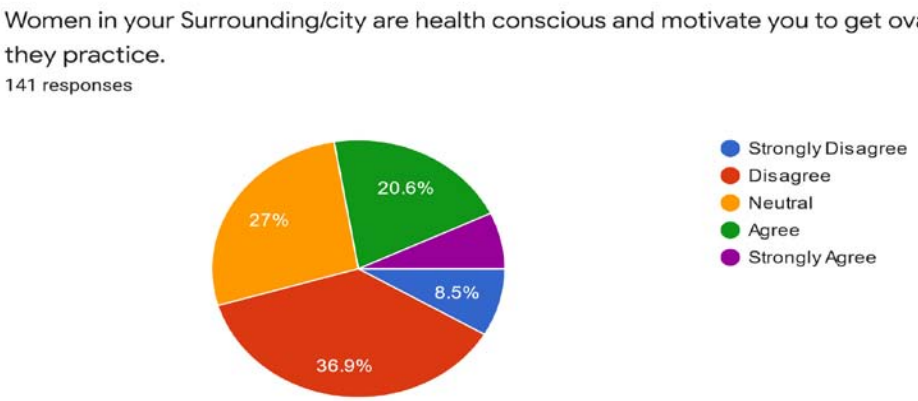

Figure No. 12: Source: Survey in Barishal, March –April 2023

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Around 37% respondents are disagreed regarding the health consciousness of the surrounding woman of them whereas about 20% have positive opinion regarding them. 27% of the surveyed woman were reluctant to take any positive or negative sides but 8.5% of the sample showed their strong negative opinion to the awareness and motivation issues of their surrounding woman. (Figure 12).

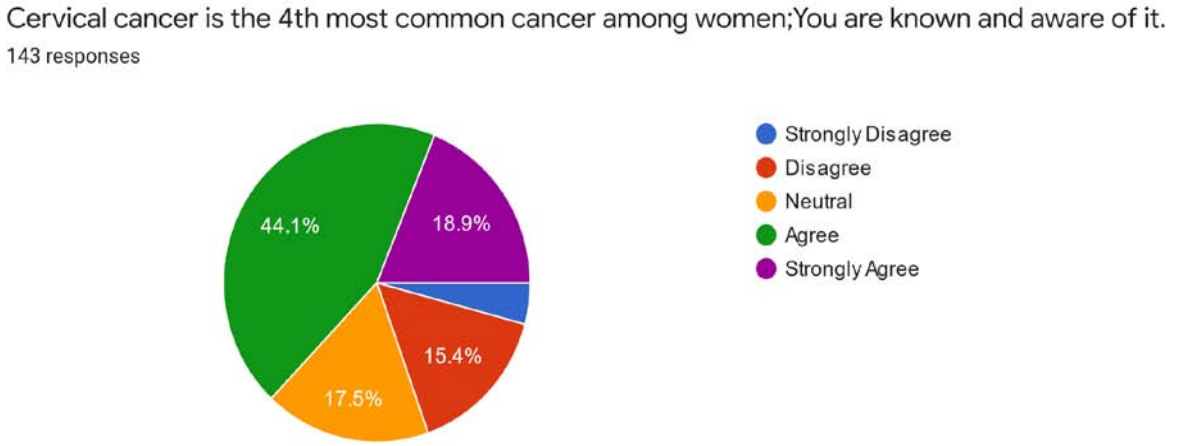

Figure No. 13: Source: Survey in Barishal, March –April 2023

Diagram 13 depicts that on an average 64% of the surveyed women are known about the widespread features of cervical cancer comprising response from the options agree and strongly agree. Around 30% respondents have no idea about the severity of cervical cancer among women. A significant number, about 18% are in neutral position without any positive or negative opinion in this respect.

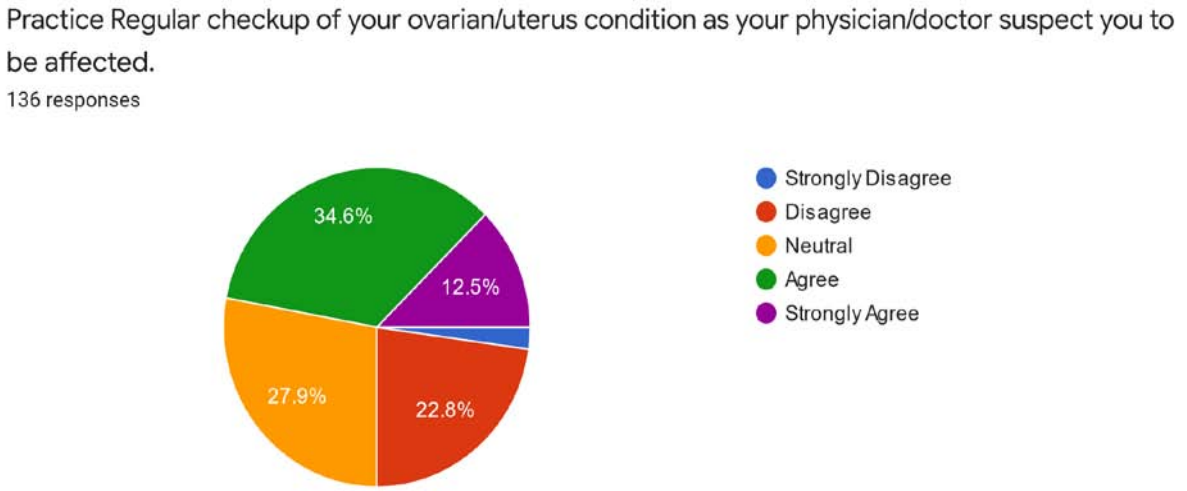

Figure No. 14: Source: Survey in Barishal, March –April 2023

An alarming scenario has been found from figure 14 that 34% of the sample use to go for regular ovarian checkup as they are suspected to be affected by cervical problem according to their physician. In addition, 12.5% strongly support their opinion. 23% of the respondents are out of suspense to be affected by any cervical issues in future. Around 28% of the sample have no straightforward response in this issue.

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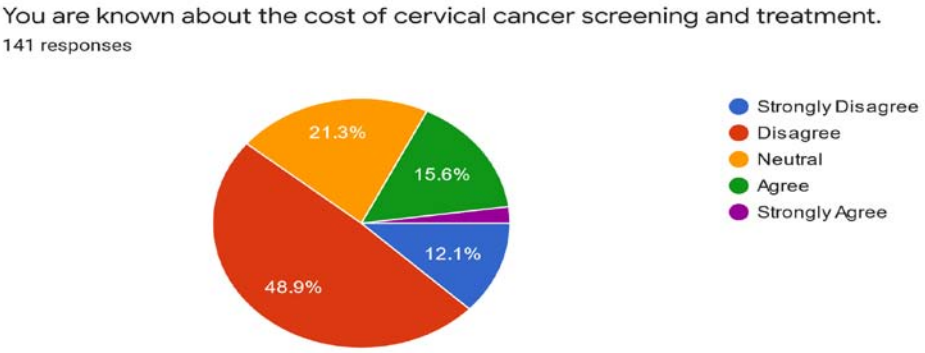

Figure No. 15: Source: Survey in Barishal, March –April 2023

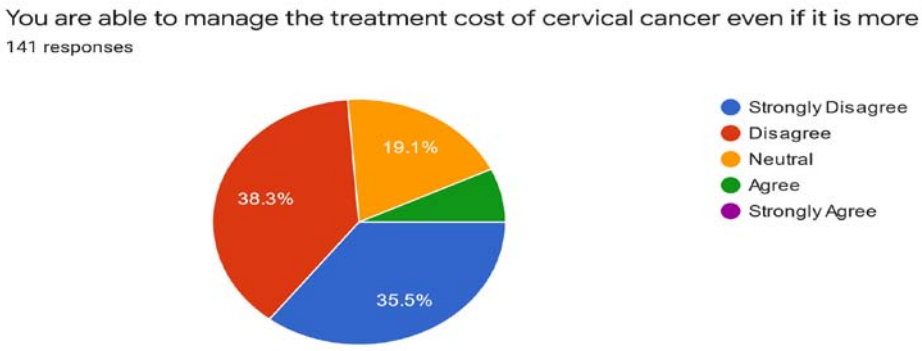

Figure No. 16: Source: Survey in Barishal, March –April 2023

It has been found from the survey (Figure 15) that almost 50% of the respondents don't have any idea regarding cost of screening and treatment of cervical cancer and 12% of the total respondents strongly supported the opinion. Only 16 % of the sample have knowledge in this respect whereas just above 20% of them are reluctant to express their concrete views in this respect. When an approximate treatment cost was revealed to the surveyed women in total 74% of them expressed their inability to carry the cost (Figure 16) of which 36% strongly opined their incapability. Just above of 19% participants are confused regarding this issue and only 8% of them believe in their capacity to arrange the required cost of cervical cancer treatment.

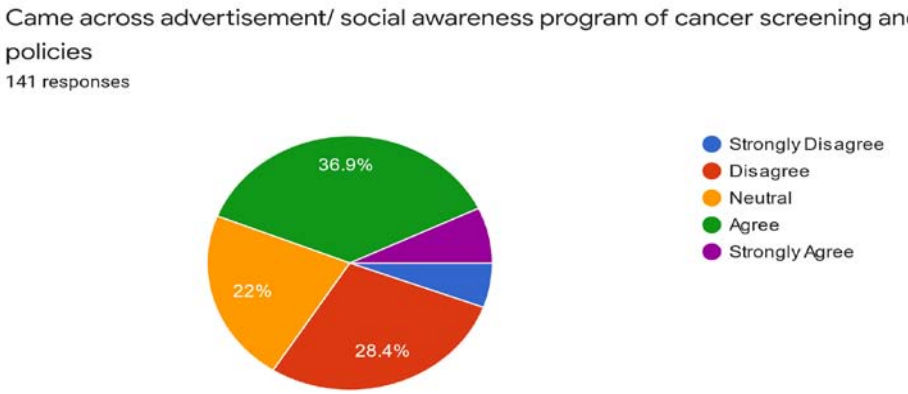

Figure No. 17: Source: Survey in Barishal, March –April 2023

From figure 17a mixed combination of responses has been originated from the question of social awareness program and advertisement concerning cervical cancer screening and insurance policy as a precaution against the treatment. Nearly about 37% of the participants previously noticed advertisement or social awareness program alternatively a little more than 28% of the total sample responses against it. Of course very insignificant proportion expressed their opinion strongly.

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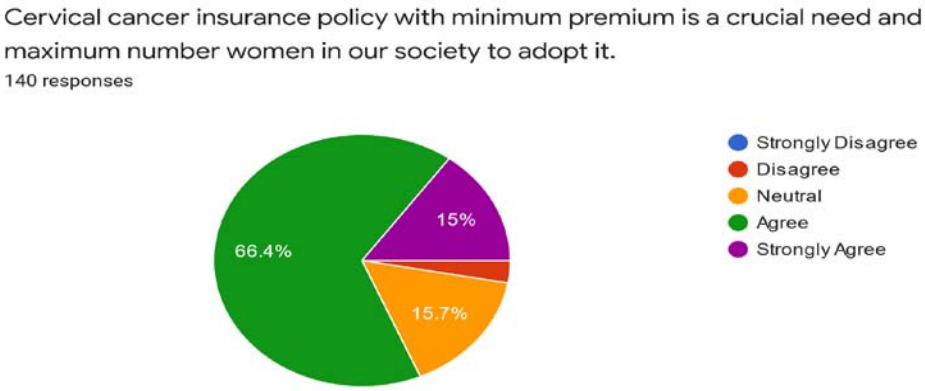

Figure No. 18: Source: Survey in Barishal, March –April 2023

Features with a very low premium can motivate a large number of women in Barishal city to purchase a cancer insurance policy is an opinion that is supported by almost 16 % of the participants. In addition, around 16% of sample has strongly supported the opinion. A very insignificant proportion gave opposite reaction in this respect (Figure 18). Again, from figure 18, their ability along with willingness to pay premium within the range 1000-2000 has been tried to be anticipated and almost same number of respondents answered both positively and negatively in answering the question 33% and 29% respectively. In addition, almost 32% of the total sample are reluctant to give a straight opinion. The answer may be varied due to variation of the income level of the respondents. Premium less than the mentioned range may attract more positive response.

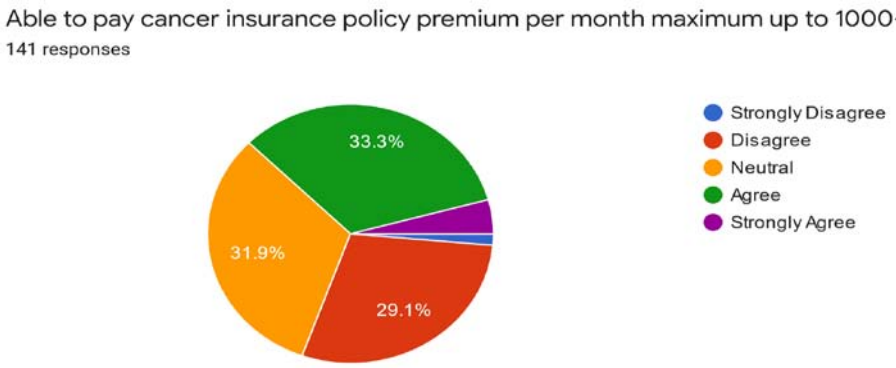

Figure No. 19: Source: Survey in Barishal, March –April 2023

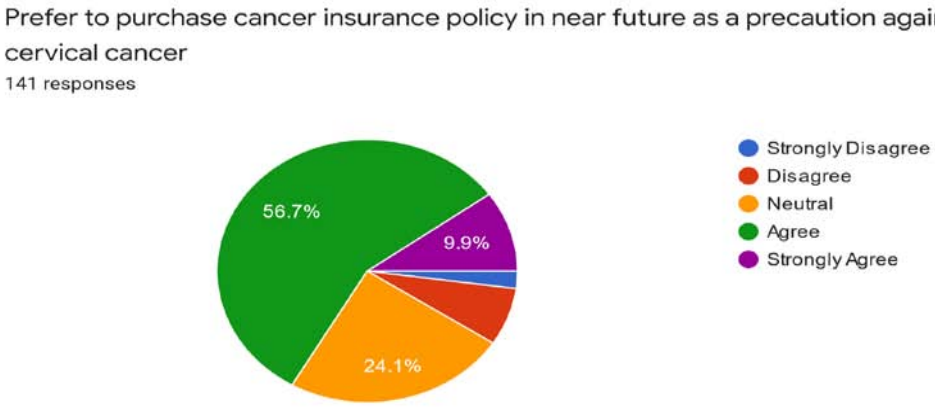

Figure No. 20: Source: Survey in Barishal, March –April 2023

Although most of the respondents have no health insurance policy having a brief previously regarding the severe effect of this deadly disease influenced them a lot in their purchasing decision of

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cancer insurance policy that is resembled in figure 19. Almost 57% of the total sample expressed their interest to purchase a cancer insurance policy within lowest level of premium in near future whereas 9.9% women from sample strongly supported the statement. However, 24% of the participants are still in a gray area in setting their decision in this respect. If a standard cancer insurance policy with affordable features are offered to them, a revolution may be arised.

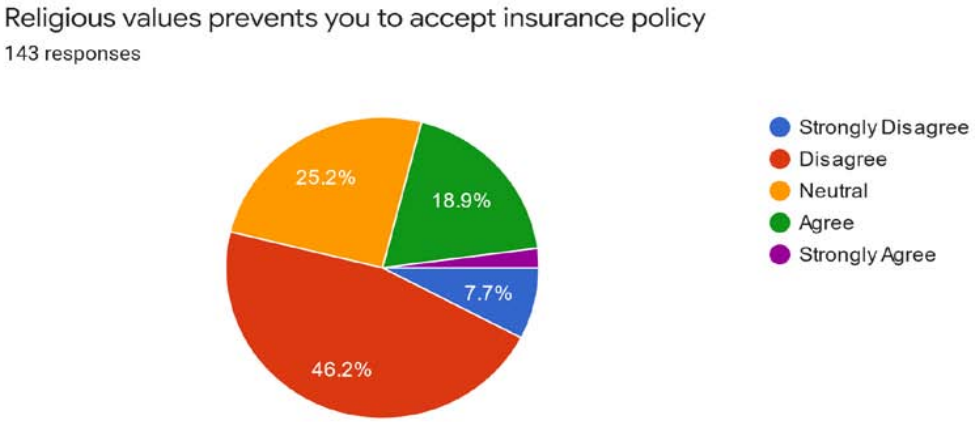

Figure No. 21: Source: Survey in Barishal, March –April 2023

Although around 20% of the respondents accused religious values as an excuse against insurance policy, most of them denied the negative relationship between the two. Again, 25% of the participants have no exact opinion. However, religious values influence the women in terms of screening and having insurance policy although the proportion is not so high. (Figure 21)

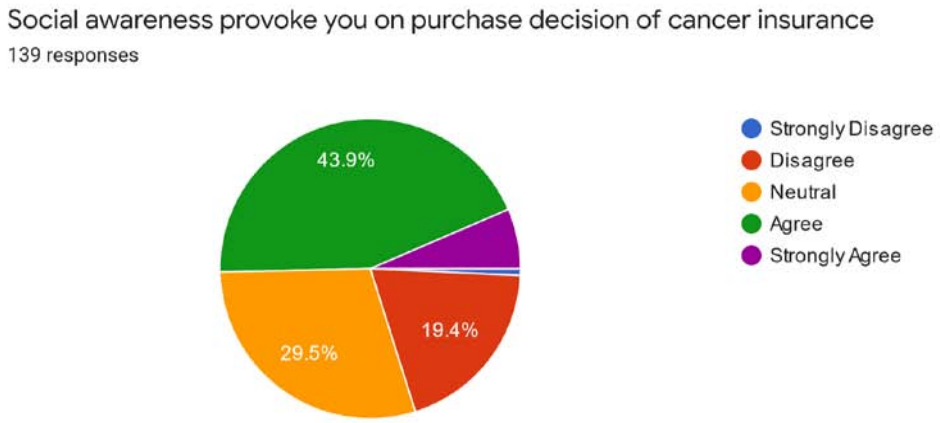

Figure No. 22: Source: Survey in Barishal, March –April 2023

A very positive impression has been found in favor of social awareness to motivate the respondents to accept an insurance policy especially for cancer. Almost 44% participants are agreed with it and 29.5% are neutral whereas 19.4% gave opposite reaction.

b) Test of Reliability and Regression Analysis

Cronbach's alpha is the most common measure of internal consistency of data. It is frequently used when we have multiple Likert questions in a surveyor questionnaire that form a scale and we wish to determine if the scale is reliable. To measure the reliability of surveyed questionnaire in this research project Cronbach alpha was run by the software SPSS and the perceived values is 0.705which indicate acceptable internal consistency. (Appendix: Table no1).

A regression has been run with the software SPSS to determine the factors significantly influencing the inclination of the women towards having an insurance policy particularly for cervical cancer. To run the model willingness to purchase has been considered as a target variable whereas 9 independent variables were used to find out the degree of relationship between the two categories. The coefficient of correlation R is 0.690 which indicates a moderately good relationship among the variables while the coefficient of determination R Square value is almost 50% (0.482) that

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means only 50% variation of dependent variable due to independent variables has been explained by the model. Adjusted R Square is not in a satisfactory level and depicts that more relevant variable can bring a standard score of adjusted R square to explain the relationship between dependent and independent variables. However, Education level, Financial income per month, Motivation from the surroundings, Suspect to future occurrence, cost of the treatment and Minimum /Lower amount of Premium are positively related to the willingness of purchasing decision of cancer insurance policy in near future. Among them Minimum amount of Premium has the highest score of coefficient 0.381 which is statistically significant while future suspect holds the lowest score of coefficients. Alternatively, previous encounter history, having insurance policy and treatment ability have negative coefficients designate the adverse relationship with dependent variable.

VI. Conclusion

Cervical cancer is one of the neglected diseases in Bangladesh. Promotions, campaigns, screenings and financial security of women are overlooked in this country due to the lack of consciousness about this disease. Public awareness is much needed to reduce the number of deaths from cervical cancer. Both government and non-government organizations should work together to make Bangladeshi females more aware and well-informed about screening and having a cancer insurance policy as a financial backup. If a well- balanced and convenient insurance policy for various categories of woman are issued by all insurance companies mandatorily, Bangladesh will be benefitted economically and socially. This is an academic research to know the attitudes of Bangladeshi women about cancer insurance policy and strongly advocates in policies' development to introduce cancer insurance policy as early as possible. Education level, cost of treatment, minimum amount of premium and social motivation are the key factors should be considered in this respect.

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Appendix

Table 1

Case Processing Summary			
		N	%
Cases	Valid	142	99.3
	Excluded[a]	1	.7
	Total	143	100.0
a. Listwise deletion based on all variables in the procedure.			

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	No. of Items
.705	.702	6

Table 2

Inter-Item Correlation Matrix						
	Motivation	Willingness	Suspection	Cost	Advertisement	Social Aware
Motivation	1.000	.275	.271	.281	.345	.221
Willingness	.275	1.000	.308	.380	.242	.167
Suspection	.271	.308	1.000	.337	.500	.172
Cost	.281	.380	.337	1.000	.308	.268
Advertisement	.345	.242	.500	.308	1.000	.156
SocialAware	.221	.167	.172	.268	.156	1.000

Table 3

Item-Total Statistics					
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Motivation	16.54	9.385	.428	.191	.669
Willingness	15.65	9.859	.418	.202	.671
Suspection	16.17	8.993	.504	.309	.643
Cost	16.94	9.492	.486	.252	.651
Advertisement	16.32	8.873	.492	.309	.647
SocialAware	15.98	10.773	.288	.100	.706

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Table 4

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.690[a]	.482	.389	.710

a. Predictors: (Constant), MINPREMIUM, SUSPECTION, PENCOUNTER, EDU, TABILITY, FINCOME, INSUPOLICY, MOTIVATION, COST

Table 5

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	46.005	9	5.112	10.154	.000[b]
	Residual	66.453	132	.503		
	Total	112.458	141			

a. Dependent Variable: Willingness(perception to cancer insurance policy)

b. Predictors: (Constant MINPREMIUM, SUSPECTION, PENCOUNTER, EDU, TABILITY, FINCOME, INSUPOLICY, MOTIVATION, COST

Table 6

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.097	.564		-.172	.864
	EDU	.135	.066	.140	2.042	.043
	FINCOME	.108	.050	.151	2.158	.033
	PENCOUNTER	-.213	.164	-.090	-1.296	.197
	INSUPOLICY	-.365	.238	-.110	-1.534	.127
	Motivation	.201	.066	.225	3.069	.003
	Suspection	.092	.066	.103	1.389	.167
	Cost	.326	.076	.329	4.308	.000
	TAbility	-.231	.069	-.233	-3.329	.001
	MiniPremium	.509	.095	.381	5.357	.000

a. Dependent Variable: Willingness(perception to cancer insurance policy)

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Examining the Relationship between Financial Leverage and Shareholder Payoffs: Insights from the Pharmaceutical Sector in India

By Bashir Ahmad Khan
University of Kashmir

Abstract- This paper empirically examined the effect of financial leverage on payoffs to shareholders, a study of listed Pharmaceutical firms in India. Using annual panel data for a period of 13 years, ranges from 2007-08 to 2019-20 with the application of econometric techniques. The empirical results show that Long Term Debt to Total Assets (LTD/TA) have positive relationship, while Total Debt to Total Assets (TD/TA) has negative relation with Return on Assets (ROE). Thereby evidenced that financial leverage has significant effect on firm performance specifically in terms of payoffs to shareholders particularly during Normal/Bullish phase of Economy when measured through EPS & ROE in sample Pharmaceutical Companies in India.

Keywords: *financial leverage, earnings per share, return on equity.*

GJMBR-C Classification: *LCC: HJ9-9940*



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Bashir Ahmad Khan

Abstract- This paper empirically examined the effect of financial leverage on payoffs to shareholders, a study of listed Pharmaceutical firms in India. Using annual panel data for a period of 13 years, ranges from 2007-08 to 2019-20 with the application of econometric techniques. The empirical results show that Long Term Debt to Total Assets (LTD/TA) have positive relationship, while Total Debt to Total Assets (TD/TA) has negative relation with Return on Assets (ROE). Thereby evidenced that financial leverage has significant effect on firm performance specifically in terms of payoffs to shareholders particularly during Normal/Bullish phase of Economy when measured through EPS & ROE in sample Pharmaceutical Companies in India.

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I. Introduction

The Pharmaceutical industry in India is the third largest in the world in terms of volume and 14th largest in terms of value. It is one of the top five sectors contributing to foreign exchange earnings and provides employment to over 2.7 million people thus playing a major role in the Indian economy. It contributes around 1.72% of the country's GDP. The size of the industry is USD 50 Bn. (2020-21) and contributes a net annual trade surplus of USD 17 Bn. India's revenue from pharmaceutical exports was $25.3 billion in the 2022-2023 financial year. In terms of the global market, India currently holds a significant share of the world market and is known as the Pharmacy of the World.

According to a recent EY FICCI report, that the Indian pharmaceutical market is estimated to reach $ 65 Bn. in 2024 & is estimated to touch US$ 130 billion in value by the end of 2030.To achieve this milestone, the need for funds in the pharmaceutical industry is huge and has to be procured either as owners' equity or borrowed funds. Whether to use owners' equity or resort to debt funds is a very crucial financial decision to be taken by the financial manager of the pharmaceutical company. Generally, companies use both debt capital and equity capital with varying proportions in their debt equity mix. Theoretically it is contented that the companies can use debt equity mix in a manner that enhances returns to its shareholders. There is a conflict as to the relevance of debt in the maximisation of shareholders' value. This controversial situation has given birth to different theories of capital structure but none of them is flawless, as they suffer from various limitations and cannot be viewed as valid proportions applicable in all situations. The relevant school of thought dominated by Prof. Durand (1952), has contended that use of debt with an equity influences cost of capital, thereby there exists an optimum capital structure. Contrary to this, the irrelevant school of thought dominated by Modigliani & Miller (1958) on the basis of their empirical study have hypothesed that within the framework of perfect Capital Markets and in the absence of corporate taxes & bankruptcy costs, there does not exist an Optimum – Capital Structure. These & several other questions related to the Capital Structure decisions remains perplexing because of diverse & conflicting theories & also due to diverse empirical results. [Abdul Aziz et al (2015), Raluca-Georgiana MOSCU (2014)]. These conflicting views overshadow the impact of financial leverage on firm performance. The fact is that no general consensus has yet emerged even after several decades of investigation [Julius Bitok et al (2011)]& scholars can be found often disagreeing even about the same empirical evidence. [Kale, A. A. (2014)]. These& other factors have made the researchers to continuously investigate into this crucial aspect of corporate financial decision making aspect. [Lucy Wamugoet al (2014)].

The capital structure decision is critical decision for any organization. The decision is important not only because of the need to maximize returns to its stockholders, but also because of the impact such a decision has on an organization's survival & growth in today's competitive environment [Dare Funso David et al (2010)]. Its added importance is, because a faulty capital structure decision can have both micro & macroeconomic implications, as remarked by Julius Bitok (2011), "Throughout the history most of the world's most severe financial crises have had their causes traced to the poor Management of debt". The financial distress in the Real Estate Business commonly known as "Bursting of Housing Bubble", which resulted in the Global recession of 2007-2009 can be cited in support for the same. Financial decision is thus very crucial for

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the Financial well-being of a firm itself [Catherine Warue Njagi (2013)] as well as general economy. It is therefore, imperative for the financial Manager to have a clear understanding of this financial decision so that they can take right decision at right time, leading thereby to optimal debt-equity mix, which is really a formidable task. For this purpose, one has to go beyond theory [Gowri- M. K. (2013). While some scholars have found positive relation between debt financing and Firm performance, others have revealed an inverse relationship between the two. Some, studies even concluded that the relationship between capital structure & Firm performance is both positive & negative [Tsangaav et al (2009), Oke & Afolabi (2008) khalaf Tanni (2013)]. Still other researchers established empirically that there isn't any significant relationship between C/S & Firm Perfomance. [Soni. B, Trividi J. (2014) Ibraham (2009)]. Though, extensive studies have been made in this regard, still no unified theory has come out, which could have derived the major support, thus leaving the subject open for further research. [Handoo. A & Sharma K. (2014)]. Like other sectors, the Impact of financial leverage on the firm performance in the pharmaceutical sector has also been assessed in various countries including India. However, impact of financial leverage on financial performance of a firm under different economic conditions has not been ascertained. More so, research works have taken the average total debt of low, average & high debt companies of the sector. But this study is restricted to only the high debt companies of the sector so as to determine the impact of high debt on the financial performance of a firm.

II. Literature Review

Capital Structure is most debated topics within the area of corporate finance. It derives its importance from the fact that, an appropriate Capital Structure is not only essential for the firm itself, but it has also micro & macro-economic implications. It is because of this significance, that a large number of theoretical as well as empirical studies in this field have emerged over the last few decades, with shifting paradigm from market economies to transitional economies, from developed economies to developing economies, from country-based studies to regional studies. The literature on capital structure is theoretical as well as empirical.

Of the various theories of Capital Structure, "The Traditional Relevance Theory" of Prof. Durand (1952) and the "Modern Irrelevance Theory" of Modigliani & Miller (1958) are the main theories both focussing on the relationship between Capital Structure & the firm performance. Out of the various prepositions on Financial Leverage regarding proportion of debt in the Capital Structure, the two extreme views are Net income approach & Net Operating Income approach [Prof. Durand (1952)], besides an intermediate approach known as the traditional. As per Net income approach, the Weighted Average Cost of Capital (WACC) decreases by including debt funds in the Capital Structure & thus the value of firm increases. However, the Net Operating income approach holds an opposite view of it. As per this approach, the overall cost of capital is independent of the financial leverage. This is based on the assumption that the cost of equity increases linearly with increase in leverage, such that the overall cost of the capital remains the same. In between these two extreme view, is the intermediate or traditional approach of Solomon (1963) Which argues that the cost of capital declines & the value of firm increases with the increase in financial leverage up to a prudent debt level- the optimum point. Thereafter with increase in the debt content in the capital structure, there is an increase in WACC which in turn has a negative impact on value of firm. The irrelevance theory of capital structure is supported by many Scholars Stighitz, (1969), Baron (1974), Stighitz (1974) Schneller (1980) & Taggart (1977). Whereas the traditional approach – which can be described as a modified version of Net income approach, is in line with what is referred to as relevancy theory of Capital Structure and has many empirical backing apart from models & hypothesis in its support. Morten (1954), Lutiner (1956), Kim (1978) Haugen & Senbet (1978) Marsh (1982) & Ozkan (2001) second this view point. A number of studies have been carried out on Capital Structure both in India & abroad. These studies have debated on different aspects of Corporate Capital Structure viz. relationship between Capital Structure decisions and cost of Capital, determinants of Capital Structure, Impact of Financial Leverage on EPS, ROI, ROE & Value of firm. In order to get the right perspective of the different aspects of Capital Structure decision, it is in the fitness of the things to have a brief review of important studies conducted so far.

The modern theory of Capital Structure began with the classical paper by Modigliani & Miller (1958) which posit that under perfect Capital Market conditions & in the absence of corporate taxes & bankruptcy costs, financing decision has no bearing on the company's composite cost of Capital and Value of firm. In favour of their thesis, they have held that the Value of firm depends on earning power of a firm which in turn depends upon the Investment decision. A number of studies like Bhandari (1988), Hecht (2000), Lasfer (1995) & Boothetal (2001) held similar views on the relationship between Financing decision & Value of firm. However, there are equally large number of studies which have challenged the relevance of M – M theorem & have suggested that a relationship between Financial Leverage & Corporate performance does exist. For example, Arditi (1967) on the basis of his study has found a negative but statistically insignificant

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relationship between financial leverage & equity returns. The inverse relationship between financial leverage & equity returns has also been found by Hovakimian et. al (2001), Hamada (1972) & Dimtrov & Jain (2008). Further, Sharma & Roa (1968) on the basis of their study have found that the leverage variable had a coefficient greater than the tax rate, thus falls in line with the traditional view that the cost of capital is affected by debt apart from its tax advantage. The studies of Panday (1981) & Ward & Price (2006) have also supported the traditional view in the sense that there exists a relationship between the levels of financial leverage & cost of capital.

Some experts are of the view that Capital Structure & Profitability have strong relationship with each other. According to interest – tax shield hypothesis, which is derived from M – M Hypothesis (1963) firms with high profits would employ high debt to gain tax benefits. On the contrary, Pecking Order of financing or asymmetric information hypothesis of Myres & Majluf (1984) postulates that the companies with higher profitability prefer internal financing. De Angelo & Masulis (1980) findings have been in conformity with the asymmetric information hypothesis & have also found that the interest – tax shield hypothesis may also not work in those firms that have other than interest tax shield avenues like depreciation.

No unanimity has been found in the empirical evidences regarding the relationship between the Capital Structure and firm performance. Positive, negative as well as mixed relationship is revealed by the research conducted by various scholars. Sharma (2006) & Kuben Reyan (2008) has found direct relation between leverage and firm value. Similar view has been held by Lasher (2016) when he asserts that increased level of debt finance can result in increased earnings per share and return on equity. Dewet (2006) proved that a significant increase in value of firm can be achieved in moving close to the optimal level of gearing. Fama & French (2010) seconded him, when they concluded that there should be a positive relation between debt ratio and firm profitability. Positive relationship between total debt and return on equity and total assets has also been reported by Larry & Stulz (1995) in firms in Ghana. Nawaz, Javid & Akhtar (2012) have also reported a positive linkage between capital structure and firm performance. Significant positive relationship between Capital Structure and EPS & financial leverage and return on equity has also been observed by Mubeen & Akhtar (2014) in the firms listed in Karachi Stock Exchange and by Abdul Azeez et al (2015) from Nigerian firms respectively. In consistency with the above findings are the empirical evidences of champion (1999), Gosh et al (2000) HadLock and Jame (2002), Frank and Goyal (2009) and Berger and Bonaccors di patti (2006).

But at the same time, no less a number of empirical studies bring out negative impact of financial leverage on firm performance measured in terms of profitability by various proxied ratios Titman & Wessels (1988), Wald (1999) Sheel (1994) Eunju and Soocheong (2005) have reported negative relationship between financial leverage and profitability. Negative Association of financial leverage and firm performance has also been observed by Gleanson et al (2000) Upneja & Dalbor (2001), Deesomsik et al (2004) and Heng (2011); Abu- Rub (2011). Return on equity and debt equity ratio has also been found negatively related in companies in Ghana by Abor (2005), Asian Corporations (Krishnan & Moyer, 1977) North American Region (King & Santor-2008). Shub & Alsawalhah (2012) in Jorden, Ebaid (2009) in Egypt. Lucy Wmage (2014) observed a negative but insignificant relationship between financial leverage and firm performance in Kenya.

The research works of various scholars in India have also supported the negative impact of financial leverage on firm performance. Suarabh Chadha, and Sharma A K (2016). Significant negative effect of capital structure on accounting performance has also been reported by Krishna Dayal Panday et al (2019)in Indian manufacturing firms traded on BSE. Similar results have been obtained by Ramachandran Azhagariah et al (2011) in Information Technology Industry in India. However, a positive relation between debt- equity and ROE, D/E and ROA has been reported by Muzumdar D J B in infrastructural companies in India. The findings of Muzumdar were confirmed by Kumar M R (2014) in Bata India Ltd. A study on leverage analysis and profitability for selected paint companies in India by Soni B & Trivedi J (2014) could not find any significant relationship between financial leverage and firm performance measured in terms of profitability. Same is in confirmatory with the findings of Ibrahim (2009).

Situation is no different in the case of pharmaceuticals companies, where positive, negative as well as no impact of financial leverage/debt on the firm performance/profitability has been empirically established. While as positive relationship of capital structure and firm financial performance has been evidenced by Hung & Pham (2020) in pharma companies of Vietnam, Shilpi & Dinesh (2016), Prakash & Sindhasha (2016), Mathur et al (2021) and Varghese & Sahai (2021) all reported negative effect of financial leverage on firm performance in Indian Pharma companies. Enekwe et al (2014), Afroze & Ahmed (2022) and Chenxin Zhang (2022) too have found negative relationship between financial leverage and firm performance in Nigeria, Bangladesh and Singapore respectively. However, no link between the financial leverage and capital structure has been documented by Tom Jacob (2020) in the pharma companies of India. As stated by him, “the results indicate that financial leverage has no link with capital structure which proves

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the Modigliani and Miller theory of capital structure" But Chen, Lecheng. (2023), negates this no link, instead empirically establishes the existence of a link between the company's capital structure and its operating performance, while assessing the impact of capital structure on the operating performance of three listed companies in pharmaceutical industry. Further, he remarks that a reasonable capital structure optimisation can improve a company's operating performance & mitigate operating risk.

From the above review of literature, it becomes quite clear that there is lack of unanimity so far as the relationship between the capital structure decision (debt equity ratio) & the firm performance (profitability) is concerned. While some studies point out a positive relationship between the debt equity ratio and profitability, (measured in terms of different proxies), others reveal a negative relationship between the two. Mixed results were also reported by the researchers. McConnell and Servaes (1995) and Agarwal and Zhao (2007) found that in firm with high growth, debt has negative effect on profitability, while firms with low growth effect is positive.

Hypothesis

H1: There is no impact of F/L on payoffs to stockholders of the sample companies.

H2: There is an impact of financial leverage on the payoffs to the stockholders of the sample companies under the conditions of economic recession and economic boom.

H3: There is no impact of financial leverage on the payoffs to the stockholders of the sample companies during the recovery phase of Economy.

III. Methodology

In the previous section, besides review of related literature rationales of the prevent study along with its objectives have been highlighted. To achieve these specific research objectives, an appropriate research methodology is structured which is a multi-step process entailing sampling design, identification and definition of research variables, selection of statistical tools for data analysis etc. as detailed below.

a) Sources of Data

The study is primarily based on Secondary Data which has been collected from the Official Websites of the Sample Companies. The main source of Data is the Annual Financial Statements of the Sample Companies which are readily available on the Official Websites of the Companies.

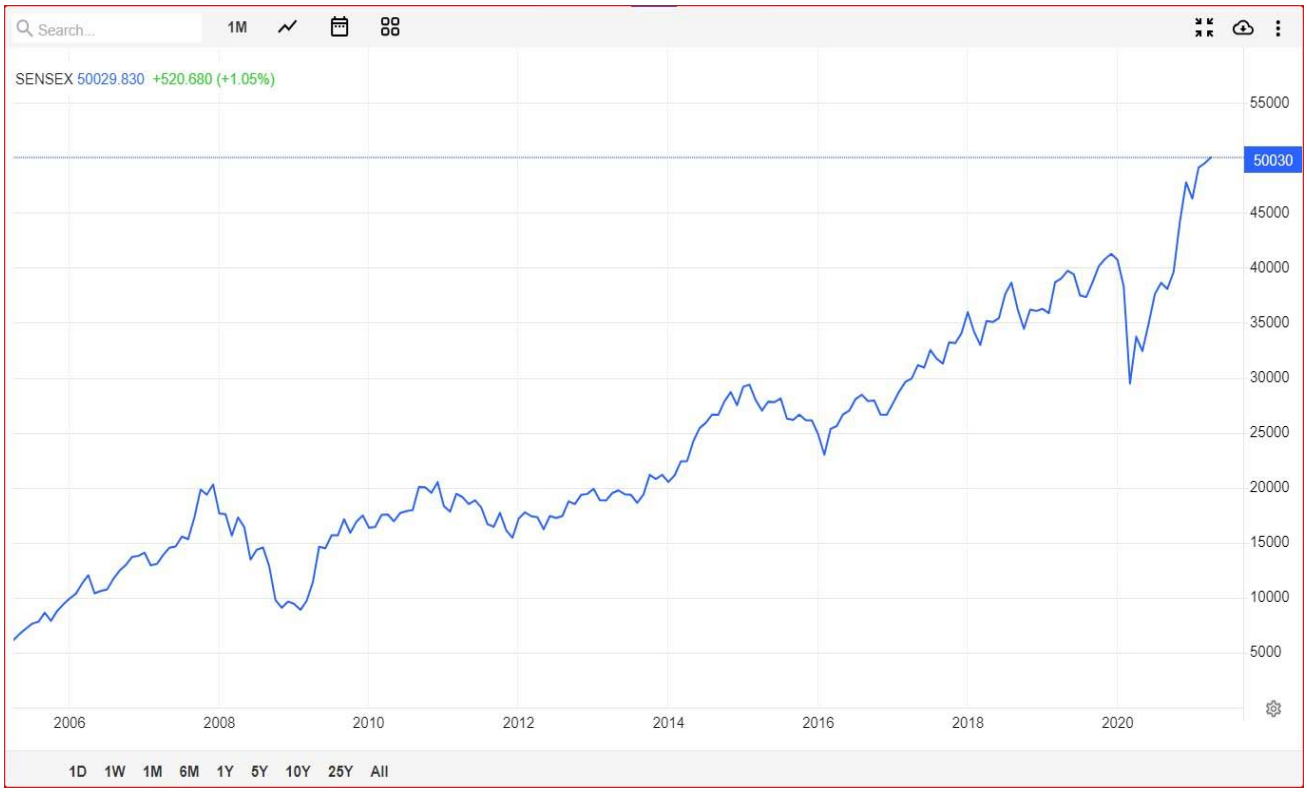
b) Reference Period

The study aims to analyze the impact of financial leverage on the Firm performance under different phases of economy/market. Accordingly, the reference period of 13 years is divided as:

2007 – 08 & 2008 – 09 → Recession/Bearish Phase

2009 –10 to 2013 – 14 → Recovery Phase

2014 – 15 to 2019– 20 → Normal/Bullish Phase



Sensex Graph [2007-2020]

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c) Sampling

The Universe for the present study is listed pharmaceutical companies in India. To ensure that a reasonable & true representative Sample is drawn for the study, sampling process used the following filters:

1. Only the Companies which have remained listed during the reference period, were selected.
2. Companies which were actively traded during the reference period have been selected
3. All the companies with complete required data available for the entire reference period were selected
4. Companies with Accounting period of 12 months coinciding with the financial Year for all the years under study were selected.

The companies so drawn were arranged in an ascending order as per their TDTA ratio. 25% of the companies, totalling 10 companies, at the top end of the order were selected as sample for the study. Thus, the sample constituted the highest debt companies of the pharmaceutical sector.

d) Variables

i. *Independent Variables*

The independent variable for the study is financial leverage. Financial leverage refers to the magnification of risk and return introduced through the use of fixed-cost financing, such as debt and preferred stock. The more fixed-cost debt a firm use, the greater will be its expected risk and return. [L. J. Gitman]. Financial leverage has been Poxied by.

Total Debt to Total Assets	TD/TA
Long Term Debt to Total Assets	LTD/TA
Short Term Debt to Total Assets	STD/TA

ii. *Dependent Variables*

Since the study aims to assess the impact of financial leverage on firm performance specifically in terms of Shareholders payoffs, therefore, the dependent variables for the present study include Return on Equity (Hasson and Gupta, 2013), and Earning per share (Abar, 2005).

1. Return on Equity

Return on equity reveals profitability of Owners' investment. Therefore, it indicates how well the company has used Owners' capital. The operational definition of ROE is.

$$\text{ROE} = \frac{\text{Net profit after Tax}}{\text{Average Equity}}$$

2. Earnings Per Share (EPS)

It refers to net earnings per equity share. Earnings per shares are the portion of a company's profit that is allocated to every individual share of the stock. The operational definition of EPS for this study is:

$$\text{EPS} = \frac{\text{Net Earnings available for Equity}}{\text{Number of outstanding Equity Shares}}$$

iii. *Control Variables*

In addition to financial leverage, there are other factors which are likely to have an impact on the profitability of a company, [Osuji Casmir (2012)]. Hence to assess the impact of financial leverage on payoffs to stockholders, other factors that are likely to have impact on profitability need to be controlled. It is in view of this fact, that some controlling variables have been added in the study which include tangibility, sales growth & growth opportunities. The operational definition of these control variables is given below:-

$$Tangibility \quad of \quad firm = \frac{fixed \quad assets}{total \quad assets}$$

$$\text{Sales growth of firm} = \frac{Current\ Year\ sales - Previous\ Year\ Sales}{Previous\ Year\ Sales}$$

$$\text{Growth opportunitie} = \frac{\text{Total Assets of Current Year} - \text{Total Assets of the Previous year}}{\text{Total Assets of the Previous year}}$$

iv. *Econometric Model and Penal Data Estimation*

The study consists of both cross sectional units and time series data. Cross sectional units comprising of 10 companies and Time series covers a period of 13 years, slotted into three phases of an economy, thus paving the way for Penal Data Modeling. "Penal Data Modeling is efficient in comparison to pure cross-sectional or time series as it produces more informative data, uses more Degree of Freedom and observe less Collinearity among the variables" [Yadav. M.P et al (2022)]. First Poolability test was employed to check whether the data is Poolable or not. Then testing of cross-sectional effect was done to decide an application of suitable Model for the Penal Data Regression. [Li M et al (2015)]. If data is poolable, pooled regression is applied otherwise Fixed or Random Effect Models are employed. The Fixed Effect Model Controls for all time – invariant differences between the individuals, so the estimated coefficients of the Fixed Effect Models are unbiased because of omitted time – invariant characteristics as observed by Yadav & Yadav (2021). It is presented as:

$$\gamma_{it} = \alpha_{it} + \beta\chi_{it} + \mu_{it}$$

Where i and t are Cross Sectional Units (Company) and Time Period respectively.

γ_{it} is dependent variable of Company i at time t

χ_{it} Independent variable

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α is Fixed over time and remodelling itself in accordance with different cross section units.

μ_{it} is the error term

In the aforesaid equation, impact of time – invariant variable cannot be estimated under the Fixed Effect Model because of their Omission. In this Model there exists correlation between Independent variable and unobserved heterogeneity and is fixed and constant across different Cross – Sectional Units. When this assumption is not fulfilled, it paves the way for Random Effect Model [REM] as in REM unobserved Heterogeneity behaves in a random fashion and has no correlation with the independent variables as being treated statistically independent of Explanatory variables. Thus will calculate the impact of variables that are not changing with the time. The representative equation is as under:

$$\gamma_{it} = \alpha_{it} + \beta_{it}\chi_{it} + \mu_{it}$$

Here α is treated as Random Variable as i merges with the Error Term and starts acting like Error Term, hence the name Random Effect. It will follow the properties of Error Term as it is not being incorporated in it. [Dr. Miklesh Yadav (2021)]. Accordingly, the Regression Equation of Penal Data Methodology for this study would be:

$$EPS_{it} = \alpha_i + \beta_1 TDTA_{it} + \beta_2 LTDTA_{it} + \beta_3 STDTA_{it} + \beta_4 Growth_{it} + \beta_5 Tang_{it} + \beta_6 Sgrowth_{it} + \mu_{it}$$

$$ROE_{it} = \alpha_i + \beta_1 TDTA_{it} + \beta_2 LTDTA_{it} + \beta_3 STDTA_{it} + \beta_4 Growth_{it} + \beta_5 Tang_{it} + \beta_6 Sgrowth_{it} + \mu_{it}$$

Where TD/TA, LTD/TA, STD/TA, Growth, Tang, S growth, are Total debt to Total Assets, Long Term Debt to Total Assets, Short Term Debt to Total Assets, Growth opportunities, Tangibiity, Sales growth, of the company (i) at time (t) respectively.

v. *Penal Data Estimation Models*

The study used static penal data estimation models viz. first difference method, ordinary least square method, fixed effect model & random effect model as per the model fitness for different data sets. While applying the different models, model fitness in respect of a particular dependent variable was tested using poolability & Hausman tests. Poolability test determines whether the data set is poolable or not. If the p-value of the test is more than o.o5, the data set is poolable and Ordinary Least Square Method is fit for the analysis of the data set, otherwise fixed or random effects model is applicable which is found out by Housman test. In case of Hausman Test when Null Hypothesis is rejected (p-value $<$ 0.05 or 5%) level of significance, FEM is more suitable otherwise REM is preferable.

IV. Data Analysis and Interpretation

The main objective of a firm is maximization of shareholders' wealth which depends on the financial performance of a company which in turn depends upon the efficiency with which decision-making is made whether financial or non-financial. One of such decisions is the capital structure decision. Although there is a difference of opinion with regard to the impact of financing decision on the value of firm. Relevant school of thought is of the opinion that there exists an optimum debt-equity mix at which the cost of capital is minimum and the value of firm is maximum. Contrary to this, the scholars belonging to irrelevant school of thought argue that the value of firm is independent of financing decision. Empirical studies conducted on this subject matter have revealed mixed results. Given the inconclusiveness of the studies conducted so far on this crucial aspect of corporate financial decision-making, the present study has been conducted with the sole purpose to assess the impact of debt on the payoffs to shareholders of the sample companies. However, before presenting the results of the data analysis, the descriptive statistics of the data set has been presented and discussed.

a) Description Statistics

Description statistics of three data sets viz. Independent Variable, Financial leverage, Dependent Variables, namely return on equity (ROE) & earnings per share (EPS) and control variables namely Growth opportunities, Tangibility & Sales growth of firms has been displayed in table 1. The descriptive analysis reveals basic statistical features like, mean, minimum, maximum, standard deviation skewness & kurtosis of various Variables.

Table 1: Descriptive Statistics of Variables of Study.

Variable	Mean	Median	Minimum	Maximum	Std. Dev.	C. V.	Skewness	Ex. kurtosis	J. B Tests
EPS	4.5559	3.475	-33.92	30.84	10.895	2.3913	-0.12064	1.1166	0
ROE	5.8855	6.335	-41	35.24	14.451	2.4554	-0.92593	1.3003	0
TD_TA	0.66775	0.67682	0.21332	0.838	0.10043	0.15039	-1.3687	3.5454	0
STD_TA	0.20785	0.20382	0.031236	0.487	0.10645	0.51216	0.74749	0.11055	0
LTD_TA	0.44536	0.45727	0.12	0.688	0.14138	0.31744	-0.47294	0.58131	0
Growth_oppo	0.10442	0.090236	-0.2105	0.68	0.16551	1.5851	1.2651	2.5214	0
TANG	0.37448	0.3744	0.066	0.62904	0.11575	0.30909	-0.58827	0.69445	0
S_GROW	0.13828	0.1379	-0.41438	0.808	0.22227	1.6074	0.57995	0.92928	0

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From the data contained in the above table it can be observed that mean EPS of the companies depicts that companies have generated positive returns for shareowners in spite of wide variations in the Earnings per Share. Further, on an average, the returns to the Equity Shareholders' has been positive during the study period, regardless of wide variations. These wide variations in the dependent variables are due to different phases of an economy/market, which were witnessed during the reference period. Initial two years 2007-08 & 2008-09, the economy witnessed recession in the entire world including India. From 2009-10 to 2013-14, the economy/market witnessed recovery from the lows of recessionary phase. Post 2014 the Indian markets have registered some kind of bullish phase It can also be seen from the above table that both the dependent variables show negative skewness but positive kurtosis. The mean debt of the sample pharmaceutical companies during the reference period was 66.77% of the total assets, which varied between a minimum of 21.33% to a maximum of 83.8% this implies that the debt levels of the sample pharmaceuticals companies during the reference period were neither more nor less.

b) Assumption Testing

1. Normality test

Normality of the data as revealed by the Skewness & Ex-kurtosis values, and further tested by J.B Test. The normality of the data set as shown by the table 1 is further refined by using the conventional cleaning procedure as recommended by Heir et al (2010).

2. Multicollinearity Test

Multicollinearity refers to a situation in which two or more Predictory variables are highly correlated. It affects the interpretability of a Regression Model, since it comprises the essential significance of independent variables.

To test the severity of Multicollinearity, Variance inflation factor [VIF] was used as: -

VIF∼1 → negligible Collinearity

VIF>1 but< 5 moderate Collinearity

VIF >10. high Collinearity

This study has applied the rule of thumb, that is VIF more that 10 as extremely Collinear. From the table 2, it is evident that none of the variables shows Multicollinearity, as the VIF is less than 10 in case of all the Variables under study.

Table 2: Diagnostic Tests of Variables of Study.

Variable	Heteroscedasticity Test White's Test (P-Value)	Autocorrelation Test (D-W Statistics)	Multicollinearity Test	Stationarity Test (VIF)
EPS	0.00209984	1.96793	1.898	0.0000
ROE	0.00237344	1.635973	2.093	0.0000
TDTA	2.05455e-05	1.99436	2.459	0.0000
STD/TA	0.310194042	1.79007	2.711	0.0000
LTD/TA	0.225127	1.8411	3.811	0.0203
G. Opp	0.18607	1.93883	1.239	0.0000
Tang	0.84821	1.837746	1.526	0.0023
Sales-Growth	0.444121	1.78927	1.245	0.0000

3. Heteroscedasticity Test

Heteroscedasticity of the data is checked by white test [Eric Luse Kuto Mwambuli (2015)]. Null hypothesis of the test is Heteroscedasticity not present and alternative hypothesis is that data is heteroscedastic. Table 2 shows the presence of Heteroscedasticity in both EPS & ROE variables as the P-Value is significant for both of them. The heteroscedasticity is removed by taking the Robust Standard Error of these variables.

4. Autocorrelation Test

Autocorrelation refers to the degree of correlation of the same variable between two successive time intervals. Durbin-Watson statistic is used to test the autocorrelation because of (i) its high power; and (ii) its limited size distortions. [Fisher (1935) and Pitman (1937)]. The outcome of D-W test ranges from 0 to 4 as: -

0 → stronger positive

2 → a very low level of autocorrelation

4→ stronger negative correlation

Table 2 above shows that none of the variables suffer from strong Autocorrelation.

c) Stationarity Test

A series is said to be stationary when its mean and variance remain constant over a period of time or in other words its mean and variance are time independent. Regressing a non-stationary time series over another non-stationary time series will result in the spurious regression which will produce misleading results about the estimated parameters. Levin-Lin-Chu Test is used for testing stationarity of data which is being recommended for balanced panel data. The null hypothesis of the test is that the series has unit roots. As

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revealed by table 2, all the variables have P-Value less than 0.05, so null hypothesis is rejected. All the variables are thus stationary at I (0) Level. Since all the variables are Stationary at I (0) Level, thus in this scenario performing a cointegration test is not necessary. This is because any shock to the system in the short run quickly adjusts to the long-run. Consequently, only the long run model is to be estimated using OLS (where variables are neither lagged nor differenced). In essence, the estimation of short run model is not necessary if series are Stationary at I (0) Level.

i. *Correlation Analysis*

Correlation analysis is applied to assess the relationship among various variables using Karl Pearson's correlation matrix. The relationship between the dependent, independent and control variables is ascertained and the results so obtained have been presented in the table 3

Table 3: Correlation Matrix of Dependent, Independent & Control Variables.

Variable	S_GROW	TANG	Growth_oppo	LTD_TA	STD_TA	TD_TA	ROE	EPS
EPS	0.1355	-0.0653	0.1109	-0.0881	-0.005	-0.0954	0.6538	1
ROE	0.3154	-0.136	0.1002	0.1478	-0.201	0.0257	1	
TD_TA	-0.0225	-0.127	0.0234	0.557	0.0889	1		
STD_TA	-0.1751	0.242	-0.02	-0.5926	1			
LTD_TA	0.0457	-0.3083	-0.0096	1				
Growth_oppo	0.2676	-0.3031	1					
TANG	-0.0805	1						
S_GROW	1							

From the above table, it is clear that EPS shows negative correlation with all the three Independent Variables, viz. TD/TA, STD/TA & LTD/TA while as ROE depicts positive correlation with TD/TA & LTD/TA but negative correlation with STD/TA. Evidently highest and positive correlation is observed between EPS & ROE.

The data is further analysed by applying regression analysis using Gretl Software. The regression models used include, First Difference Method, Ordinary Least Square Method, Fixed Effect Model & Random Effect Model Prior to the application of regression analysis, the respective model fitness is ascertained by Poolobility and Housman Tests.

ii. *Test for Poolability*

Table 4: Poolability Test of Dependent Variables EPS & ROE.

S. NO	VARIABLE	P-VALUE	POOLABLE/NOT POOLABLE	MODEL CONSISTENT
1	EPS	2.95973E-05	NOT POOLABLE	FIXED/RANDOM
2	ROE	0.000248718	NOT POOLABLE	FIXED/RANDOM

Poolability of the data is checked by the test for differing group intercepts, the null hypothesis for which is, "The groups have common intercept" The p-values for EPS & ROE are both less than 5%, level of significance, so we reject the null hypothesis of common intercepts of groups and accept the alternate hypothesis that groups do not have common intercepts ,which implies that the data set is not Poolable, therefore either Fixed or Random Effect Model is to be applied depending upon the results of Housman Test.

iii. *Housman Test*

To decide whether fixed of random model is consistent for the variable EPS & ROE, Housman test is applied. The results obtained are shown in table below.

Table 5: Housman Test of Dependent Variables EPS & ROE.

S. NO	VARIABLE	P-VALUE	MODEL CONSISTENT
1	EPS	0.000769613	FIXED EFFECT MODEL
2	ROE	1.89099e-06	FIXED EFFECT MODEL

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As revealed by table 5, P-value of both the variables is less than critical value [(5%) level of significance], thus the null hypothesis is rejected, implying that Fixed Effect Model is suitable for both the variables. Further analysis of the data is carried out in adherence to model consistency as disclosed by the table 5. Above.

Table 6: Regression Coefficients of Dependent Variables EPS & ROE.

DV		Regressers	coefficient	std. error	t-ratio	p-value
EPS		const	12.1514	5.32469	2.282	0.0484 **
	IDV	TD_TA	−13.5272	5.54592	−2.439	0.0374 **
		STD_TA	0.805281	9.67845	0.0832	0.9355
		LTD_TA	3.82354	5.62469	0.6798	0.5137
	Control variable	Growth_oppo	10.9545	5.97996	1.832	0.1002
		TANG	−6.61112	9.7366	−0.6790	0.5142
		S_GROW	6.50149	2.69949	2.408	0.0394 **
	LSDV R-squared 0.297835			Within R-squared 0.074507		
	Test statistic: F(6, 9) = 4.01467			p-value = 0.0309302		
DV		Regressers	coefficient	std. error	t-ratio	p-value
ROE		const	−0.623100	8.93991	−0.06970	0.946
	IDV	TD_TA	−13.6951	14.1812	−0.9657	0.3594
		STD_TA	−5.31107	8.0838	−0.6570	0.5276
		LTD_TA	22.5067	18.3663	1.225	0.2515
	Control variable	Growth_oppo	3.21275	8.95787	0.3587	0.7281
		TANG	10.7022	23.2056	0.4612	0.6556
		S_GROW	17.2874	4.45331	3.882	0.0037***
	LSDV R-squared 0.333865			Within R-squared 0.120644		
	Test statistic: F(6, 9) = 9.33721			p-value = 0.00192033		

Source: Compiled on the basis of Secondary Data Collected from the audited Financial Statements of the sample companies sourced from their respective websites.

Form the table NO. 6, it is evident that EPS has negative and statistically significant relationship with TD/TA at 5% level of significance. It means that with the increase in ratio of total debt to total assets, the returns to the shareholders decreases when measured in terms of EPS. In other words, it can be said that high debt content in the capital structure of the sample companies adversely effects the return to the stockholders in terms of lower EPS. However, both STD/TA & LTD/TA show positive but insignificant relationship with the EPS. The null hypothesis that the financial leverage has no impact on the shareholders payoffs is rejected in terms of EPS when measured in relation to total debt to total assets. The results are in line with Majumdar & Chhiber (1997); Roa M, Yahyaee & Syed (2007); Aatherine Njagi (2012) Sabar Akbarian 2013.Raheel Mumtaz etal (2013), but are contrary to Lasher (2003), Nawaz, Javid & Akhtar (2012), Mubeen & Akhtar (2014), Abdul Azeez et al (2015) etc. when the impact of financial leverage on EPS was assessed with relation to STD to TA & LTD to TA there was insufficient evidence to conclude that there is an impact of financial leverage . The model is significant as the p-value is 0.0309302 i.e. lower than the critical value. The above referred table also discloses that ROE has statistically insignificant inverse relationship with TD/TA & STD/TA but insignificant positive relation with LTD/TA. The negative relation of ROE with TD/TA is in contradiction with the correlation analysis results, as well as with the null hypothesis. The results of regression analysis of STD/TA & LTD/TA are in conformity with the correlation analysis results. LTDTA shows insignificant positive relationship with both the dependent variables viz. EPS & ROE, but STDTA depicts insignificant positive and negative relationship with EPS & ROE respectively.

d) Periodical Analysis

Since it was intended to ascertain the impact of financial leverage on the payoffs to the stockholders in different phases of economy/market, the study was accordingly carried out separately for each phase as well. The three phases were identified on the basis of economic/market conditions as depicted by the Sensex graph, deemed as the barometer of the economic conditions especially in relation with financial performance of corporate sector. The three phases are labelled as Recessionary/Bearish Phase, Recovery Phase and Normal/Bullish Phase of Economy/Market.

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Regression analysis of the data sets for these respective phases has been conducted and the results so obtained are presented in their respective tables as follows.

i. *Recession/Bearish Phase*

The recession/bearish market phase started with what is commonly called as, "Bursting of Housing Bubble" in 2007 and continued for two years, 2007-08 & 2008-09. It lasted for short period & the economy immediately started to recover from the shock which originated in the western nations and had global ramifications though with varying intensities in different countries, wherein some countries suffered more & some less. An attempt has been made to ascertain the impact of financial leverage on the sample pharmaceutical companies during this recessionary/bearish phase of the economy/market using regression analysis. First Difference Method of regressing is applied as the period of recession is only of two years. The regression results so obtained are presented in the table 7 below.

Table 7: Regression Coefficients of Dependent Variables-EPS & ROE during Recessionary/Bearish Phase.

DV		Regressers	coefficient	std. error	t-ratio	p-value
EPS		const	5.05921	5.79445	0.8731	0.4053
	IDV	d_TD_TA	−26.5522	124.165	−0.2138	0.8354
		d_STD_TA	−2.45082	64.7206	−0.03787	0.9706
		d_LTD_TA	−17.8368	111.718	−0.1597	0.8767
	Control variable	d_Growth_oppo	−23.2599	16.8034	−1.384	0.1996
		d_TANG	−65.1102	37.9269	−1.717	0.1202
		d_S_GROW	33.7581	16.1815	2.086	0.0666*
	R-squared 0.627726			Adjusted R-squared -0.116823		
	F(6, 9) 2.511827			P-value(F) 0.103590		
DV		Regressers	coefficient	std. error	t-ratio	p-value
ROE		const	8.23088	6.93271	1.187	0.2655
	IDV	d_TD_TA	−33.7705	145.532	−0.2320	0.8217
		d_STD_TA	−3.01783	75.6404	−0.03990	0.969
		d_LTD_TA	14.3459	131.746	0.1089	0.9157
	Control variable	d_Growth_oppo	−6.97031	19.5279	−0.3569	0.7294
		d_TANG	−17.9995	46.0195	−0.3911	0.7048
		d_S_GROW	38.0606	21.2417	1.792	0.1068
	R-squared 0.575167			Adjusted R-squared -0.274499		

Source: Compiled on the basis of Secondary Data Collected from the audited Financial Statements of the sample companies sourced from their respective websites.

From table 7 it is evident that EPS has statistically insignificant negative relationship with all the three proxies of financial leverage, viz. TDTA, STDTA & LTDTA. While as, ROE shows positive relationship with LTDTA and negative relationship with other two proxies of financial leverage but the relationship is statistically insignificant in all the cases. This insignificant relationship is against the general belief that during the recessionary phase there is adverse effect of financial leverage on the financial performance of the companies and the effect is more severe in case of companies having high content of debt in their capital mix. This insignificant effect is probably because of the two fold reasons of short span of recessionary phase and the intensity of recession was low in India. The results reject our alternative hypothesis of an impact of financial leverage on the shareholders payoffs.

V. Recovery Phase

As already stated that the recessionary phase lasted for two years (2007-08 & 2008-09) and the economy started recovering from the housing bubble shock from the year 2009-10. The recovery phase was spanned over five years till 2013-14. The impact of financial leverage on the performance of the sample companies during the recovery phase was assessed by using regression analysis. But before the application of regression analysis the regression model fit for the respective data set of the recovery phase was determined by Poolability test and Housman test.

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a) Poolability Test

Poolability test is applied to find out whether the data is poolable or not. The null hypothesis of the test is that the groups have the common intercept. When the p-value of the test is more than the critical value i.e. 0.05 or 5%, the null hypothesis is accepted. That means the data is poolable and the Ordinary Least Method of regression is fit for the analysis of the data set. However, when the p-value of the test is less than the 0.05 or 5%, the null hypothesis is rejected implying thereby that the data is not poolable and Ordinary Least Squares Method is not fit for the regression of the data sets. Under such situation either the Fixed or Random Effect Model is fit. The fitness of the model between the two is determined by Housman test.

Table 8: Poolibility Test of two Dependent Variables EPS & ROE Recovery Phase.

S. NO.	VARIABLE	P-VALUE	POOLABLE/NOT POOLABLE	MODEL CONSISTENT
1	EPS	0.177101	POOLABLE	ODINARY LEAST SQUARE METHOD
2	ROE	0.301935	POOLABLE	ODINARY LEAST SQUARE METHOD

Since the p-value of the tests for both the variables viz. EPS & ROE is more than the critical value 0.05 or 5%, so the data sets are poolable and Ordinary Least Square method of regression is fit to be applied for the regression of the data sets, the results drawn are shown in the table 8 below

Table 9: Regression Coefficients of Dependent Variables EPS & ROE during the Recovery Phase.

SDV		Regressers	coefficient	std. error	t-ratio	p-value
EPS		const	41.6138	31.2974	1.33	0.2164
	IDV	TD_TA	−38.3515	43.3649	−0.8844	0.3995
		STD_TA	−1.75220	20.6603	−0.08481	0.9343
		LTD_TA	−2.64820	16.0325	−0.1652	0.8725
	Control variable	Growth_oppo	−9.78180	11.3492	−0.8619	0.4111
		TANG	−22.9643	12.1649	−1.888	0.0917*
		S_GROW	10.3355	11.8937	0.869	0.4074
	R-squared 0.121165			Adjusted R-squared -0.035463		
	F (6, 9) 2.333652			P-value (F) 0.122048		
DV		Regressers	coefficient	std. error	t-ratio	p-value
ROE		const	36.5908	31.1603	1.174	0.2704
	IDV	TD_TA	6.07678	40.7978	0.1489	0.8849
		STD_TA	−58.1315	23.9362	−2.429	0.0381**
		LTD_TA	−27.8510	28.4884	−0.9776	0.353
	Control variable	Growth_oppo	−11.0843	16.1276	−0.6873	0.5092
		TANG	−28.5102	21.9039	−1.302	0.2254
		S_GROW	19.9356	11.7126	1.702	0.1229
	R-squared 0.228364			Adjusted R-squared 0.120694		
	F(6, 9) 9.699443			P-value (F) 0.001670		

Source: Compiled on the basis of Secondary Data Collected from the audited Financial Statements of the sample companies sourced from their respective websites.

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Like the recessionary phase, the relationship of EPS with all the three proxies of financial leverage during the recovery phase was also negative and statistically insignificant. However, other variable ROE shows statistically significant negative relationship with STDTA at 5% level of significance, the p-value being 0.0381 but the other two proxies viz. TDTA & LTDTA show insignificant positive and negative relationship with ROE respectively. The significant negative relationship of ROE with STDTA indicates that increase in the short term debt component in the overall capital, decreases the return to the shareholders in terms of ROE. The average STD in the sample companies is about one third of the average total debt of the sample companies.

b) Normal/Bullish Phase

It took almost five years for the economy to reach to the pre-recession levels. As such the normal phase of the economy started from the year 2014-15 as is clear from the forgoing Sensex graph, when the graph touched the same height from where it had dipped. This good growth period continued till the world was hit by the Covid-19 pandemic, definitely for a very short period of time. Thereafter, it showed a steep hike. Generally, it is believed that during the times of normal/bullish phase of economy/market, the companies with high debt deliver good returns to their stockholders, particularly due to the effect of trading on equity. How for this general belief holds good in the case of sample pharmaceuticals companies was ascertained by applying suitable model of regression analysis determined by Poolability & Housman tests.

i. *Poolability Test*

Table 10: Poolability Test of Dependent Variables EPS & ROE during Normal/Bullish Phase.

S. NO.	VARIABLE	P-VALUE	POOLABLE/NOT POOLABLE	MODEL CONSISTENT
1	EPS	0.000529089	NOT POOLABLE	FIXED/RANDOM
2	ROE	0.00137651	NOT POOLABLE	FIXED/RANDOM

The poolability test of the data sets indicated that both the dependent variables viz. EPS & ROE are not poolable, since p-values of test for both the variables were less than the 0.05, the admit table level of significance, as such either Fixed or Random Effect Model was fit for the data sets for its result oriented analysis. The fitness of the model between the two regression models was detected by Housman test.

ii. *Housman Test*

Housman test is applied to determine the fitness of the regression model among the fixed and random effect models. The null hypothesis for the test is that the GLS estimates are consistent. The null hypothesis is accepted when the p-value of the test is greater than the critical value 0.05 (5%), otherwise rejected when the p-value of the test is less than 0.05(5%). The rejection of null hypothesis means that fixed effect model is fit for the data set and the acceptance of the null hypothesis means that the random effect model of regression analysis is fit for the analysis of the data set of the dependent variable as is case here. For both the dependent variables, EPS & ROE the p-values of the test are greater than the critical value (5%), so random effect model is fit for the regression analysis of the data sets.

Table 11: Housman Test of Dependent Variables, EPS & ROE during Normal/Bullish Phase.

S. NO.	VARIABLE	P-VALUE	MODEL CONSISTENT
1	EPS	0.909447	RANDOM EFFECT MODEL
2	ROE	0.963523	RANDOM EFFECT MODEL

Thus the regression analysis of the two data sets of dependent variables EPS & ROE was carried out by the random effect model as indicated by Housman test and the results so obtained are presented in table 12 below

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Table 12: Regression Coefficients of Dependent Variables EPS & ROE during the Normal/Bullish Phase.

DV		Regressers	coefficient	std. error	Z	p-value
EPS		const	−9.45807	10.0797	−0.9383	0.3481
	IDV	TD_TA	−17.9187	13.3685	−1.340	0.1801
		STD_TA	5.9589	20.4361	0.2916	0.7706
		LTD_TA	33.9002	12.6964	2.67	0.0076***
	Control variable	Growth_oppo	19.2654	11.1253	1.732	0.0833*
		TANG	21.0956	15.2395	1.384	0.1663
		S_GROW	0.775329	9.64396	0.0804	0.9359
	quasi-demeaning = 0.669324			corr(y,yhat) ^ 2 = 0.0617846		
	Chi-square(6) = 44.5012			with p-value = 5.87936e-08		
DV		Regressers	coefficient	std. error	Z	p-value
ROE		const	−7.24960	12.3485	−0.5871	0.5571
	IDV	TD_TA	−44.5305	16.1811	−2.752	0.0059***
		STD_TA	43.2248	22.3991	1.93	0.0536*
		LTD_TA	67.6218	23.5951	2.866	0.0042***
	Control variable	Growth_oppo	9.28632	5.88559	1.578	0.1146
		TANG	2.81806	21.115	0.1335	0.8938
		S_GROW	16.5008	11.3921	1.448	0.1475
	quasi-demeaning = 0.659512			corr(y,yhat) ^ 2 = 0.0976242		
	Chi-square(6) = 37.5236			with p-value = 1.39185e-06		

Source: Compiled on the basis of Secondary Data Collected from the audited Financial Statements of the sample companies sourced from their respective websites.

From table 12 it is observed that TDTA has negative relationship with both the indicators of the financial performance (EPS & ROE) of the sample companies. However, this negative relationship of TDTA with EPS & ROE is statistically insignificant in case of EPS but significant with ROE at 1% level of significance. Both the dependent variables viz. EPS & ROE show positive relationship with STDTA but insignificant with EPS and significant with ROE at 10% (0.0536) level of significance. LTDTA which forms about two third of the mean TDTA shows positive relationship with both EPS & ROE and in both cases the relationship is statistically significant at 1% level of significance as their respective p-values are 0.0076 & 0.0042. It implies that during the normal/bullish phase of economy/market, LTDTA has a favourable effect on the financial performance of the sample companies. In other words, it can be said that during the normal/bullish phase of economy/market, more long term debt in the capital mix of the company can be beneficial. However, at the same time it is observed that TDTA has negative relationship with both the indicators of financial performance viz. EPS & ROE, though insignificant with EPS but significant with ROE at 1% (0.0059) level of significance. This situation leads us to infer that the debt content in the debt equity mix of a company is financially beneficial to it during the normal economic phase but only to a certain limit and higher amounts of debt content in the capital mix will have negative impact on the financial performance of the company during the normal phase of economy in the case of pharmaceutical sector, as is reflected by the negative relationship of TDTA with EPS & ROE. The ratio of the TDTA is more than LTDTA due to inclusion of STDTA in it along with LTDTA. As such it can be concluded that during the normal phase of economy/ market inclusion of limited debt content in the capital mix of a pharmaceutical company can be financially advantageous to its shareholders in terms of EPS & ROE. The findings are in line with the Trade-off Theory of the Capital Structure which advocates for striking of trade-off between the costs and benefits of debt finance, so as to have the minimum weighted average cost of capital and maximum returns to its shareholders.

VI. Results, Discussions and Conclusions

Generally, companies use both sources of Funds in their capital structure in different proportions which vary from country to country and within the country, industry to industry and even company to company within an industry. The Pharmaceutical

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Companies in India have used both the sources of funds in their Capital Structure. Whether the debt fund as used by the Pharmaceutical Companies magnify the shareholders' wealth or not was the subject matter of this research work. Accordingly, the researcher undertook a detailed & systematic analysis of the relevant data, the results of which are presented in the forgoing Chapters.

From the forgoing results of multilinear regression analysis, it is evident that the financial leverage adversely effects the financial performance of the sample pharmaceutical companies in terms of EPS. While as in terms of ROE, the insignificant adverse relationship provided insufficient evidence to conclude that there is an impact of financial leverage on the financial performance of the sample companies. Therefore, the study reveals inconclusive results with regard to the impact of financial leverage on the financial performance when measured in terms of ROE & EPS which are the two sides of the same. The analytical results of the recessionary phase revealed an insignificant relationship of financial leverage with the firm performance. The results did not support the general belief of the corporate world that during recession phase of economy, the companies suffer financially and high debt companies suffer more. It is probably due to two fold reasons of very short span of recessionary phase coupled with the low intensity as was felt in India. Likewise, the mixed insignificant positive and negative results of regression analysis of the data sets of recovery period do not provide sufficient evidence regarding the impact of financial leverage on the financial performance of the sample pharmaceuticals companies. Only STDTA showed significant negative relationship with ROE at 5% level of significance. The reason for the same may be that that STDTA forms around one third of the total debt.

Theoretically, it is a general perception in the corporate world that during normal/bullish phase of the economy/market, the companies will dispense better financial performance to its shareholders particularly due to trading on equity. However, this theoretical perception is partially supported by the empirical findings as both negative and positive impact of financial leverage was observed during the normal/ bullish phase. While TDTA showed significant negative impact of financial leverage on the firm performance in terms of ROE at 1% level of significance, the LTDTA revealed significant positive relationship with both the indicators of firm performance viz. EPS & ROE that too at 1% level of significance. This negative and positive relationship of proxies of financial leverage with the two indicators of firm performance leads to infer that the debt content, up to a certain level, in the debt-equity mix can magnify the financial returns of the sample pharmaceutical companies, but beyond that level of financial leverage the sample pharmaceuticals will suffer financially. The results are in line with the Trade-off Theory of Capital Structure which propounds for striking a trade-off between the costs and benefits of debt financing so as to have the optimal capital structure. At the same time, the findings negate the irrelevance school of thought. Further the findings are similar to the empirical findings of Abolaji Daniel et al (2020), who found a positive impact of financial leverage in the listed pharmaceuticals companies of Nigeria but are contrary to the empirical findings of BadriaMunthashofi et al. (2018), who reported negative impact of financial leverage on the profitability of listed pharmaceutical companies of Indonesia.

a) Future Research Prospectus

1. Inclusion of unlisted Companies
2. Longer time periods.
3. Selection of companies at same (almost same) stage of growth.
4. Inclusion of more and more control variable for better results.
5. Alternate measures of Proxies to be used.

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Effects of Banking Competition on Financial Stability: Cases of Some Countries in Sub-Saharan Africa

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Abstract- The African banking sector has undergone changes over the past two decades. During the 1980s, the banking sector in Africa was imposed by public banks, subject to restrictive regulations. Financial remission, modernization of institutions and regulations, and globalization have changed the face of financial systems across the region. Furthermore, the literature has identified that competition in the financial sector is important for the stability of the financial system (Boyd at.al, 2009). To this problem, the results obtained by the method of ordinary least squares (OLS) applied to 15 countries of sub-Saharan Africa during the period 2010-2014 showed that the Lerner variable which captures banking competition according to market power explains significantly financial stability with a positive coefficient of 9.96693. This means that when the competition in the banking sector increases by one the financial stability increases by 9.96693. These results corroborate our first "competition-stability" or "concentration-fragility" vision.

Keywords: *competition, stability, MCO, crisis.*

GJMBR-C Classification: *JEL Code: G15, G21, G24*



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Effects of Banking Competition on Financial Stability: Cases of Some Countries in Sub-Saharan Africa

Effets De La Concurrence Bancaire Sur La Stabilite Financiere: Cas De Quelques Pays En Afrique Subsaharienne

Nakuno Balemba

Abstract- The African banking sector has undergone changes over the past two decades. During the 1980s, the banking sector in Africa was imposed by public banks, subject to restrictive regulations. Financial remission, modernization of institutions and regulations, and globalization have changed the face of financial systems across the region. Furthermore, the literature has identified that competition in the financial sector is important for the stability of the financial system (Boyd at.al, 2009). To this problem, the results obtained by the method of ordinary least squares (OLS) applied to 15 countries of sub-Saharan Africa during the period 2010-2014 showed that the Lerner variable which captures banking competition according to market power explains significantly financial stability with a positive coefficient of 9.96693. This means that when the competition in the banking sector increases by one the financial stability increases by 9.96693. These results corroborate our first "competition-stability" or "concentration-fragility" vision.

Keywords: competition, stability, MCO, crisis.

Résume- Le secteur bancaire africain a connu des changements au cours des deux dernières décennies. Au cours des années 1980, le secteur bancaire en Afrique a été dominé par les banques publiques, soumis à une réglementation restrictive. La libéralisation financière, la modernisation des institutions et des réglementations et la mondialisation ont changé le visage des systèmes financiers dans toute la région. En outre, la littérature a identifié que la concurrence dans le secteur financier est importante pour la stabilité du système financier (Boyd at.al, 2009). A cette problématique, les résultats obtenus par la méthode de moindre carré ordinaire (MCO) appliquée sur 15 pays d'Afrique subsaharienne durant la période de 2010-2014 ont montré que la variable Lerner qui capte la concurrence bancaire en fonction du pouvoir de marché explique significativement la stabilité financière avec un coefficient positif de 9.96693. Cela signifie que lorsque la concurrence dans le secteur bancaire augmente d'une unité la stabilité financière augmente de 9.96693. Ces résultats corroborent notre première vision « concurrence-stabilité » ou « concentration-fragilité ».

Mots Clés: concurrence, stabilité, MCO, crisis.

I. Introduction

Le secteur bancaire africain a connu des changements au cours des deux dernières décennies. Au cours des années 1980, le secteur bancaire en Afrique a été dominé par les banques publiques, soumis à une réglementation restrictive. La libéralisation financière, la modernisation des institutions et des réglementations et la mondialisation ont changé le visage des systèmes financiers dans toute la région. Récemment, la plupart des pays disposent de systèmes financiers plus profonds et plus stables, bien que les problèmes de concentration, de concurrence limitée et de coûts élevés persistent (Beck at.al, 2014) cité par Mohammed (2020).

Une caractéristique commune du secteur bancaire africain est qu'un grand nombre de banques investissent dans des titres d'État au lieu de prêter au secteur privé. Par exemple, en 2011, le crédit au secteur privé représentait en moyenne 78% du produit intérieur brut (PIB) (contre 132, 5% pour les autres marchés émergents d'Asie de l'Est et du Pacifique). Avant la crise financière de 2008, le ratio des liquidités par rapport au total des passifs des banques d'Afrique subsaharienne (ASS) était en moyenne d'environ 30%, tandis que celui des autres pays en développement était d'environ 4% (Allen at.al, 2014).

Dans le cadre de la promotion de la concurrence dans les systèmes bancaires africains, les banques transfrontalières jouent un rôle important au cours de la période. Par exemple, la Standard Bank d'Afrique du Sud opère actuellement dans 15 pays d'Afrique subsaharienne. La banque togolaise Ecobank a triplé son réseau d'affiliés en Afrique entre 2000 et 2013, passant de 11 à 32 pays, tandis que la United Bank for Africa (UBA) du Nigeria a étendu sa présence de 1 à 19 pays. La banque marocaine Attijariwafa Bank est présente dans 12 pays africains, et la Banque Marocaine du commerce Extérieur (BMCE) est passée de deux à 18 pays au cours de la même période (Mohammed, 2020).

L'Afrique subsaharienne a connu, ces dernières années, de forts taux de croissance économique, d'importantes réformes menées par différents États et une expansion rapide de sa classe moyenne. Les perspectives de développement de l'Afrique sub-saharienne restent prometteuses, la croissance réelle des pays qui la composent étant estimée par le FMI à plus de 4% en 2015, devançant ainsi celle de toutes les autres régions en développement. Toutefois, ce rythme

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de croissance sera inférieur au taux moyen annuel de 4, 4% enregistré ces deux dernières décennies, étant donné qu'un net ralentissement dans les pays émergents a fait chuter la demande d'exportations de produits de base issues de la région, avec à la clé des effets négatifs immédiats sur les positions extérieures et la situation budgétaire des pays concernés (Bending at. Al, 2016).

Hormis quelques exceptions notables, les systèmes financiers d'Afrique subsaharienne continuent d'accuser un retard de développement. Les secteurs bancaires y sont généralement concentrés et le plus souvent inefficaces en matière d'intermédiation financière. Ils sont limités par leur petite taille. La concurrence demeure modeste, même si elle s'intensifie. Selon la base de données de la Banque mondiale sur l'inclusion financière, seuls 34% des adultes disposaient d'un compte bancaire en Afrique subsaharienne en 2014, contre 24% en 2011. Par conséquent, l'accès au financement en Afrique subsaharienne, certes en progression, demeure parmi les plus faibles au monde et un des principaux obstacles à l'activité et à la croissance des entreprises, surtout des micro-entreprises et des PME. Élément encourageant, les transformations structurelles en cours, notamment l'émergence de groupes bancaires panafricains et des services bancaires mobiles, commencent à stimuler la concurrence, à approfondir les marchés financiers subsahariens et à améliorer l'accès au financement. L'Afrique subsaharienne est un chef de file mondial dans le domaine des comptes d'argent mobile: 2% des adultes sont titulaires d'un compte d'argent mobile dans le monde, alors qu'ils sont 12% en Afrique subsaharienne. L'inclusion financière, si elle reste insuffisante, s'améliore rapidement (Bending at.al, 2016).

Le développement de la concurrence dans les systèmes bancaires en ASS est lié tout d'abord à la taille de chacun de ses marchés. Ainsi, les pays dont le produit intérieur brut (PIB) et la population sont les plus importants sont également les pays les plus concurrentiels. Cette relation peut refléter l'importance des coûts fixes des banques (exigences de capital minimum, dirigeants, installation de succursales en fonction de la densité de la clientèle potentielle) et des économies d'échelle pour assurer la viabilité d'un nombre élevé d'établissements. L'intégration régionale des marchés bancaires apparaît alors comme un objectif important des politiques de développement de la concurrence entre banques, afin de désenclaver les marchés nationaux et encourager la concurrence bancaire. Cette relation se vérifie également dans les deux unions monétaires de la Zone franc, même si, dans ces unions monétaires, les marchés bancaires demeurent cloisonnés et le marché interbancaire peu développé. Si la constitution d'unions bancaires formelles (agrément unique, système prudentiel, système fiscal, etc.) peut faciliter la création de marchés bancaires unifiés, elle ne constitue pas une condition suffisante: la déconcentration doit aller de pair avec une intégration effective des marchés interbancaires, monétaires et financiers et une véritable volonté d'intégration financière, impulsée par les acteurs privés, et soutenue par les autorités publiques (JACOLIN at. al, 2017).

Une concurrence solide dans le secteur bancaire est d'une grande importance économique car elle permet une prestation efficace des services financiers, améliore la qualité des produits financiers et le degré d'innovation financière (Claessens at.al, 2004). En outre, la littérature a identifié six raisons pour lesquelles la concurrence dans le secteur financier est importante: premièrement, pour l'accès des entreprises et des ménages aux services financiers (Beck at. al., 2004); deuxièmement, pour le bon fonctionnement du secteur financier (Claessens at. al, 2005); troisièmement, pour la stabilité du système financier (Boyd at. al, 2009); quatrièmement, pour une gestion efficace des intermédiaires financiers (Berger at. al, 1989); cinquièmement, pour l'amélioration de la transmission de la politique monétaire par le biais des taux du marché interbancaire (van at. al, 2010); et enfin, pour la croissance industrielle et économique globale (Allen at. al, 2004). La concurrence peut stimuler l'innovation, faire baisser les prix et augmenter la qualité des produits et services produits, ce qui à son tour améliore le choix et le bien-être. En outre, Zarutskie (2011) cité par Mohammed (2020) affirme que la concurrence permet aux banques soit de se spécialiser dans certains types de prêts, soit d'améliorer leurs capacités de sélection des emprunteurs dans des segments particuliers du marché du crédit, ce qui leur permet de devenir plus rentables par rapport à leurs concurrents, Dick at. Al, (2010) cité par Mohammed (2020) fournissent des preuves suggérant que la concurrence augmente les capacités de prêt des banques et réduit les défauts de paiement.

En Afrique, la question de la concurrence dans le secteur des services financiers a des effets importants, en particulier sur l'amélioration de l'efficacité productive, la stabilité financière et l'efficacité de la réglementation et de la surveillance. Selon Kasekende at. Al (2009) cité par Mohammed (2020), ces incidences peuvent avoir des retombées positives sur le reste de l'économie, voire d'un pays africain vers le reste du continent. Ainsi, les stratégies de prêt efficaces de certaines banques en réponse à la concurrence augmentent le niveau de rentabilité des banques par rapport à leurs concurrents.

La présence de banques transfrontalières peut accroître la concurrence, ce qui est bénéfique pour la stabilité des banques (Boyd at. al, 2005). Carlson (2004) cité par Mohammed (2020) est d'avis que les banques transfrontalières ont moins de chances de survivre et

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que la durée de survie est également relativement beaucoup plus courte. L'entrée de banques transfrontalières ou de banques étrangères a plusieurs répercussions sur les pays d'accueil, en particulier les pays d'Afrique subsaharienne (ASS): elle renforce la concurrence interbancaire et garantit une plus grande utilisation des technologies de pointe pour améliorer les compétences et les services des entreprises, élargir l'accès aux services financiers, peut apporter une grande stabilité, améliorer le développement de la surveillance bancaire locale et des réglementations juridiques, accroître la transparence et la disponibilité des capitaux internationaux et stimuler les performances financières et économiques des emprunteurs.

Cette étude vise à étudier dans un premier temps les déterminants de la concurrence bancaire pour acheminer vers les effets de celle-ci sur la stabilité financière de quelques pays en Afrique Subsaharienne.

II. Revue De La Littérature

Nous allons examiner la littérature théorique et empirique portant sur la relation entre concurrence bancaire et stabilité financière.

a) Littérature Théorique

L'effet de la concurrence bancaire sur la stabilité financière a fait l'objet des plusieurs débats au cours des deux dernières décennies. Berger at al. (2009) développent une vision neutre qui soutient que la concurrence et la concentration peuvent coexister et peuvent simultanément induire la stabilité ou la fragilité financière. Entre-temps, la crise financière a en outre démontré l'urgente nécessité d'aborder la relation complexe entre la concurrence bancaire et solidité financière (OCDE, 2011). En particulier, des études récentes sur les causes de la crise du crédit ont mis en évidence la déréglementation et la concurrence excessive comme des facteurs qui ont conduit le secteur financier à effondrements aux États-Unis et au Royaume-Uni.

L'effet de la concurrence bancaire sur la stabilité du système financier reste l'un des sujets de recherche et de discussion qui font débat. Cependant, jusqu'à présent, les preuves théoriques et empiriques fournissent des conclusions. D'une part, la vision « concurrence-stabilité » ou « concentration-fragilité » soutient qu'une concurrence bancaire accrue améliore la stabilité du système financier en raison de son effet sur la baisse des taux de prêt réduisant ainsi la probabilité de défaut et par conséquent risque systémique (Boyd et De Nicolo, 2005; Tabak at al., 2012). De plus, un prêt plus élevé les taux peuvent entraîner un aléa moral lorsque les emprunteurs augmentent leurs investissements dans des projets à risque en vue d'améliorer leur capacité à rembourser les prêts (Tabak at al., 2012). Au contraire, la vision « concurrence-fragilité » ou « concentration-stabilité » stipule que la concentration des banques renforce la stabilité du système financier. Ce point de vue soutient que les banques concentrés gagnent des marges bénéficiaires plus élevées, créant ainsi un tampon contre la crise et réduit leurs incitations à investir dans des actifs à risque (Chileshe, 2017), Ceux qui soutiennent l'hypothèse de la « concurrence-stabilité » soutient que les systèmes bancaires concentrés sont plus difficile à surveiller et à réglementer car une grande partie de ces banques s'engagent dans plus des produits complexes, souvent difficiles à contrôler pour les régulateurs (Beck at al., 2006).

Diamond (1984), Ramakrishnan et Thakor (1984), Boyd et Prescott (1986), Williamson (1986), et d'autres montrent que les systèmes bancaires plus concentrés sont composés de grandes banques et que les banques peuvent capitaliser sur les économies d'échelle et de gamme et mieux diversifier leurs portefeuilles (Salma, 2015). Smith (1984) soutient que les relations bancaires peuvent durer plus longtemps dans des environnements moins concurrentiels si les informations sur la distribution de probabilité des besoins de liquidité des déposants sont privées. Par conséquent, plus de concentration et moins de concurrence pourraient réduire le risque de responsabilité et conduire à une plus grande stabilité dans le secteur bancaire (Adalgiso, at. al 2021).

Boot et Greenbaum (1993) at allen et Gale (2000, 2004) cité par (Xiaoqing at. al, 2015), suggèrent que dans un environnement plus concurrentiel, les banques tirent moins de rente informationnelle de leurs relations avec les emprunteurs, ce qui réduit leurs incitations à filtrer correctement les emprunteurs et augmente le risque de fragilité.

b) Littérature Empirique

Xiaoqing (Maggie) Fu at al. Analysent la concurrence bancaire et la stabilité financière utilisant des données sur 14 économies d'Asie-Pacifique de 2003 à 2009. Leur étude examine l'influence de la concurrence bancaire, de la concentration, de la réglementation et des institutions sur la fragilité de chaque banque, mesurée par la probabilité de faillite et la Z-score. Les résultats suggèrent qu'une plus grande concentration favorise la fragilité financière et que des prix plus bas induit également une exposition au risque bancaire. En outre, rien n'indique que les grandes banques de cette région pourraient mieux diversifier leurs portefeuilles. Enfin, les résultats indiquent qu'un meilleur développement et des exigences strictes en matière de capital améliorent la stabilité financière, tandis que les droits de propriété et l'assurance des dépôts sont associés à une plus grande fragilité bancaire.

Allen N. Berger at al. (2008) étudie l'effet de la concurrence bancaire sur la stabilité dans 23 pays développés. Ils régressent les mesures du risque de

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crédit, risque bancaire et fonds propres bancaires sur plusieurs mesures du pouvoir de marché, ainsi que des indicateurs de l'activité environnement. Les résultats suggèrent que, conformément au point de vue traditionnel « concurrence-fragilité » les banques avec un plus grand pouvoir de marché ont également moins d'exposition à risque. Les données fournissent également un certain soutien pour l'élément de la vision « compétition-stabilité » qui le pouvoir de marché augmente le risque du portefeuille de prêts. Les auteurs montrent que ce risque peut être compensé en partie par des fonds propres plus élevés ratios de fonds propres.

Franco Fiordelisi at al. (2014) examinent le lien entre la concurrence bancaire et la stabilité financière en utilisant la récente crise financière comme cadre. Ils utilisent la variation de la concurrence bancaire au niveau des États et constatent que les banques confrontées à moins de concurrence sont plus susceptibles de s'engager dans des activités risquées, plus susceptibles de faire face à une intervention réglementaire et plus susceptibles d'échouer. En nous concentrant sur le marché immobilier, Ils constatent que les États moins concurrentiels avaient des taux d'approbation de prêts hypothécaires plus élevés, ont connu une plus forte inflation des prix des logements avant la crise et ont connu une baisse plus prononcée des prix des logements pendant la crise. Dans l'ensemble, leur étude est cohérente avec une plus grande concurrence augmentent la stabilité financière.

Jin Q. Jeon at al. (2013) fournissent de nouvelles preuves que la relation entre la concurrence bancaire et la stabilité financière varie en fonction des caractéristiques des banques. En utilisant un échantillon de deux types de banques différentes, les banques commerciales coréennes et les caisses d'épargne mutuelles, ils constatent que la relation non linéaire entre la concurrence et la stabilité des banques commerciales reflète un compromis entre l'effet d'intérêt et l'effet de transfert de risque. Cependant, conformément à Boyd et De Nicolo (2005), la concurrence a un effet positif sur la stabilité des caisses d'épargne mutuelles avec un risque commercial plus élevé et une gouvernance d'entreprise plus faible. Nos résultats ont des implications importantes sur la politique de concurrence bancaire.

Taback at.al, (2012) utilisent les données bancaires de 10 pays d'Amérique latine de 2003 à 2008 et trouvent preuve que la relation entre la concurrence et la prise de risque n'est pas linéaire. C'est-à-dire à la fois haut et bas les niveaux de concurrence augmentent considérablement la stabilité bancaire, alors que l'inverse est vrai dans des conditions modérées.

Beck et al. (2013) étudient la variation entre les pays de la relation entre la concurrence bancaire et la stabilité. Plus précisément, ils étudient comment les caractéristiques réglementaires et institutionnelles hétérogènes affectent cette relation entre les pays. Leur article montre que la concurrence réduit considerablement la stabilité des banques dans les pays avec des restrictions d'activité plus fortes et des environnements de marché plus homogènes. Ils trouvent aussi que la politique d'assurance des dépôts et l'efficacité du partage des informations sur le crédit sont des déterminants importants de la relation négative entre stabilité et concurrence.

Christopher James Hope at al. (2013) explorent la relation entre la concurrence bancaire et la stabilité du secteur financier en utilisant les données 2005–2010 pour dix pays africains. L'étude utilise une méthode généralisée des moments approche de régression des indices de stabilité bancaire – Z-score, ratio de prêts non performants et rendement actifs des banques – sur les indices de concurrence bancaire – Lerner-Index, Herfindahl-Hirschman Index total actifs et dépôts totaux de l'indice Herfindahl-Hirschman. Les résultats montrent une relation positive robuste relation entre le pouvoir de marché et la stabilité financière. Ceci suggère sans équivoque qu'il y a un arbitrage entre la concurrence bancaire et la stabilité du secteur financier dans ces pays, selon le vision concurrence-fragilité.

Chileshe at al. (2017) examine l'effet de la concurrence bancaire, de la taille des banques, de la diversification et de capitalisation sur le comportement de prise de risque des banques commerciales à l'aide de données de panel de la Zambie. En outre, l'étude examine l'effet de la capitalisation et de la taille de la banque sur la banque le lien concurrence-stabilité. L'analyse empirique est effectuée en deux étapes. En particulier, les résultats montrent qu'une augmentation du pouvoir de marché réduit le risque de crédit d'une banque tout en augmentant la stabilité globale de la banque. Ces résultats sont cohérents avec les hypothèse de « concentration-stabilité » courante dans certaines publications empiriques. Par ailleurs, la taille et la capitalisation des banques sont associées à une amélioration de la stabilité bancaire alors que le manque de la diversification des revenus réduit la stabilité bancaire. Enfin, les résultats de cette étude indiquent également que les grandes banques bien capitalisées et puissantes sur le marché sont plus stables que les petites et les moins capitalisées.

III. Méthodologie

Afin de comprendre l'effet de la concurrence bancaire sur la stabilité financière de quelques pays d'Afrique subsaharienne, nous nous sommes référés à la méthodologie et au modèle utilisé par Jin Q. Jeon (2013) dans leur article portant sur « Concurrence bancaire et stabilité financière: Une comparaison entre les banques commerciales et caisses d'épargne mutuelles en Corée ». En utilisant les données de panel, nous allons régresser la variable dépendante sur la

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variable indépendante et les variables de contrôle. Voici notre modèle:

$$Stabilitéit=\alpha+1Concurrenceitk=1NkitXkit+eit$$

Où i représente les banques et t la période. Nos mesures de stabilité et de concurrence sont discutées plus en détail ci-dessous. X est l'ensemble des N variables de contrôle, y compris les variables spécifiques à la banque et variables liées au marché. Nous effectuons à la fois une analyse OLS et une analyse de panel pour estimer les équations.

Suivant Berger at. al. (2009), nous utilisons le Z-index, le ratio prêts non performants sur prêts bruts (NPL) et le rendement des actifs (ROA) pour mesurer la stabilité financière. L'indice Z est une variable proxy inverse de la probabilité de défaillance de l'entreprise et est donc utilisé comme mesure directe de la stabilité. Il a d'abord été développé par Roy (1952) puis utilisé plus tard dans des études bancaires empiriques par Boyd et al. (2009), Berger et al. (2009) et Turk Ariss (2010), entre autres. Une capitalisation bancaire plus élevée, et donc la stabilité, est représentée par un indice Z plus élevé, avec des bénéfices instables représentés par un indice Z plus faible. Ainsi, une augmentation de l'indice Z indique une plus grande stabilité et une diminution de l'indice Z indique une instabilité. Une variable d'indice est calculée par entreprise sur la période d'échantillonnage. L'indice Z représente le nombre d'écarts types en dessous de la moyenne par lesquels les bénéfices de la banque devraient baisser pour épuiser complètement les fonds propres (Boyd at. al, 2009). Il s'agit d'une mesure de la distance d'une banque à l'insolvabilité et est formellement défini comme (Christopher at. al, 2013):

$$Zi==ROAi+capital\ ratioiROAi$$

où Z_i est l'inverse de la probabilité de défaillance (l'indice Z), ROA_i est le rendement moyen des actifs sur la période pour la banque i, $Captial\ ratio_i$ est la moyenne de la période des capitaux propres par rapport au total des actifs de la banque i, et σROA_i est l'écart type moyen de la période sur le rendements des actifs pour la banque i. La variable proxy NPL est un ratio au niveau de la banque des prêts non performants par rapport au total des prêts. Le taux de non-performance est moyenné sur la période de l'étude, ce qui donne un point de données par banque sur la période d'échantillonnage.

a) Choix De Quelques Pays d'Afrique Subsaharienne Et Justification De La Période D'étude

Selon (FMI, 2016), ces dernières années, l'accès aux services financiers en Afrique subsaharienne a progressé régulièrement. De nos jours, il est moins souvent nécessaire de parcourir de longues distances pour accéder à des services financiers. Par exemple le Rwanda est le pays qui illustre le mieux la forte augmentation de la part de la population ayant accès à des services financiers: en 2016, 89% de sa population disposaient d'un accès à ces services, contre 75% quatre ans auparavant. La révolution numérique a permis aux abonnés à la téléphonie mobile de réaliser des opérations financières et des transferts d'argent depuis leur téléphone. Les coûts réduits de ces services leur ont laissé un revenu disponible plus important, et ils disposent désormais d'une solution sûre pour stocker des liquidités, même s'ils travaillent dans l'économie informelle.

Le Kenya par exemple bénéficie toujours des avantages de son adoption précoce des services financiers numériques, qui a permis à l'inclusion financière de gagner du terrain. En outre, au Kenya, une part bien plus importante de la population se situe à moins de 5 km d'un « point d'accès à des services financiers » et le pays dispose de bien davantage de points d'accès par personne que les autres pays de la région; en moins de dix ans, l'utilisation de l'argent mobile est passée de zéro à 75% de la population adulte, et le secteur de l'assurance s'est développé, grâce à la classe moyenne émergente du pays. Grâce aux réformes bancaires et aux mutations technologiques, l'environnement bancaire est progressivement devenu plus compétitif.

L'Afrique subsaharienne est, à l'échelle mondiale, la région en développement qui abrite la plus forte proportion de banques sous contrôle étranger (Claessens et van Horen, 2012). L'étroitesse et la faiblesse de la concurrence qui caractérise le nombre de marchés d'Afrique subsaharienne a permis aux banques d'Afrique subsaharienne de mener des activités transfrontalières et de rivaliser avec les banques locales. L'apparition de ces banques africaines régionales dotées d'une claire ambition panafricaine a modifié le paysage bancaire et favorisé la concurrence et l'innovation. Les groupes bancaires régionaux africains ont établi leur siège dans divers pays et certains sont bien implantés dans un grand nombre de pays. Ils sont présents sur de grands marchés bancaires comme l'Angola, le Kenya, le Maroc, le Nigeria et l'Afrique du Sud, mais aussi sur plusieurs marchés de plus petite dimension.

Ainsi dans le cas de notre étude voici les quelques pays dans lequel on pourra tester les déterminants de la concurrence: Benin, Cameroun, Ghana, Kenya, Mali, Maurice, Mauritanie, Mozambique, Namibie, Nigeria, Rwanda, Sénégal, Sud-Afrique, Tanzanie, Zambie. Le choix de ses pays a été guidé par des changements positifs observés sur le plan financier, économique et d'autres facteurs purement institutionnels au cours de ces dernières années.

Le choix de la période d'étude s'est fait en fonction de la disponibilité des données. Pour notre cas, les données de la variable dépendante sont accessibles durant la période 2010-2014. Ce problème lié à la

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difficulté de trouver les données à limiter notre champ d'étude pour 5 ans.

b) La Source Des Données Et Leurs Caractéristiques

L'ensemble de données statistiques à utiliser pour l'estimation des paramètres de notre modèle d'analyse des facteurs déterminants de la concurrence bancaire de quelques pays en Afrique subsaharienne proviennent de la base des données world bank development indicators,).

c) Les Variables Et Données Du Modèle

i. *Variable dépendante: Le Z-score*

Z-score est utilisé pour gérer la santé financière et stabilité des banques sur le marché.

ii. *Variable indépendante: Concurrence Bancaire*

Nous utilisons l'indice de Lerner comme variable proxy de la concurrence. Cet indice est utilisé pour mesurer la puissance du marché. Affiche la différence entre le prix de sortie et la marque jusqu'au coût. Un indice de Lerner élevé implique la diminution force concurrentielle dans le secteur bancaire. Voici comment il est calculé:

$$Lernerit=Pit-MCitPit$$

i est la banque et t est l'année. P, le prix de sortie du banque, est le ratio du revenu total (revenus d'intérêts et revenus le revenu) à l'actif total. MC, le coût marginal de la banque, dérivé de la fonction de coût translog. L'estimation détaillée du MC se trouve dans l'appendice.

iii. *Variables De Contrôle*

- *Taux De Concentration Du Secteur (Concentration):* Le ratio des cinq grandes banques en premier mesure de la concentration du marché bancaire, défini comme la part de marché totale des cinq plus grandes banques d'un pays donné, selon le crédit total.
- *Crédit Fourni Au Secteur Privé (Credifourni):* Le crédit intérieur fourni au secteur privé désigne les ressources financières apportées aux ménages et aux entreprises par les entreprises financières sous forme de prêts, d'achats de titres autres que de capital, de crédits commerciaux et autres créances. En outre, dans certains pays, le crédit au secteur privé peut parfois inclure le crédit aux entreprises détenues en partie ou en totalité par l'État.
- *Le Ratio Du Capital Bancaire Sur Les Actifs (Bankcapital):* le ratio du capital bancaire aux actifs, une mesure de la solvabilité et de la résilience des banques, montre la mesure dans laquelle les banques peuvent faire face à des pertes inattendues. Le capital bancaire comprend les fonds apportés par les propriétaires, les bénéfices non distribués, les réserves générales et spéciales, les provisions et ajustements d'évaluation. Le total des actifs bancaires comprend tous les actifs non financiers et financiers.
- *La Propriété Étrangère Des Banques (Propriete):* Pourcentage du nombre de banques étrangères par rapport au nombre total de banques dans une économie. Une banque étrangère est une banque dont 50 % ou plus de ses actions sont détenues par des étrangers.
- *Taux De Croissance Économique (Croissance):* Taux de pourcentage annuel de croissance du PIB aux prix du marché basé sur les devises locales constantes. Les données agrégées sont basées sur les dollars américains constants de 2010. Le PIB est la somme de la valeur ajoutée brute de tous les producteurs résidents d'une économie plus toutes taxes sur les produits et moins les subventions non incluses dans la valeur des produits. Elle est calculée sans effectuer de déductions pour la dépréciation des biens fabriqués ou la perte de valeur ou la dégradation des ressources naturelles.

IV. Estimation et Résultats

Afin de comprendre l'effet de la concurrence bancaire sur la stabilité financière de quelques pays d'Afrique subsaharienne, nous nous sommes référés à la méthodologie et au modèle utilisé par Jin Q. Jeon (2013) dans leur article portant sur «Concurrence bancaire et stabilité financière: Une comparaison entre les banques commerciales et caisses d'épargne mutuelles en Corée ». En utilisant les données de panel, nous allons régresser la variable dépendante sur la variable indépendante et les variables de contrôle. Voici notre modèle:

$$Stabilitéit=\alpha+1Concurrenceitk=1NkitXkit+eit$$

a) Analyse Statistique Des Variables

Les séries utilisées lors de cette analyse sont des données annuelles qui rappellent les évolutions qui ont marqué l'environnement bancaire de quelques pays d'Afrique subsaharienne durant la période 2010-2014. Les propriétés statistiques des variables sont (tableau n°11):

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Tableau 1: Les Propriétés Statistiques Des Variables

	Z_Score	Lerner	Concentration	Propriete	Bankcapital	Creditfourni	Croissance
Mean	14.95287	0.275165	82.49719	59.66667	8.983354	27.17913	5.348057
Median	14.66266	0.271289	86.80637	60.00000	9.221040	16.33974	5.098823
Maximum	26.75399	0.468260	100.0000	94.00000	18.70000	128.8498	14.04712
Minimum	3.868844	0.000000	48.65394	15.00000	0.000000	0.000000	-0.836735
Std. Dev.	5.381040	0.106008	16.41509	24.38318	5.063268	30.83484	2.295963
Skewness	0.133515	-0.532132	-0.484324	-0.135381	-0.436130	2.362506	0.627968
Kurtosis	2.531346	3.745142	1.852666	1.697652	2.540572	7.318979	4.705630
Jarque-Bera	1.091031	6.329610	8.454950	6.635334	3.644670	153.6724	16.82455
Probability	0.579543	0.042222	0.014589	0.036237	0.161648	0.000000	0.000222
Sum	1345.759	24.76489	7424.747	5370.000	808.5018	2446.122	481.3251
Sum Sq. Dev.	2577.048	1.000161	23981.50	52914.00	2281.665	84620.08	469.1588
Observations	90	90	90	90	90	90	90

Source: Auteur À Partir d'Eviews 10

Tableau 2: Matrice De Corrélation

Matrice De Corrélation	Z_Score	Lerner	Concentration	Propriete	Bankcapital	Creditfourni	Croissance
Z_SCORE	1.000000						
LERNER	0.0938	1.000000					
CONCENTRATION	0.0757	-0.4945	1.000000				
PROPRIETE	-0.6076	0.0529	-0.0526	1.000000			
BANKCAPITAL	0.1937	0.3934	-0.5575	-0.1010	1.000000		
CREDITFOURNI	-0.0444	0.1478	0.0572	-0.2628	-0.0575	1.000000	
CROISSANCE	-0.2582	0.0039	-0.2222	0.1061	0.2546	-0.3371	1.000000

La matrice de corrélation montre une corrélation positive entre le Z-Score et l'indice de lerner, la concentration bancaire, le ratio du capital bancaire sur les actifs. Tandis qu'une relation négative s'observe entre la variable z-score et la propriété étrangère des banques, le crédit fourni au secteur privé, la croissance économique.

Tableau 3: Estimation Par MCO(OLS)

reg Zscore Lerner Concentration Propriete creditfourni croissance

Source	SS	df	MS
Mode	1463.49249	6	243.915414
Residual	1113.55562	83	13.4163328
Total	2577.04811	89	28.9555968

Number of obs = 90
F(6, 83) = 18.18
Prob > F = 0.0000
R-squared = 0.5679
Adj R-squared = 0.5367
Root MSE = 3.6628

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Z-score	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Lerner	9.96693	4.423688	2.25	0.027	1.168391	18.76547
concentration	.0718672	.0310284	2.32	0.023	.0101529	.1335815
Propriete	-.1413428	.016913	-8.36	0.000	-.174982	-.1077036
Bankcapital	.2501365	.0971793	2.57	0.012	.0568507	.4434223
credit fourni	-.060848	.0140688	-4.33	0.000	-.0888302	-.0328658
croissance	-.7494658	.1874253	-4.00	0.000	-1.122247	-.3766843
_cons	18.12985	3.980116	4.56	0.000	10.21356	26.04614

Source: Auteur À Partir Du Logiciel Stata 13

Les résultats de la régression par l'estimateur MCO montre que la concurrence bancaire(Lerner), la concentration, la propriete, Bankcapital, creditfourni, et la croissance explique significativement la stabilitié financière au seuil de 1% et 5%.

b) Interprétation Des Résultats

Nos recherches sur le sujet ont révélé l'existence d'une littérature conséquente, soulignant l'intérêt de la sphère académique, mais aussi assurément des régulateurs et de la société, pour la stabilité financière. Cependant, la portée normative des travaux aussi bien théoriques qu'empiriques semble assez diffuse. Il ne se dégage, en effet, nullement de la littérature, une relation claire entre concurrence et stabilité financière. Alors que certaines études concluent à l'existence d'effets positifs, d'autres, en revanche, font valoir les effets adverses d'un excès de concurrence en termes de stabilité. La divergence marquée des résultats a conduit à la structuration de la littérature en deux paradigmes distincts. Ainsi, les études qui établissent un lien positif entre concentration et stabilité sont regroupées sous l'anglicisme concentration stability ou encore sous le terme competition fragility. Le second paradigme voit, quant à lui, la concentration comme une source de fragilité (concentration fragility), c'est-à-dire la concurrence comme stabilisatrice (competition-stability). Une accentuation de la concurrence serait ainsi, dans ce cadre, en mesure de stabiliser le système bancaire. La revue de littérature qui suit est partagée entre les apports théoriques d'une part, et les contributions empiriques d'autre part, de ces différents paradigmes.

Nos résultats montrent que la variable Lerner qui capte la concurrence bancaire en fonction du pouvoir de marché explique significativement la stabilité financière avec un coefficient positif de 9.96693. Cela signifie que lorsque la concurrence dans le secteur bancaire augmente d'une unité la stabilité financière augmente de 9.96693. Ces résultats corroborent avec notre première vision « concurrence-stabilité » ou « concentration-fragilité » qui soutient qu'une concurrence bancaire accrue améliore la stabilité du système financier en raison de son effets sur la baisse des taux de prêt réduisant ainsi la probabilité de défaut et par conséquent risque systémique (Boyd et De Nicolo, 2005; Tabak at al., 2012). Ces résultats sont identiques avec ceux trouver par les auteurs tels que Xiaoqing (Maggie) Fu at al. Analysent la concurrence bancaire et la stabilité financière utilisant des données sur 14 économies d'Asie-Pacifique de 2003 à 2009, Leurs résultats suggèrent qu'une plus grande concentration favorise la fragilité financière et que des prix plus bas induit également une exposition au risque bancaire. En outre, rien n'indique que les grandes banques de cette région pourraient mieux diversifier leurs portefeuilles. Allen N. Berger at al. (2008) étudie l'effet de la concurrence bancaire sur la stabilité dans 23 pays développés. Ils regressent les mesures du risque de crédit, risque bancaire et fonds propres bancaires sur plusieurs mesures du pouvoir de marché, ainsi que des indicateurs de l'activité environnement. Les résultats suggèrent que, conformément au point de vue traditionnel « concurrence-fragilité » les banques avec un plus grand pouvoir de marché ont également moins d'exposition à risque.

Franco at. al, (2014) examinent le lien entre la concurrence bancaire et la stabilité financière en utilisant la récente crise financière comme cadre. Dans l'ensemble, leur étude est cohérente avec une plus grande concurrence augmentent la stabilité financière.

Christopher at. Al, (2013) explorent la relation entre la concurrence bancaire et la stabilité du secteur financier en utilisant les données 2005–2010 pour dix pays africains. L'étude utilise une méthode généralisée des moments approche de régression des indices de stabilité bancaire – Z-score, ratio de prêts non performants et rendement actifs des banques – sur les indices de concurrence bancaire – Lerner-Index,

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Herfindahl-Hirschman Index total actifs et dépôts totaux de l'indice Herfindahl-Hirschman. Les résultats montrent une relation positive robuste relation entre le pouvoir de marché et la stabilité financière. Ceci suggère sans équivoque qu'il y a un arbitrage entre la concurrence bancaire et la stabilité du secteur financier dans ces pays, selon la vision concurrence-fragilité.

Nos résultats montrent que la concentration bancaire explique significativement la stabilité financière avec un coefficient positif de 0.0718672. C'est-à-dire que lorsque la concentration augmente d'une unité la stabilité financière augmente de 0.0718672. La concentration a un effet positif et effet stabilisateur sur la stabilité financière par le canal de la rentabilité. Cela appuie la preuve que les revenus supplémentaires liés à la concentration bancaire pourraient accroître le capital des banques et, par conséquent, leur capacité pour absorber les chocs négatifs lors des crises financières.

La propriété des banques étrangères explique significativement la stabilité financière avec un coefficient négatif de -0.1413428. Les banques étrangères pourraient bénéficier d'avantages concurrentiels par rapport à leurs homologues nationaux. Les banques étrangères utilisent technologies plus avancées en raison de la vive concurrence sur le marché intérieur. Les banques étrangères pourraient également être plus compétitives par rapport aux banques nationales en raison d'un marché actif pour le contrôle des entreprises dans le pays d'origine, et parce qu'ils ont accès à une main-d'œuvre instruite et capable d'adopter de nouvelles les technologies. Ainsi le suivi des informations douces des clients dans les banques nationales est meilleur que dans les banques étrangères; étranger l'entrée bancaire peut nuire aux clients des banques et aggraver leur bien-être. Les banques étrangères présentent une efficacité supérieure à celle de leurs homologues nationaux, toutefois, les banques étrangères qui ont acquis des banques nationales ne semblent pas avoir amélioré leur efficience. Les banques sous contrôle étranger sont supposées avoir de moins bons résultats que banques sous contrôle national en raison de coûts plus élevés pour fournir les mêmes services financiers ou en raison de baisse des revenus. D'où La propriété étrangère a un effet négatif et est associée avec une plus grande prise de risque, c'est-à-dire moins de stabilité mesurée par le Z-score (un proxy de la distance au défaut). Toutefois, lorsqu'une banque appartient à des intérêts étrangers alors elle est associée à des risques plus élevés que les banques nationales.

Le ratio du capital bancaire sur les actifs explique significativement la stabilité financière avec un coefficient positif de 0.2501365. Cela s'explique par le fait que durant notre période d'étude la l'économie s'est caractérisée par une absence d'insolvabilité systémique, ce qui recouvre la maitrise du cycle financier, la maîtrise des prix d'actifs (solvabilité macroéconomique), et des bilans bancaires et financiers sains (solvabilité individuelle prévenant une contagion négative des conditions de financement).

Le crédit fourni au secteur privé explique la stabilité financière avec un coefficient négatif de -0.060848. Cela peut s'expliquer par le fait que, vu la concurrence dans le secteur bancaire et un besoin de financement de la part des entrepreneurs, les banques se spécialisent dans des projets le plus risqués sans être sur de ne pas prêter à un mauvais emprunteur (aléa moral). La probabilité de défaut de l'emprunteur étant élevée, un choc de non remboursement de prêt entraine l'instabilité du système financier.

La croissance économique explique significativement la stabilité financière avec un coefficient négatif de -0.7494658. Une situation financière stable secteur est nécessaire à la croissance économique. Plus précisément, l'adéquation du capital et la liquidité dans le secteur financier sont des éléments importants pour stimuler la croissance économique. Ceci est dû au fait l'adéquation élevée des fonds propres protège les banques d'une éventuelle insolvabilité grâce à l'absorption les pertes susceptibles de se produire en raison de l'aléa moral et de la prise de risques élevés. Cela a un moyen de faciliter les transactions commerciales et, d'ailleurs, l'activité économique. Aussi, un l'augmentation de la liquidité augmente l'activité économique dans le sens où les investisseurs peuvent avoir facilement accès à des fonds au fur et à mesure des besoins à des fins productives.

La qualité des actifs est également importante dans le secteur financier. Une base de faible qualité des actifs influence négativement la croissance. Cela tient au fait que des proportions élevées de prêts non performants indiquent inefficacité dans le processus d'attribution des crédits et dans le système institué pour le prêt remboursement. Cela est souvent dû au problème de l'asymétrie de l'information, en particulier dans le secteur financier. Cela peut essentiellement entraver les investissements productifs et inhiber l'activité économique et la croissance. La stabilité financière exige clairement une rentabilité bancaire suffisante, des liquidités, des fonds propres et la qualité des actifs. Une condition préalable à la formulation de politiques efficaces pour améliorer la croissance économique consiste donc à comprendre les facteurs qui assurent la stabilité financière. Ces résultats affirment notre hypothèse selon laquelle la concurrence bancaire à un effet positif sur la stabilité financière de quelques pays en Afrique subsaharienne.

V. Conclusion

Cette recherche consistait à montrer les effets de la concurrence bancaire sur la stabilité financière de quelques pays d'Afrique subsaharienne. Ainsi une

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hypothèse a été formulée selon laquelle, la concurrence bancaire a un effet positif sur la stabilité financière de quelques pays d'Afrique Subsaharienne. Nos résultats montrent que la variable Lerner qui capte la concurrence bancaire en fonction du pouvoir de marché explique significativement la stabilité financière avec un coefficient positif de 9.96693. Cela signifie que lorsque la concurrence dans le secteur bancaire augmente d'une unité la stabilité financière augmente de 9.96693. Ces résultats corroborent avec notre première vision « concurrence-stabilité » ou « concentration-fragilité » qui soutient qu'une concurrence bancaire accrue améliore la stabilité du système financier en raison de son effet sur la baisse des taux de prêt réduisant ainsi la probabilité de défaut et par conséquent risque systémique. Ces résultats nous ont permis d'affirmer notre hypothèse de départ. Comme recommandations, les dirigeants de ses pays devront favoriser le climat des affaires en réduisant les restrictions dans le secteur bancaire, stimuler les investissements directs à l'étranger dans le but de permettre une concurrence qui améliorera la stabilité financière et fournir une bonne prestation des services financiers.

Annexes

a) Le Test De Ramsey Reset

Le test de Ramsey reset permet de tester l'omission des variables explicatives pertinente et une mauvaise spécification du modèle (Kangni, 2005).

Tableau 4: Test De Ramsey

Ramsey RESET Test using Powers of the Fitted Values of Hstatistic
Ho: model has no omitted variables
F(3, 82) = 0.40
Prob > F = 0.7543

Par l'auteur à partir de stata 13

La probabilité du test est de 0.7543, on ne peut donc pas rejeter l'hypothèse Ho au seuil de 5% ou 1%. Il n'y a pas donc omission des variables

b) Le test de normalité de résidu

Le test skewness/Kurtosis est un test d'hypothèse qui cherche à déterminer si les données suivent une loi normale. Pour le tester nous pouvons émettre l'hypothèse suivantes: H0: il y a normalité des résidus, H1; pas de normalité des résidus. Si la P est inférieure à 5% on rejette l'Hypothèse nulle.

Tableau 5: Test De Normalité De Résidu

Skewness/Kurtosis tests for Normality ------- joint ------					
Variable	Obs	Pr(Skewness)	Pr(Kurtosis)	adj chi2(2)	Prob>chi2
residu	90	0.8218	0.4563	0.62	0.7348

Par L'auteur À Partir De Stata 13

La probabilité du test est de 0.7348, on ne peut donc pas rejeter l'hypothèse Ho de normalité des erreurs au seuil de 5% ou 1%.

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Financial Modeling with Geometric Brownian Motion

By Chelsea Peng & Colette Simon

Abstract- This project evaluates the Brownian Motion model's effectiveness compared to historical stock market data. This paper analyzes its potential reasons for inaccuracies across time spans, specifically delving into its inability to incorporate major events such as the COVID-19 pandemic and the 2008 stock market crash. The paper uses the 2008 stock market crash and the Great Depression example instead of the COVID-19 pandemic to allow long-term accuracy to be tested. A prominent element of this model is the stochastic differential equation, which represents the randomness and uniqueness that the price of a derivative depends on. Stochastic elements reflect factors that influence the value of a derivative, like time, volatility of the underlying asset, interest rates, and other market conditions. The Markov property simplifies this complicated figure, meaning that the future value is independent of past prices. The Markov property is a "memoryless" feature; the current price is the only factor in future pricing, aligning with the effective market hypothesis. Finally, the paper offers insights on enhancements to the model, adjusting it to be a more efficient tool for economic forecasting.

GJMBR-C Classification: FOR Code: 1502



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Financial Modeling with Geometric Brownian Motion

Chelsea Peng [α] & Colette Simon [σ]

Abstract- This project evaluates the Brownian Motion model's effectiveness compared to historical stock market data. This paper analyzes its potential reasons for inaccuracies across time spans, specifically delving into its inability to incorporate major events such as the COVID-19 pandemic and the 2008 stock market crash. The paper uses the 2008 stock market crash and the Great Depression example instead of the COVID-19 pandemic to allow long-term accuracy to be tested. A prominent element of this model is the stochastic differential equation, which represents the randomness and uniqueness that the price of a derivative depends on. Stochastic elements reflect factors that influence the value of a derivative, like time, volatility of the underlying asset, interest rates, and other market conditions. The Markov property simplifies this complicated figure, meaning that the future value is independent of past prices. The Markov property is a "memoryless" feature; the current price is the only factor in future pricing, aligning with the effective market hypothesis. Finally, the paper offers insights on enhancements to the model, adjusting it to be a more efficient tool for economic forecasting.

I. Introduction

Stochastic calculus allows the modeling of random systems such as financial markets. "Stochastic components" in such models are randomly determined, with a random probability distribution that may be statistically analyzed but is impossible to predict precisely. The basis of this area of mathematics lies in continuous but not differentiable functions, requiring a theory of integration where integral equations do not need defined derivative terms.[1] Brownian Motion is often a component in the stochastic differential equations of stochastic calculus, representing the unpredictable aspect. Named for Robert Brown, the botanist who observed the motion of pollen particles in water in 1827, the Brownian motion model imitates prices in a continuous-time setting and is independent of past movements. It can be considered a limit of a symmetric random walk (a sequence of vertices and edges of a graph) with small steps in short time intervals.[2] In each time unit Δt, a step of size Δx is taken to the left or right with equal probability. Each step is an independent event with a value of either 1 or -1. The step size Δx is related to the time interval Δt by $\Delta x = \sigma\sqrt{(\Delta t)}$ where σ represents the standard deviation and the position at time t, denoted by $X(t)$, is the sum of all steps taken up to time t.[3]

The history of stochastic calculus begins with Brownian motion, and its origin can be traced back to two men who developed their models independently: L. Bachelier, who created a model while deriving the dynamics of the Paris stock market, and A. Einstein, who created a model of small particles suspended in a liquid. In an attempt to model the Paris Bourse market, Bachelier used the Central Limit Theorem, which states that the sampling distribution of a variable approximates a normal distribution as long as it is large enough.[4] He concluded that increments in stock prices should be independent (future movements are independent of past movements), stationary (statistical properties are constant over time), and normally distributed (as Δt approaches 0, $X(t)$ becomes a continuous process with mean 0 and variance $\sigma^2 t$). He was able to define processes related to Brownian motion, such as finding the maximum change during a time interval. Bachelier was the first to suggest using Brownian motion to model stock prices. In creating his model, Einstein assumed Bachelier's finding that Brownian motion was a stochastic process with independent increments, continuous paths, and stationary Gaussian increments. He concluded that the visible random movement of particles in water that Robert Brown observed was due to water molecules' invisible and random motion. In a statistical mechanics approach, he modeled these molecules as randomly moving particles that collide with suspended particles to cause erratic movements. Most importantly, he derived the diffusion equation, which relates the mean square displacement of a particle to the time interval of observation, which is given by: $(x^2)=2Dt$ where (x^2) is the mean square displacement of the particle, D is the diffusion coefficient, and t is the time interval. If the kinetic energy of fluids was right, the

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[1] "Stochastic Calculus for Financial Mathematics." *Frontiers*. https://www.frontiersin.org/research-topics/49221/stochastic-calculus-for-financial-mathematics. Accessed 15 September 2023.

[2] Siegrist, Kyle. "18.4: Geometric Brownian Motion." *Probability, Mathematical Statistics, and Stochastic Processes*. LibreTexts, 29 Jan. 2020, https://stats.libretexts.org/Bookshelves/Probability_Theory/Probability_Mathematical_Statistics_and_Stochastic_Processes_(Siegrist)/18%3A_Brownian_Motion/18.04%3A_Geometric_Brownian_Motion. Accessed 27 September 2023.

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[4] Chen, James. "Central Limit Theorem." *Investopedia*, 29 May 2021, https://www.investopedia.com/terms/c/central_limit_theorem.asp. Accessed 11 December 2023

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molecules of water moved at random, and a small particle would receive a random number of impacts of random strength from random directions in any period of time, which would cause the particle to move in the same way that Brown first observed.[5]

Economist Paul Samuelson found Bachelier's thesis in the MIT library and argued that prices must have fluctuated randomly in 1965, 65 years after Bachelier assumed it. His papers became the basis of the efficient market hypothesis and the foundation of option pricing theory. Samuelson proposed that changes in future prices were uncorrelated across time, a generalization of Bachelier's random walk model, and claimed that this postulate could be extended to an immediate application to options.[6]

As for Einstein's contribution to financial modeling, the stock price can be envisioned as a particle undergoing Brownian motion. Just as in Einstein's model driven by molecular collisions, a stock price moves randomly, caused by various unpredictable market factors. Based on his derived diffusion equation, the analogous function for stock prices would be $\Box S^2)=\sigma^2 t$ where (S^2) is the variation in stock price, σ^2 quantifies the degree of risk associated with the price, and t is the time interval. This equation implies that the uncertainty or random movement in stock price increases with time. [7]

Stock markets, foreign exchange markets, commodity markets, and bond markets are all assumed to follow Brownian motion, where random amounts alter the change of state on the assets. The models used to describe this motion are fundamental tools on which financial asset pricing and derivatives pricing models are based. The assumption that asset prices follow Brownian motion is essential to options pricing models. Options, which give its holder the right but not the obligation to buy or sell a certain amount of a financial asset by a certain date for a certain strike price, are determined by derivative pricing. Using Brownian motion to determine the fair price of an option, these models can more accurately describe how prices change over time. [8]

In this paper, the Dow Jones Industrial Average (DJIA) will be used to discuss Brownian Motion's accuracy in predicting stocks. The DJIA is a stock market index measuring the performance of 30 large and publicly owned companies. The index is price-weighted: the components are weighted based on their stock prices rather than their market capitalization. The DJIA index is relatively measured; its value represents the aggregate stock prices of its component companies. The units of the index are not specified in terms of a specific unit, currency, or percentage. The DJIA values indicate the index level at a point in time. The index value refers to the combined stock prices of the 30 companies in the index, weighted by their prices, equated to that numerical value. Changes in the DJIA over time reflect the overall performance of the stock market as represented by these 30 companies. The DJIA can be used to track the overall health and trends in the stock market as the companies within it span many important industries and commodities.

II. Options Pricing and Geometric Brownian Motion

Because Brownian motion can take on negative values, it is not always suitable for modeling stock prices. As a result, we use a non-negative variation called Geometric Brownian motion. A stochastic process S_t is said to follow a Geometric Brownian motion if it can be defined by $S(t) = S_o e^{X(t)}$, where $X(t) = \sigma B(t) + \mu t$ is Brownian motion with drift *and* $S(0) = S_0 > 0$ is the initial value. After taking the natural logarithm, the equation becomes $X(t) = \ln(S(t)/S_0) = \ln(S(t)) - \ln(S_0)$. $\ln(S(t)) = \ln(S_0) + X(t)$ is normal with mean $\mu t + \ln(S_0)$, and variance $\sigma^2 t$. The idea of using this model is to create a "level playing field" where the activity of buying or selling stock offers no arbitrage or simultaneously buying and selling the same asset in different markets to try to profit off of the tiny differences in price between markets, so no one should be able to make a profit with certainty.[9]

It also must satisfy the following stochastic differential equation $dS_t = S_t(\mu dt + \sigma dB_t)$ where dS_t is the change in the stock price, S_t is the stock price at time t, μ is the percentage drift representing the

[5] "Chapter 3: Einstein Diffusion Equation." *University of Illinois at Urbana-Champaign*, https://www.ks.uiuc.edu/Services/Class/PHYS498/LectureNotes/chp3.pdf. Accessed 11 December 2023.

[6] Jarrow, Robert, and Philip Protter. "A Short History of Stochastic Integration and Mathematical Finance: The Early Years, 1880-1970." *Imperial College London*, https://www.ma.imperial.ac.uk/~ ajacquie/IC_AMDP/IC_AMDP_Docs/Literature/Jarrow_Protter_History_Stochastic_Integration.pdf.

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[8] Lamberton, Damien, and Bernard Lapeyre. "Brownian Motion and Stochastic Differential Equations." *Introduction to Stochastic Calculus Applied to Finance*, 2nd ed., 2007. https://eds.s.ebscohost.com/eds/ebookviewer/ebook/bmxlYmtfXzE0OTk0NTRfX0FO0?sid=a48a5c70-802c-42c8-806f-cb32f6abeced@redis&vid=2&format=EB&lpid=lp_7&rid=0. Accessed 15 September 2023.

[9] "Option Pricing Based on the Generalized Fractional Brownian Motion." *Journal of Physics: Conference Series*, vol. 1180, no. 1, 2019, IOP Publishing, https://iopscience.iop.org/article/10.1088/17426596/1180/1/012011. Accessed 11 December 2023.

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expected return of the stock per unit of time, σ is the percentage volatility measuring the standard deviation of the stock's returns, and dB_t represents a Brownian motion process. Higher volatility increases the option's value since there is a greater chance that the stock price will move significantly by the expiration date. This equation has an analytic solution: $S_t = S_0 e^{(\mu - \sigma 2/2)t + \sigma dBt}$ for an arbitrary initial value S_0. The expected price grows like a fixed-income security with a continuously compounded interest rate. In practice, the compounded interest rate is much greater than the real fixed-income interest rate so that one would invest in stocks. This model is used in options pricing. [10]

The rights without obligations that options provide have financial value, so option holders must purchase them and make them assets. They are called derivative assets because they derive their value from other assets. For an exercise price K and an exercise date T, one has the right to buy stocks with price K and sell them with S_T in the market if $S_T > K$. If not, one has no obligation to purchase. This option is called a European call option, and we define claim C (payoff at time T) by $C = (S_T - K)_+ = \max(S_T - K, 0)$. So, if $S_T > K$, then the option owner will obtain the payoff C at time T, while if $S_T \leq K$, then the owner will not exercise their option, and the payoff is 0. At the time of writing the option, S_T is unknown and therefore raises the problem of pricing the option, or how should one price at time t = 0 an asset worth $(S_T - K)_+$ at time *T*? The primary goal is to determine the fair price at t = 0 for a European call option, which is only one example of financial derivate. The oldest derivative and most natural claim on a stock is the forward. If two parties enter into a forward contract, the seller agrees to give the other party the stock at some set time for some set price. If *T* denotes the expiry date, *F* denotes the strike price, and the value of the stock at time $t > 0$ is S_t. The stock must be exchanged at time *T* for $*F*, so to determine the fair value of this contract means to determine the value of *F*.[11]

III. Markov Property

Geometric Brownian Motion follows the Markov property, a memoryless feature that allows the future price to be independent of the past prices, given the present price. This feature aligns with the efficient market hypothesis that all past information is already reflected in current prices. In the context of Brownian Motion, the Markov property simplifies the process's modeling. The property allows for the future movements of a particle in Brownian motion to rely only on its current position, disregarding the path the particle took to get there. This simplifies the analysis and modeling of Brownian motion because once the current state of a particle is known, its history of motion can be ignored, as its past does not influence its future.

The Markov property is defined by the equation $\mathbb{P}(55{+}5 \in 5 \mid \mathscr{B}) = \mathbb{P}(55{+}5 \in 5 \mid 55$ φορ αλλ $5, 5 \in 5$ and $5 \in 5$.[12] The starting point is a probability space $(\Omega, \mathscr{F}, \mathbb{P})$, so that Ω is the set of outcomes, $\mathscr{F}$ the 5-algebra (a subset of the set algebras) of events, and $\mathbb{P}$ the probability measure on $(\Omega, \mathscr{F})$.[13] The time set 5 is either $\mathbb{N}$ (discrete time) or $[0,\infty)$ (continuous time).

The defining condition states that the conditional distribution of $55{+}5$ given $\mathscr{F}5$ is the same as the conditional distribution of $55{+}5$ just given 55. Conditional distribution is the probability distribution of a random variable.[14] It is calculated according to the rules of conditional probability after observing another random variable. In the equation, s can be thought of as present time, so that $5{+}5$ is a time in the future. The present state, 55 is known, so the events in the past are irrelevant for predicting the future state, $55{+}5$.

IV. Comparing Brownian Motion Stock Index Models

Python and Sublime Text were used to simulate Brownian Motion.[15,16] A random seed value, 42, was generated. The specific value doesn't matter; what's important is that using the same seed value will produce the same sequence of random numbers, making your code more predictable and reproducible. When prompted with "code for Brownian motion with the value of Dow Jones stocks as y-axis and from 2000 to 2015 in Python," and "code for Brownian motion with the value of Dow Jones stocks as y-axis and from 1900 to 2000 in Python," ChatGPT-generated code for the simulated

[10] "Option Pricing." *ESE 3030: Stochastic Systems Analysis and Simulation*, University of Pennsylvania School of Engineering and Applied Science, https://ese3030.seas.upenn.edu/stochastic-systems-analysis-and-simulation/option-pricing/. Accessed 13 December 2023.

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[12] Siegrist, K. (2021). Probability, Mathematical Statistics, and Stochastic Processes. University of Alabama in Huntsville. https://stats.libretexts.org/Bookshelves/Probability_Theory/Probability_Mathematical_Statistics_and_Stochastic_Processes_(Siegrist)

[13] Sengupta, A. (2005). Chapter 1 Sigma-Algebras. In Pricing derivatives: The financial concepts underlying the mathematics of pricing derivatives. essay, McGraw-Hill.

[14] Kuter, K. (2019). MATH 345 - Probability. Saint Mary's College. https://stats.libretexts.org/Courses/Saint_Mary's_College_Notre_Dame/MATH_345__-_Probability_(Kuter)

[15] Van Rossum, G., & Drake, F. L. (2009). Python 3 Reference Manual. Scotts Valley, CA: CreateSpace.

[16] Skinner, J. (2008). Sublime Text. [Software] https://www.sublimetext.com/

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graphs.[17] These codes were edited slightly to produce better results and to fix minor errors.

To create the Brownian Motion function, the line def brownian_motion(dt, n_steps) was used to define a function named brownian_motion that takes two parameters, (1) dt (time step) and (2) n_steps (number of steps). t = np.linspace (1900, 2000, n_steps + 1) creates an array t representing time from 1900 to 2000 with n_steps + 1 points. Increments = np.random.normal (0, np.sqrt(dt), n_steps)generates random increments from a normal distribution with mean 0 and standard deviation√dt. Bm = np.cumsum (increments) calculates the cumulative sum of the increments to obtain the Brownian motion values. return t, bm: Returns the time array t and the corresponding Brownian motion array bm. To set the function's parameters, dt=1/252.0 was used to set the days per year in which stocks are traded (252 trading days in a year). n_years = 2015 - 2000 or n_years = 2000 - 1900 was used to calculate the number of years. In Figure 1, n_years = 2015 - 2000 was used. In Figure 3, n_years = 2000 - 1900 was used. Lastly, to generate Brownian Motion t, bm = brownian_motion(dt, n_steps)was used to call the brownian_motion function to generate time (t) and corresponding Brownian motion values (bm) based on the specified time step and number of steps. To simulate Dow Jones Stock Values, initial_price = 10000 was used to set the initial index value to 10,000. Then, dow_jones = initial_price * np. exp(0.02 * t + 0.1 * bm)simulates Dow Jones stock values using the geometric Brownian motion equation. To plot geometric Brownian Motion plt. figure(figsize=(10, 6)): Creates a new figure with a specified size.plt.plot(t, dow_jones, label='Dow Jones Index'): Plots the Dow Jones stock values against time. plt.title('Brownian Motion with Dow Jones Stock Values (1900-2000)')sets the plot's title, plt. label ('Time (Years)')sets the label for the x-axis, plt. label ('Dow Jones Index')sets the label for the y-axis, plt.legend(), adds a legend to the plot, plt.grid(True), adds a grid to the plot, and plt. show(), displays the plot.

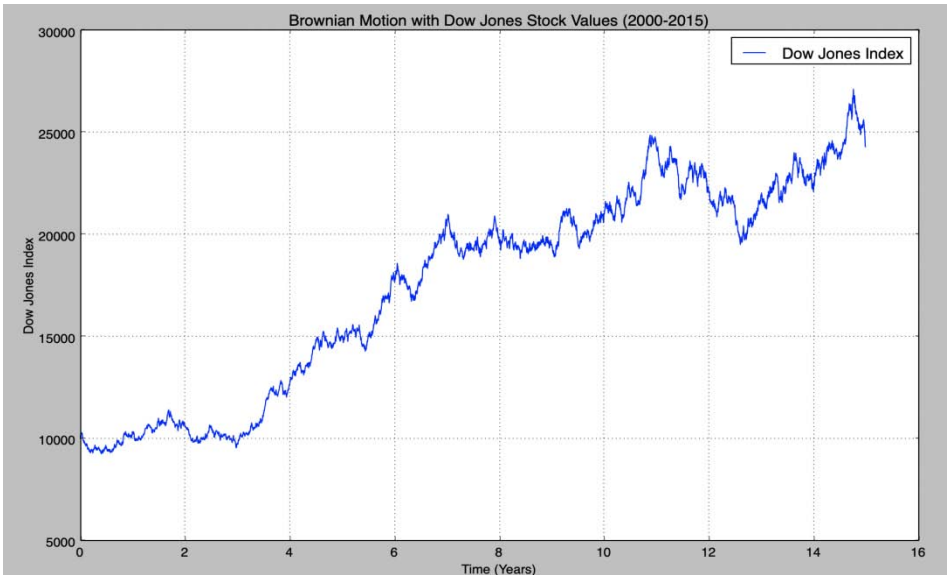

Figure 1: Simulated Brownian Motion From 2000-2015 Measuring Dow Jones Industrial Average Index.[18]

[17] OpenAI. (2023). GPT-3: Language Models for Cognitive Tasks. Retrieved from [https://chat.openai.com/chat]

[18] Hunter, J. D. (2007). Matplotlib: A 2D graphics environment. Computing in Science & Engineering, 9(3), 90-95. https://doi.org/ 10.1109/MCSE. 2007.55

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Figure 2: Real-life Dow Jones Industrial Average Index From 2000-1015.[19]

In comparing the simulated Dow Jones Industrial Average (DJIA) index to the real-life index over fifteen years, from 2000 to 2015, the overall trends of the simulated graph are accurate, but the changes in the index from year to year are not. In the simulated chart, the index starts at around 10,000, whereas the index in 2000 was about 20,000. The start value of the simulated graph is set to 10,000 as that value cannot be predicted or changed by Brownian Motion. Over time, the predicted values become more closely related to the real-life values without considering any events that significantly affect the economy and stock market. In the time period from 2000 to 2015, the DJIA index lost nearly half its value because of the stock market crash of 2008 but then made a complete recovery. However, because this decrease in the index happened so suddenly and the economy was able to recover quickly and completely, the trend of the simulated graph is still closely related to the actual health of the stock market. The simulated value of the DJIA steadily rose, with minor depressions, from 2000 to 2015, which aligns with the real-life stock market trends, except for the 2008 crash. In both the real-life and simulated graphs, during 2015, the index was about 25,000, with the simulated value slightly higher than the actual index. Overall, Brownian Motion on a small time interval is semi-accurate compared to the true DJIA index but is not precise enough for any factual claims to be made. The trends of the graphs mirror each other well, but when observing shorter time periods or a specific year, the values differ greatly.

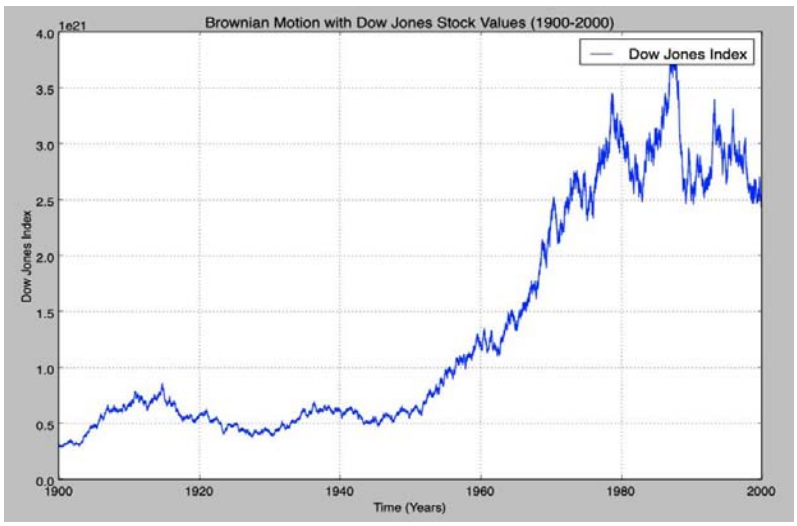

Figure 3: Simulated Brownian Motion from 1900-2000 measuring Dow Jones Industrial Average Index with the y-axis being in the thousands.[20]

[19] Dow Jones - DJIA - 100 Year Historical Chart. (2020). Macrotrends.net. https://www.macrotrends.net/1319/dow-jones-100-year-historical-chart

[20] Hunter, J. D. (2007). Matplotlib: A 2D graphics environment. Computing in Science & Engineering, 9(3), 90-95. https://doi.org/10.1109/MCSE.2007.55

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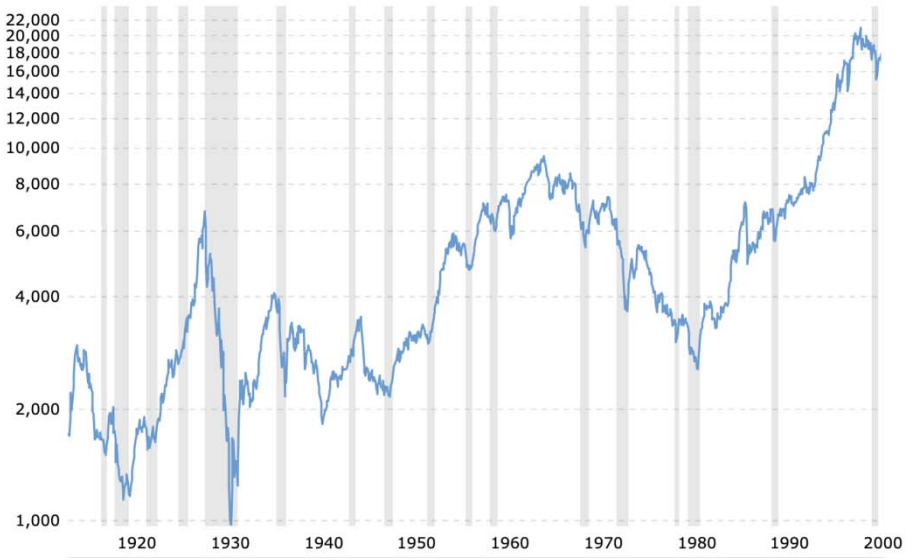

Figure 4: Real-life Dow Jones Industrial Average Index From 1900-2000.[21]

In comparing the simulated Dow Jones Industrial Average (DJIA) index to the real-life index over one hundred years, from 1900 to 2000, the overall trends of the graphs are very similar. The start value–randomly generated in the simulated graph–is inaccurate, but the simulation quickly balances out as time progresses. When analyzing large periods of time, especially in the last century, where significant advances have been made (including the inception of the internet), it makes sense that the simulated graph would be inaccurate. While the real-life diagram depicts sharp declines and increases, the geometric Brownian Motion steadily rises with time, providing incorrect results. Due to the nature of Brownian Motion and its properties of randomness, sharp peaks and valleys like those depicted in the real-life graph are unlikely to be represented. Overall, the long-term estimate of the DJIA is almost entirely different from the actual graph, primarily due to the many events occurring in the 20th century. Although this depiction is inaccurate, Brownian Motion's uses are still helpful as a baseline for predicting future stock values. In the shorter time period of fifteen years, while disregarding the stock market crash, the simulated graph is closely related to the actual stock values.

V. Limitations

Although geometric Brownian motion has widespread uses, it has many limitations and faces criticism for its oversimplification and the many assumptions it makes. For instance, GBM assumes constant volatility over time, which isn't true in the real market.[22] Additionally, actual financial returns often exhibit fat tails–greater-than-expected probabilities of extreme values–and are not normally distributed. Geometric Brownian Motion also does not account for market crashes or price jumps. While the model provides a framework for understanding stock pricing, real-world financial markets are influenced by factors that are not entirely random, like global pandemics and depressions, and can exhibit trends and cycles. Therefore, while the Brownian motion model is useful, it oversimplifies the complexities of financial markets.

VI. Discussion

The primary motivation behind these models comes from the nature of the stochastic processes. In practice, the price changes in the stock market are so frequent that a discrete-time model can hardly follow its movement. On the other hand, continuous-time models such as the ones used in Brownian motion lead to more explicit computations, even if they require code for simulation. While the Brownian motion model effectively captures the randomness of market movements through its stochastic components, it also reveals the challenges of predicting large-scale economic events.

This analysis emphasizes the need for continuous refinement of financial models to better understand and predict market behaviors. Incorporating elements into the algorithm that account for sudden, significant economic events could greatly enhance the model's accuracy in real-world scenarios, leading to more informed investment strategies and better financial planning. The balance between mathematical modeling

[21] Dow Jones - DJIA - 100 Year Historical Chart. (2020). Macrotrends.net. https://www.macrotrends.net/1319/dow-jones-100-year-historical-chart

[22] Brownian Motion and Its Applications In The Stock Market Angeliki Ermogenous. (2006). https://ecommons.udayton.edu/cgi/view content.cgi?article=1010&context=mth_epumd

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and practical economic realities underscores the importance of considering both random and systematic factors in economic forecasting. As the global economy continues to evolve in complexity, the adaptation and improvement of models such as Brownian motion become imperative. The ability of models like Brownian motion to provide insight into market dynamics directly impacts financial decision-making, risk management, and policy formation. With the world still grappling with the effects of the COVID-19 pandemic, understanding how major events disrupt the economy is pivotal in navigating current and future economic crises. By striving to refine and improve these models, one can hope to achieve a more stable and predictable financial future.

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11. Pick a good study spot: Always try to pick a spot for your research which is quiet. Not every spot is good for studying.

12. Know what you know: Always try to know what you know by making objectives, otherwise you will be confused and unable to achieve your target.

13. Use good grammar: Always use good grammar and words that will have a positive impact on the evaluator; use of good vocabulary does not mean using tough words which the evaluator has to find in a dictionary. Do not fragment sentences. Eliminate one-word sentences. Do not ever use a big word when a smaller one would suffice.
Verbs have to be in agreement with their subjects. In a research paper, do not start sentences with conjunctions or finish them with prepositions. When writing formally, it is advisable to never split an infinitive because someone will (wrongly) complain. Avoid clichés like a disease. Always shun irritating alliteration. Use language which is simple and straightforward. Put together a neat summary.

14. Arrangement of information: Each section of the main body should start with an opening sentence, and there should be a changeover at the end of the section. Give only valid and powerful arguments for your topic. You may also maintain your arguments with records.

15. Never start at the last minute: Always allow enough time for research work. Leaving everything to the last minute will degrade your paper and spoil your work.

16. Multitasking in research is not good: Doing several things at the same time is a bad habit in the case of research activity. Research is an area where everything has a particular time slot. Divide your research work into parts, and do a particular part in a particular time slot.

17. Never copy others' work: Never copy others' work and give it your name because if the evaluator has seen it anywhere, you will be in trouble. Take proper rest and food: No matter how many hours you spend on your research activity, if you are not taking care of your health, then all your efforts will have been in vain. For quality research, take proper rest and food.

18. Go to seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

19. Refresh your mind after intervals: Try to give your mind a rest by listening to soft music or sleeping in intervals. This will also improve your memory. Acquire colleagues: Always try to acquire colleagues. No matter how sharp you are, if you acquire colleagues, they can give you ideas which will be helpful to your research.

20. Think technically: Always think technically. If anything happens, search for its reasons, benefits, and demerits. Think and then print: When you go to print your paper, check that tables are not split, headings are not detached from their descriptions, and page sequence is maintained.

21. Adding unnecessary information: Do not add unnecessary information like "I have used MS Excel to draw graphs." Irrelevant and inappropriate material is superfluous. Foreign terminology and phrases are not apropos. One should never take a broad view. Analogy is like feathers on a snake. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Never oversimplify: When adding material to your research paper, never go for oversimplification; this will definitely irritate the evaluator. Be specific. Never use rhythmic redundancies. Contractions shouldn't be used in a research paper. Comparisons are as terrible as clichés. Give up ampersands, abbreviations, and so on. Remove commas that are not necessary. Parenthetical words should be between brackets or commas. Understatement is always the best way to put forward earth-shaking thoughts. Give a detailed literary review.

22. Report concluded results: Use concluded results. From raw data, filter the results, and then conclude your studies based on measurements and observations taken. An appropriate number of decimal places should be used. Parenthetical remarks are prohibited here. Proofread carefully at the final stage. At the end, give an outline to your arguments. Spot perspectives of further study of the subject. Justify your conclusion at the bottom sufficiently, which will probably include examples.

23. Upon conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print for the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects of your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form which is presented in the guidelines using the template.
- Please note the criteria peer reviewers will use for grading the final paper.

Final points:

One purpose of organizing a research paper is to let people interpret your efforts selectively. The journal requires the following sections, submitted in the order listed, with each section starting on a new page:

The introduction: This will be compiled from reference matter and reflect the design processes or outline of basis that directed you to make a study. As you carry out the process of study, the method and process section will be constructed like that. The results segment will show related statistics in nearly sequential order and direct reviewers to similar intellectual paths throughout the data that you gathered to carry out your study.

The discussion section:

This will provide understanding of the data and projections as to the implications of the results. The use of good quality references throughout the paper will give the effort trustworthiness by representing an alertness to prior workings.

Writing a research paper is not an easy job, no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record-keeping are the only means to make straightforward progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear: Adhere to recommended page limits.

Mistakes to avoid:

- Insertion of a title at the foot of a page with subsequent text on the next page.
- Separating a table, chart, or figure—confine each to a single page.
- Submitting a manuscript with pages out of sequence.
- In every section of your document, use standard writing style, including articles ("a" and "the").
- Keep paying attention to the topic of the paper.



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- Use paragraphs to split each significant point (excluding the abstract).
- Align the primary line of each section.
- Present your points in sound order.
- Use present tense to report well-accepted matters.
- Use past tense to describe specific results.
- Do not use familiar wording; don't address the reviewer directly. Don't use slang or superlatives.
- Avoid use of extra pictures—include only those figures essential to presenting results.

Title page:

Choose a revealing title. It should be short and include the name(s) and address(es) of all authors. It should not have acronyms or abbreviations or exceed two printed lines.

Abstract: This summary should be two hundred words or less. It should clearly and briefly explain the key findings reported in the manuscript and must have precise statistics. It should not have acronyms or abbreviations. It should be logical in itself. Do not cite references at this point.

An abstract is a brief, distinct paragraph summary of finished work or work in development. In a minute or less, a reviewer can be taught the foundation behind the study, common approaches to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Use comprehensive sentences, and do not sacrifice readability for brevity; you can maintain it succinctly by phrasing sentences so that they provide more than a lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study with the subsequent elements in any summary. Try to limit the initial two items to no more than one line each.

Reason for writing the article—theory, overall issue, purpose.

- Fundamental goal.
- To-the-point depiction of the research.
- Consequences, including definite statistics—if the consequences are quantitative in nature, account for this; results of any numerical analysis should be reported. Significant conclusions or questions that emerge from the research.

Approach:

- Single section and succinct.
- An outline of the job done is always written in past tense.
- Concentrate on shortening results—limit background information to a verdict or two.
- Exact spelling, clarity of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else.

Introduction:

The introduction should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable of comprehending and calculating the purpose of your study without having to refer to other works. The basis for the study should be offered. Give the most important references, but avoid making a comprehensive appraisal of the topic. Describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will give no attention to your results. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here.

The following approach can create a valuable beginning:

- Explain the value (significance) of the study.
- Defend the model—why did you employ this particular system or method? What is its compensation? Remark upon its appropriateness from an abstract point of view as well as pointing out sensible reasons for using it.
- Present a justification. State your particular theory(-ies) or aim(s), and describe the logic that led you to choose them.
- Briefly explain the study's tentative purpose and how it meets the declared objectives.

Approach:

Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done. Sort out your thoughts; manufacture one key point for every section. If you make the four points listed above, you will need at least four paragraphs. Present surrounding information only when it is necessary to support a situation. The reviewer does not desire to read everything you know about a topic. Shape the theory specifically—do not take a broad view.

As always, give awareness to spelling, simplicity, and correctness of sentences and phrases.

Procedures (methods and materials):

This part is supposed to be the easiest to carve if you have good skills. A soundly written procedures segment allows a capable scientist to replicate your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order, but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt to give the least amount of information that would permit another capable scientist to replicate your outcome, but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section.

When a technique is used that has been well-described in another section, mention the specific item describing the way, but draw the basic principle while stating the situation. The purpose is to show all particular resources and broad procedures so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step-by-step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

Materials may be reported in part of a section or else they may be recognized along with your measures.

Methods:

- Report the method and not the particulars of each process that engaged the same methodology.
- Describe the method entirely.
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures.
- Simplify—detail how procedures were completed, not how they were performed on a particular day.
- If well-known procedures were used, account for the procedure by name, possibly with a reference, and that's all.

Approach:

It is embarrassing to use vigorous voice when documenting methods without using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result, when writing up the methods, most authors use third person passive voice.

Use standard style in this and every other part of the paper—avoid familiar lists, and use full sentences.

What to keep away from:

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings—save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part as entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Use statistics and tables, if suitable, to present consequences most efficiently.

You must clearly differentiate material which would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matters should not be submitted at all except if requested by the instructor.



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Content:

- Sum up your conclusions in text and demonstrate them, if suitable, with figures and tables.
- In the manuscript, explain each of your consequences, and point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation of an exacting study.
- Explain results of control experiments and give remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or manuscript.

What to stay away from:

- Do not discuss or infer your outcome, report surrounding information, or try to explain anything.
- Do not include raw data or intermediate calculations in a research manuscript.
- Do not present similar data more than once.
- A manuscript should complement any figures or tables, not duplicate information.
- Never confuse figures with tables—there is a difference.

Approach:

As always, use past tense when you submit your results, and put the whole thing in a reasonable order.

Put figures and tables, appropriately numbered, in order at the end of the report.

If you desire, you may place your figures and tables properly within the text of your results section.

Figures and tables:

If you put figures and tables at the end of some details, make certain that they are visibly distinguished from any attached appendix materials, such as raw facts. Whatever the position, each table must be titled, numbered one after the other, and include a heading. All figures and tables must be divided from the text.

Discussion:

The discussion is expected to be the trickiest segment to write. A lot of papers submitted to the journal are discarded based on problems with the discussion. There is no rule for how long an argument should be.

Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implications of the study. The purpose here is to offer an understanding of your results and support all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of results should be fully described.

Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact, you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved the prospect, and let it drop at that. Make a decision as to whether each premise is supported or discarded or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."

Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work.

- You may propose future guidelines, such as how an experiment might be personalized to accomplish a new idea.
- Give details of all of your remarks as much as possible, focusing on mechanisms.
- Make a decision as to whether the tentative design sufficiently addressed the theory and whether or not it was correctly restricted. Try to present substitute explanations if they are sensible alternatives.
- One piece of research will not counter an overall question, so maintain the large picture in mind. Where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

When you refer to information, differentiate data generated by your own studies from other available information. Present work done by specific persons (including you) in past tense.

Describe generally acknowledged facts and main beliefs in present tense.

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Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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