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An Investigation of The Feasibly of Trading In Derivatives on The Zimbabwe Stock Exchange (ZSE)

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ABSTRACT

The benefits of trading in derivatives to the financial markets and the economy as a whole are well documented in literature yet there is no uptake of trade in these products on ZSE or any indications that it would happen in the foreseeable future. The purpose of this research is to investigate why derivatives are not traded on the Zimbabwe Stock Exchange (ZSE)? What is required for derivatives to be traded on the (ZSE)? View points and experiences of financial market participants were sought through a questionnaire. Respondents were experts in the particular subject matter of study. Data was collected using questionnaires from a target group of brokers, ZSE, insurance companies, asset management companies, other financial institutions and investment portfolio management. Research hypotheses were then tested by a statistical inference procedure. The statistical model used is based on Bayes' theorem of statistical inference. Having established the statistical validity and reliability of the opinions of respondents, the present scenario and future prospects of trading in derivative on ZSE were interpreted. It was concluded that there is a lucrative market for derivative products. It was also concluded that the current good performance of the ZSE in facilitating trade in stocks could be extended to trade in derivatives and that the operationing environment and the legal and regulatory aspects have to be improved or put in place. Derivatives are important in that they improve overall market scenario through improved price determination processes, information dissemination and portfolio management strategies. Further introduction of stock options, futures and other derivatives will help in aiding the liquidity of the financial markets, increasing the number of investors, reducing the number of risks, and improving the general performances of the markets.

Key words: derivatives, feasibility, probability density distribution, statistical inference

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1.0 Background of the study

The functions and benefits of trading in derivatives to the financial markets and the economy as a whole are well documented in literature yet, there is no uptake of trade in these products on ZSE or any indications that it would happen in the foreseeable future. The study seeks to investigate why derivatives are not traded on the Zimbabwe Stock Exchange and the feasibility of starting trade as well as future prospects. The research will review the period between 2011 and 2015.

A derivative is a financial contract that derives its value from an underlying asset. The buyer agrees to purchase the asset on a specific date at a specific price. Derivatives are often used on commodities, currencies, stocks or bond and interest rates Kimberly Amadeo (2017). The underlying asset may be financial or non-financial. Risk management is the most important function of derivatives as well as portfolio management. They are a risk management tool that help an organization to effectively transfer risk. Types of derivatives are forwards, futures, options and swaps.

Njanike K. (2010) observed that a futures derivative market for equities seems to be a missing ingredient for fund management firms. Generally equity price efficiency will be facilitated in a stock market where there are derivatives instruments like put options, call options and futures. The risk sharing characteristic of derivatives seems also to be a missing link in the Zimbabwean financial markets.

Why would a financial market be so inactive in trading on products that have received considerable attention in the study of finance and economics for decades now? Researchers hypothesise that:

H_0: It is not feasible to trade in derivatives on the Zimbabwean stock exchange

$H_{1:}$ It is feasible to trade in derivatives on the Zimbabwe stock exchange.

In investigating this hypothesis the study would be able reveal mechanisms that would initiate effective and efficient trading in derivative instruments. It is meant to generate interest in these products for investors on ZSE.

2.0 Literature review

2.1 Theoretical Framework

Njanike K. (2010), Bonga W. G, Chikeya Cloudio and Rodrick Sithole (2015), Laurine Chikoko (2008) and Potsiwa E. (2005) articulated well the functions, benefits and possible dangers of trading in derivatives. They also outlined the prerequisites for developing a market for

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derivatives, developments in the Zimbabwean financial system and markets as well as developments in the economy as a whole. In their articles they cited many authors who wrote on the theoretical framework and empirical evidence of trading in derivatives. Authres cited are Blake (2000), Howells and Bain (2002) Effenberger (2004) Hamilton (1998) The Deustche Bundesbank report (2006) Hull (2001) Abken, 1994 Gibson (1991) (Tsetskos and Varangis, 1997) Hawkesby (2000) Pickel (2006) Rodríguez (2009), Thomas (2000 Scalcione (2011) Strate (2013) Alberta Market Solutions (2003) , Pickel (2006) Dabla-Norris (2012) IMF (March, 2003 (Dudley & Hubbard 2004) and many more. Researchers avoided covering the same ground in this section.

2.2 Empirical Literature Review

Tsetsekos and Varangis (1997) stated that the process of introducing successful derivative products was lengthy and that both government regulations and a self-regulatory structure are usually needed. Governments could encourage and support assessments of the feasibility of such markets, to assure a broad domestic and foreign participation in the process, and to clearly define and implement the regulatory framework. It is up to the market participants and the exchanges to develop appropriate products, trading mechanisms, and self-regulatory systems compatible with the degree of market development.

Dodd (2002) stated that there are public interest concerns with derivatives in developing countries. These are abuses of derivatives and misuse of derivatives. Abuse of derivatives poses a threat to the integrity of markets and the information content of prices while he described the misuse as the one which poses a threat to the stability of the financial sector and the overall economy by increasing systemic risk, risk of contagion and possibly serving as a catalyst, or an accelerator, to financial disruption or crisis.

Haiss and Sammer (2010) examined the impact of derivatives markets on the United States' economic growth and found a very weak link between the two. On the other hand, Rodrigues *et.al* .(2012) found that the existence of derivatives markets made a significantly positive contribution to the countries' he studied per capita GDP growth.

The empirical evidence, to the use of derivatives mainly with reference to the U.S economy, suggests that the introduction of derivatives does not destabilize the underlying market. Bolonga and Cavallo (2002), examined the stock market volatility in the post derivative period in the context of Italian stock exchange and reported a decline in volatility. Thenmozhi (2002) reported a decline in volatility in the case of India. Nathan Associates (1974) reported that the introduction of derivatives seemed to have helped stabilize trading in the underlying stocks. This

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result has been supported by Skinner (1989) and also by other authors for the UK, Canada, Switzerland and Sweden stock markets.

3.0 Research Methodology

3.1 Questionnaire Design

Expert opinion poll was conducted through a questionnaire. The questionnaire was designed and distributed electronically over Google's online survey platform. The questionnaire captures the opinions for the various research statements. Questionnaire data was then used to estimate the distribution of opinions within the entire target sample. The Bayes statistical inference model was used to establish the validity and reliability of the opinions. A level of confidence of the validity and reliability of opinions was statistically established. The model assumes a binomial distribution meaning respondents either agree or disagree with the postulates. Each response is completely independent of the others, meaning the responses have independent and identically distributed. The distribution of opinion of the sample does not change in time, meaning it is stationary.

The following 15 questionnaire statements were sent to the target sample.

Q1: There are risks being experienced in trading at the ZSE.

Q2: There are counter-party risk measures in place.

Q3: Derivatives are useful to the Zimbabwean financial markets

Q4: There is trade of derivatives on the Over The Counter (OTC).

Q5: The process of trading derivatives is operationally effective.

Q6: There is market transparency in trading.

Q7: There is a class of investors called speculators, arbitrageurs and hedgers on the ZSE.

Q8: This class of investors see a need for risk management tools such as derivatives.

Q9: The legal and regulatory framework influence development of derivatives.

Q10: Liquidity in the underlying market is inadequate to sustain derivatives trading in Zimbabwe.

Q11: The introduction of derivatives will reduce the risks faced in trading.

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Q12: Derivatives cause increased volatility in interest rates and exchange rates.

Q13: Highly levels of foreign exchange reserves will greatly enhance derivatives trading.

Q14: Derivatives trading will enhance market turnover of the underlying markets.

Q15: Trading in the derivatives markets will be greatly influenced by overseas institutional investors.

3.2 Collection of Data

There is no quantitative data on trade in derivatives from the Zimbabwean financial markets as there has been no trade in these products. Information was collected from primary sources. The target population for the research was mainly the market participants who can make use of the derivatives. The target population comprised of the regulators, stock brokers. the stock exchange, banks, asset management firms as well as the insurance companies. Sample size consisted of the Zimbabwe Stock Exchange, the Securities Exchange, 10 banks, 10 insurance companies, 10 Asset management companies, 10 stock broking firms. The Securities Exchange commission is the regulator who can put in place the regulatory framework necessary for trading in derivatives.

The sampling method used was convenience sampling that is a non-probability sampling method that relies on data collection from population members who are conveniently available to participate in the study.

3.3 Statistical Inference

The Bayesian statistical inference process was used to analyze expert opinions given on the questionnaire. It is a robust statistical inference methodology, which is highly regarded in literature. The execution of the inference procedure starts with the determination of a prior distribution which models the beliefs about the situation before seeing the data. Then the Bernoulli likelihood function is used to model the likelihood profile of population proportions based on observed data. Finally, Bayes' rule is applied to obtain a posterior distribution for the population proportion parameter, it is from this posterior distribution that estimates and credible intervals used in testing hypothesis are computed.

Bayes' theorm inference process

Bayes' theorem of statistical inference which is defined as follows;

$$P(\theta \backslash x) = \frac{P(x \backslash \theta)P(\theta)}{P(x)}$$

Where:

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- (θ) is the prior distribution of the unknown parameter. The researcher's prior view on the probability of how the population is distributed, before any evidence, x.
- $(\theta|x)$ is the posterior distribution. The refined strength of the researcher's view on the population distribution in light of the evidence, x.
- $(x|\theta)$ is the likelihood function. The probability seeing the data x as generated by a model with parameter, θ.
- (x) is the marginal likelihood, which is the probability of observing the data, x averaged across the entire parameter space.

Deriving the probability distribution equations for the analysis is a lengthy process. The main equations derived are indicated in the six steps below.

Step One – Modelling the prior distribution

The first step in the Bayesian analysis process is to quantify the prior beliefs about the proportion of the sample agreeing with the hypothesis. In this study, a probability distribution called the beta distribution was used to model those beliefs. This is the "prior distribution". The range of values that θ can take and how each of those values are likely to occur is considered, where: θ = 0, indicates an entire sample in disagreement with the hypothesis, while, θ = 1, indicates an entire sample in agreement with the hypothesis. A sample split equally in opinion is denoted by, θ = 0.5. Hence, $\theta\epsilon$ [0,1]. This implies that the probability distribution exists on the interval, [0, 1].

The researchers' prior beliefs about the distribution of opinion in the target sample was that at least two thirds of the sample is in agreement with all the hypotheses of the study. This would mean that if all the elements in the sample took the questionnaire, all the questions would have "I strongly agree" or "I agree", responses making up at least 66.67% of all the responses for the respective questions/statements.

To model this belief, the researchers used the beta distribution as specified above. The assumed proportion of 66.67% translates to a proportion parameter, θ of 0.67. A certainty parameter, σ of 0.1 was also adopted. The figures, θ = 0.67 and σ = 0.1 were entered for questions one to fifteen in the data analysis model. The values of, θ and σ for all questions are automatically assigned to mean, μ and standard deviation, σ of the beta distribution for all the respective questions.

The mean and standard deviation of the beta distribution were used to determine the values of the, α and β parameters of the beta distribution. This was achieved using the formulas which link

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the mean, μ and standard deviation, σ of a beta distribution to the parameters, α and β of the same distribution. These formulas are as follows:

$$\alpha = (\frac{1-\mu}{\sigma^2} - \frac{1}{\mu})\mu^2$$

$$\beta = \alpha(\frac{1}{\mu} - 1)$$

The values of the, α and β parameters of the beta distributions for the respective questions were substituted into the generic structure of the beta distribution to obtain the specific probability distribution functions for the respective questions. The resultant being models for the researchers' prior beliefs as captured by the beta distribution which is specified as follows:

$$P(\theta|\alpha,\beta) = \frac{\theta^{\alpha-1}(1-\theta)^{\beta-1}}{B(\alpha,\ \beta)}$$

Bin data series for the beta distributions were then generated to allow for the plotting of graphs of the prior distributions for the respective questions. Values for the beta probability distribution functions of the respective questions where calculated for the probabilities of 0.01 through to 0.99 with a frequency of 0.01.

Step Two - Determining the likelihood function

The probability of getting a particular set of N responses assuming a fixed sample proportion that would respond positively represented by the parameter, θ was determined. The likelihood function chosen for this purpose in the study was the Bernoulli likelihood function which has a general form as follows:

$$P(k|\theta) = \theta^k(1-\theta)^{1-k}$$

The number of positive responses, z in N responses, give a Bernoulli likelihood function as follows:

$$P(z,N|\theta) = \theta^z(1-\theta)^{N-z}$$

Step Three - Determining the posterior distribution

The beta distribution that was used to model the prior distribution forms a conjugate pair with the likelihood function that was used in the study, this means that the posterior distribution was also

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going to be a beta distribution. To determine the posterior beta distributions the, α and β parameters for the posterior were determined using the following formulas.

$$\alpha' = \alpha + z$$

$$\beta' = N - z + \beta$$

Where:

- α and $\beta$are the parameters of the prior.
- z is the total number of positive responses for a particular question from N responses.
- α', β' are the parameters of the posterior distribution.

The values of the parameters were then substituted into the general beta distribution form to obtain the specific models or probability density functions of the respective questions. Bin data series were generated for the posterior distributions and graphs were plotted.

Step Four - Inference

The mean, μ' and standard deviation, σ' of the prior distribution were calculated in order to produce estimates for the sample parameter, θ and the uncertainty involved in the estimate. The formulas are as follows:

$$\mu' = \frac{\alpha'}{\alpha' + \beta'} = \theta$$

$$\sigma' = \sqrt{\frac{\alpha'\beta'}{(\alpha' + \beta')^z (\alpha' + \beta' + 1)}} = uncertainty$$

θ represents the proportion of the sample that are in agreement with a particular statement in the questionnaire, that is the proportion that would respond with "I strongly agree" or "I agree".

Step Five - Calculation of Bayesian credible intervals

A range of values with high posterior probability of containing the parameter θ were calculated. This range of values is known as the Bayesian credible interval. This gives the 95% credible interval, which is the range of values in which we are 95% certain the sample proportion parameter, θ falls, based on our sample data.

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Bin data series for the posterior were then generated with the values of the probability density function (p.d.f.) defined only for the probabilities within the bounds of the Bayesian credible intervals for the respective questions..

Step Six - Hypothesis testing

A decision rule was determined beforehand whereby a threshold of at least two thirds or 66.67% for θ was required. This implies a, θ_0 value of 0.67. A significance level, α of 0.05 was determined beforehand, meaning that for a hypothesis to be accepted , the probability of values to the right of 0.67 had to be at least 0.95 or 95%. The p-value was calculated by determining the value of the p.d.f. of the posterior distribution. This gives $(1- pvalue)$, the probability of values to the left of, θ_0 which was set at 0.67 in this study. Having determined the probability of values to the left of the cut-off point, this figure was compared with the pre-set significance level, α. Where the probability was less than a, α of 0.05, the verdict of the test was concluded to eb positive, meaning we cannot reject the hypothesis.

4.0 Resuits

Out of the 120 questionnaires send to individuals 106 individuals responded. This was a good responds as the minimum valid responses needed where found to be thirty-five (35) by the normal distribution estimation method for Bayesian sample size determination. The questionnaire responses were automatically recorded onto a spread sheet on the cloud. The response options were "I strongly agree"; "I agree"; "I cannot decide"; "I disagree"; and "I strongly disagree". Numerical codes were assigned to questionnaire responses for the 15 statements, with 1 representing the response, "I strongly disagree", 2 for "I disagree" and so on up to 5 for "I strongly agree". This procedure transforms the qualitative data from the questionnaire into numerical data. The proportions of the sets were computed.

The maximum posterior credible interval width was set at 0.25 (25%), which is a satisfactory interval width given the research objective of hypothesis testing (and not point parameter estimation).

4. 1Prior Distribution

The six steps outlined in the methodology of the Bayesian statistical inference model were followed. From the resultant data the prior and posterior distributions were plotted. For the prior distribution, the values are similar for all the research propositions, this is consistent with the assumed sample proportion and certainty which were set to the same values for all the research propositions as specified above.

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Fig 1 prior distribution plot

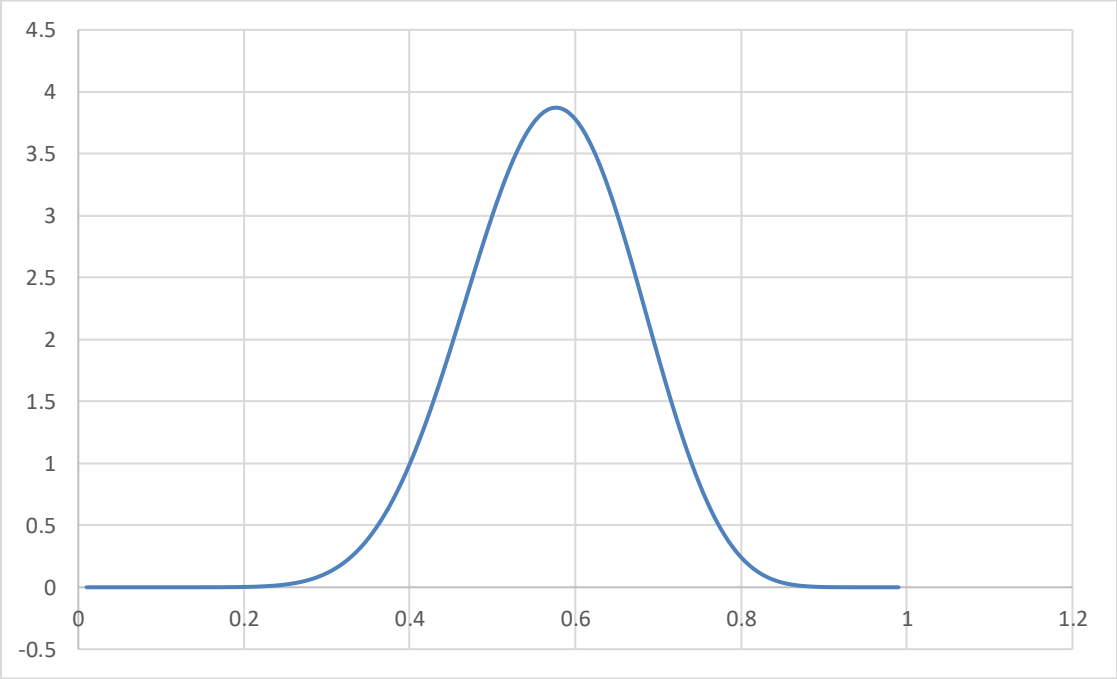

Fig 1 is a plot of the prior probability density functions for θ values of 0.01 to 0.99. The x-axis in the graph represents the value of the sample proportion parameter θ, the y-axis represents the likelihood or density of the θ values. The graph describes the distribution of the likelihood of values of θ. The plot is significantly skewed towards the right, this shows that the researchers' prior belief was that the sample is inclined to agree with the propositions of the study.

4.2 Posterior Distribution

Greater attention is paid on the posterior distribution on which hypothesis testing is based. Parameter z represents positive responses while w represents the negative responses. N is the total number of questionnaire responses = 106. The probability of getting a particular set of questionnaire responses is determined by likelihood function

Questionnaire statement one (Q1):

$P(z,N|\theta) = \theta^{106}(1-\theta)^{0}$

The probability of getting z positive responses in N qualified, valid responses given a particular value of θ is exactly equal to the product of θ to the power 106 and $(1-\theta)$ to the power 0.

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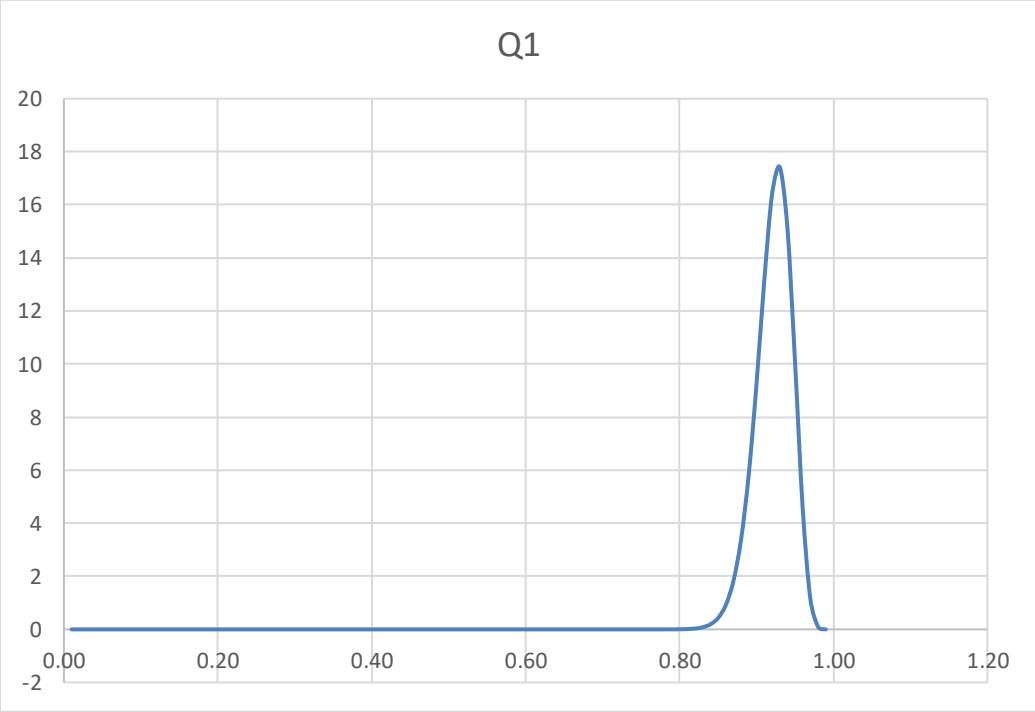
With regard to the posterior distribution the likelihood functions for research propositions/questionnaire statements one, two, three, five, six, seven, eight, nine, eleven, thirteen, fourteen and fifteen are identical. This is because the binomial proportions for these statements were also identical with the exception of questionnaire statements Q4, Q10, Q12. Because they are identical, one likelihood function was modelled to present identical questions

Fig 2 Plot of the posterior density function



X-axis represents the value of the population proportion parameter θ, Y-axis represents the likelihood or density of the θ values. The graphs describe the distribution of the likelihood of values of θ.

Fig 2 shows the plot of the posterior probability density function for research propositions/questionnaire statements one, two, three, five, six, seven, eight, nine, eleven, thirteen, fourteen and fifteen summarised in one plot (question 1), since their propositions are identical. The crests are significantly to the right of the median proportion (θ = 0.50). The right skew means that the target sample is inclined to be in agreement with the respective propositions for which the graphs are plotted. Posterior distribution plots: Q4 and Q10 were done separately as above examples. The graphs were significantly skewed to the left meaning that the sample is inclined to disagree with propositions. Q12 the graph was skew to the right more than any other graph, showing that there was overwhelming agreement on the statement.

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Fig 3 Comparisons of prior and posterior distributions

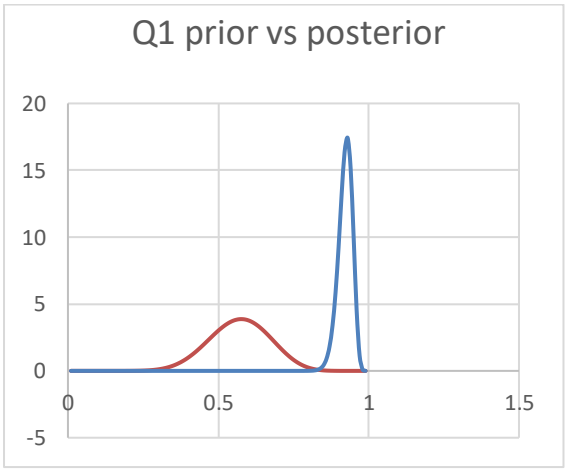

Fig 3 shows the posterior is skewed to the right. This means the sample is more inclined to be in agreement with all of the research propositions than was initially expected by the researchers. This also suggests that the actual sample parameter values for all the propositions is higher than the 0.67 initially expected by the researcher.

Table 1 posterior distribution parameters

Question	α'	β'
Q1	119,40	10,11
Q2	119,40	10,11
Q3	119,40	10,11
Q4	51,40	78,11
Q5	119,40	10,11
Q6	119,40	10,11
Q7	119,40	10,11
Q8	119,40	10,11

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Q9	119,40	10,11
Q10	106,40	23,11
Q11	119,40	10,11
Q12	62,40	67,11
Q13	119,40	10,11
Q14	119,40	10,11
Q15	119,40	10,11

Table 1 presents the resultant parameters of the posterior distribution density. The posterior distribution parameters were determined by factoring in the prior beliefs and the binomial questionnaire data.

Table 2 Probabilistic density function (Obtained in Excel)

probabilistic Model
beta dist p.d.f, P(θ|α',β')
θ^118.4007 (1 - θ)^9.1093 / B(119.4007 , 10.1093)
θ^118.4007 (1 - θ)^9.1093 / B(119.4007 , 10.1093)
θ^118.4007 (1 - θ)^9.1093 / B(119.4007 , 10.1093)
θ^50.4007 (1 - θ)^77.1093 / B(51.4007 , 78.1093)
θ^118.4007 (1 - θ)^9.1093 / B(119.4007 , 10.1093)
θ^118.4007 (1 - θ)^9.1093 / B(119.4007 , 10.1093)
θ^118.4007 (1 - θ)^9.1093 / B(119.4007 , 10.1093)
θ^118.4007 (1 - θ)^9.1093 / B(119.4007 , 10.1093)
θ^118.4007 (1 - θ)^9.1093 / B(119.4007 , 10.1093)
θ^105.4007 (1 - θ)^22.1093 / B(106.4007 , 23.1093)
θ^118.4007 (1 - θ)^9.1093 / B(119.4007 , 10.1093)
θ^61.4007 (1 - θ)^66.1093 / B(62.4007 , 67.1093)
θ^118.4007 (1 - θ)^9.1093 / B(119.4007 , 10.1093)
θ^118.4007 (1 - θ)^9.1093 / B(119.4007 , 10.1093)
θ^118.4007 (1 - θ)^9.1093 / B(119.4007 , 10.1093)

Table 2 these functions describe the relative likelihood for the actual sample proportion parameter to take on a given value. The term in the denominator, (α,) is a normalising constant. The functions are as follows:

Questionnaire statement one (Q1):

$$P\theta|\alpha,\beta = \frac{\theta^{118.4007}(1-\theta)^{9.1093}}{\beta(119.4007,10.1093)}$$

The probability of the sample proportion parameter taking any value θ, is exactly equal to the product of θ to the power of 118.4007 and $(1-\theta)$ to the power of 9.1098 all divided by$\Gamma(119.4007)\Gamma(10.1093)$for research propositions/

Table 3 posterior distribution bin data

	P(θ|α,β)															
proportion, θ	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q9	Q10	Q11	Q12	Q13	Q14	Q15
0,01	4,49E-222	4,49E-222	4,49E-222	9,75995E-64	4,4891E-222	4,49E-222	4,49E-222	4,49E-222	4,49E-222	5,25E-185	4,49E-222	1,6374E-84	4,489E-222	4,489E-222	4,489E-222	4,489E-222
0,02	1,8E-186	1,8E-186	1,8E-186	6,6311E-49	1,7954E-186	1,8E-186	1,8E-186	1,8E-186	1,8E-186	2,25E-153	1,8E-186	2,5476E-66	1,795E-186	1,795E-186	1,795E-186	1,795E-186
0,03	1,16E-165	1,16E-165	1,16E-165	2,25547E-40	1,1559E-165	1,16E-165	1,16E-165	1,16E-165	1,16E-165	6,51E-135	1,16E-165	8,3905E-56	1,156E-165	1,156E-165	1,156E-165	1,156E-165
0,04	6,53E-151	6,53E-151	6,53E-151	2,01005E-34	6,5275E-151	6,53E-151	6,53E-151	6,53E-151	6,53E-151	7,63E-122	6,53E-151	1,9842E-48	6,528E-151	6,528E-151	6,528E-151	6,528E-151
0,05	1,77E-139	1,77E-139	1,77E-139	6,8687E-30	1,7682E-139	1,77E-139	1,77E-139	1,77E-139	1,77E-139	9,92E-112	1,77E-139	8,857E-43	1,768E-139	1,768E-139	1,768E-139	1,768E-139
0,06	3,81E-130	3,81E-130	3,81E-130	2,97365E-26	3,8088E-130	3,81E-130	3,81E-130	3,81E-130	3,81E-130	1,74E-103	3,81E-130	3,2007E-38	3,809E-130	3,809E-130	3,809E-130	3,809E-130
0,07	2,92E-122	2,92E-122	2,92E-122	3,08524E-23	2,9176E-122	2,92E-122	2,92E-122	2,92E-122	2,92E-122	1,564E-96	2,92E-122	2,0359E-34	2,918E-122	2,918E-122	2,918E-122	2,918E-122
0,08	1,94E-115	1,94E-115	1,94E-115	1,12224E-20	1,9433E-115	1,94E-115	1,94E-115	1,94E-115	1,94E-115	1,595E-90	1,94E-115	3,6234E-31	1,943E-115	1,943E-115	1,943E-115	1,943E-115
0,09	2E-109	2E-109	2E-109	1,82901E-18	2,0035E-109	2E-109	2E-109	2E-109	2E-109	3,085E-85	2E-109	2,4329E-28	2,004E-109	2,004E-109	2,004E-109	2,004E-109
0,10	4,74E-104	4,74E-104	4,74E-104	1,57902E-16	4,7402E-104	4,74E-104	4,74E-104	4,74E-104	4,74E-104	1,607E-80	4,74E-104	7,5583E-26	4,74E-104	4,74E-104	4,74E-104	4,74E-104
0,90	9,2533805	9,2533805	9,2533805	5,15116E-42	9,253380547	9,2533805	9,2533805	9,2533805	9,2533805	0,4855752	9,2533805	2,4282E-30	9,25338055	9,25338055	9,25338055	9,25338055
0,91	13,112117	13,112117	13,112117	2,66345E-45	13,11211672	13,112117	13,112117	13,112117	13,112117	0,1514942	13,112117	4,5179E-33	13,1121167	13,1121167	13,1121167	13,1121167
0,92	16,356499	16,356499	16,356499	5,25209E-49	16,35649945	16,356499	16,356499	16,356499	16,356499	0,0354591	16,356499	3,6704E-36	16,3564994	16,3564994	16,3564994	16,3564994
0,93	17,431307	17,431307	17,431307	3,05669E-53	17,43130727	17,431307	17,431307	17,431307	17,431307	0,0057868	17,431307	1,0452E-39	17,4313073	17,4313073	17,4313073	17,4313073
0,94	15,186286	15,186286	15,186286	3,60693E-58	15,18628606	15,186286	15,186286	15,186286	15,186286	0,0005914	15,186286	7,5611E-44	15,1862861	15,1862861	15,1862861	15,1862861
0,95	10,099644	10,099644	10,099644	4,82121E-64	10,09964407	10,099644	10,099644	10,099644	10,099644	3,203E-05	10,099644	8,4362E-49	10,0996441	10,0996441	10,0996441	10,0996441
0,96	4,570524	4,570524	4,570524	2,75231E-71	4,570524027	4,570524	4,570524	4,570524	4,570524	6,956E-07	4,570524	6,2911E-55	4,57052403	4,57052403	4,57052403	4,57052403
0,97	1,1342899	1,1342899	1,1342899	1,07792E-80	1,134289883	1,1342899	1,1342899	1,1342899	1,1342899	3,584E-09	1,1342899	6,538E-63	1,13428988	1,13428988	1,13428988	1,13428988
0,98	0,0950721	0,0950721	0,0950721	4,77326E-94	0,095072102	0,0950721	0,0950721	0,0950721	0,0950721	1,351E-12	0,0950721	2,8033E-74	0,0950721	0,0950721	0,0950721	0,0950721
0,99	0,0005727	0,0005727	0,0005727	4,8846E-117	0,000572695	0,0005727	0,0005727	0,0005727	0,0005727	8,705E-19	0,0005727	6,5692E-94	0,00057269	0,00057269	0,00057269	0,00057269

Table 3 presents a sample of the series for all the research propositions/questionnaire statements. The first column from the left presents the θ values for which the functions were evaluated. Columns labelled Q1 to Q7 show the probabilities of the parameter taking the value in the first column for the respective propositions. An example of the reading of the table data is, for proposition one (Q1), there is a 4.74 ×10 ^ −10 probability that 10% of the target population (θ = 0.10) is in agreement with the proposition. All the data in that table can be interpreted in the same way as in this example. Plotting the data of the full bin series from θ=0.01 to θ=0.99 as sampled yields a visual representation of the entire probability distribution function.

4.3 Bayesian Inference and credible intervals.

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The results for the Bayesian credible intervals were that for all the opinions the upper bound was 0.85 and lower bound 0.46. The credible intervals represent a region of highest likelihood for the value of the sample parameter. The stipulated regions have a 95% probability of containing the actual sample proportion parameter.

The hypothesis tests results show that for all the propositions the threshold (test stat) was 0.67, the significance level was 0.05, 1-(p-value) was 0.82762 and p-value was 0.17238. The threshold (test stat) represents the hypothesis test decision rule. This means that, any propositions that were estimated to have a sample proportion parameter of at least 0.67 with a significance level of 0.05, would be considered as having passed the hypothesis test (cannot be rejected).

From the results it can be stated with 95% confidence that, for all the research propositions, at least two thirds of the sample of individuals with experience and knowledge of the Zimbabwean financial markets are in agreement with the respective propositions. Conclusions can be made about the hypothesis of the study based on the results of the propositions. All the 15 propositions are correct statements in explaining the state of the derivative market on the ZSE.

5.0 Interpretation

Q1 There are risks being experienced in trading at the ZSE. This implies that there are opportunities for investment management strategies using derivatives and risk management tools are required.

Q2 There are counter-party risk measures in place. Counter-party risk measures that have evolved through trading in equities and other stock market products can be extended to the derivative market.

Q3 Derivatives are useful to the Zimbabwean financial markets. Market participants do agree that derivatives are important to the market. This point is also confirmed in literature.

Q4 There is trade of derivatives on the Over The Counter (OTC). They are currently being traded on the OTC and their trade is operationally effective but no trade of derivatives listed on the ZSE.

Q5 The process of trading derivatives is operationally effective. Borrowing from experience of trading in stocks, it is possible to establish an operationally effective derivative market on the ZSE.

Q6 There is market transparency in trading. The transparency exhibited in trading in stock can be effected when trading in derivatives.

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Q7 There is a class of investors called speculators, arbitrageurs and hedgers on the ZSE. Speculators, arbitrageurs and hedgers are essential players in a derivative market. They provide the liquidity necessary for efficient and effective operation of a derivative market. The class of investors called speculators, arbitrageurs and hedgers on the ZSE do see the need of trading derivatives and they view it as an important tool for risk management in the market. This establishes the fact that it is feasible to introduce derivatives because there is a perceived need for them.

Q8 The legal and regulatory framework influence development of derivatives. The regulatory framework of ZSE lacks sufficiency to regulate, control and monitor the trading of derivative instruments. The ZSE lacks the infrastructure that permits the adoption of derivatives as alluded to in the literature review. Derivative trading cannot develop in the absence of a legal and regulatory framework specifically for trading in derivatives to minimise related risks. There is no legal and regulatory framework for derivatives at the ZSE.

Q9 Liquidity in the underlying market is inadequate to sustain derivatives trading in Zimbabwe. The major concern raised by the market participants is that, ZSE lacks the level of financial depth that is adequate for derivatives trading. Participants do agree that liquidity in the underlying market is inadequate to sustain derivatives trading on the Zimbabwe Stock Exchange and therefore a major drawback to the introduction and sustainability of trading in derivatives.

Q10 The introduction of derivatives will reduce the risks faced in trading. This is an opinion which makes trading in derivatives feasible.

Q12 Derivatives cause increased volatility in interest rates and exchange rates. This could be a negative factor on trading in derivatives. Empirical evidence show a decline in volatility.

Q13 High levels of foreign exchange reserves will greatly enhance derivatives trading. To the extend, that a large foreign reserve is important in managing the balance of payments and related problems such as exchange rate volatility (assuming own currency). This would reduce the risks of exchange rate fluctuations and provide a stable environment for foreign investors to trade in stocks and derivatives. This would also sustain a functional level of liquidity in the economy and ZSE.

Q14 Derivatives trading will enhance market turnover of the underlying markets. This is one of the important benefits of trading in derivatives and makes introduction of derivatives feasible.

Q15 Trading in the derivatives markets will be greatly influenced by overseas institutional investors. They have the expertise to trade in derivative if the market is conducive for trading, institutional investor participation would bring with it liquidity and financial deepening.

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6.0 Conclusions

It can be concluded with 95% confidence that individuals with experience and knowledge of the Zimbabwean financial markets are in agreement with the fact that derivatives are an important instrument in the market. It is feasible to introduce derivative trading on the ZSE. There is a lucrative market for derivatives. Six of the 15 statements investigated confirm these points. This agrees with Njanike K. (2010), Bonga W. G *et al* (2015), Laurine Chikoko (2008).

There are a number of important conditions satisfied by the ZSE which are conducive for introduction of trading in derivatives: There are counter-party risk measures in place. Derivatives are were traded on the OTC. The process of trading in equities is operationally effective. There is market transparency in trading stocks.

The major drawbacks are:

The absence of a legal and regulatory framework specifically for trading in derivatives, to minimise related risks. The ZSE lacks the infrastructure that permits the adoption of derivatives. Liquidity in the underlying market is inadequate to sustain derivatives trading on the Zimbabwe Stock Exchange. Low levels of foreign reserves in the economy impacting on liquidity. ZSE lacks the level of financial depth that is adequate for derivatives trading. The conclusion is in agreement with Bonga W. G *et al* (2015), Laurine Chikoko (2008).

The findings lead researchers to conclude that the ZSE would need to invest in processes and technologies that make it operationally efficient and minimize trading risk. This is in agreement with Njanike K. (2010).

The attitude of the banking sector in derivative trading is important for the take off of the trade. Banks constitute a crucial element to the functioning of the capital markets. They are the dominant financial institutions is the financial sector in the Zimbabwean economy. About 80% of the financial sector is dominated by banks. Also, the banking sector is highly concentrated with the three largests banks accounting for over 90% of total deposits in 2006 Bonga W. G *et al* (2015). As such their participation in related derivatives market could greatly influence developments in that market. The Zimbabwean banking sector may not have opened up to derivative trading because of a conservative approach to these products, that are associated with high risks and unclear levels of returns. Njanike K. (2010) and Laurine Chikoko (2008). The interest of the top three banks in derivatives is particularly influential.

According to the daily news (21 April 2003), five local banks including Barbican Bank, Interfin Merchant Bank, Kingdom Merchant Bank, Continental Securities and Trust Banking Corporation formed a Derivative Association to pioneer trade in derivatives. These banks traded

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share options over the counter call options Laurine Chikoko (2008). Unfortunately, these pioneering banks collapsed and with them the interest in developing derivative trading. The prevailing unfavourable economic conditions have put banks in survival mode making them more risk averse to take up new products. Under booming economic conditions, there could be an uptake of derivative trading by banks.

Another important factor to trading in derivatives is the role of the Reserve Bank of Zimbabwe (RBZ). Njanike K. (2010) pointed out that in 2003 there was a ban on trading in derivatives imposed by the RBZ. Laurine Chikoko (2008) stated that post 2004 period, trading in derivatives became illegal. There has been no legal, active derivative market in Zimbabwe since 2004. Such restrictions kill innovation, motivation and any initiatives in trading in derivatives. As literature indicates ZSE may not achieve financial deepening.

Skills development in derivative trading is important for trade in this area to take off. A critical mass of derivative experts may have been attained in the economy by now with universities like Harare Institute of Technology (HIT) and National University of Technology (NUST) producing financial engineering graduates each year that are well schooled in derivatives. Also, with the level of education in Zimbabwe, there is a significant pool of graduates with a Masters degrees in Finance or Economics who undertook derivative courses. Knowledge in derivative trading may not be a drawback.

With regard to market capitalisation, the research found out that market capitalization is important for adopting a derivative market, a rising market capitalization means there is increase in trade and volumes traded. Market capitalisation is calculated by multiplying the number of shares issued by a company by its current share price. To increase market capitalisation there has to be an increase in number of companies listed on the ZSE and the shares issued. High levels of derivatives trading are usually associated with a high level of stock trading. This in the main, is a product of good economic performance and policies in encouraging the establishment and growth of the corporate sector.

The general conclusion of the study from the views of the respondents is that introduction of stock options, futures and other derivatives is desirable and feasible and that there is a market for them. However, it is going to be a long wait before trade take place. Time is required to institute the legal and regulatory framework, improve operational environment of ZSE and achieving good economic performance.

Apart from absence of regulatory from work, prohibitions by RBZ stand out to be the major contributor to inactive derivative markets. They put a dead end to trading in these products.

7.0 Recommendations

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Regulatory bodies such as the Securities Exchange of Zimbabwe (SEC) should put in place the necessary regulatory requirements needed for an effective and efficient use of derivatives. The regulations should come first to minimise the risks of pioneer traders.

ZSE would need to invest in processes and technologies that make it operationally efficient and minimize trading risk.

When it comes to development of financial markets and products, RBZ would need to pursue market oriented policies in this regard. It's role in creating an enabling environment for trade through contributing to mechanisms and rules that minimise trading risk and ensure fair trade should be applied. A prohibition should have been a short term solution while improving the trading environment.

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