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Evaluating Multi Sector Shocks Effect on the Global Economy

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ABSTRACT: The Global economy has experienced various shocks and effects of different impacts. These include war, corruption, civil unrest, politics, piracy, terrorism to name but just a few. These have had a great influence on the global economy such that with the many austerity measures that have been undertaken in the past four years the world at large has not been able to mitigate these influences. Most of the great economies have not recovered yet and if they have it fluctuates. This research generally investigated the sector shock effect on the Global economies by modeling the returns and risks of a sample of major stock indices which were variants since they have been known to capture changes in many economies which may result from social, economic or political happenings. The research then determined a model that could evaluate the effect of various happenings on the averaged Global economy. The multi sector cost of returns was found to be 0.078 or 7.8 % and the multi sector total risk 0.20 or 20.12 %, which is very high 20.12 %. The results then clearly indicated very high risks and low returns during tumultuous times of global happenings.

KEYWORDS: Global economy. Multivariate, Share index, Shocks.

1.0 INTRODUCTION

Studies show that a large enterprise's success can bring many firms' development in related industries while a large enterprises failure can cause social fears, which is manifested as negative value effect. For example the bankruptcy effect of MCL world com, United Airlines and Global crossing Limited in 2002 caused great shocks on the United States of America (USA) business community by dealing a heavy blow to the United States economy which hindered the economic recovery process of America as indicated by Peng *et al* (2005). Since 2007, there has been a domino effect caused by the USA subprime mortgage crisis brewed on Wall Street's financial crisis which spread like a plague around the world and lead to a large number of enterprises' financial crisis. The collapse of Lehman brothers and the bankruptcy crisis of General Motors fully explain the financial risks role in the development of enterprises. Similarly the recent unrests in the North of Africa and Middle East have had an effect on the prices of oil in the world. There is need for investigations to generate common global cost of return and global risks to enable correct estimations of interest rates, dividend rates hedging rates and so on.

In simple terms, a variable represents a measurable attribute that changes or varies across the experiment whether comparing results between multiple groups, multiple people or even when using a single person in an experiment conducted over time (Mariecor, 2018). According to the oxford dictionary a variable as a noun is an element, feature, or factor that is liable to vary or change. From the definitions of a variable above this research studied some of the various different major world share indices as variables which are referred to as detectors in this study in order to model the global risks and their costs during global happenings be it political, economic or otherwise. In particular some of the variables used include the British Financial Times Stock Exchange index (FTSE 100) which is a share index of the 100 companies listed on the London Stock Exchange with the highest market capitalization. It is seen as a gauge of prosperity for businesses regulated by United Kingdom (UK). The United States of America (USA) Dow 30 commonly referred to as the "Dow," or the "Dow Jones Industrial Average," which was created by the Wall Street Journal editor Charles Dow, who then gave it his name Dow and that of his business partner, Edward Jones. The combined stock price of the 30 large, publicly-traded companies determines the Dow Jones Industrial Average (DJIA). As some of the top stocks in the marketplace, the belief is that the Dow 30 represents a strong assessment of the market's overall health and tendencies. China's Shanghai Composite Index, launched in 1991, is also another global share index studied which follows all of the class A and class B shares that are listed on the Shanghai Stock

Exchange, the biggest stock exchange in mainland China. Ashares are also known as domestic shares because they use the Chinese Renminbi (RMB) for valuation, while B-shares are quoted in foreign currencies, such as the U.S. dollar, and are more widely available to foreign investors. The Chinese index is determined as follows:

$$\text{Current Index} = \frac{\textit{Market Cap of Composite Members}}{\textit{Base Period}} \textit{ x Base Value}$$

The determination of Shangai Composite Index indicates that it varies depending on the availed unknowns in the equation which change speedily over very short period, a phenomenon shared by most share indices. The South African share indexes the Financial Times Stock Exchange (FTSE)/ Johannesburg Stock Exchange (JSE) affectionately known as the FTSE/JSE Top 40 Index, a capitalization weighted index. Companies included in this index are the 40 largest companies by market capitalization. The index was developed with a base value of 10399.53 as of June 21, 2002. The relatives of these indexes and their risks over a twelve month period is determined and used to model the multisector effects on the global economy. The sampled global indexes represent the different sectors of the globe and the eventual resultant risks and returns produce unitary values that reflect the global performance, an index of the spillage effect of different sectors. For example in an economy in which some markets fail to clear, such failure can influence the demand or supply behavior of affected participants in other markets, causing their effective demand or effective supply to differ from their notional (unconstrained) demand or supply. Another kind of spillover is generated by information for example, when more information about someone generates more information about people related to her, and that information helps to eliminate asymmetries in information, then the spillover effects are positive (this issue has been found constantly in the economics and finance literature, see for instance the case of local banking markets by Garmaise *et al,* 2016). These spillage effects are well captured in modeling the returns and risks of the sampled global share indices resulting in a unitary value that is then used to compare how much the changes occurring in different parts of the economy affect other parts.

1.1 Statement of the problem

The continual shocks (these are economic shocks, also known as a macroeconomic shocks, which are unexpected event that have a large-scale, unexpected impact on the economy) on the Global economy have led to its deterioration. For example the recent unrests in North Africa leading to the collapse of well performing economies such as Egypt and Libya, the wars in the Middle East, the unrest in Ukraine, the Ebola crisis in west Africa. Therefore there is need for these shocks effect on the economy to be evaluated and determined in order to mitigate their impact currently and in the future. Robertson *et al* (2008) in measuring real and nominal macroeconomic shocks and their International transmission under different monetary systems uses a Value at Risk (VaR) methodology that incorporates long-run identifying restrictions. Although VaR is a popular method of measuring macroeconomic shocks, it assumes that a one percent fluctuation in returns is equally likely to occur at any point in time (Linda *et al* 2004). It should be noted that stationarity is a common assumption in financial economics, because it simplifies computations considerably. Anyika *et al* (2012) did not assume that total risk i.e. diversifiable and non-diversifiable risk, are equal to one but isolated and determined each risk uniquely thus accentuating the accuracy of their model. This study thus uses the Real Risk Weighted Pricing model determined by Anyika *et al* (2012) to evaluate and determine the various shocks and their effect on the global economy. The study furthers the model in Anyika *et al* by determining a multivariate model with a multiple weight scenario. This then facilitates the comparison of the broader based situation with the simpler unitary ones thus enabling the determination of a phenomenon impact in this case the spillage of shocks.

1.2 General Objective

To investigate the sector shock effect on the Global economies

1.3 Specific Objectives

i) To assess the detectors that measure the sector shocks effect on the Global economy
ii) To determine a model to investigate the sector shocks effect on the Global economy
iii) To model the sector shocks effect on the Global economy
iv) To examine the sector shocks spillage effect on the Global economy

1.4 Research Questions

i) What are the detectors that measure the sector shocks effect on the Global economy

ii) What model investigates the sector shocks effect on the Global economy
iii) What model measures the sector shocks effect on the Global economy
iv) What is the sector shocks spillage effect on the Global economy

1.5 Significance of the study

Investigation of the effects of various shocks on the Global economy is the first step towards determining mitigating measures. Many times austerity measures are taken without this knowledge leading to ineffective corrective action on the Global economy. A model that investigates and measures these shocks effects should produce their risks and costs. This will result in a clear basis for future corrective action.

1.6 Limitations of the study

The limitation of the study was sourcing for the sampled countries' indexes. This was overcome by using Google search access the sampled international stock markets

2. LITERATURE REVIEW

2.1 Theoretical Framework

Anyika *et al* 2012 theorized and proved that non- diversifiable risk can be determined, that is it is not equal to one minus the diversifiable risk and it is not diversifiable. This is applicable in the total risk part of the modeling of global costs of returns and its risks In this research we theorize as follows:

Theorem

Global cost of returns *GR* is the weighted average of global costs of different sectors given $s_i r_i$ as that of sector *i* of the globe.
Proof:

$$\text{Let } GR = \frac{\sum_{i=1}^{n} s_i r_i}{\sum_{i=1}^{n} s_i} \tag{2.1}$$

$$\text{Then, } \frac{\sum_{i=1}^{n} s_i r_i}{\sum_{i=1}^{n} s_i} = \frac{s_1 r_1 + s_2 r_2 + s_3 r_3, \ldots, + s_n r_n}{s_1 + s_2 + s_3, \ldots, + s_n} \tag{2.2}$$

Taking Expectation gives,

$$= \frac{s_1 E(r_1) + s_2 E(r_2) + s_3 E(r_3) +, \ldots, + s_n E(r_n)}{s_1 + s_2 + s_3 +, \ldots, + s_n} \tag{2.3}$$

$$= \frac{\frac{1}{n} s_1 GR + \frac{1}{n} s_2 GR + \frac{1}{n} s_3 GR +, \ldots, + \frac{1}{n} s_n GR}{s_1 + s_2 + s_3 +, \ldots, + s_n} \tag{2.4}$$

Simplifying results in,

$$= \frac{\frac{n}{n} GR(s_1 + s_2 + s_3 +, \ldots, + s_n)}{s_1 + s_2 + s_3 +, \ldots, + s_n} \tag{2.5}$$

$$= GR \qquad \text{(global return)} \tag{2.6}$$

Thus Global cost of returns *GR* is weighted average of global costs of different sectors. The study thus implores this theory in modeling global costs and risks below.

2.2 Empirical Framework

The mean-variance, or risk-return, approach to portfolio analysis by Markowitz's (1952) is based upon the premise that the investor in allocating his wealth between different assets takes into account, not only the returns expected from alternative portfolio combinations, but also the risk attached to each such holding. This risk is usually assumed to arise out of uncertainty over future asset prices, and can occur in any asset where the expected holding period is less than the term to maturity. The curren t portfolio literature is concerned with notions of efficient sets and systematic risk rather than with utility functions and mean-variance. While much has been gained from a utility-free methodology, it is ultimately predicated upon a separation theorem and, hence, an environment with zero transactions costs. But security markets are not costless and the separation theorem may not hold. In that event, a utility-dependent approach to portfolio analysis could potentially lead to more powerful results especially if such an approach could be empirically implemented, (Varouj *et al*, 2009). The former is largely deemed efficient relative to the later which derives much of its appeal from the underlying Von-Neumann-Morgenstern (UNM) amortization. However, in certain contexts, EU and mean - Variance approach are closely related. In fact they are perfect substitutes if and only if all attainable lotteries can, after normalizing them by their mean be completely ordered by Rathschild-Stiglitz for increases in risk as seen by Bigelow (1993). These phenomena thus assume perfect conditions which are not practical particularly in this study which envisions shocks in the market. Anyika *et al* (2012) developed a method for determining total risks of single shares in a stock exchange and compared the risks among other stocks. This paper further develops a multivariate model with the risk measures not assuming unitary situations which are very often unrealistic. This paper has thus investigated multivariates in different economies with shocks to these economies predicted. This makes comparability easy since there is a centralized global unit of measure used to gauge the performance of all the other countries.

2.3 Conceptual Framework

There is general no specific global market index for stock trading and instead each country has a stock exchange where they may have rules governing international trade in shares and stock. This paper has developed a global sector stock index that may allow the formation of a centralized global market for all countries. The study identifies the global sectors stock indices rate of change given by r_i measured as means, returns or averages as the independent variables and the overall determined global index *GR* as the dependent variable.

3. METHODOLOGY

3.1 Research Method

The methodology in this study was mathematical modeling. This in many cases is done through computer programming or otherwise**.** These models serve many of the same purposes as physical models, but are determined entirely by mathematical relationships between variables that are defined numerically (Carpi *et al* 2011). In this case, the building blocks are fundamental concepts and theories which can be assembled into a wide variety of models.

3.2 Sampling and Data Processing

The population of this study was all the countries stock exchanges. Six prominent stock exchanges were selected using the exponential discriminative snowball sampling method after which simple random sampling was used to select four of them. The indexes sampled monthly values were processed for their averages and risk values. For example the Dow index for the year 2012 per month were sought and their mean referred to as return (r) and standard deviation or risk (σ) determined.

3.3 Multisector Cost Model

LetC_i be the cost of a certain economy which can also represent the expected cost of return

$E(r)$ return of a portfolio of securities in the economy probably the global economy, V_i represent the various random variables (detectors) affecting the economy and w_i the weight attributed to every random variable.

The multivariate model of cost will be represented by the following basic model

The multivariate model of cost of returns will be represented by the following basic model

$$E(r_w) = a_w + b_w E(r_i) \qquad (3.1)$$

$E(r_i)$, being the expected returns of a portfolio of interrelated sector returns,

$$\text{and } F_i = E(r) - K_w - S_w \qquad (3.2)$$

Where, $a_w = \sum_{i=1}^{n} w_i a_i, b_w = \sum_{i=1}^{n} w_i b_i, w_i$ is the weight of security *i* , *a* is the constant return unique to security *i*, b_i is a measure of the sensitivity of the return in the portfolio

$$\text{and } F_i = E(r) - K_w - S_w \tag{3.2}$$

and $v_{(r)}$ the total risk of a sector represented as:

$$v_{(r)} = v_p + v_m \tag{3.3}$$

v_p being the weighted portfolio risk $K_w + S_w$, and v_m the weighted market risk, $K_w + e_r$

Where $K_w = \sum_{i=1}^{\infty} w_i^2 v_i^2 \quad S_w = 2 w_i w_j v_{ij} \quad e_r = \sum_{i=1}^{\infty} v_{e_i}^{\ 2} \quad v_j^2$ is the variance of security *j* , v_i^2 variance of security *i* , $v_{e\,i}^{\ 2}$ variance of random error of security *i*.

4.0 DETERMINATION OF WEIGHT

The value of the weight that maximizes the financial sector portfolio returns and minimizes total risk is determined as follows:

$$\frac{\partial F_i}{\partial w_i} = 0$$

That is

$$a_i + b_i E(R_i) - 2 w_i v_i^2 - 2 w_j v_{ij} = 0 \tag{3.4}$$

and

$$\frac{\partial v_r}{\partial w_i} = 0$$

That is

$$4 w_i v_i^2 + 2 w_i v_{ij} = 0 \tag{3.5}$$

Equating equation 4 and 5 and expanding results in the following expression

$$\begin{aligned}
&a_1 + b_1 E(r_1) - 6w_1 v_1^2 - 4w_2 v_{12} - 4w_3 v_{13} - 4w_4 v_{14} - 4w_5 v_{15}, \ldots, \quad -4w_n v_{1n} = 0\\
&a_2 + b_2 E(r_2) - 6w_2 v_2^2 - 4w_1 v_{12} - 4w_3 v_{23} - 4w_4 v_{24} - 4w_5 v_{25}, \ldots, \quad -4w_n v_{2n} = 0\\
&a_3 + b_3 E(r_3) - 6w_3 v_3^2 - 4w_1 v_{31} - 4w_2 v_{32} - 4w_4 v_{34} - 4w_5 v_{35}, \ldots, \quad -4w_n v_{3n} = 0\\
&a_4 + b_4 E(r_4) - 6w_4 v_4^2 - 4w_1 v_{41} - 4w_2 v_{42} - 4w_3 v_{43} - 4w_5 v_{45}, \ldots, \quad -4w_n v_{4n} = 0\\
&a_5 + b_5 E(r_5) - 6w_5 v_5^2 - 4w_2 v_{51} - 4w_3 v_{52} - 4w_3 v_{53} - 4w_5 v_{54}, \ldots, \quad -4w_n v_{5n} = 0\\
&\vdots \qquad \ddots \qquad \vdots\\
&a_n + b_n E(r_n) - 6w_n v_n^2 - 4w_n v_{n1} - 4w_n v_{n2} - 4w_n v_{n3} - 4w_n v_{n4}, \ldots, -4w_n v_{nn} = 0
\end{aligned}$$

and rearranged to give

$$\begin{aligned}
&a_1 + b_1 E(r_1) - 6w_1 v_1^2 - 4w_2 v_{12} - 4w_3 v_{13} - 4w_4 v_{14} - 4w_5 v_{15}, \ldots, \quad -4w_n v_{1n} = 0\\
&a_2 + b_2 E(r_2) - 4w_1 v_{12} - 6w_2 v_2^2 - 4w_3 v_{23} - 4w_4 v_{24} - 4w_5 v_{25}, \ldots, \quad -4w_n v_{2n} = 0\\
&a_3 + b_3 E(r_3) - 4w_1 v_{31} - 4w_2 v_{32} - 6w_3 v_3^2 - 4w_4 v_{34} - 4w_5 v_{35}, \ldots, \quad -4w_n v_{3n} = 0\\
&a_4 + b_4 E(r_4) - 4w_1 v_{41} - 4w_2 v_{42} - 4w_3 v_{43} - 6w_4 v_4^2 - 4w_5 v_{45}, \ldots, \quad -4w_n v_{4n} = 0\\
&a_5 + b_5 E(r_5) - 4w_2 v_{51} - 4w_3 v_{52} - 4w_3 v_{53} - 4w_5 v_{54} - 6w_5 v_5^2, \ldots, \quad -4w_n v_{5n} = 0\\
&\vdots \qquad \ddots \qquad \vdots\\
&a_n + b_n E(r_n) - 4w_n v_{n1} - 4w_n v_{n2} - 4w_n v_{n3} - 4w_n v_{n4} - 4w_n v_{n5}, \ldots, -6w_n v_n^2 = 0
\end{aligned}$$

Then

$$
\begin{aligned}
&6w_1v_1^2+4w_2v_{12}+4w_3v_{13}+4w_4v_{14}+4w_5v_{15},\dots,+4w_nv_{1n}=a_1+b_1E(r_1)\\
&4w_1v_{12}+6w_2v_2^2+4w_3v_{23}+4w_4v_{24}+4w_5v_{25},\dots,+4w_nv_{2n}=a_2+b_2E(r_2)\\
&4w_1v_{31}+4w_2v_{32}+6w_3v_3^2+4w_4v_{34}+4w_5v_{35},\dots,+4w_nv_{3n}=a_3+b_3E(r_3)\\
&4w_1v_{41}+4w_2v_{42}+4w_3v_{43}+6w_4v_4^2+4w_5v_{45},\dots,+4w_nv_{4n}=a_4+b_4E(r_4)\\
&4w_2v_{51}+4w_3v_{52}+4w_3v_{53}+4w_5v_{54}+6w_5v_5^2,\dots,+4w_nv_{5n}=a_5+b_5E(r_5)\\
&\vdots\qquad\qquad\ddots\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\vdots\\
&4w_nv_{n1}+4w_nv_{n2}+4w_nv_{n3}+4w_nv_{n4}+4w_nv_{n5},\dots,+6w_nv_n^2=a_n+b_nE(r_n)
\end{aligned}
$$

And then simplified to

$$
\begin{pmatrix}
6v_1^2+4v_{12}+4v_{13}+4v_{14}+4v_{15},\dots,+4v_{1n}\\
4v_{21}+6v_2^2+4v_{23}+4v_{24}+4v_{25},\dots,+4v_{2n}\\
4v_{31}+4v_{32}+6v_3^2+4v_{34}+4v_{35},\dots,+4v_{3n}\\
4v_{41}+4v_{42}+4v_{43}+6v_4^2+4v_{45},\dots,+4v_{4n}\\
4v_{51}+4v_{52}+4v_{53}+4v_{54}+6v_5^5,\dots,+4v_{5n}\\
\vdots \qquad\qquad\qquad\qquad \vdots\\
4v_{n1}+4v_{n2}+4v_{n3}+4v_{n4}+4v_{n5},\dots,+6v_n^2
\end{pmatrix}
\begin{bmatrix} w_1\\ w_2\\ w_3\\ w_4\\ w_5\\ \vdots\\ w_n \end{bmatrix}
=
\begin{pmatrix} a_1+b_1E(r_1)\\ a_2+b_2E(r_2)\\ a_3+b_3E(r_3)\\ a_4+b_4E(r_4)\\ a_5+b_5E(r_5)\\ \vdots\\ a_n+b_nE(r_n) \end{pmatrix}
\qquad (3.6)
$$

$$
\begin{pmatrix}
6v_1^2+4v_{12}+4v_{13}+4v_{14}\\
4v_{21}+6v_2^2+4v_{23}+4v_{24}\\
4v_{31}+4v_{32}+6v_3^2+4v_{34}\\
4v_{41}+4v_{42}+4v_{43}+6v_4^2
\end{pmatrix}
\begin{bmatrix} w_1\\ w_2\\ w_3\\ w_4 \end{bmatrix}
=
\begin{pmatrix} a_1+b_1E(r_1)\\ a_2+b_2E(r_2)\\ a_3+b_3E(r_3)\\ a_4+b_4E(r_4) \end{pmatrix}
\qquad (3.7)
$$

The weights are then calculated by substituting the unknowns from data of returns of 4 major world economies the British, United States of America, China and South Africa and solving using matrix algebra resulting in the following equation.

$$
\begin{pmatrix}
2.27 & 5.12 & -1.4 & -0.04\\
5.13 & 5.52 & 9.48 & 8.96\\
-1.4 & 9.48 & 6.54 & 9.04\\
-0.04 & 8.96 & 9.04 & 7.38
\end{pmatrix}
\begin{bmatrix} w_1\\ w_2\\ w_3\\ w_4 \end{bmatrix}
=
\begin{pmatrix} 0.20\\ 1.24\\ 0.61\\ 0.24 \end{pmatrix}
\qquad (3.8)
$$

Inverse matrix algebra is used to solve to determine the weights, the inverse matrix on the left is determined using R program whose results is

$$
\begin{pmatrix}
0.10 & 0.12 & -0.07 & -0.06\\
0.12 & -0.07 & -0.01 & 0.1\\
-0.07 & -0.01 & -0.20 & 0.26\\
0.06 & -0.10 & 0.26 & -0.30
\end{pmatrix}
\qquad (3.9)
$$

The matrix on the left is pre multiplied by the inverse matrix above to result into the following weights

$$\begin{pmatrix} W_1 \\ W_2 \\ W_3 \\ W_4 \end{pmatrix} = \begin{pmatrix} 0.11 \\ -0.04 \\ -0.09 \\ 0.19 \end{pmatrix} \tag{3.10}$$

Multi sector cost of returns is determined by substituting the weights in equation 1 resulting into 0.078 or 7.8 % which is very low far much less than the risks.

Multi sector total risk is given by substituting the weights in equation 3 resulting into 0.20 or which is very high 20.12 % .

5. CONCLUSION

A lot of resources have been spent on finding suitable solutions to shocks in the Global economy. These include extreme measures such as fighting wars. A lot of world economies are spending a lot of time debating austerity measures for either their own countries or other countries. This also calls for a lot of time, effort and resources. Therefore there is need for a lot of research in these areas. In particular that which concerns the effect of shocks on the Global economy which would then lead to concrete mitigates. This research has determined a model for portfolio cost of returns and portfolio total risk that is able to capture the global economy thus resulting in a global cost of returns of 7.8 % and a Global risk of 20.12 % which has a sum negative effect on the economy since the risks are higher than the returns. These results are so essential since they can govern the movement of interest rates, foreign exchange rates, dividend rates etc for most multi sector global economic activities which are now the order of the day as well as the global total risk measure which could govern mitigation measures such as hedging activities. Currently the high risk and low returns of the various happening in the globe are leading to low oil prices which are spilling over negatively to the economies of oil producing countries, and positively to the economies of non-oil producing countries. This also marks the development of a global market index that may be used to value shares and stocks in international trade and markets. This paper recommends that similar research studies should be aimed to develop a globally harmonized currency for ease of trade, comparability and equity.

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