ANGLIA RUSKIN UNIVERSITY

CONSEQUENCES OF NATURAL RESOURCE CONSTRAINT ON
GLOBAL GROWTH: EVIDENCE FROM THE FINANCIAL SECTOR.

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ANGLIA RUSKIN UNIVERSITY

ABSTRACT

FACULTY OF SCIENCE AND TECHNOLOGY

DOCTOR OF PHILOSOPHY

CONSEQUENCES OF RESOURCE CONSTRAINT ON GLOBAL GROWTH:
EVIDENCE FROM THE FINANCIAL SECTOR.

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An investigation and evaluation of the risks involved with resource constraints on global growth, with evidence from the finance sector. This is part of the GRO (Global Resource Observatory) project at the GSI, whose main project aim is to investigate how the scarcity of finite resources will impact global social and political fragility in the short term. This particular research focuses on how the scarcity of these finite resources will impact on the financial sector especially through investments, insurance, pension schemes and banking activities. The finance sector under investigation is the UK finance sector, considered to have one of the most globalised economies worldwide. The resources which were analysed were food, oil and energy/gas. The reason for the selection of food, oil and energy/gas prices is the volatility of its prices during the past decades and its high rate of fluctuations in its price in the last decade. A quantitative analysis is carried out using regression analysis of over 11 models with different combinations of resource and finance variables and a Granger causality analysis. Results show that resources only significantly affect the finance sector holding GDP constant, with exceptions where food and gas prices significantly affect bank variables even with the inclusion of GDP. The Granger causality analysis shows a couple of 1 and 3 year unidirectional relationships between some finance variables which could indicate the possibility of systemic risks in the finance sector caused by resource scarcity.

Resource Constraints, Financial Stability, Finance Sector, Systemic Risks, Price Volatility, Regulations

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Chapter 1. Background to Research

1.1 Introduction

For nearly half a century the world has been undergoing significant climate change and rising concerns, in some places, over the long-term availability of water, food and other key commodities (CDP (Carbon Disclosure Project) Report 2012). According to the World Economic Forum report (2012), the magnitude and frequency of weather shocks, combined with the long-term economic forecasts of climate change effects and increases in fossil fuel costs are having a political as well as an economic impact on the global economy. Natural resources such as water, fuel, oil and coal are depleting and becoming more scarce leading to an absolute increase in prices and their volatility (Jones *et al.,* 2013). According to the World Bank Report (2011), a third of the world's population was facing water scarcity, 70% of world fisheries were depleted, soil degradation affected over 40% of agricultural lands and 30% of irrigated lands. The increasing limited availability of these resources presents long term challenges to empowering global growth in a sustainable way. Following the review of the Stern Review by Nordhaus (2006), the overall costs and risks of climate change and natural resource scarcity on the economy could be equivalent of losing "5% of GDP now and forever" and "our actions" now and in a few years could create risks on a similar scale to those concomitant to the economic depression in the early 20th century. Stern (2010) asserted that the past decade has witnessed significant reduction in natural resource intensity in both developed and developing countries imposing potential threats to growth. These natural resource constraints coupled with the global financial crisis that has spread across the world has triggered a considerable slowdown in economic activities in most developed and developing countries and has already affected financial markets and growth prospects globally having negative implications in the real economy (Cali *et al.,* 2008).

The intensity of resource scarcity has been aggravated, for the most part, by climate change. Lal et al., (2011) identify three broad categories of impacts of climate change; ecological, social and economic, of which the scarcity of resources is reflected and inherent in each of these impacts. The ecological effects of climate change are the impact on biodiversity, density of agricultural productivity (food scarcity), decline in the quality and quantity of water (rainfall variability, reduced fresh water availability) and stress from pests and wildfire; social impacts include the change in employment, equity and distribution risks, health and relocation of population and the economic effects are basically the increased risks and uncertainty of

agricultural and forest production, alteration of productivity of crops, reduction in the supply of goods and services from the ecosystem and overall increase in the costs of goods and services. In a nutshell, the major impact of climate change to the global population is the scarcity of major resources; food, water and energy.

As a result of such scarcity, where natural resources cannot satisfy the increasing demands placed on them, the economic competition for such resources is continuously increasing in size, reality and complexity. Neimi & Whitelaw (2007) identified the complexity of the four main demands for natural resources; dominant and competitive commercial use, intrinsic values and demand from households and the potential overlap in these demand categories thus increasing its complexity.

However, the fact that natural resources increase the growth of an economy cannot be ignored; natural resources increases the wealth and purchasing power of an economy over imports, increasing the economy's investments and growth rates. In the UK, natural resources play a vital role, contributing enormously to GDP growth through manufacturing, investments, employments and financial activities. Therefore, the scarcity of such resources can have negative effects on the economy as a whole through the effect on supply chains of production and affecting also the most vital part of the economy; the finance sector.

According to Jones *et al.,* (2013) the financial sector, and the global economy in general, are facing systemic risks where many resources are increasingly becoming more expensive and rising environmental pressures are creating additional costs. The potential consequence of these risks in the finance sector is potentially a collapse of the entire financial system which could be reflected mainly in insurance, pension, banking and investment sectors and thus could be translated into business risks (Williams 2010). For direct investment, the risks are reflected on different levels ranging from the increasing costs of finding and cultivating the needed resources and costs of operation to the volatility of financial markets. For insurance, the risks could be reflected in the mis-management of short term funding and derivative trading on non-insurance balance sheets (Jobst 2012) as well as underwriting risks, risks of high cost claims, falling investments and other risks identifiable with the overall financial system (Krenn & Oschisching, 2012). And the risk to pension, the effect of climate change and natural resources on price levels could hit across various portfolios and cripple the pension fund scheme through a range of different scenarios – from the effect of an investment constraint as a result of resource constraints to more systemic risks. The banking sector could face potential risks

reflected in defaults on credit from clients due to constrained incomes as a result of resource constraints, crippling of lending and credit provision activities, falling investment returns and other potential systemic risks. The financial system and market as whole are vulnerable to such risks due to the inter-linkages and interdependencies involved ranging from money markets, banks, commodity markets and businesses (Gray & Jobst 2011).

1.2 Problem Statement

According to the World Development Report (2011), there is an increasing demand for resources especially in developing and emerging countries, given the projected rise in population over the last few decades from 7 billion today to about 9.1 billion in 2030. The report went further to make projections on food demand to increase by 50% in 2030, a rise in oil demand by 1% and water demand by 32% in the same year, with the use of water doubling the population growth rate. On the other hand, the supply prospects for these natural resources are not looking as hopeful as the increase in demand. The productivity of food has been showing diminishing returns during the past decades; falling from a productivity of 2.2% between 1970-1990 to 1.1% between 1990-2007 and projected to continue to decline. The concern about the declining food productivity is aggravated by the constraints on arable land due to climate change, degradation and the growing competition on land use by food production, pastureland ventures and most importantly expanding cities (FAO, 2009). On water, the level of scarcity is reflected on the number of people living in "water stressed" areas to increase from 1.2billion to 1.8 billion in 2025 (WDR, 2011). As regards the prospects of oil supply, Hook (2009) assert that the evaluation of giant oil fields in areas like Cantarell in Mexico, are already undergoing rapid phases of depletion and by 2030, the supply of oil from these fields would have reduced by another 50%. These rapid depletion rates and projections for the future indicate the possibility of high risks in the economy and potentially the finance sector. The risks for the economy are potentially inflation and the volatility of financial markets which could result in a large range of risks both economically and politically.

Despite the depth of empirical studies on inter-linkages of the Global Financial system and the risk involved with it, very little has been done on the impact of resource constraints on the growth of the global economy and its effect on the financial sector. A lot of emphasis has been laid on the effect of climate change (only) on financial institutions like insurance and pensions. Not much thought and analysis has been given to the risks of resource constraints on these

financial institutions, especially in the UK. Scarcity in resources have the potential to affect the insurance companies through increases in cost of claims for affected parties, underwriting risks and risks on investments. Banks on the other hand are vulnerable to the effects of resource scarcity such as inflation, causing risks credit risks and investment risks. Thus the main issue of concern or problem statement is that a clear pathway and model of the effect of natural resources on the financial sector has not been identified, especially through pensions, investment, insurance and banking activities in the UK, given that the aspect of natural resource constraint and depletion is a growing area of concern. Another issue of concern is the identification of a possible link or systemic risk from natural resource constraint through the financial sector to the economy as a whole and to make a clear investigation on the direction of causality of risks between the financial sector and the economy; are the risks in the financial sector a result of resource constraint, which could possibly lead to further economic risks or a possible crisis, or is it the other way round? Also an important gap is the lack of literature on natural resource constraint being the possible cause of systemic risk within the financial sector, that is, between insurance, investment, pension and banks and how the flow of risks from resource constraint could eventually lead to a collapse of the financial sector, possibly in the UK. Thus the aim of this research is to identify a clear model and pathway of the effect of, and risks involved with, natural resource constraint in the financial sector and identify the direction of the risks and effects within the financial sector and between the finance sector and the UK economy.

Therefore, this research seeks to answer the following questions:

What is the effect of resource constraint on insurance? Are insurance companies affected directly by resource constraints through its stock availability and market prices or indirectly through insured parties?

Are banking activities affected directly or indirectly by resource constraints?

What is the effect of resource constraint on investments, and how do these effects become potential risks for investments?

Are pension funds affected by natural resource constraints? Are the effects indirect through other financial institutions (systemic risks) or direct through market prices of these resources. What are the potential risks faced by the pension schemes and are risks different for the different pension plans/schemes?

Are there systemic risks in the economy that are manifest through the finance sector as a result of resource constraints? In what patterns do these systemic risks occur (domino effect, contagion channels, critical function or fire sale)?

Do financial regulations both in the UK and from abroad, have any significant effect on the response of the finance sector to resource constraints? Do these regulations make recovery from such effects easier or more difficult for the finance sector?

This research work is important as it investigates the possible effects of natural resource constraints on the financial sector through important facets of the financial system such as insurance, investments and pension funds and also to find out if there will be systemic risks in the economy through the finance sector. Due to the fact that little has been done on the impact of resource constraints in the finance sector and its potential systemic risks, this research will add to existing knowledge and perhaps help in the economic and financial decision making with regards to natural resource constraint.

1.3 Research Objectives

The main aim of this study is to investigate and evaluate the risks involved with Resource constraint on Global Growth, with evidence from the finance sector. This is part of the GRO (Global Resource Observatory) project at the GSI, whose main project aim is to investigate how the scarcity of finite resources will impact global social and political fragility in the short term. This particular research will focus on how the scarcity of these finite resources will impact on the financial sector especially through investments, insurance, pension schemes and banking activities.

The specific objectives are:

- o Examine the impact of resource constraint on the growth of the financial sector.

- o Examine and determine how and why resource scarcity affects the insurance sector
  The main types of risks faced by insurance companies as a result of resource constraints are: the risk of (in)solvency, credit risks, underwriting risks, investment risks, and insurance specific risks (depending on the type of

insurance). There are other risks which are grouped into the cost competitiveness, stakeholder confidence, customer reach and operational agility.

A theoretical example of the risks natural resource constraint could cause on insurance companies can be illustrated thus; an increase in the price of a natural resource like oil could have macroeconomic effects like inflation, increase in interest rates, unfavourable exchange rates, which could cause considerable costs pressure on the insurance company (cost competitiveness), high underwriting risks (if the insured parties are adversely affected through loss of assets), investment risks (in conjunction with the company's asset management if affected by increase in interest rates or inflation).

o Investigate the risks involved with resource constraint on investment.
The risks which will be investigated will be the default risks, business risks, liquidity, interest rate risks and market risks.

o Identify and investigate potential risks on banking activities as a result of resource scarcity. Such risks could be the increase in default on credit by clients due to inflationary effects of resource constraint, fall in investment returns, pressure on capital and liquidity requirements to be able to cope with other potential economic risks caused by resource scarcity and systemic risks.

o Investigate how resource constraint affects pension funds and the risks involved. Potential risks to be investigated include; investment risks and liability risks. This could also determine how the risks would differ for the different pension plans (defined benefits & defined contribution plans), the nature of sensitivity of the benefits to inflation and availability and flexibility of funding (Bodie *et al.,* 1988). For instance, investment risks for pension fund members are less likely to occur for defined benefits type of pensions than it would for defined contribution plans. In defined contribution the contributions of the members are invested in the stock market and the profits accredited to the members account therefore they are exposed directly to investment markets however in defined benefit schemes if investment returns are significantly reduced then the benefit

liability far outweighs the investment assets and this could cause the defined benefit pension fund to become insolvent over time (Jones et al 2013). Thus adverse risks could affect pension accounts.

o   Determine if there are potential systemic risks in the finance sector through the resource constraints. To determine whether and how the risks faced by some institutions, due to resource constraints could have cascading (contagion and domino) effects on other institutions within the financial sector and how it could possibly spread out to the entire economy.

o   Examine and evaluate how financial regulations could impact on the performance of the finance sector in the event of resource scarcity.

The rest of the thesis is structured as follows: chapter two will examine a comprehensive literature review on the effect of natural resource constraint on the finance sector, beginning with the effect of resource scarcity on economic growth as a whole, then goes on to examine its effects on insurance, banking, pensions and investment. This literature review is a quite important contribution to knowledge, as it brings out different views of the effects of resource scarcity based on theories and academic research and also identifies important gaps in existing literature on potential effects of resource scarcity. In chapter 3, a conceptual framework is developed examining the importance of natural resources to the economy and finance sector and also uses a hypothetical event of a scarce resource (oil), bringing out the flow of events from the scarce resource to potential effects on the finance sector. Chapter 4 elaborates in the methodology used in the thesis and brings out arguments why this methodology is suitable. The results of the study are presented in chapter 5, discussed in chapter 6 and the study concludes in chapter 7 with some recommendations.

The next chapter will examine theory and empirical literature on natural resource scarcity and its effects on the economy and the finance sector. The theories which will be examined will form the foundation and basic assumptions and relationships on which the research will be based on and the direction to the hypothesis formation. The empirical literature will be examined to identify gaps which need to be filled and will be used to validate, confirm and/or contrast the research findings in the discussion chapter.

Chapter 2. Literature Review

2.1. Introduction

As discussed in the background, the limited availability of natural resources and its effect on the growth of the economy through its various sectors is an issue of modern concern (Neumayer 2000). As a result, the issue of resource constraint and its effects have been the centre of attention for academia, business and political organisations and thus a wealth of both theoretical and empirical literature have been developed to give explanations to the reasons for the resource scarcity and its effects and to provide solutions and recommendations.

Given the focus of this research, which is the effects and risks involved with resource constraint in the finance sector through pensions, insurance, investments and businesses, literature will be reviewed in the following manner; First, it is important to understand the role of the economy on global growth and how natural resource constraints can affect the economy, so there will be a theoretical and empirical analysis of the effect of natural resource on the economy as a whole. The second section will explore the finance sector and the main parts, such as pensions, insurance and banks and their investments and how natural resource constraints could impact on their performance through theory and empirical literature as well. Then the third section will examine potential systemic risks in the finance sector and the linkages to resource scarcity and climate change.

Section I gives a broad idea and an understanding of the basic and main relationship between natural resources and the economy, emphasising on the importance of natural resources on the economy and the consequences of the scarcity of resources on an economy, which could be transferred on to the finance sector. First, there is an analysis of theories of natural resource and the various hypotheses on the measurement of resource scarcity to give an understanding of the rationale behind the choice of measurements. Then there is an examination of economic theories, to be able to situate the importance of resources to the economy from the view point of the main schools of economic thought and to be able to identify a consensus amongst the viewpoints or possible contrasts.

2.2. Economic Growth and Natural Resource Constraints.

  The growth of an economy is fundamental to its development, and economic development is one of the main objectives of every society in the world (Anwer and Sampath 1997). Sustained economic growth is the utmost dominant eradicator of poverty and therefore critical to achieving development outcomes. Livelihood improvement, job creation and the increase in household and government incomes result from the growth of the economy. Nations worldwide are therefore driven by the prospects of better living standards through the positive performance of their economies and an increase in their annual GDPs (Romer, 2007). Given the nature of inequality amongst the developed and developing nations/countries, the need for, and nature of, growth in developed countries is bound to be different from developing countries. Economic growth is predominantly determined by advances in productivity, which involves the production of more goods and services with the same amount of contributions of labour, capital, energy and raw materials. Thus natural resources play an important part in the economic growth and wellbeing of a country given its main contribution to manufacturing, technological advancement, trade (both local and international), employment, improved standards of living and its effects on the social, political and, most importantly, the financial sector.

There is, however, a complex relationship between economic growth, environmental crisis (resource constraint/scarcity) and social recession. As the economy grows, the resource implications associated with such growth expand as well and these impacts are already unsustainable. (Sustainable Development Commission 2009)

  This complex relationship between natural resource scarcity or abundance and economic growth of countries has had conflicting conclusions on whether the scarcity of natural resources positively or negatively affects growth or vice versa. Before an analysis of the empirical literature, on the relationship between resource constraint and economic growth, some theories on natural resource scarcity and economic growth will be examined.

2.2.1 Theoretical Framework

2.2.1.1 Theories on Natural Resource Scarcity

Theory of Scarcity Indicators

Cleveland and Stern (1997) defined increases in the scarcity of natural resources as a decrease in economic wellbeing due to the drop in the accessibility, quality and/or productivity of natural resources. A natural resource indicator encapsulates the direct and indirect costs, involved with obtaining a unit of that resource (Fischer 1979). Smith (1979) asserted that natural resource scarcity could simply be considered a result of the demand and supply conditions of the resource, so that its price, under the best conditions, offers the best index for scarcity while Brown & Field (1978) claim that unit cost, product output prices, and rental rates were all useful proxies for scarcity, though marginal discovery costs, are preferred over the rival measures. Thus, there has been a constant debate in literature on the ideal measurement of scarcity; which of these units of measurement - resource prices, unit costs of extraction, resource rents, energy cost and elasticity of substitution - measured and presented a more accurate reliable representation of natural resource scarcity (Fisher 1979, Hall & Hall 1984, Cleveland & Stern 1993, Ozdemiroglu, 1993).

Tietenberg (1988) identified three key measures for choosing between scarcity indicators; Comparability, where the indicator should allow for the assessment of the level of scarcity of diverse resources and their alternatives in order to classify the level and seriousness of the problem of scarcity ; Computability where the collection of data and calculation technique should be consistent and straightforward and Foresight, where the indicator of scarcity should not only describe historic levels of scarcity but it should essentially be able to predict and/or forecast future scarcity through the future demand for the resource, substitution possibilities, and changes in extraction cost;

Cleveland and Stern (1993) classified natural resource scarcity into two main concepts: the Exchange scarcity and the Use scarcity. The exchange scarcity as commonly measured by the rent and/or price of the resource and is applicable to scarcity both in output and factor markets, in other words the "opportunity cost of using a particular resource", while "use scarcity" refers to the strain involved in the production of natural resource commodities in terms of the balance between the availability and productivity of the resource base and the technological level (Cleveland & Stern, 1993; Cleveland & Stern 1997).

Cleveland & Stern (1997) identified three models of Scarcity; the classical, neo-classical and the biophysical models of scarcity.

2.2.1.1.1. Classical Model of Scarcity

Following the theories of Marx and Ricardo on the labour cost of production being a measure of the use value of commodities, Barnet & Morse (1963) defined the increase in resource scarcity as "an increase in the resistance of nature to the efforts of people to produce resource commodities". Thus according to classical theory, the suitable measure of scarcity is the labour and capital required to produce a unit of the commodity; rising scarcity means more labour is required. Barnet & Morse (1963) (in Cleveland & Stern 1997) combined the neoclassical production function and the Ricardian model to measure scarcity accounting for capital inputs. Here, the unit cost of the resource is the inverse of the multi-factor productivity in respect to capital and labour;

$$UC_t = \frac{\alpha_t(L_t/L_b) + \beta_t(K_t/K_b)}{Q_t/Q_b}$$

Where;

UC_t = unit cost of extraction at time t

Q_t = net output (value added) in constant dollars

L_t = labour cost measured as the number of persons employed

K_t = capital cost measured as net capital stock in constant dollars

Q_b, L_b, K_b = output, labour, capital at base year

The above model was derived under the assumption that resources were used in order of descending quality.

2.2.1.1.2. Neo-Classical Model of Scarcity

The neo classical model of scarcity begins with the hypothesis that owners of resources make the most of the discounted profits from the mining and sale of the resource (Hotelling 1931). This assumption is demonstrated by Fischer (1979) with a model of an optimal control problem of non-renewable resource extraction (Cleveland & Stern 1997). Fischer's model showed that price and rent were the appropriate scarcity indicators. Market price had the capability of

capturing the total sum of direct expenses such as cost of labour and indirect costs like, changes in the net present value of future profits thereby sinking the size of the remaining stock of resources. If the main interest is the sacrifices related to the depleting stock of resources, then the "rent" is a better indicator. Thus according to the neoclassical view, the market price is a good indicator of scarcity if the resource commodity is the main interest and rent can be used as an indicator if the resource stock is the one being measured. This is in accordance with Landsberg et al (1963), who stated that

"The 'real cost' of resource products, which over the long run can be measured by the behaviour of their prices in comparison with the general price level, has shown no marked change. This is the classic economic test of in-creasing scarcity. Deflated prices, as adjusted to allow for the influence of the general price level upon each resource commodity, have moved erratically since 1870 with many ups and downs and possibly some slight tendency upward. ... But the overall picture does not indicate that resource materials have become scarcer at any general or alarming scale over a good many decades in the past. "pg. 554

2.2.1.1.3. The Biophysical Model of Scarcity

The biophysical model regards the scarcity of resources based on the energy cost of transforming these resources to a more productive state (Ruth 1993). Resources are not useful in their natural state to the production process and so must undergo a transformation process (location, extraction, refinement and transportation) which involves high levels of energy. The lower the quality of resources, the more energy is required to upgrade it to a useful state (Cleveland 1993).

The three models of scarcity have been criticised on various platforms. The classical model was criticised based on the shortcoming, identified by Hall (1988), that unit cost as an indicator excludes all other inputs apart from capital and labour. Howe (1978) criticised unit costs based on the fact that it is a created index requiring expectations about the best way to measure inputs, outputs and the weighing factors.

The neoclassical model was criticised firstly by Fischer (1979) where he asserted that price and rent only measure "private scarcity" and that market failures and imperfections could divert attention from private to social indicators of scarcity. Rent as well could fall to zero as a lower quality of a resource could be substituted for a depleted higher quality resource. Cleveland & Stern (1997) observed that prices were derived from restrictive assumptions about the market structure and its conditions and real world situations strip prices from its theoretical advantages.

This is because the prices of natural resources are determined in more complex market scenarios than those described in theoretical models.

Stern (1996) criticised the use of energy cost as an indicator of scarcity under the premise that unless it is possible to contribute to the energy theory of value where the efficiency of the non-energy inputs is a linear function of the energy used in their production, energy cost is not an appropriate measure of scarcity. In cases where energy could be substituted for capital or labour, the cost of energy could increase even though there is no change in the productivity of resources or in the state of technology (Cleveland 1993).

As a follow up from the above definitions, Stern (1998) decomposed the use scarcity concept using econometric models to incorporate the private and social perspectives as well as looking at the size of the capital stocks in addition to their average and/or marginal value.

Following from the first attempt to decompose the use scarcity concept by Barnet & Morse (1963) which started with a production function for the resource commodity Y, stated below;

$$Y = f(A1, ..., An\text{-}1, AR, X1, ..., Xn\text{-}1, R, S)$$

where R is the resource base from where the resource is extracted, and S is a trajectory of added unrestrained natural resource inputs. For instance, when the scarcity of agricultural land, changes in rainfall and temperature is considered. The Xi are adjustable factors of production controlled by the extractor, and the Ai are growth factors linked with the respective factors of production. AR is the growth index of the resource base. In theory the effective units per crude unit of S is allowed to vary, however in most applications it is assumed that the growth index is constant (Cleveland 1993).

Empirical literature on the theory of scarcity indicators, illustrates a wide variety of views and critiques of the measures of resource scarcity.

According to Ozdemiroglu (1993), there are certain situations, where changes in resource scarcity cannot be identified by any indicator. The main conditions are:

- When the resources are extracted under open access administrations. Though in this case, there are established markets, resources such as open sea fisheries can be near extinction just because of the extractors' unawareness of the stock levels;
- Also when there are no formal markets in which the resources such as some non-timber forest products are traded. In this case, therefore, there are no data available for the rent, unit cost or price, although increasing scarcity of such resources has great importance;

- When there is a lack of the reflection of the public good characteristics of natural resources and their positive externalities such as biodiversity and assimilative capacity in an existing market.

- And when there are no future markets for the resource. The users, in this case, would act as risk averse individuals. This would increase the current consumption as well as prices and exaggerate the resource scarcity.

2.2.2. Natural *Resource Economics*

2.2.2.1. Hoteling's Rule

"Hotelling's formal analysis of nonrenewable resource depletion generates some basic implications for how the finite availability of a nonrenewable resource affects the resource price and extraction paths…. An important opportunity cost of current extraction and consumption of one unit of a resource is that there is less to extract and consume in the future" *(Krautkraemer, 1998, pg. 2065)*

Hotelling's rule principally tackles one rudimentary problem of the owner or agent involved in the exploitation of the non-renewable resource: How much of the asset should one consume now and how much can and should one store for the future? In other words, the agent has to choose between the current value of the asset if extracted and sold and the future increased value of the asset if left unexploited (Gaitan et al., 2006).

According to Hotelling's rule, the stock of natural resource in situ is an asset to its owner and thus in a market economy, the value of this asset, like for any other capital asset, will be related to the expected rate of return it would yield to its owners (Gaudet 2007).

Typically, the rate of return on a physical asset can be broken down into three components:

• The first element is attributable to the flow of product produced by the marginal unit of the asset — its rate of marginal productivity or dividend rate.

• The second element is owing to the fact that the asset's physical characteristics may change over time, a factor which may or may not depend on the use being made of it or on the size of the stock being held.

• The third element is the rate at which the asset's market value changes over time.

This may be negative, as long as it is offset by some other positive components of the return.

From the three elements outlined above, assume that the physical elements are non-renewable resources. Such assets, being non reproducible, have the characteristic that the size of their

existing stock cannot be increased over time. Moreover, holding such an asset in situ yields no dividend: as long as it is left untouched, it is totally unproductive, contrary to a machine or a piece of equipment, which are capable of generating a flow of services. Therefore, the first element is equal to zero. As concerns the second element, there is usually no precise equivalent in the case of resource stocks, in the sense that physical deterioration will not occur from simply holding the asset in the ground. There is a sense however in which keeping the marginal unit of the asset stored in the ground rather than extracting it prevents the average quality of the remaining stock from deteriorating. This second component therefore enters positively in the rate of return, rather than negatively.

This leaves the rate of appreciation in value as the only source of return on the stock of natural resource. The value of the marginal unit of resource held in the ground is what it can fetch on the flow market, net of the cost of taking it out of the ground. If P_t is the current flow price which the resource can fetch on the market once extracted and C_t is the marginal cost of extraction, then its marginal value untouched should be;

$\pi_t = P_t - C_t$

which represents the asset price of the resource

If the rate of interest is denoted *r*, then asset markets equilibrium requires:

$\pi_t' / \pi_t = r$

π = asset price of resource

π_t' = Change in asset price at time t

This is the famous Hotelling's rule, derived as an equilibrium condition on the asset markets. It states that the net price of the natural resource must grow at the market rate of interest.

If the marginal cost of extracting the resource is independent of the rate of extraction and invariant over time, then this immediately yields a prediction as to the behaviour of the market price over time, namely:

$P_t'/P_t = r\,(1 - c/P_t)$

Where; P_t = Price of resource

P_t' = change in price of resource

c = marginal cost of extracting the resource

If this were a correct representation of reality, we should observe the price of non-renewable resources continuously growing at a rate which tends to the rate of interest as the share of cost in price gets smaller and smaller over time and that of the scarcity rent gets higher and higher.

The decreasing cost of extraction of natural resources is the first factor that comes to mind which is likely to diminish the growth in the flow price of the resource due to technological progress (Gaudet, 2007).

Thus the degree of change of the market price of a resource is the weighted sum of the rate of interest and the degree of decrease in cost due to technological change. If the portion of marginal cost in price is adequately high, the outcome of the degree of technological change on cost dominates. The opposite is true if the portion of marginal cost in price is adequately low. This is consistent with a price path that would be at first decreasing and then increasing (Slade 1982 in Gaudet, 2007). It cannot however validate persistently flat or falling price paths. In the long run, as the share of cost in price becomes insignificant, the consequence of the market rate of interest must come to dominate and the degree of growth of price must ultimately become positive and again approach the degree of interest over time.

Another reason besides technological progress for the cost of extraction is the rate of return on physical assets which fluctuates over time. As the resource stock gets depleted, it can be assumed that the marginal cost of extraction has to increase, due to the fact that the resource tends to be less easily available and of lesser grade. A marginal addition to current resource extraction not only uses up the resource stocks, but it uses up the cheapest available and hence increases all future cost (Hotelling, 1931).

The net price per unit of product received by the owner of a mine depends not only on the current rate of production but also on past production. The accumulated production affects both cost and demand. The cost of extraction increases as the mine goes deeper; and durable substances, such as gold and diamonds, by their accumulation influence the market. (Hotelling,1931).

In a hypothetical market with free competition, Hotelling assumes the resource owner is indifferent whether he receives a price, P_0, for a unit of his product now or a price P_t after time t, thus it is not unreasonable to expect that the price P_0 will be a function of the time of the form $P_0 = P_t$. This will not apply to monopoly, where the form of the demand function is bound to affect the rate of production, but is characteristic of completely free competition. The various

units of the mineral are then to be thought of as being at any time all equally valuable, excepting for varying costs of placing them upon the market. If interest rates vary among the resource owners, this fact will also affect the order of extraction. Here P_0 is to be interpreted as the net price received after paying the cost of extraction and placing upon the market (Hotelling, 1931).

In an imperfect market situation, if the resource stock is in under monopolistic protection, the marginal value to the owner of the stock of resource left in the ground will be equal to the marginal profit it can bring on the flow market once extracted. To a monopolist, this is less than the net price. The asset markets equilibrium condition will still require that the rate of return on the resource stock be equal to the rate of interest. Only now the rate of appreciation of the in situ value is not measured by the rate of change of the net price, but by the rate of change of the monopolist's marginal profit. Hence, marginal revenue will rise at the rate of interest (Gaitan et al., 2006).

2.2.3. Theories on Economic Growth

2.2.3.1. Adam Smith's Theory on Economic Growth

A characteristic feature of the classical approach is the view that production involves labour, produced means of production and natural resources. In order to appreciate real growth processes one has to come to the understanding of the related rules managing the pace of capital accumulation, growth of population, and the rate and bias of technical innovation in an environment characterised by the inadequacy of natural resources. The core aspect of Adam Smith's theory dwelled on capital accumulation and division of labour. He viewed the growth process as strictly endogenous assigning distinctive importance on the effect of capital accumulation on labour productivity.

Smith recognized only three factors of production: land, labour and capital. Considering these three factors, his production function may be expressed as

$Y=f (K, L, N)$

where,

K = capital

L = labour force

N = land

In his theory, he did not consider his production function to have Diminishing marginal productivity. Nevertheless, his production function is subject to increasing returns to scale (which means that, output increases more than proportionally to an equal percentage increase in all inputs). According to Smith, as the size of the market increases, internal and external economies of scale increases, which eventually lowers down the cost of production. This process would be initiated by improvement in the production techniques and a greater degree of division of labour.

Smith upheld that an examination of the growth of income per capita is first and foremost an analysis of the causes of its improvement, in the productive powers of labour, and the order, according to which its product is naturally distributed among the 'different ranks and conditions of men in the society'. The key to labour productivity is division of labour which is dependent on the extent of the market and capital accumulation. He further emphasised the effect of division of labour both within and between firms and industries on division of labour which reflects on the productivity of labour in the improvement and the dexterity of the workers, time saving from movement of one activity to another and the invention of machinery.

Smith's analysis indicates the concepts of induced and embodied technical progress, learning by doing, and learning by using. The creation of new machines and the enhancement of known ones is said to be originally due to the workers in the production process and those occasionally to use the machines. "New technical knowledge is systematically created and economically used, with the sciences becoming more and more involved in that process. The accumulation of capital propels this process forward, opens up new markets and enlarges existing ones, increases effectual demand and is thus the main force behind economic and social development" (Kurz & Salvadori 2005).

Adam Smith also pointed out the difference between the "natural price" and the "market price" of a commodity. The natural price is defined by the total amount of labour commanded in the market, while the market price is defined by the relative scarcity of goods. The notion of economic rent rises from this relative scarcity and can be defined as "the price that a rational individual would pay to have one more unit of a resource available today" (Barbier, 1989 in Ozdemiroglu, 1993). Therefore, it is estimated that an increase in relative scarcity of a resource will increase the resource rent and also the market price of the resource.

2.2.3.2. Thomas Malthus Economic Growth Theory

The debate on scarcity and growth actually started with Thomas Malthus's observations on the "fecundity of human nature and the relative stinginess of Mother Nature" (Malthus 1798 in Krautkraemer 2005). Thomas Malthus established a strict model of a dynamic growth process wherein each country congregated toward a stationary per capita income. He argued that technological change improvement in standard living population growth reduced the average person to the subsistence level again. In the long run there would be no increase in the standard of living unless there were some limits on population growth (Bah, 2007).

The concept of scarcity as it appeared in the ideological struggle about the poor laws was very crude, so Malthus' simplistic formulation served admirably as a political weapon. Malthus proved to the satisfaction of the ruling classes that they had no responsibility for the existing state of affairs (Perelman, 1987).

Contrary to Smith and Ricardo, who postulate that savings is always equal to investment implying any act of savings would lead to an increase in wealth of the economy, Malthus asserted that savings brought about a reduction in effective demand by reducing the ability of people to consume, in turn bringing a decline in profits and investments.

According to Malthus

$$Y = R + W$$

where,

$$Y = \text{National income}$$

$$R = \text{profit}$$

$$W = \text{wages}$$

Alternatively,

$$R = Y - W$$

From the above equation, we can deduce that profits are equal to total output (income) minus the workers' wages.

According to Malthus, National Income (Y) is created by investment (I) and consumption (C), which is divided into capitalist consumption (Cc) and worker consumption (Cw). As the wages of workers equals their consumption level, profits are equal to Investment plus the capitalist' consumption. Malthus argues that abstinence to consume on the part of the capitalist only contributes to growth if the savings are then invested. In case this does not happen, the capitalist' savings would only retard growth. Nonetheless he also states that when the opportunities for profitable investment are exhausted, savings cannot be converted into investment. At this point abstinence on the part of the capitalist only reduces the amount of effective demand in the economy, thereby reducing the possibility of growth

The concept of diminishing marginal returns was a cornerstone of classical economics and played an important role in his pessimistic view of the prospects for economic improvement. Malthus wrote at a time of great social upheaval. The English population was growing rapidly and the prices of basic foodstuffs had been increasing and were kept high by restrictions on grain imports. The enclosure movement had moved thousands from their traditional agricultural roles to cities, where many were unable to find work and lived on relief. Malthus could not have foreseen the rapid technological progress and the decline in fertility rates that would allow large portions of the world to avoid the Malthusian population trap. Some would argue that this is because human society has been living off its natural capital endowment, while others would argue that humankind's ingenuity in finding solutions to resource constraints has allowed it to prosper.

The English population was not about to raise questions about subjects such as the effect of private property on the availability of resources: it was enough for them that Malthus showed that " . . .the real cause of the continued depression and poverty of the lower classes of society was the growth of population"

Malthus' well known works; *An Essay on Population* and *Principles of Political Economy*, brought out the first concerns about the future availability of natural resources. His main concern was the diminishing returns to economic effort, which resulted from the difference between the constant quantity of resources and the demands of an increasing population. According to him, as more capital and labour inputs were applied to a fixed amount of land, the marginal product of capital and labour combined would eventually decrease and

so would output per capita. Expansion of agricultural activity to previously uncultivated land was not a solution since the best agricultural land would be put into production first. Productivity could improve with technological improvements, but the pace at which technology progressed up to that time had been slow, thus this was not given great weight by Malthus and other classical economists of his time. Consequently, material living standards declined as the population increased. Fearing a catastrophic end to the world due to the physical limits of natural resources (absolute scarcity), he concentrated on agricultural land as the ultimate resource. Any substitution of natural resources by capital and/or labour is ignored in his analysis (Ozdemiroglu, 1993).

Malthus' second dilemma was that of mankind's propensity to reproduce. If wages were above a subsistence level, Malthus argued, then family size would increase. According to his model, death rates fell and fertility rose when incomes exceed the equilibrium level, and the opposite occurred when incomes are less than that level (Becker et al., 1994). Population growth combined with diminishing marginal returns would bring wages down to a subsistence level, or even below, and stem the population growth through malnutrition, famine, and delayed marriage. Malthus argued that population tended to increase geometrically while agricultural output increased arithmetically, so the demand for food would necessarily bump up against the ability to produce food, the end result being a subsistence standard of living for most of the population.

Given the philosophy of the Malthusian theory, Krautkraemer (2005) concludes that population and economic growth, especially in the next century, will continue to increase the demand for natural resource commodities and, most importantly, place further pressure on natural environments.

2.2.3.3. David Ricardo's Theory of Economic Growth

Ricardo's theory was mainly centred on the law of diminishing returns which very much applies to concept of natural resource scarcity. The law of diminishing returns states that if more units are added to one of the factors of production and the rest is kept constant, the quantity of output produced by the additional units will ultimately become smaller down to a point where the overall output will begin to fall.

The diminishing economic return was considered by David Ricardo to be the cause of the diminishing quality of resources, not their absolute scarcity. The definition of economic rent

according to Ricardo is "that portion of the produce of the earth, which is paid to the landlord for the use of the original and indestructible powers of the soil." Therefore, the changes in resource rents are determined by these `powers of the soil' such as its fertility, not by the quantity of soil available. Actually, the disastrous end of the capitalist system would be through class struggle between renters and profit earners. As the quality of scarce arable land drops, renters profit from growing rents, leaving profit earners with an ever decreasing share. Ricardo presumed in this forecast, "that resource use follows the natural quality pattern of the resource, i.e., the best quality is extracted first and the worst quality extracted the last" (Ozdemiroglu, 1993). In real world situations, such a detailed pattern of resource use is highly questionable due to lack of information about resource reserves. It would be impossible to survey the entire globe, but on a smaller scale Ricardo's theory does partly hold true: resources once discovered are used according to their declining quality. This quality decline demands increasingly productive labour, capital and energy for the extraction of a given unit of mineral ore or for cultivation of a fixed plot of land. These extra requirements also have accelerating effects on the scarcity of inputs such as energy resources (Common, 1992).

Following from the classical view of economic growth through production, Paul Douglas and Charles Cobb came up with a production function to better present the relation between labour and capital.

In its most standard form for production of a single good with two factors, the function is

$$Y = AL^{\beta}K^{\alpha}$$

where:

- Y = total production (the real value of all goods produced in a year)
- L = labour input (the total number of person-hours worked in a year)
- K = capital input (the real value of all machinery, equipment, and buildings)
- A = total factor productivity
- α and β are the output elasticities of capital and labor, respectively. These values are constants determined by available technology

The description of the production function is a distinct case of the constant-elasticity-of-substitution production function (CES), with the elasticity of substitution being equal to one

and with the usual theoretical assumptions used in the empirical literature (Barro & Sala-i-Martin 2004). Positive and diminishing marginal products of each input (L, K) are assumed. This restricts both α and β to values between 0 and 1. Also, returns to scale are assumed to be constant, i.e. $\beta = (1 - \alpha)$. When applying the Cobb-Douglas production function, the parameter α and β is assumed to be constant over time (Dennis et al., 2006) Theoretically, if the factor markets are competitive, then the marginal product of each input equals its factor price, implying;

$\partial Y / \partial L = w$
and $\partial Y / \partial K = r$,

where Y is output, L and K labor and capital inputs, w and r are the wage rate and the rental rate of capital respectively.

For the Cobb-Douglas production function,

$\partial Y / \partial L = \partial Y / L = w$.

Under the assumption of constant returns to scale in capital and labor, $rK + wL = Y$ and the capital share $\beta = rK / Y$ equals the complement to one of the labor share $\alpha = w L / Y$.

  In using this production function, it is possible to consider changes in the supply-side performance on the foundation of the concurrent developments detected in the quantity of labor, capital and total factor productivity. For example, an upsurge in the rate of capital growth supplemented by a growth in total factor productivity may indicate enhancement in the supply-side performance. The production function thus represents a useful and powerful tool for the macroeconomic analysis and evaluation of the governmental structural policies.

2.2.3.4. Keynesian Economics

Reference to Keynesian Economics on environmental and natural resource issues is extremely rare (Berr 2008). Keynesian Economics lays most stress on supply and demand of goods and services and thus natural resources, savings and investments, persistence and fluctuation of unemployment. While the New Keynesian economics emphasises on efficiency wage theories,

capital market imperfections and credit rationing which could be linked to natural resource scarcity and investment in natural resources.

In his general theory, Keynes needed to find a source of fluctuations in economic activity. It was apparent that changes in technology, in supply, could not account for what was occurring in the Great Depression. He therefore naturally turned to changes in demand. Those brought up in the Marshallian tradition were schooled in analysing demand and supply disturbances separately. Keynes's reliance on the Marshallian demand/supply framework posed problems which he never satisfactorily resolved. The Marshallian theory suggests that firm equilibrium is at the point of intersection between demand and supply. Thus firms in solving their profit maximisation problems, act as though price and quantity are fixed and thus do not consider prices to affect sales quantity (Stiglitz 1984).

In saving and investment, there was the difference between the funds within a firm and that of households. If capital markets where perfect, there would be no difference between firms and households. Keynesian multiplier later modified by Richard F. Kahn in 1931, shows that exogenous increases in spending, such as an increase in government expenses, increases total spending by a multiple of that increase. A government could arouse a great deal of new production with a modest expenditure if the people who receive this money spend most on consumption goods and save the rest and this extra spending gives businesses the opportunity to hire more people and pay them, which in turn allows a further increase in consumer spending.

This process continues. At each step, the increase in spending is smaller than in the previous step, so that the multiplier process tapers off and allows the attainment of equilibrium. This story is modified and moderated if we move beyond a "closed economy" and bring in the role of taxation: The rise in imports (of natural resource substitutes) and tax payments at each step reduces the amount of induced consumer spending and the size of the multiplier effect.

Secondly, Keynes re-analyzed the effect of the interest rate on investment. In the classical model, the supply of funds (saving) determines the amount of fixed business investment. That is, under the classical model, since all savings are placed in banks, and all business investors in need of borrowed funds go to banks, the amount of savings determines the amount that is available to invest. Under Keynes's model, the amount of investment is determined independently by long-term profit expectations and, to a lesser extent, the interest rate. The latter opens the possibility of regulating the economy through money supply changes, via

monetary policy. Under conditions such as the Great Depression, Keynes argued that this approach would be relatively ineffective compared to fiscal policy.

According to Keynes, capital market imperfections are a derivative from imperfect information. There are asymmetries of information between managers of firms and potential investors, which could result to "equity rationing." Equity rationing matters because it means that if firms desire to acquire more capital, to invest or to increase production, they must borrow the funds, thus the exposure to considerable risk, including the risk of bankruptcy. The repercussions of this are firms cannot sell the goods which they plan to produce until after they have produced them and such risks are aggravated by the nonexistence of futures markets. Every decision made by management is a risk decision especially production decision, a risk which the managers and equity holders must bear, and which they cannot easily shift on to others. The absence of futures markets implies that firms cannot sell their output at the time of production. Thus, an analysis of firm performance must centre on its compliance to undertake these risks. Unexpected changes in its working capital base (caused for instance by unexpected changes in the prices at which it can sell its existing stock of goods) could, for instance, have a deleterious effect on its willingness to produce (Greenwald & Stiglitz 1987).

Firms, at times, are willing to produce given the potential risk limit on the volume of production and at other times, firms' have limited access to capital because there is credit rationing. The grounds on which suppliers of capital do not increase interest rates in the presence of an excess demand for capital are comparable to the reasons that firms do not lower wages in the presence of an excess supply of labour: increasing interest rates may lower the expected return to the supplier of capital, either because of selection effects or because of incentive effects (Greenwald and Stiglitz 1987).

The economic theory of Keynes covers key areas in the research such as investments, savings, risks which require insurance and most importantly the issue of demand and supply which could relate to natural resources.

2.2.3.5. The Harrod Domar Growth Model

The Harrod–Domar growth model, developed by Sir Roy F. Harrod in 1939 and Evsey Domar in 1946, is a growth mainly used in development economics using the level of saving and productivity of capital to explain an economy's growth rate. It suggests that there is no natural reason for an economy to have balanced growth. The model was the precursor to the exogenous growth model. It was initially created to help analyse the business cycle, but was later adapted to explain economic growth. Its implications were that growth depends on the quantity of labour and capital; more investment leads to capital accumulation, which generates economic growth. The model also had implications for less economically developed countries (LEDCs) because labour was in plentiful supply in these countries but physical capital was not, thereby slowing economic progress. LEDCs did not have sufficient average incomes to enable high rates of saving, and therefore accumulation of the capital stock through investment is low. The Harrod Domar model measures the rate of growth of output or income over time which will make aggregate supply equal aggregate demand. Given aggregate supply or income in a simple economy is

$$Y = C + S \ldots\ldots\ldots\ldots\ldots. (1)$$

and aggregate demand is

$$E = C + I \ldots\ldots\ldots\ldots\ldots (2)$$

Y on E defined as above

Y = Income

E = Expenditure

I = Investment

C = Aggregate consumption

S = Aggregate savings

Aggregate supply = Aggregate demand

$$Y = E \quad => \quad C + S = C + I \ldots\ldots\ldots \quad (3)$$

$$S = I \ldots\ldots\ldots\ldots\ldots. (4)$$

Equation 4 measures growth or income which will make aggregate savings equal aggregate investment in each period. In order to device the model, we have to derive the S and I function and equate the two.

Every economy must save a certain proportion of its national income for use in replacing worn out or impaired capital goods. New investment representing capital stock is necessary.

Direct relationship between the size of K and Y

GDP = K/y

Where K = capital

Y = income

S = sy,   I = dk

S = sy   = kdy = dk = I

Sy = kdy

Where s = national savings ratio

K = capital/output ratio

Divide both sides by K and Y

$\underline{Sy}$ = $\underline{kdy}$

Ky = ky

$\underline{dy}$ = s/k

Y

$\underline{dy}$ = g

Y

G = s/k

The above model shows that growth in GDP depends positively on national savings ratio (s) and inversely on national capital/output ratio (k).

The model implies that economic growth depends on policies to increase investment, by increasing saving, and using that investment more efficiently through technological advances. The model concludes that an economy does not find full employment and stable growth rates naturally, similar to the Keynesian beliefs.

2.2.3.6. Exogenous (Neoclassical growth) Vs. Endogenous Model

The most basic proposition of the Exogenous growth theory is that in order to sustain a positive growth rate per capita in the long run, there must be continual advances in technological knowledge in the form of new goods, new markets, or new processes. This proposition can be demonstrated using the neoclassical growth model which shows that if there were no technological progress, then the effects of diminishing returns would eventually cause economic growth to cease (Aghion & Howitt 2000). According to Cesaratto (1999) exogenous growth implies that the long run growth rate depends on the growth rate of the labour force and

on labour augmenting exogenous technical progress. Thus savings have no effect on the rate of capital accumulation. In a nutshell it attempts to explain long run economic growth by looking at productivity, capital accumulation, population growth, and technological progress (Solow 1956; Swan 1956).

The Solow- Swan model, as earlier mentioned, attempts to explain long-run economic growth by looking at capital accumulation, labor or population growth, and increases in productivity, commonly referred to as technological progress. At its core is a neoclassical aggregate production function, usually of a Cobb–Douglas type.

The key assumption of the neoclassical growth model is that capital is subject to diminishing returns in a closed economy.

- For a given fixed stock of labor, the impact on output of the last unit of capital accumulated will always be less than the one before.
- With no technological progress or labor force growth, diminishing returns implies that at some point the amount of new capital produced is only just enough to make up for the amount of existing capital lost due to depreciation
- In the short-run the rate of growth slows as diminishing returns take effect and the economy converges to a constant "steady-state" rate of growth
- Including non-zero technological progress is very similar to the assumption of non-zero workforce growth, in terms of "effective labor": a new steady state is reached with constant output per worker-hour required for a unit of output.

The Solow-Swan model is a modification of the Cobb-Douglas model as follows

$$Y(t) = K(t)^\alpha (A(t)L(t))^{1-\alpha}$$

Where

t = time,

$0 < \alpha < 1$ = the elasticity of output with respect to capital,

$Y(t)$ = total production

A = labor-augmenting technology

Therefore,

AL = effective labor.

All factors of production are fully utilized, and initial values $A(0)$, $K(0)$, and $L(0)$ are given. The number of workers, which is labour, as well as the level of technology grow exogenously at rates n and g, respectively:

$$L(t) = L(0)e^{nt}$$
$$A(t) = A(0)e^{gt}$$

The number of effective units of labor, $A(t)L(t)$, therefore grows at rate $(n+g)$. Meanwhile, the stock of capital depreciates over time at a constant rate δ. But, only a fraction of the output ($cY(t)$ with $0 < c < 1$) is spent, leaving a saved share

$s = 1 - c$ for investment:

$$\dot{K}(t) = sY(t) - \delta K(t)$$

where $\dot{K}$ is equivalent to $\dfrac{dK(t)}{dt}$, the derivative with respect to time.

Since the production function $Y(K, AL)$ has constant returns to scale, it can be written as output per effective unit of labour:

$$y(t) = \frac{Y(t)}{A(t)L(t)} = k(t)^\alpha$$

Swan (1956) came up with a modernised version of the Cobb Douglas function incorporating the factor of scarce land; Let L stand for the supply of land, then

$Y = KaNbLc$, a + b + c = 1.

Since gL = 0 by assumption, gY = agK + bgN. Hence when gY = gK

gY = [b/ (b + c)] gN < gN.

Output per head must therefore fall until y is just sufficient to induce gN at the rate gY, upon which further population growth must be constrained to the rate of output growth:

(gN = gY) = [s/ (1 – b)] a(Y/K) = [s/ (1 – b)] r.

Where gN = growth in productive workers

gY = growth in production

gK = growth in capital

However, the explanation of exogenous growth by neoclassical economists have "run into difficulty" and criticisms by unsatisfied economic practitioners (Nelson & Winter, 1974; Rynn, 2001; Henning, 2008). Top on the lists is its lack of consistency and is based on a shaky foundation especially on the issue of capital and diminishing returns. The theory in general is built and heavily reliant of diminishing returns. It is practically difficult to describe how something increases if the main process used to describe the increase is a process of decreasing values (Rynn 2001). The theory failed to take into account the role of entrepreneurship and the power of institutions which promote growth. It is also criticised on concentrating too much on short run scenarios and processes, failing to provide long term solutions and benefiting the population as a whole, thus enhancing unsustainable development. Therefore, the Neo-Classical model is based on the premise of weak sustainability, which is a fairly simple premise which states overall capital stock should be non-decreasing. It allows for natural resources to be completely depleted as long as other forms of capital compensate for this loss. As a result, a country could quickly find itself on a track to unsustainable development (Henning, 2008). It also failed to explain how and why technological progress occurs and how saving rates come about. Due to the failure of the Exogenous growth model to explain the rate of savings and rate of technological progress, the endogenous model was developed in an attempt to overcome the shortcomings of the exogenous model.

The Endogenous growth model on the other hand is dependent and controlled by economic agents (Lee 2003). The Endogenous growth theory holds that economic growth is primarily the result of endogenous and not external forces. The theory holds that investment in human capital, innovation, and knowledge are significant contributors to economic growth. The theory also focuses on positive externalities and spill over effects of a knowledge-based economy which will lead to economic development (Romer 1994). The endogenous growth theory primarily holds that the long run growth rate of an economy depends on policy measures. For example, subsidies for research and development or education increase the growth rate in some endogenous growth models by increasing the incentive for innovation (Rebello 1991).

The main model which best explains endogenous growth is the AK model which assumes a continuous, exogenous, saving rate. It also models technological progress with a single parameter, which is usually A. It also assumes that the production function does not display diminishing returns to scale to lead to endogenous growth.

The model works assuming there is an absence of diminishing returns to capital. The simplest form of production function with non-diminishing return is:

$$Y = AK$$

where

A = positive constant that reflects the level of the technology.

K = capital (including human capital)

$y = AK$, output per capita and the average and marginal product are constant at the level $A > 0$

If we substitute $\dfrac{f(k)}{k} = A$ in equation of transitional Dynamics of Solow-Swan model (Exogenous growth model) which shows how an economy's per capita incomes converges toward its own steady-state value and to the per capita incomes of other nations.

Endogenous growth theory has reawakened attention in the role of innovation in determining long-term economic growth. Generally, the body of literature has overlooked the contribution of natural resources to growth or the role of innovation in overcoming resource scarcities. The second problem has been a focus of attention for resource economics for many years, but revolution is usually modelled as exogenous rather than endogenous technological change. Investigations in the last few years in political economy have also recommended that the 'supply' of revolution may itself be inhibited by resource scarcities, especially in the developing world. Barbier's (1999) paper endeavoured to connect these theoretical gaps through the formal analysis of two issues: Firstly, a basic 'Romer-Stiglitz' model of endogenous growth with resource scarcity and population growth was developed to define the optimal 'balanced' growth path for the economy. Secondly, the simple model was stretched further to permit the idea for the possibility of resource availability restraining the supply of innovation, so that in the long run innovation net of any resource constraint is zero. However, under the latter conditions it is still likely to evade exhaustion of resources and thus attain a persistent level of per capita consumption in the long run. Barbier (1999) therefore validated that endogenous growth could overcome resource scarcity, but the result in the long run depended critically on assumptions concerning any constraints imposed by resource availability on the generation of innovation (Barbier 1999).

The endogenous theory has been criticized in turn on the failure to clearly explain the conditional convergence reported in its theory (Sachs & Warner 1997). Another recurrent

critique focuses on the principal assumption of diminishing returns to capital. It is contended that this growth theory has proven no more successful than exogenous growth theory in explaining the income divergence between the developing and developed worlds (Daron 2009) Krugman (2013) also criticized endogenous growth theory as nearly impossible to verify empirically as a bulk of it comprised making assumptions about how "unmeasurable things affected other unmeasurable things".

2.2.3.7. Rostow's Stages of Economic Growth

One of the developmental theories of economic growth was suggested by Walt Rostow in 1960. Rostow contended that economies must undergo a number of developmental stages towards better economic growth. He argued that these stages followed a consistent succession, where each stage could only be reached through the completion of the previous stage. "It is possible to identify all societies, in their economic dimensions, as lying within one of five categories: the traditional society, the preconditions for take-off, the take-off, the drive to maturity, and the age of high mass-consumption." (Rostow 1960) The model proposed that all countries exist somewhere on this linear pathway, and climb upward through each stage in the development process.

The first stage is the traditional society, dominated by agriculture and barter exchange, with intensive labour and low levels of trading, and where the population that does not have a scientific perspective on the world and technology. The concept of the traditional society however does not eliminate increases in output. According to the theory, these societies due to the limitations in productivity devote a very high proportion of their resources to agriculture; and flowing from the agricultural system there is a hierarchical social structure, with relatively narrow scope for vertical mobility. This stage to some extent reflects the stage where most low-income countries find themselves in.

 In the second stage, known as the Pre conditions to Take off, the economy begins to develop manufacturing, and a more national/international outlook. It is mainly characterized by the development of education and an understanding of science, the application of science to technology and transport, and the emergence of entrepreneurs and a simple banking system, and consequently an increase in savings. According to Rostow (1960) this stage of growth hardly ever, if it does, arise endogenously, but from some intrusion of more advanced

economies. Thus the emergence of the technology to be able to extract, refine and use stocks of resources for production purposes.

The third stage of growth is the Take off stage where there is a brief period of intensive growth, in which industrialization commences, and workers and institutions become concentrated around a new industry with positive growth rates occurring in particular sectors and where organised systems of production and remuneration replace traditional methods and norms. During the take-off, the rate of effective investment and savings may rise, new industries develop quickly, yielding profits in large proportions which are reinvested in new plants and these new industries, consecutively, stimulate, a further expansion in urban areas and in other modern industrial plants. The whole process of expansion in the modern sector yields an increase of income. New techniques are introduced and spread in agriculture, as agriculture is commercialized. The revolutionary changes in agricultural productivity are an essential condition for successful take-off; for modernization of a society increases radically its bill for agricultural products. In a decade or two both the basic structure of the economy and the social and political structure of the society are transformed in such a way that a steady rate of growth can be maintained (Rostow 1960).

The Drive to Maturity stage takes place over a long period of time, with improved standards of living, increased use of technology, a significant growth rate in many sectors and a more diversified national economy. This is the stage in which an economy displays the capacity to move ahead of the original industries which powered its take-off and to absorb and apply the technology efficiently over a very wide range of its resources. In other words, "an economy that demonstrates that it has the technological and entrepreneurial skills to produce not everything, but anything that it chooses to produce" (Rostow 1960). Many developed countries are in this stage of growth. With the power to be able to be more technologically capable production wise, the depletion of natural resources increases tremendously at this stage.

In the final stage, the Age of Mass Consumption, a country's economy flourishes in a capitalist system, characterized by mass production and consumerism and where citizens enjoy high and rising consumption per head, and where rewards are spread more evenly. Rostow believed at that time that the US was in this stage of growth and development. In this stage the leading sectors shift towards durable consumers' goods and services, real income per head rise to a point where a large number of individuals gain a command over consumption which transcends basic food, shelter, and clothing and the structure of the working force transforms in ways

which enhances not only the proportion of urban to total population, but also the proportion of the population working in offices or in skilled factory jobs-aware of and anxious to acquire the consumption fruits of a mature economy. In addition to these economic changes, the society ceases to accept the further extension of modern technology as an overriding objective and resource are shifted to the promotion of welfare and security.

2.2.3.8. Lewis Theory of Economic Development

Lewis' theory elucidates the mechanism of the changing structure of underdeveloped economies from subsistent agriculture to a more modern and urbanized system. This model turned out to be the generally accepted theory of the course of development during the 1960s and early 1970s.

In this theory, Lewis divided the underdeveloped economy into 2 sectors; the capitalist/industrial sector and the agricultural/subsistence sector. The agricultural sector is assumed to have huge amounts of excess labour that result in an awfully low, almost zero, marginal productivity of labour. The agricultural wage rate is believed to follow the sharing rule and be equal to average productivity, which is also known as the institutional wage. This sector exists alongside a high-productivity modern urban industrial sector into which labour from the subsistence sector is gradually transferred. The non-agricultural/industrial sector has an abundance of capital and resources relative to labour. It pursues profit and employs labour at a wage rate higher than the agricultural institutional wage by approximately 30% (Lewis, 1954)

The major relationship between the two sectors is that when the capitalist sector grows, it draws labour from the subsistence sector. In other words, the non-agricultural sector accumulates capital by drawing surplus labour out of the agricultural sector. The expansion of the non-agricultural sector takes advantage of the infinitely elastic supply of labour from the agricultural sector due to its labour surplus. When the surplus labour is exhausted, the labour supply curve in the non-agricultural sector becomes upward-sloping. As employment increases, there will be more output hence more income and proceeds. Additional income will increase demand for domestic goods & services while increase in profits will be reinvested. The rural-urban migration therefore offers self-generating growth.

Lewis model of modern-sector growth in a two-sector economy can be illustrated using the figure below. Looking at the traditional agricultural sector portrayed in the two right-side

diagrams of figure 1 it shows how subsistence food production differs with upsurges in labour inputs. It is a classic agricultural production function where the total output or product (*TPA*) of food is defined by changes in the amount of the only variable input, labour (*LA*), with a fixed quantity of capital, *KA*, and unchanging traditional technology, *tA*. In the bottom right diagram, the average and marginal product of labour curves, *APLA* and *MPLA*, are presented which are derived from the total product curve shown above. The quantity of agricultural labour (*QLA*) available is the same on both horizontal axes and is expressed in millions of workers, as Lewis is describing an underdeveloped economy where 80% to 90% of the population lives and works in rural areas (Goulet, 2009).

Figure 4.1 The Lewis Model of Modern-Sector Growth in a Two-Sector Surplus-Labor Economy
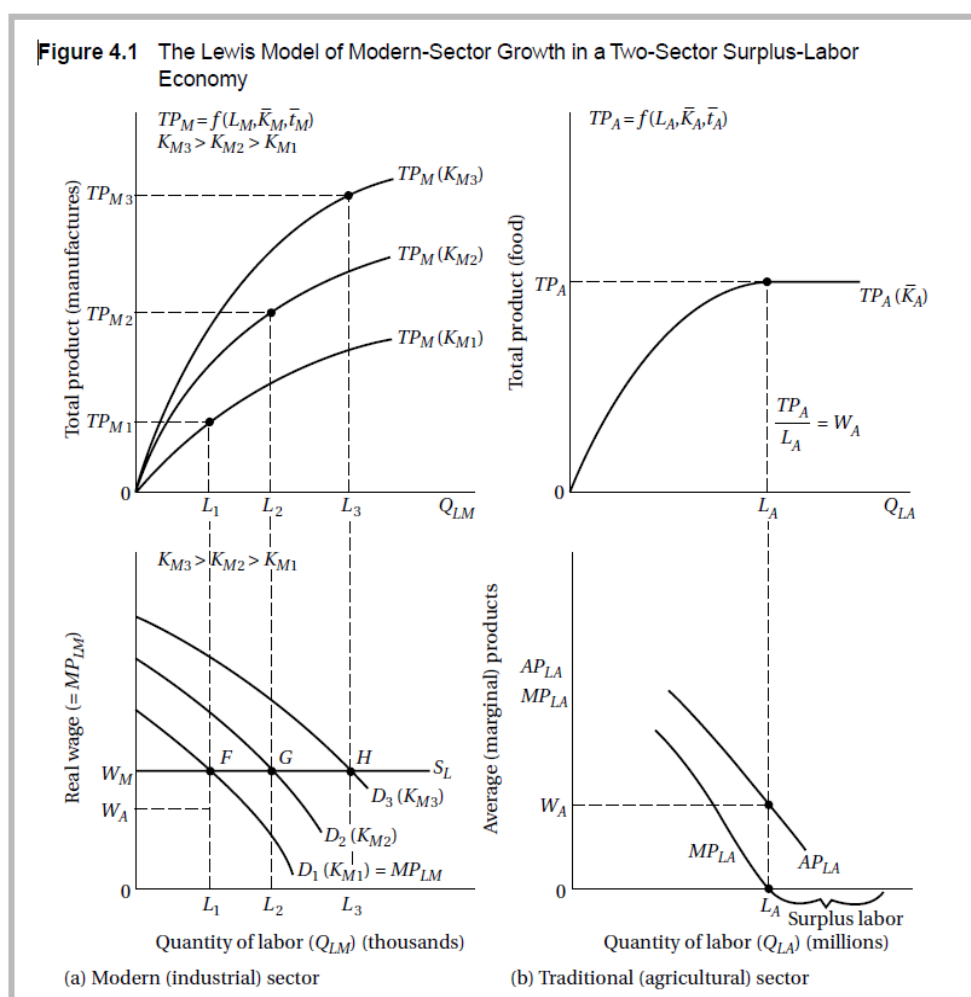
Fig. 1; Lewis Model

Source; Goulet (2009)

Two assumptions are made about the traditional sector;

- There is surplus labour so that *MPLA* is zero, and
- All rural workers have an equal share in the output so that the rural real wage is defined by the average and not the marginal product of labour.

Lewis' theory has been proven applicable in the real world by empirical studies carried out by scholars like Fei and Ranis (1973), Minami (1967b) and Ohkawa (1965). They found that agricultural labour migration promoted economic growth in developing economies.

The table below gives an overview of the views of the various economists on economic growth with possible similarities and differences

Table 1; Summary of Views on Economic Growth

Category	Name	Key Element	Result
Classical Economists	Adam Smith	Capital accumulation and division of labour	Growth in the labour force and stock of capital Improvement in the efficiency with which capital is used in labour through greater division of labour and technological progress Promotion of foreign trade that widens the market and reinforces the other two sources of growth
	Thomas Malthus	Population Growth Vs. Economic growth	Growth falls as the population increases
	David Ricardo	Law of diminishing returns in growth	The diminishing economic return was the cause of the diminishing quality of resources, not their absolute scarcity

Keynesian Economists	J.M Keynes	Inducement to invest	Low interest rates, government investment, and redistribution to the poor
	Harrod/Domar	Growth depends on the quantity of labour and capital	Economic growth depends on policies to increase investment, by increasing saving, and using that investment more efficiently through technological advances.
Neoclassical Economists	Solow/Swan	Explain long-run economic growth by looking at capital accumulation, labor or population growth, and increases in productivity, commonly referred to as technological progress.	Exogenous growth implies that the long run growth rate depends on the growth rate of the labour force and on labour augmenting exogenous technical progress.
Development Economists	W.W Rostow	Economies must undergo a number of developmental stages towards better economic growth.	Economies actually undergo a number of developmental stages towards better economic growth.
	W. A Lewis	Mechanism of the changing structure of underdeveloped economies from subsistent agriculture to a more modern and urbanized system	Two types of economies live and inter-relate with each other; subsistence and urban economies
Main Similarity; The issue and existence of diminishing returns			

The next subsection examines empirical literature on the effect of natural resource scarcity on economic growth and gives a clear picture of the calibre of research already done concerning such effects and the ability to identify gaps this research seeks to fill.

2.3. Empirical Literature

Reduced oil (resource) supply is likely to result in reduced or negative economic growth (Tverberg, 2012)

Krautkraemer (2005) asserts that empirical literature on natural resource scarcity/constraint spells "impending doom" on economic growth and technological progress which is not necessarily true, "at least not yet… If there is any systematic bias to past predictions of the future, it is an underestimation of the ability of technological progress to overcome natural resource scarcity." However, a huge bulk of academic and professional literature have a different opinion on the effect of resource scarcity on the growth of an economy, for instance according to Brown & Yucel, (2002), a scarce resource such as oil, causing a rise in oil prices and oil price uncertainty, can be an indicator of a classic supply-side shock that decreases prospective output and is a pointer to the increased scarcity of energy which is a rudimentary input to production. As a result, the growth of output and productivity are slowed. The decline in productivity growth lessens real wage growth and increases the unemployment rate at which inflation accelerates (Rasche & Tatom (1977 and 1981); Barro (1984), Brown and Yucel (1999) and Jo (2014)).

A large amount of literature depicts the depressing effects of oil scarcity, and thus high oil prices, on economic and financial growth and development. For instance, Hamilton (1988a) asserted that oil shocks affect the macro economy primarily through the depression of demand for important consumption and investment goods. Historically, oil shocks have been characterised by widespread concerns about the price and availability of energy which could cause investment decisions to be postponed, thereby adversely affecting economic growth. Freder's (1996) investigation of the impact of oil shocks on the US economy supported the above assertion that oil prices affect macro-economic growth adversely especially through its effect on output growth. In a comprehensive survey of the empirical literature, Jones and Leiby (1996) found that the estimated oil price elasticity of GNP in the early studies ranged from 2% to 8%, with the estimates consistently clustered around 5%. Jones and Leiby (1996) argue that values around 5% are in the ballpark for output elasticities that are roughly equal to factor shares which are a bit contrary to Tobin (1980) who thought the estimated effects seemed too high to be consistent with a classic supply shock, but after the 1973 oil-price shock, oil's share in GNP was around 4–6%.

In a historical analysis, Hirsch (2008) showed a graph indicating that increases in world GDP correspond with increases in world oil production during the period 1986 to 2005, Rubin (2008), also based on a review of the historical record, indicated that in the United States, four out of five recessions between 1970 and 2007 were preceded by oil shocks and Hamilton (2009) showed that the oil price run-up in 2007-2008 was sufficient to explain the 2008-2009 recession of the United States and also indicated that in the United States, 11 out of 12 recessions since World War II were preceded by oil price shocks. The probability of oil price shocks preceding recession in so many instances would appear to be extremely low, if a causal relationship were not involved. Alpanda & Peralta-Alva (2010) did a similar historical investigation to validate the hypothesis that the sharp rise in energy costs during 1973-74 resulted in the fall of the value of the firms' existing capital and reduced their market value. To quantify this undesirability channel of the energy crisis, they simulated a calibrated dynamic general equilibrium model, where firms adopted energy-saving technologies along with the rise in energy prices, and the value of their installed capital fell due to the irreversible nature of their investments. Results portrayed that this channel can account for a third of the decline in the firm's observed output. They also considered the role of investment subsidies extended by the government during this period to advance the adoption of energy-saving technologies. Empirical support was also found for the channel of capital which was considered useless in cross-sectional regressions, where it was shown that the sectoral variation in the decline of energy use following the crisis was significant in explaining the sectoral variation in the drop of market values. Stern (2010) also examined the effect of energy resources on economic growth and concluded that the scarcity of energy resources could impose strong constraints on the economy's growth but when it is abundant its effect on economic growth is reduced. This elucidates the industrial revolution as a relief of the constraints on economic growth through the development of ways of using coal and the discovery of new fossil fuel resources. A time series analysis was also done and the results showed that energy and GDP co-integrated and energy Granger caused GDP. However, he confirmed the existence of various mechanisms that could weaken the link between energy and growth and declining energy return on investment could not only affect growth but the overall output of the economy and therefore sustainability.

Eminent in the literature is an attempt to differentiate the impact of oil shocks the growth of both oil exporting and importing countries. Lescaroux & Mignon (2009) investigated empirically the connections between oil prices and various macroeconomic and financial variables for a considerably huge set of countries, including both oil-importing and oil-exporting countries. The analysis was carried out both short-run and long-run through the implementation of Granger-causality tests, evaluation of cross correlations between the cyclical components of the series in order to identify lead/lag relationships and cointegration analysis. Results highlighted the existence of various relationships between oil prices and macroeconomic variables and, especially, an important link between oil and share prices on the short run. Turning to the long run, numerous long-term relationships are detected, the Granger-causality generally running from oil prices to the other variables. An important conclusion is relating to the key role played by the oil market on stock markets. Bildirici & Kayikci (2010) concentrated on analysing the relationship between oil production and economic growth in major oil exporting Eurasian countries. Empirical results reveal that oil production and economic growth are cointegrated for these countries. Furthermore, there is positive bi-directional causality between oil production and economic growth both in the long run and in the short run which supports the policies about investing in energy infrastructure. Ftiti et al., (2014) on the other hand attempted to complement existing analysis of the impact of oil price shocks on the growth of importing countries by assessing such impacts in the growth of (4) oil exporting (OPEC) countries using the co-spectral analysis by Priestly & Tong (1973). This analysis indicated that oil exporting countries were more sensitive to oil shocks that oil importing countries, significantly affecting real economic activity.

Mehrara (2007) examined the causal relationship between energy use and consumption and economic growth for 11 oil exporting countries and the results showed a strong unidirectional relationship from economic growth to energy consumption. Thus trends in economic growth could forecast increases in energy consumption and energy conservation measures can be imposed with no significant impact on economic growth. He further identifies two emerging points in literature on the energy-economic growth analysis; energy consumption is a limiting factor to growth and energy consumption is neutral to growth. The energy consumption-economic growth nexus was reinvestigated by Mahadevan & Asafu-Adjaye (2007) in a panel error correction model using data on 20 net energy importers and exporters from a period of 30 years. There was bidirectional

causality between economic growth and energy consumption among the energy exporters in the developed countries in both the short and long run, whereas energy consumption stimulates growth only in the short run in the developing countries. The former result was also found for energy importers and the latter result exists only for the developed countries within this group. Furthermore, developed countries have a higher response elasticity in terms of economic growth from an increase in energy consumption compared to that of developing countries, although its income elasticity was lower and less than unitary. Lastly, the implications for energy policy calling for a more holistic approach were also discussed. Thirty years is a long time to be able to capture the in-depth impact of energy consumption as the impact is spread over a number of years. Berument et al., (2016) put a little twist in their study as they investigated the effects of oil shocks on MENA countries, both importers and exporters but who are evidently too small to affect changes in oil prices. Oil prices, apparently, had mixed effects on these countries, regardless of whether they were oil exporters or importers. Oil prices had significant effects on growth outputs of Algeria, Iran, Iraq, Kuwait, United Arab Emirates, Oman, Libya Syria and Qatar, and had no significant effects on Bahrain, Israel, Egypt, Djibouti, Tunisia, Morocco and Jordan. However, Sotoudeh & Worthington (2015) assert and conclude that the economies of oil producing (oil exporting) and oil consuming (oil importing) countries react in a similar manner to global oil price shocks.

For developed countries, Soytas & Sari (2003) found out from their investigation, a bi-directional causality for Argentina, a unidirectional causality for Italy and Korea running from GDP to energy consumption and a uni-directional relationship ran from energy consumption to GDP in Turkey, Germany, Japan and France indicating a possibility of energy conservation affecting the growth of these four countries.

For developing countries, Balassa (1985) in his study of 43 developing countries in the 1973–78 period of oil price shocks, the results showed that inter-country differences in the rate of economic growth are affected by differences in investment rates and by the rate of growth of the labour force, by the initial trade policy stance and by the adjustment policies applied, as well as by the level of economic development and the product composition of exports. The results also showed that the oil policies adopted have importantly influenced the rate of economic growth in developing countries. In particular, an outward-oriented policy stance at the beginning of the period and reliance on export promotion in response to these shocks, appear to have favourably affected growth performance. The results further indicated the possibilities for low-income countries to accelerate their economic growth through the

application of modern technology in an appropriate policy framework as well as the advantages of relying on manufactured exports. Brown et al., (2011) examined the causal relationship between energy and economic growth by using "a macro ecological approach to integrate perspectives of physics, ecology, and economics with an analysis of extensive global data to show how energy imposes fundamental constraints on economic growth and development". Results showed that most metrics of wellbeing, including GDP, literacy, etc., were all positively correlated with, and caused by, energy consumption.

Lee (2005) re-investigated the co-movement and the causality relationship between energy consumption and GDP in 18 developing countries, using data for the period 1975 to 2001. Tests for the panel unit root, heterogeneous panel cointegration, and panel-based error correction models were employed. The empirical results delivered a clear backing of a long-run cointegration relationship after allowing for the heterogeneous country effect. The long-run relationship is estimated using a full-modified Ordinary Least Squares (OLS). The evidence shows that long-run and short-run causalities run from energy consumption to GDP, but not vice versa. This result indicates that energy conservation may harm economic growth in developing countries regardless of being transitory or permanent. These results are questionable because the methods used in computing causality are not appropriate as OLS cannot truly quantify the nature and direction of causality. Lee & Chang (2008) found that although economic growth and energy consumption had no short run causal relationship, in 16 Asian countries from 1971-2002, however, there is long-run unidirectional causality running from energy consumption to economic growth. This means that reducing energy consumption does not adversely affect GDP in the short-run but would in the long-run; thus, these countries should adopt a more vigorous energy policy. Ozturk et al., (2010) use panel data of energy consumption and GDP for 51 low and middle income countries to investigate the relationship between the two factors. Results showed that energy consumption and GDP were co-integrated and a long-run causality ran from GDP to energy consumption for low income countries and a bi-directional relationship for middle income countries. Arac & Hasanov (2014) in their examination of the dynamic interrelationship between energy consumption and economic growth in Turkey, demonstrated asymmetric effects of positive versus negative and small versus large energy consumption shocks on output growth and vice versa using the Generalised Impulse Response Function. It was found that negative energy shocks have a greater effect on output growth than positive energy shocks, and that big negative energy shocks affect output much more than small negative energy shocks, which is consistent to current theory and

literature. However, it is unlikely that the current political instability around oil price issues especially around its geographic borders was taken into consideration.

Bildirici & Bakirtas (2014) carried out a causality analysis to investigate the causal relationship between economic growth and coal, natural gas and oil consumption using the ARDL (autoregressive distributed lag bounds) testing approach for a period of 31 years in Brazil, Russian, India, China, Turkey and South Africa. According to long-run and strong causality results, there is bi-directional causality between oil energy consumption and growth for all countries. The long-run causality and strong causality results between coal consumption and economic growth indicated that there is bi-directional causality for China and India. According to long-run causality results and a strong causality result, there are bi-directional causality relationships between NGC (natural gas energy consumption) and economic growth for Brazil, Russia and Turkey.

Chen et al., (2014) assert that despite the accumulation of empirical evidence on the effects of energy consumption and oil prices on growth there are, nevertheless, two major lacks are apparent in the conventional method of modelling oil price shocks frequently used in the literature. Firstly, oil price shocks are assumed to be exogenous even though a reverse causality may run from real economic activities to oil prices. Secondly, recent literature also presents evidence of the relation between oil prices and stock prices depending on the origin and nature of oil price shocks (Ciner, 2013; Degiannakis et al., 2013). These results show that the macroeconomic effects of oil price shocks could depend on other underlying causes, which have not been fully accounted for in previous analyses. In order to overcome such deficiencies, Kilian (2009) proposed a two-step approach to the analysis of the macroeconomic impacts of oil price shocks. In the first step, a vector autoregression (VAR) which included oil production, global economic activity, and oil prices as endogenous variables was estimated in order to classify three categories of structural shocks that caused oil price changes: an oil supply shock, an aggregate demand shock, and an oil market-specific demand shock that mirrored unexpected changes in precautionary oil demand. In the second step, ordinary least squares (OLS) regressions were estimated to evaluate the impact of the identified and classified structural shocks on the macroeconomic indicators. The framework was adopted to demonstrate that US macroeconomic indicators responded differently to oil price shocks depending on the types of underlying shocks. Fang & You (2014) modified this framework to analyse the impact of oil price shocks to the stock market prices of the New Industrialised Economies (NIEs) (China, India and Russia). They find that the impact of oil price shocks on stock prices in these large

NIEs is mixed, partly in contrast to the effects on the U.S. and developed countries' stock markets. This result is also consistent with the previous empirical findings that the NIEs' stock markets are "partially integrated" with the other stock markets and oil price shocks. Similar results come from the analysis carried out by Narayan et al., (2014) on the predictability of growth from oil prices from 28 developed and 17 developing countries. Their results showed that there was greater evidence of predictability in developed than developing countries Rijsberman (2006) reviewed water scarcity indicators and global assessments based on these indicators. The most widely used indicator, the Falkenmark indicator, was popular because it was easy to apply and understand the true nature of water scarcity, though it didn't give a full explanation of the nature of scarcity in question. He found that there is definitely water scarcity in densely populated arid areas, such as Central and West Asia, and North Africa, with projected availabilities of less than 1000 m3/capita/ year. This scarcity relates to water for food production and in most of the rest of the world water scarcity at a national scale has as much to do with the development of the demand as the availability of the supply. Accounting for water for environmental requirements showed that abstraction of water for domestic, food and industrial uses already have had a major impact on ecosystems in many parts of the world, even those not considered ''water scarce''. He thus predicted that water would be a major constraint for agriculture in coming decades and particularly in Asia and Africa this will require major institutional adjustments. According to Berrittella et al., (2007) a full comprehension of water use is not possible without an understanding of the international market for food and related products, such as textiles. The water embedded in such commodities is called virtual water. Based on a general equilibrium model, they investigated the role of water resources and water scarcity in the context of international trade. They considered five alternative scenarios, analysing the effects of water scarcity due to reduced availability of groundwater. Four scenarios were based on a ''market solution'', where water owners could capitalize their water rent or taxes were recycled. In the fifth ''non-market'' scenario, supply restrictions implied productivity losses. Restrictions in water supply would shift trade patterns of agriculture and virtual water. These shifts were larger if the restriction was larger, and if the use of water in production was more rigid. Welfare losses were substantially larger in the non-market situation. Water-constrained agricultural producers lost, but unconstrained agricultural produces gained as well as industry gains. Consequently, there were regional winners and losers from water supply constraints. They further recommended that because of the current distortions of agricultural markets, water supply constraints could improve allocative efficiency; this welfare gain may more than offset the welfare losses due to the resource constraint.

From Barbier's (2004) point of view the influence of water utilisation on economic growth is represented by a growth model that comprises this non excludable good (water) as a productive input for private producers. Growth is negatively affected by the government's appropriation of output to supply water but positively influenced by the contribution of increased water use to capital productivity, leading to an Inverted-U relationship between economic growth and the rate of water utilisation. His cross-country estimations confirmed this relationship and suggest that for most economies current rates of fresh water utilisation are not yet constraining growth. However, for a handful of countries, moderate or extreme water scarcity may adversely affect economic growth. Nevertheless, even for water-scarce countries, there appeared to be little evidence that there were severe diminishing returns to allocating more output to provide water, thus resulting in falling income per capita.

The CERES report (2009), identified eight water-intensive industry sectors affected by water-related risks. Three prominent sectors include:

- The High-Tech industry where eleven of the world's 14 largest semiconductor factories in the Asia- Pacific region, are severely affected by water quality risks. Revenue of up to $100-$200 million or $0.02 or $0.04 per share could be lost as a result of water-related risk shutdown at a fabrication facility operated by these firms.

- The Beverage industry where the Coca-Cola and PepsiCo bottlers lost their operating licenses in parts of India due to water shortages and all major beverage firms were facing stiff public opposition to new bottling plants – and to bottled drinking water altogether.

- Reduced water availability in agriculture had already been impacting food commodity prices, as shown by the previous year's sharp increase in global rice prices triggered by a drought-induced collapse of rice production in Australia. Approximately 70% of the water used globally is for agriculture, with as much as 90 percent in developing countries where populations are growing fastest.

The report also identified water-related risks for electric power/energy, apparel, biotechnology/pharmaceutical, forest products and metals/mining firms. For companies in these and other sectors, climate change would further reduce the availability of reliable and high quality water, impacting productivity, costs, revenues, public goodwill and reputation.

The report also highlighted the escalating struggle between energy use and water availability. With increasing regularity, selecting one of these resources could mean undermining the other – the other, usually being water.

Another CERES report (2012) on water risks to economic growth and investment asserted that water risks and stress continued to intensify as a result of the droughts which occurred in 2011 and 2012 in the USA which has made the nations supply of water to be vulnerable and the cause of economic losses worth $billions. Consequently, the pricing of water risks in the market is beginning to change as investment in public water systems is taking a different perspective. Also declining revenue and rising costs are exacerbating water supply challenges and projecting future water demand is a highly uncertain proposition.

The next section brings to fore the present state of the finance sector and the effect of natural resource scarcity on its performance and volatility. Finance theories will be examined to give a basic understanding of how the various facets of the finance sector work and therefore be able to ascertain how natural resource scarcity can cause vulnerability in the system. Then empirically assess research on the effect of scarcity on the finance sector to give a clear picture on past and present research and identify possible gaps to fill.

2.4. The Finance Sector and Natural Resource Constraints

According to Tverberg (2012), world oil supply has not increased and the world has been through a severe economic crisis since 2005. The expected impact of the reduced oil supply worldwide is the reduction of the ability of economies to utilise debt for leverage. Also, if the world oil supply should remain considerably low, there is the possibility that oil consumption in OECD countries would continue to decline, as a larger share of the total oil available is consumed by emerging markets and thus the possible continuation and even worsening of the financial crisis and a potential collapse of the financial system. The finance system/sector, which is an integral part of the economy providing essential economic services, mainly encompasses a broad range of organizations that manage money, including credit unions, banks, credit card companies, insurance companies, accountancy companies, consumer finance companies, stock brokerages, investment funds. The financial services sector, defined above as private and public institutions that offer insurance, banking, and pension services, is an exclusive qualitative pointer to the potential socioeconomic impacts of climate change because the sector is very sensitive to climate change and offers an integrator and spread of effects of climate change on other sectors and the society (Vellinga & Mills, 2001).

However, there seem to be a viscous cycle running from oil price shocks to financial shocks, especially in financial markets, which get right back into causing oil price shocks. Chen et al., (2013) in their investigation on the macro economic impacts of oil prices, identified financial shocks as one of the shocks underlying oil price shocks making it a major determinant of oil price. Thus if oil price shocks affect the finance sector, the finance sector could in turn influence oil prices and if this viscous cycle is not curbed from one party or both, the effects could escalate to risk levels which could be difficult to manage in the future.

Each of these institutions will be examined separately, assessing the possible effects of natural resource constraint and climate change both from the theoretical and empirical perspective.

2.4.1. Insurance

Insurance as one of the components of the finance sector is extremely sensitive and important because it represents a risk-spreading mechanism through which the costs of weather-related events are distributed among other sectors and throughout society. It provides risk cover for economic, climatic, technological, political and demographic risks that enables individuals to go about their daily life and companies to operate, innovate and develop. Basically Insurance is an equitable way of transferring the risk of a loss or hardship from one party to another in exchange of a payment (premium). According to the Chartered Insurance Institute certain risks are insurable which include; the finance risk (risks with financial measurement), pure risk (real risk, unrelated to gambling) and particular risk.

In order to properly provide cover for the various possible risks, a range of insurance policies exists of which the top 10 in value of number of policies are; Life insurance, vehicle insurance, property and casualty, health insurance, accident insurance, and travel insurance. Other types of insurance which are less common but relevant to the research include;

- Flood insurance; a specific insurance which covers against property loss from flooding
- Earthquake insurance which is a form of property insurance that pays the policyholder in the event of an earthquake that causes damage to the property.
- Pollution insurance is insurance that covers costs related to pollution
- Crop insurance is insurance which covers the loss of crops due to natural disasters, such as hail, drought, and floods, or the loss of revenue due to declines in the prices of agricultural commodities. Typically purchased by agricultural producers, including farmers, ranchers, and others to protect themselves.

- Political risk insurance is a type of insurance that can be taken out by businesses, of any size, against the risk that revolution or other political conditions will result in a loss

- Deposit insurance is a measure implemented to protect bank depositors, in full or in part, from losses caused by a bank's inability to pay its debts when due. Deposit insurance systems are one component of a financial system safety net that promotes financial stability

- Business interruption insurance (also known as business income insurance) covers the loss of income that a business suffers after a disaster while its facility is either closed because of the disaster or in the process of being recuperation after it.

In order for the smooth functioning of the coverage of risks by insurance, three parties are involved with the provision for the policy and its implementation; the agent, broker and the insurance company.

An agent is someone who represents an insurance company and sells its insurance products. In some cases, a life insurance agent may represent several different insurance companies and must usually be licensed in the province or territory in which they do business. While a broker is a person or company who sells the insurance products of several different insurance companies and must usually be registered in the province or territory in which they do business.

Insurance companies can be divided into two groups; the life insurance company and the general insurance company. The fundamental role of insurance companies is usually the provision of financial coverage for the loss an individual is expected to suffer due to unpredicted events and circumstances, and therefore reduces the impact of that event. The financial cost of a particular event is repaid by these companies against the premium they collect from people who obtain the policy from them. Insurance companies also provide life insurance policies to pay the costs for the burial, to pay off debts and to restore the financial losses incurred by the family. These companies utilize a large group of insured people to easily determine the average rate of mortality. People who live longer than an average age effectively fund the payment for those who die before the average mortality age. Therefore, insurance companies help reduce the risk faced by the families due of the uncertainty of death and secure the family members of the deceased. Aside life insurance, insurance companies also provide health insurance to reduce the cost of illness by pooling the risk of illness, car insurance and all the insurance policies listed above and more.

The insurance sector is governed by a set of rules to monitor its performance and risk assessment. After the financial crisis, Solvency II was set up by the EU to govern the insurance sector;

Solvency II

The insurance sector is governed by a set of rules known as Solvency II that codifies and harmonises the EU insurance regulation. Principally this regards the amount of capital that EU insurance companies must hold to reduce the risk of insolvency. The pillars set by Solvency II are defined by EIOPA (European Insurance and Occupational Pensions Authority) as a way of grouping Solvency II requirements. Solvency II is split into three pillars;

- **Pillar 1** covers financial requirements. This pillar aims to ensure firms are adequately capitalised with risk-based capital. All valuations in this pillar are to be done in a prudent and market consistent manner.
- **Pillar 2** imposes higher standards of risk management and governance within a firm's organisation. This pillar also gives supervisors greater powers to challenge their firms on risk management issues. The Own Risk and Solvency Assessment requires a firm to undertake its own forward-looking self-assessment of its risks, corresponding capital requirements and adequacy of capital resources.
- **Pillar 3** aims for greater levels of transparency for supervisors and the public. There is a private annual report to supervisors, and a public solvency and financial condition report that increases the level of disclosure required by firms. Our current returns will be completely replaced by reports containing core information that firms will have to make to us on a quarterly and annual basis. This will ensure that, overall, a better and more up-to-date information on a firm's financial position is available.

(Financial Services Authority (FSA) 2013)

2.4.1.1 Insurance Theories

2.4.1.1.1. The Theory of Insurance Risk Premiums (IRP)

Insurance is the impartial transfer of the risk of a loss, from one party to another in exchange for a fee, called the premium. It is a form of risk management primarily used to guard against

the risk of a contingent, uncertain loss. According to Cutler & Zeckhauser (2003), the main aim of insurance is to move financial resources from low marginal utility of income states to those where the marginal utility of income is high. If this process of insurance is actuarially fair, the marginal utility of money is constant across states at a given point. When the process is unfair, insurance will be partial and the greater the risk aversion.

According to the theory of IRP, insurance premium should reflect both the expected claims and risk loadings; risk loadings to cover commissions, administrative costs, claim settlements, loading to cover profits and the risks taken by the insurer (Kahane, 1979) and the insurers price setting decisions is dependent on his ability to estimate expected claims and costs and the selection of a fair risk loading (Borsch 1970 in Kahane 1979). Thus the effectiveness of insurance is highest when the loss is common enough to attract attention but not frequent enough to be a routine which could cause low risk benefits and high risk loading (Cutler & Zeckhauser, 2003).

The Capital Asset Pricing Model (CAPM) has been used to calculate insurance premium and associated risks by authors like Kahane (1979), Borsch (1985), Cummins (1990) and Vaughn (1999) to be able to better illustrate and understand the relationship of the risks and returns in insurance. Meyer (1996) made this statement;

"It would be desirable to adopt this securities pricing model to the insurance pricing (and premium) problem. One approach would be to let the insurer play the role of the investor and the insurance policy or line of insurance play the role of the individual security and use CAPM directly"

According to Borsch (1985) CAPM has led to deeper insights to the functioning of the financial markets as a whole and thus following the CAPM the insurance premium theory should encompass; the stochastic element of risk, the stochastic relationship between a particular risk and the claims in the market as a whole, the attitude to risks in the market and the total assets of all insurance companies in the market, and proposes a fifth element which is the interest earned on premium before claims are paid by multiplying the premium by the appropriate discount factor. On Kahane's (1979) point of view, CAPM shows that there should be an objective market price per unit of risk, suggesting that insurance risk loading should be done objectively rather than subjectively from the point of view of the insurance company as regards their attitude towards risk, thus the CAPM is useful in generating the exact parameters for risk loading. According to Vaughn (1999), the major implication of the CAPM for insurance is that insurer's underwriting results cannot be considered in isolation because investors hold insurance stocks as part of a well-diversified portfolio. Thus the required rate of return on the

stock of an insurance company is dependent on the relationship between the stock's return and market portfolio's return. Cummins (1990) describes the correct application of the CAPM to the insurance pricing problem in a formulation where the premium is determined by equating the expected rate of return to the required rate of return. Besides, the required rate of return is determined in accordance with the CAPM by examining the relationship between the return on the insurance policy and the return on all securities in the financial market place.

2.4.1.1.2. Demand for Insurance

In analysing and examining the demand and supply of insurance, Grace et al., (2001) asserted that the demand for this market arises from the optimal choice of a particular bundle of insurance policies and company attributes by the consumer, given the personal characteristics of the insured party and its immediate environment. According to Nyman (2001) the theory of the demand for insurance is based on the theory of expected utility theory and an assumed preference for certain losses over uncertain ones of the same expected magnitude. Thus a high demand for insurance comes from a group of risk averse consumers, who get insurance to hedge against the risk of a loss under uncertain circumstances (Manning & Marquis 1996).

The expected utility hypothesis depicts that, when the price of insurance is fair to the consumer on an actuarial basis, a risk-averse consumer will prefer to fully insure against a potential loss (Cleeton & Zellner 1993). The only part that income has to play in affecting the level of demand for insurance at the "actuarially fair price" is to affect the size of the potential loss. The result of this effect is independent of the consumer's degree of risk aversion or how it varies with income. However, the consumer's degree of risk aversion and its relation to the consumer's income level must be considered at a price of insurance above or below the actuarially fair level, if we are to usefully describe consumer behaviour (Eckles & Wise 2011).

The basic assumption of the conventional expected utility theory is that a consumer's utility, U, is a function of disposable income, Y. Assuming a health insurance context, there is a probability, p, that the consumer will become ill and spend L on medical care. Otherwise, the consumer could purchase full insurance coverage for the actuarially fair premium of $P = pL$, for which the consumer would receive a payoff transfer, I, if ill. For simplicity, assume that I = L. Thus, expected utility without insurance is:

EUu = (I-P) U(Y) + pu (Y-L)

Expected utility with insurance is

$$EU_i = (I\text{-}P)\ U(Y\text{-}P) + pU(Y\text{-}L + I\text{-}P) = U(Y\text{-}P)$$

If marginal utility of income is diminishing, the consumer is better off paying P for insurance and avoiding the risk of loss, L. Thus, the expected-utility-maximizing consumer would purchase insurance coverage for these expenditures if

$$EU_i > EU_u ,$$

 or if

$$U(Y\text{-}P) > (1\text{-}p)U(Y) + pU(Y\text{-}L).$$

This assertion, however, is contradicted by empirical evidence by studies which found out that risk in uncertain conditions are preferred to risks under certainty when it comes to insuring against such risks. That is when the risk of a loss is known and anticipated, consumers are ready to accept and benefit from such losses and could possibly "exploit" the risk of a loss (Tversky and Kahneman 1990). The expected utility theory has been criticised on the premise that people will insure fully if, and only if, they face actuarially fair premiums. Since insurance firms have to at least cover their costs, market premiums have to be above the actuarially fair ones. Thus, *EU* (expected utility) provides a completely rational explanation of the widely observed phenomenon of under-insurance. However, *EU* is unable to explain several stylized facts from insurance (Nowaihi & Dhami 2010)

   Spinnewijn (2013) states that an individual's demand for insurance is dependent upon the risks involved, the individual's perception of the risk exposure and willingness of the individual to insure which in turn depends on the default option. He formulated a formula where he assumed that one type of insurance contract is offered and all individuals can buy this contract at the same price *p*. Individuals, however, differ in several dimensions: different preferences, risk types, perceptions, cognitive ability, wealth and liquidity. For any individual *i*, these characteristics jointly determine the true value of insurance v_i and the revealed value of insurance $\tilde{v}_i$. The true value *vi* refers to the actual insurance value for the individual and is assumed to be relevant for welfare. The revealed value $\tilde{v}_i$ equals the maximum price at which the individual buys insurance and thus reflects the individual's insurance demand. That is,

individual i buys insurance if and only if $\tilde{v}_i \geq p$, but maximizes her utility by buying insurance if and only if $vi \geq p$. I denote the difference between the true and revealed value by a simple noise term

$\varepsilon_i = \tilde{v}_i - vi.$

This difference is driven by demand frictions, which may be individual-specific. Hence, both heterogeneity in the true valuations and heterogeneity in the frictions drive the heterogeneity in the demand for insurance across individuals. This particular theory is important in this research as the perception of risk exposure to natural resource constraints is increasingly becoming a factor in determining the price and demand for insurance in resource related investments. Thus according to this theory, the price of insurance in investments related to natural resources is dependent on the risk involved with natural resources and the perception of such risks.

The demand for insurance by firms/companies, known as corporate demand for insurance, is based on, according to Michel-Kerjan et al (2009), the behaviour of firms under risks and uncertainty. If corporations were perfectly risk-neutral agents and simply profit maximizers, insurance priced above actuarially fair rates should not be attractive to them. Still, firms, small and large, do purchase such insurance, because they are required by law to do so (Michel-Kerjan et al 2009). Ashby & Daicon (1998) identify a number of factors which could influence the corporate demand for insurance; first, the risk averse nature of shareholders and managers could cause managers to purchase insurance, which stabilises corporate profits and be considered the "second best" solution to the "principal –agent" problem associated with corporate governance. Another point related to corporate governance was the need to control "agency" costs where the insurers monitor the organisation to ensure a group of shareholders are not taking actions at the detriment of others (Mayers & Smith 1987, Macminn & Han 1990). Many companies also demand for insurance because it could increase the firm's value through the reduction of the cost of financial stress, bankruptcy and liability to tax (Main 1982., Macminn 1987., Freeman & Kunreuther 1996); to signal private information and to fulfil the requirements given by creditors of the firm (Grace & Rebello 1993., Cheyne & Nini 2010).; and as part of a strategic move and motive on the part of the company in competitive environments (Seog 2006).

Thus the question is; is the demand for insurance by companies which deal directly with natural resources driven by the need to fulfil legal obligations (Michel-Kerjan et al 2009), risk

averse nature of management especially to natural resource risk (Ashby & Daicon 1998), to increase the firms value (Freeman & Kunreuther 1996) or to be part of a strategic move and motive on the part of the company in competitive environments (Seog 2006)?

2.4.1.2 Empirical Literature on Insurance and Resource Constraint

The view that climate change (and natural resource scarcity) is of strategic business importance is more prevalent within the insurance and reinsurance business than perhaps any other segment of the financial services industry (INNOVEST, 2002, pg. 17).

The role insurance companies' play in the global economy makes it vital for them to incorporate climate change and resource constraint in their investment decisions (Leurig & Dlugolecki 2013). Insurance companies are vulnerable to climate change and resource scarcity related risks through the activities of their clients who deal with the physical effects of such risks. As a result, insurers can expect to see increases in liability claims stemming from extreme climatic conditions and resource constraints (Stausboll 2012). According to Crichton (2002), climate change and resource constraint will have direct effects on the global insurance industry in terms of rising occurrence and severity of natural disasters and scarcity of vital resources. It will also have indirect effects, not only those arising from government actions to mitigate climate change, but also from likely increases in civil unrest and terrorism caused by poverty, famine, and water shortages. Climate change will need society to adapt, and it will be more vulnerable to "sideswipes" from such events as volcanic eruptions and earthquakes. In many cases, insurers will be in the "front line" in dealing with the aftermath of such events. Some insurers are beginning to take action, both to mitigate climate change and to encourage adaptation to its effects. Closer partnerships are needed between insurers and government to respond to these challenges, but as yet many remain to be convinced.

In a corporate and business environment that depends on historical events to price prospective risks, insurers are confronted by climate change with radically changing weather patterns and more recurrent and austere and extreme weather events as well as resulting resource scarcity. Thus the insurance companies' abilities to underwrite and price physical risks are challenged, posing a threat to insurance availability and affordability and creating new types of liability exposures (AES, 2011). Property and casualty insurers are already seeing more claims due to severe weather, health insurers may start to see more claims due to the

increased spread of disease and lack of adequate support due to scarce resources, and reinsurers are exposed to all of these losses (including paying a large portion of losses from catastrophic events) (Ceres, 2011). Insurers' sizable investment portfolios may also be affected by physical climate impacts on companies, countries, and infrastructure (Ceres, 2011). At the same time, insurance can be a key component of climate adaptation solutions for many sectors, governmental bodies, and private individuals (Gardiner et al., 2012)

Young et al., (2009) carried out a risk assessment for viable insurance industries in the USA in relation to resource constraints and climate change. Out of the 27 companies studied in this sector, 18 (67%) had no mention of climate change or related risks anywhere in their Security and Exchange Commisions (SEC) filings. 23 out of 27 companies (85%) failed to disclose their emissions or a statement on climate change, while 24 out of 27 companies (89%) omitted disclosure on actions to address climate change and resource constraint, despite the wide range of opportunities for new, climate-related insurance products. Mills *et al.,* (2012) investigated the risks and losses associated with resource scarcity and climate change on insurance companies and found out that weather related insurance losses in the US were rising significantly higher than economic growth, premiums and even population growth and government provided crop insurance were experiencing rising losses and causing twice as much economic damage compared to a few decades before. According to Leurig & Dlugolecki (2013), resource constraints through climate change seriously affects and changes the "insurer's business landscape" severely distorting the insurance industry's ability to allocate prices to physical and market losses (especially on business and life & health insurance), creating large-scale liabilities and threatening the performance of the industry's investment portfolios. However, they also assert that insurers with a significant level of asset management businesses have developed the culture of incorporating resource constraints and climate change in their development strategies in response to the growing number of institutional investors drive to building in climate change into their own strategies.

Changnon *et al.,* (1997) analysed the impact of extreme weather conditions and its implication on natural resource scarcity on the insurance industry in the USA between 1991 and 1994 and results showed that there was over $40 billion in insured losses, creating major impacts and eliciting diverse responses in the insurance industry. Compared to the 1960s and 1980s, these losses were 3.1 times more terms of economic losses, and 5 times more, in terms of insured losses (Hauffler 2006). Such losses incurred by insurance companies due to weather related events increased further to $45 billion in 2004 and $70 billion in 2005 (UNEP 2005). The property-casualty sector increased rates, created key changes in insurance availability in high-

risk areas, and stiffened underwriting restrictions in hurricane-prone areas, and made extensive assessments of weather risks and risks related to scarce resources. The reinsurance industry increased rates up to 200%, sought and received funds from the financial markets, and developed new firms. However, some existing firms also withdrew from the marketplace, crop losses led to major changes in the nation's crop insurance program and the property casualty and reinsurance sectors, which experienced the greatest losses, gained a greater appreciation of the need to incorporate atmospheric data, information, natural resource constraints and expertise into their operations (Changnon *et al.,* 1997).

Dlugolecki (2008) asserted that climate change matters to the insurance sector. In terms of underwriting risks, on one instance, could cause the economic cost of weather losses to reach over $1 trillion in a single year by 2040. These effects could worsen in developing countries and collaboration between the private sector and the public sector is necessary, as part of a "triple dividend" approach to coordinate adaptation, disaster management and sustainable economic development. Political instability, as a result of resource scarcity, is a serious blockage to market forces, and the re-evaluation of assets and project returns is happening too slowly. Therefore, due to risks faced by the insurance company, insurers have a duty as ubiquitous players in the economy and society to help to shape climate policies in a responsible and effective way. According to Gardiner et al., (2012), the insurance sector has a distinctive and wide-ranging susceptibility to the physical impacts of climate change, not really because of the risks climate change (and resource scarcity) posed to insurance companies' facilities or employees, but rather because the industry is accountable for insured losses caused by weather-related perils, such as floods, storms, and wildfires and the scarce natural resources as a result.
  Hecht (2008) stated in his empirical survey of the effect of climate change on insurance that climate change creates an extraordinary challenge to the insurance industry, because factors such as increasing uncertainty, have financial consequences to businesses and individuals and the potential for highly associated losses in vital resources could make it tough to insure against climate change-related risks and could put pressure on the capital markets and their ability to compensate those who are affected. He further went on to say that if the insurance industry rises to the challenge, it stands the chance to profit while facilitating our most successful responses to climate change related threats around the world. If not, insurers will suffer along with everyone else. A report issued recently by a major financial services firm identified climate change (and resource scarcity) as the top two "strategic threats" facing the insurance

industry, noting that it is a "long-term issue with broad-reaching implications that will significantly affect the industry" (Maynard, 2008).

2.4.2 Pensions

2.4.2.1 Pension Theories

2.4.2.1.1. Defined Benefit and Defined Contribution Pension Plans

A pension is an agreement for a fixed amount to be paid on a regular basis to an individual following retirement from service. There are basically two broad categories of pensions; the defined benefit and the defined contribution (Bodie et al., 1988; Yang, 2004).

The defined benefit (DB) plan defines the entitlement of the employee's pension benefit is determined by a formula which takes into consideration the number of years of service for the employer and, in most cases, the wages or salary, in other words a function of both years of service and wage history. Most defined benefit formulas also take into consideration the social security benefits to which an employee is entitled (Bodie et al., 1988). And this type of benefit is provided by the government, through the social security system, in most countries to their retirees (Cocco & Lopes, 2004). According to Yang (2004), the down side of the defined benefit scheme, especially for young employees, is that if an employee leaves a job before retirement, the DB pension is usually frozen without "future indexation" and consequently when the benefit is sought at retirement it could be affected by inflation.

For the defined contribution (DC) plan each employee has an account into which the employer and, if it is a contributory plan, the employee makes regular contributions. Benefit levels depend on the total contributions and investment earnings of the accumulation in the account. Defined contribution plans are, in effect, tax deferred savings accounts in trust for the employees, and they are by definition fully funded. And the probable only significant downside to the DC scheme, according to Yang (2004), is the risk faced by the employee on his investment portfolio's return on an annual basis. Early termination does not affect the pension scheme as the account can be transferred to a new employee account and continue to accumulate investment returns.

A considerable amount of empirical literature has examined the trade-off and shift from the DB to the DC pension scheme, examining it particularly from the risks involved (Bodie et al., 1988; Cocco & Lopes, 2004; Yang, 2004; Broadbent et al., 2006), where the general consensus is that one of the major trade-off and reason for shifts in pension plan is the risk involved with

interest rate and wage uncertainty. With regards to interest rates, though the DB plan may seem to guarantee interest rates at retirement by offering life annuities, these interest rates are nominal and not real interest rates which is highly questionable in terms of future inflation rates. While DC plans can offer at retirement the same nominal interest rate guarantee through the purchase of deferred life annuities as a DB plan, even though these interest rates may be uncertain in terms of the stock of benefits available at retirement.

On investment risk and performances (Bodie et al., 1988; McCarthy, 2003), though the investment risks in DC are prominent, it could be controlled and thus does not pose any significant risk on participants and provides flexibility in selecting risk-return strategies according to the individual preferences of the employees. The DB plans, on the other hand, force individuals to save the pension in the form of life annuities, limiting the risk-return choice. In terms of termination and portability (Bodie et al., 1988; Childs et al., 2002; Yang, 2004; Broadbent et al., 2006), it is asserted that the DC plan is more desirable by young employees, employees with high turnover rates, high risk aversion and high contribution rates because this plan can hedge against job change risks and flexibility in changing pension accounts. On the other hand, the DB plan could be preferred by employees with higher accrued benefits and more years of service. (Aaronson & Coronado, 2005; Broadbent et al., 2006) one of the reasons for the general trend from DB to DC schemes was due to structural shifts in labour markets such as changes in industrial mix of employment and increasing labour mobility. Information and familiarity to the stock market have caused employees to prefer to have their savings directed to the DC plan. With regards to incentives and taxes, Broadbent et al., (2006) found that DB plans are governed by rules contained in pension legislation, regulation, and tax policy that, over time, have become increasingly complex and costly to administer and thus less desirable especially on the part of employers.

The recent fast paced movement of pension plans towards DC plans due to factors such as; pension under-funding and its tenacity as a result of the fall in long-term interest rates, the increase in regulatory burden and uncertainty and the recognition of the impacts of increased longevity on plan costs and the move to more market based accounting. Since DC contributions can be fixed as a predictable share of payroll, migrating to a DC plan offers employers a means of reducing balance sheet and earnings volatility at least over the long term.

2.4.2.1.2. Financial Theory of Pensions

"Classical financial theory offers a normative prescription for pension fund asset allocation that rejects the widely adopted portfolio selection theory favoured by practitioners in favour of close asset and liability matching" *(Exley et al., 2003, pg. 5).*

To begin with Exley et al., (1997) came up with the reasons, from the survey by the Department of Social Security (DSS), as to why private organisations provide pensions; to provide for employees after retirement and at old age, reward a specific group of employees and recruitment and retention. From the point of the DB plan, a high risk investment strategy appears to be detrimental in the joint event of bankruptcy and a pension fund shortfall, which could be the cause of a reduction in benefits. However, the probability of corporate bankruptcy is generally minimal and the overall preference for a low risk investment strategy arising from this scenario may not be particularly marked.

2.4.2.1.3. Neoclassical Theory of Pensions

The defined benefit pension has been the centre of attention recently and a lot has been written about alternative methods of its provision. Most of the literature takes the view centred primarily on the scheme participants, or their trustees. More recently, the viewpoint of the investors in a company has been the area of emphasis and concern.

Existing neoclassical economic theory in the area of DB pension schemes begins with the work of Black (1980) and Tepper (1981), but draws on the pioneering work of Modigliani and Miller (1958). More recent work in the United Kingdom includes Exley, et al., (1997). There seems to be a general consensus as to the basic theory underlying pension provision. The general conclusions include;

First of all, in the first order, the cost of the provision of a DB pension scheme is independent of the way it is funded, if it is funded at all. In particular, shareholders do not gain from an equity investment policy over bond investment (Exley et al., 2003).

The second-order effects of the DB plan are the credit risk of the scheme (including the risk of non-portability), and also the possibility of outflow of surplus to members in the form of superior benefits. These are affected by the asset mix of the scheme. However, these effects

are all zero sum, in that a gain to members is a loss to shareholders, and vice versa. So, to the extent that members and shareholders recognize these issues, the cost will already be factored into the members' equilibrium compensation package. There is, again, no overall gain to shareholders or members from picking one investment mix over another.

Other second-order effects to this pension scheme include various frictional costs, including transaction costs, capital raising and distribution costs, fund management fees, agency costs and tax. For various reasons, most of these suggest there is a very substantial joint gain to members and shareholders from investing a pension scheme in government or corporate debt securities. The neoclassical theory is very elegant and easy to understand. The main conclusion for investment is that members and shareholders usually have a joint advantage in holding debt securities. However, this conclusion is at an obvious variance with current practice, at least in the United Kingdom, where the majority of pension schemes hold a very significant part of their assets in equities.

2.4.2.1.4. Theory of Underfunding

The theory of underfunding of pensions, according to Cooper & Ross (2002), is based on the perspective of the optimal contacting theory and centres on the part played by pensions in replacing missing insurance and borrowing opportunities for workers. From their analysis of the US pension system, underfunding can be attributed to moral hazards as a reaction to the presence of pension benefit insurance. Two circumstances were examined where pension costs were too high and underfunding occurred as a result of either capital market imperfections or portfolio restrictions on the allocation of pensions; borrowing restrictions and interest rate differentials (Cooper & Ross 2002).

The problem of borrowing restrictions gives a better understanding into insufficient capital as one source of underfunding. The problem is simply that the firm does not have sufficient internal financing to credibly commit to repaying a loan. Consequently, the firm is forced to underfund the pension. Thus, workers are exposed to the risk of low productivity and consequently low retirement pay. The shortage of funds creates an incentive for an upward sloping compensation profile in the optimal contract. In this way, the marginal utility of consumption in the first period is set equal to the expected marginal utility of consumption in the second period. Another reason for underfunding comes from the cost of creating pension funds when the opportunity cost of funds surpasses the returns on pension fund investments. This opportunity cost could be the result from two main reasons; there could be restrictions on

the regulation of pension portfolios which could reduce the return on investment and distortions in capital markets (Bernanke et al (1999).

An alternative explanation of underfunding was given by Ippolito (1985), where the underfunded portion of the pension fund is held as a ''hostage,'' by firms to prevent trade union from taking actions like making excessive wage demands, for instance, that threaten the long-term viability of the firm. An underfunded pension plan makes employees bondholders of the firm, giving them an important stake in its continued operation. Since this hostage thwarts opportunistic behaviour, it gives room for the achievement of more efficient outcomes and is in fact even preferred by the union.

2.4.2.2 Empirical Literature on Pensions and Resource Constraint

According to Leurig & Dlugolecki (2013), a rising number of institutional investors outside the insurance industry are already taking concrete steps to managing climate-related risks in their portfolios. For instance, the California Public Employees' Retirement System (CalPERS), the largest public pension fund in the United States, requires these risks to be built into portfolio construction decisions across all asset classes. In the study carried out by Jones et al., (2013), on the effect of resource constraints on actuarial assumptions, state that resource constraints caused lower returns on assets and higher costs for pension schemes in an actuarial model. Results also showed that defined benefit schemes could become insolvent in 35 years due to limitations to growth as a result of natural resource scarcity.

2.4.3 Banking

2.4.3.1 Theories on Banking

Empirical literature on financial intermediation suggests that commercial banks can potentially solve adverse selection and moral hazard problems caused by the imperfect information between borrowers and lenders, by their screening and monitoring function. From the information obtained from checking account transactions and other sources, banks assess and manage risk, write contracts, monitor contractual performance, and, when required, resolve non-performance problems. (Bhattacharya and Thakor, 1993 in Hughes & Mester, 2008).

2.4.3.1.1 Theory of Bank Behaviour and Capital Regulation

According to Rime (2001), capital regulation is highly influenced by the concern that a bank may possess less capital than is accepted as socially optimal relative to its riskiness as the market capital requirements do not reflect the negative externalities resulting from bank default. Under this theory, Van Hoose, (2007) encompassed the main idea of the behaviour of banks under capital regulation under three categories; capital-constrained portfolio selection, capital requirement, incentives and moral hazard and capital regulation, adverse selection and monitoring in a diverse banking system.

  The first step to examining the capital-constrained portfolio selection is to regard banks as managers of a portfolio of assets (Van Hoose, 2007). Some literature like Kahane (1970) and Koehne & Santomero (1980) study a mean–variance portfolio selection model where a representative bank takes asset prices and yields as given and decides on its optimal portfolio with the purpose of maximizing the expected utility derived from the end-of-period capital, which in turn depends on the degree of the bank's risk aversion as measured by the coefficient of relative risk aversion. Kahane (1977) suggests that capital regulation cannot reduce overall bank portfolio risk unless the asset composition of the bank's portfolio is also subjected to regulation. On the other hand, according to Keeley & Furlong (1990), an unregulated bank will take excessive portfolio and leverage risk (risks higher than the first best) in order to maximise shareholder value at the expense of deposit insurance.

  According to Kim & Santomero (1988), the main reason for capital requirements is to minimise the possibility of increased risk caused by the mispricing of deposit insurance. Furlong and Keeley (1989) incorporate the option value of deposit insurance into a state-preference model of a representative bank with an objective function that is linear in expected return. Their conclusion is that an increase in bank capital is unambiguously associated with a reduction in the level of bank asset risk. Gennotte and Pyle (1991) on the other hand look at a situation where banks raise a fixed amount of deposits and choose among a set of loan portfolios with different net present values and risks and extend loans with non-zero net present values. Here, deposit insurance subsidizes banks, which invest to the point at which the subsidy on the marginal dollar offsets the negative present value of the marginal investment. If a bank's marginal costs increase with risk – which occurs when the asset portfolio is a combination of

investments in safe and risky assets – then the bank responds by increasing the fraction invested in the risky asset, and its scale decreases. There are two effects of a capital tightening on the probability of bankruptcy which include; increased asset risk, which increases the bankruptcy probability and reduced leverage, which reduces the bankruptcy probability. The ratio of the elasticities of the net present value of investments with respect to the mean and variance of the present value determines which effect dominates (Rimes 2001).

Therefore, in an attempt to minimise risk, banks could choose portfolios with less risky assets, in the case where the risk weights used in the computation of capital ratios are proportional to the market or systematic risks of the assets and in that way the risk based capital standards could become relevant (Rochet 1992).

Regarding incentives and capital requirements, Blum (1999) studied the inter-temporal effect of capital regulation in a dynamic framework. According to his model, if it is too costly for the bank to raise capital ratio to meet the capital standard in the future, then the bank would increase its risk investments at present to meet this standard. Calem & Rob (1999) found a u-shaped relationship between the capital position of a bank and the amount of risk it takes, where undercapitalised banks take more risks and banks with higher capital take less risk, then as capital increases it takes on more risk. Milne (2002) asserts that the main effects of capital regulation operate through banks' efforts to avoid ex post penalties imposed by regulators if violations of capital adequacy standards take place. This perspective suggests seeking to reduce banks' risk-taking behaviour by toughening regulatory penalties rather than assessing more stringent or more requirements tied to asset risks.

According to Balthazar (2006), given the vital function of banks in the economy, it is no surprise they are being subject to much constrain and regulation. The next few paragraphs will be looking at the main regulation of the banking system in most developed countries which is governed by the Basel Committee on Banking Supervision (BCBS), known as the BASEL regulations (BASEL I, II and III). It will also look at each of these regulations and how the weaknesses of BASEL I led to the development of BASEL II and reasons for the issue of BASEL III.

BASEL I

Given the long history of bank crisis due to tight regulations (1863-1977) and deregulations and presence of competitors (1979-1988) (Balthazar 2006), the Basel Committee on Banking Supervision in 1988, developed the BASEL 1988 Capital Accord also known as BASEL I.

BASEL I made emphasis on credit risk by defining capital requirements by the function of a bank's on- and off-balance sheet positions. The two stated main objectives of the initiative were:

- To strengthen the soundness and stability of the international banking system.
- To diminish existing sources of competitive inequality among international banks.

The guidelines were designed to delineate a "minimum capital level", but national supervisors could implement stronger requirements. It was also expected to be functional in internationally active banks, but many national banks applied it as well.

The key principle of the solvency rule was to assign to both on-balance and off-balance sheet items a weight that was a function of their estimated risk level, and to require a capital level equivalent to 8% of those weighted assets.

In 1998, the BASEL accord incorporated market risks into the regulations. Market risk was defined as "the risk of losses in on- and off-balance sheet positions arising from movements in market prices." The main risks to look out for were:

- The interest rate risk and equities risk in the trading book

- The foreign exchange risk and commodities risk throughout the bank.

Despite the positive impacts of BASEL I in creating a "worldwide benchmark" on bank regulations and decreased bank failure to some extent, it had a lot of deficiencies. Its main weakness was the issue of capital arbitrage. Capital arbitrage was the response by sophisticated banks (given sophisticated quantification techniques) where these banks make an arbitrage between regulatory and economic capital to line them up more diligently. Given that these new operations are priced correctly; they will increase the returns to the shareholders unlike the destruction of shareholder value when trying to keep up with capital requirements. However, the more this practice spread and the more it was facilitated by financial innovations, the less the 1988 Basel Capital Accord remained efficient.

Other main weaknesses BASEL I, included:

- An incomplete coverage of risk sources as it focused only on credit risk ignoring other risks
- A limited recognition of collateral.
- No recognition of diversification.
- The lack of risk sensitivity.

- A "one-size-fits all" approach. The requirements are virtually the same, whatever the risk level, sophistication, and activity type, of the bank.
- An arbitrary measure. The 8% ratio is arbitrary and not based on explicit solvency targets.

(Balthazar 2006)

As a result of these weaknesses, BASEL II was issued in an attempt to address these weaknesses and improve on regulation.

BASEL II

In an attempt to address the weaknesses of BASEL I, BASEL II was developed in 2004 after six years of elaborate discussion and three Quantitative impact studies (BCBS 2005). The accord had three main objectives;

- To increase the stability and quality of the banking sector
- To maintain a level field for internationally active banks
- To adopt stricter risk management policies

The third objective was an indication of a shift to a regulation that recognised and relied more on internal data, practices and models from a ratio based regulation.

BASEL II is structured in three main pillars;

- The first pillar "Pillar 1" is the solvency ratio. The BASEL I's 8% requirement is still the reference value, but the assets weighing procedure is different. The values from BASEL II are derived explicitly from a standard simplified credit risk model unlike that of BASEL I which were just rough estimates. Thus capital requirements are closely aligned to economic capital.
- Pillar 2 is grounded on internal controls and supervisory review. Banks are required to have internal systems and models for the evaluation of their capital requirements in accordance to the regulatory framework and incorporate the banks' particular risk profile. It is required, also, that banks incorporate risks which are not fully covered by the Accord.
- Market discipline is the 3rd pillar of BASEL II, where banks are required to construct complete reports on their internal risk management systems and on the way the Basel II is being executed, which should be published in the market semi-annually.

Thus BASEL II was an improvement from BASEL I by; increasing sensitivity of capital requirements to risk, recognized risk reduction techniques, was more flexible by leaving options at the discretion of national supervision, increased power of national regulators and introduced regulatory capital need for operational risk.

However, BASEL II had been influential in investment decisions, since its publication, in a way that stimulated many risky lending practices which were the main cause of the financial crisis (Lall, 2009). Thus the crisis exposed the weaknesses of BASEL II and brought about the need for these regulations to be tightened as well as the fast growing innovative risk management techniques needed as the scope of risks integrated into the banking system have widened due to other issues like climate change and resource scarcity. Such weaknesses include;

- The capital requirements based on the Basel II regulations were cyclical and therefore reinforced business cycle fluctuations
- The valuation of credit risk was given to non-banking institutions, such as rating agencies, who could be subject to possible conflicts of interest
- The average level of capital required by the new discipline was inadequate and this was one of the reasons of the recent collapse of many banks
- The key assumption that banks' internal models for measuring risk exposures are superior than any other has proved wrong (Henry & Majid, 2011)

As a result, BASEL III is being developed.

BASEL III

In response to the financial crisis of 2007/2008 which exposed the shortcomings of the financial system, and its interdependent nature the G20 came up with a set of new international framework regulations for banks; BASEL III (Georg 2011).

Basel III is a wide-ranging set of reform measures, developed by the Basel Committee on Banking Supervision, to reinforce the regulation, supervision and risk management of the banking sector (Basel Committee on Banking Supervision (BCBS) 2010b). These measures aim to:

- Improve on the risk management and governance of the banking sector
- Improve on the ability of the banking sectors to absorb shocks arising from financial and economic stress, regardless of the source

- Fortify the banks' transparency and disclosures. And the reforms target:

- The macro-prudential, system wide risks that could develop and accumulate across the banking sector as well as the pro-cyclical amplification of these risks over time.

- The bank-level, or micro-prudential, regulation, which will help raise the resilience of individual banking institutions to periods of stress.

These two approaches to supervision are complementary as greater resilience at the individual bank level reduces the risk of system wide shocks (Basel Committee on Banking Supervision 2010b).

BASEL III Liquidity Rules

The main aim for the BASEL III liquidity rules is to promote a more resilient banking sector, improving the sector's ability to absorb shocks arising from financial and economic stress, and thus reducing the risk of spill over from the financial sector to the real economy (BCBS 2010). The difficulties experienced by some banks during the "liquidity phase" of the financial crisis, were due to lapses in basic principles of liquidity risk management. The BCBS, in response to these difficulties, as the foundation of its liquidity framework, published the Principles for Sound Liquidity Risk Management and Supervision ("Sound Principles").

These Principles provide detailed guidance on the risk management and supervision of funding liquidity risk and should help promote better risk management in this critical area, but only if there is full implementation by banks and supervisors. As such, the BCBS will coordinate rigorous follow up by supervisors to ensure that banks adhere to these fundamental principles. The principles encompass regulatory standards and monitoring tools for liquidity. The regulatory standards include;

- Liquid Coverage ratio (LCR); The standard requires that the value of the ratio to be no lower than 100% (the stock of high-quality liquid assets should at least equal total net cash outflows)

- Net Stable Funding Ratio; The amount of available amount of stable funding to the amount of required stable funding. This ratio must be greater than 100%

And the Monitory tools include

- Contract Maturity match; Contractual cash and security inflows and outflows from all on- and off-balance sheet items, mapped to defined time bands based on their respective maturities

- Concentration funding; Identify those sources of wholesale funding that are of such significance that withdrawal of this funding could trigger liquidity problems.
- Available unencumbered assets; that are marketable as collateral in secondary markets and/or eligible for central banks' standing facilities
- LCR by significant currency; allows the bank and the supervisor to track potential currency mismatch issues that could arise.
- Market-related monitoring tools; Monitor Data from market wide information and information from the financial sector.
(BCBS 2010)

BASEL III Capital Rules

The financial crisis of 2007/2008 accompanied the gradual erosion of the capital base held by the banking sector. Thus the BCBS is raising the resilience of the banking sector by strengthening the regulatory capital framework, building on the three pillars of the Basel II framework. The reforms raise both the quality and quantity of the regulatory capital base and enhance the risk coverage of the capital framework. These reforms;

- Raise the quality, consistency and transparency of the capital base
- Enhance risk coverage
- Supplement the risk-based capital requirement with a leverage
- Reduce procyclicality and promoting countercyclical buffers

For the minimum capital requirements, BCBS defined capital into two categories; Tier 1 Capital (Common equity tier 1 and additional tier1) and Tier 2 capital. The limits were set at;

- Common Equity Tier 1 must be at least 4.5% of risk-weighted assets at all times.
- Tier 1 Capital must be at least 6.0% of risk-weighted assets at all times.
- Total Capital (Tier 1 + Tier 2) must be at least 8% of risk weights assets at all times.

Below is a figure which summarises these three regulations and the flow from one regulation to the other.

```
┌─────────────────────┐      ┌─────────────────────┐      ┌─────────────────────┐
│       BASEL I       │      │       BASEL II      │      │      BASEL III      │
│     OBJECTIVE       │      │     OBJECTIVE       │      │     OBJECTIVES      │
│  To strengthen the  │      │ To increase the     │      │ Improve on the risk │
│ soundness and       │      │ stability and       │      │ management and      │
│ stability of the    │  ▶   │ quality of the      │  ▶   │ governance of the   │
│ international        │      │ banking sector      │      │ banking sector      │
│ banking system.     │      │ To maintain a level │      │ Improve on the      │
│  To diminish        │      │ field for           │      │ ability of the      │
│ existing sources of │      │ internationally     │      │ banking sector's to │
│ competitive         │      │ active banks        │      │ absorb shocks       │
│ inequality among    │      │ To adopt more       │      │ arising from        │
│ international banks. │      │ strict risk         │      │ financial and       │
│                     │      │ management policies │      │ economic stress,    │
│      CRITIC         │      │                     │      │ regardless of the   │
│  Capitl arbitrage   │      │      CRITIC         │      │ source              │
│  Less risk Sensitive│      │ Financial crisis    │      │ Fortify the banks'  │
│  No diversification │      │ exposed weaknesses  │      │ transparency and    │
│  No recognition of  │      │ and need to tighten │      │ disclosures.        │
│  collateral         │      │ regulations for     │      │                     │
│                     │      │ less vulnerability  │      │                     │
└─────────────────────┘      └─────────────────────┘      └─────────────────────┘
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Fig 2; BASEL I to BASEL III

It can be seen from the figure that the weaknesses of one regulation necessitated the need for an improved regulation.

2.4.3.2 Empirical Literature on Resource Constraints and Banking Activities

Very little literature has been identified which regards natural resource scarcity as a whole or the prices of individual resources, like food, oil and gas, as the direct cause or possible causes of poor bank performance or that they could affect bank performance. However, a large volume of literature identifies causes of poor bank performance to be; illiquidity, rapid asset growth, cost inefficiency, low equity capital, low profitability, high business, commercial and real estate loans and low asset quality or non-performing loans (Schaeck, 2008; Young & Torna, 2013). Nevertheless, scarcity and the consequent high price of natural resources could be the underlying cause of the above mentioned predictors of poor bank performance and could also affect bank profitability through trade interdependence, inflation, economic growth and market interest rates (Kosmidou *et al.,* 2012). There is limited empirical literature on the relationship between resource constraints and banking activities which is mainly centred on monetary policy, interest rates and inflation.

Cologni & Manera (2005), assert, that for most of the countries considered in their investigation (G7), the impact of unexpected oil price increases is reflected on interest rates which suggest a contractionary monetary policy response in order to fight inflation rates.

Ratti & Vespignani (2014) introduced a global factor-augmented error correction model to compute the relationship between oil price and the global economy. Global factors were constructed for global oil price and global interest rate, money, real output and inflation over 1999-2012. The global factors were constructed to get a clear picture of developments in the largest developing and developed economies. The quantity theory of money operates at a global level where output, prices and global money are cointegrated with each other. Positive changes in global money, CPI and outputs is connected with increase in oil prices while positive changes in global interest rate are associated with decline in oil prices. Thus oil prices mainly affect the banking system through interest rates.

2.4.4 Investment

Investment in economics and business is the purchase and accumulation of new physical property like new buildings in the hope of improving the business and for better profit. But in finance, investment is the procurement of an asset or item with the expectation that it will create revenue or increase in value in the future and be sold at the higher price. The term investment is usually used when referring to a long-term outlook. Investments are often made indirectly through intermediaries, such as pension funds, banks, brokers, and insurance companies. These institutions may pool money received from a large number of individuals into funds such as investment trusts. The theoretical and empirical literature below encompasses the investment in the financial sector and how resource constraints could affect the returns on such investments.

2.4.4.1 Investment Theories

2.4.4.1.1 Modern Portfolio Theory (MPT)

The MPT is an investment theory which provides investors with a framework to be able to optimize their risk and return from a set of portfolios of stocks and bonds (Orman & Duggan, 1999). It basically attempts to maximize the amount of return of a portfolio, given a certain level of risk and also minimizes the amount of risk in a portfolio for an amount of expected return (Taleb, 2007).

The MPT is based on the following assumptions;

- All investors aim to maximize profit and minimize risk.

- All investors act rationally and are risk averse.

- All investors receive the same information at the same time.

- Investors do not need to pay any taxes or transaction costs

- Investors can buy any security of any size

- Investors can lend or borrow any amount of securities at the risk free rate

- Investors are price takers and their actions do not influence prices

- The correlations between assets are always fixed and constant

- Return on assets are normally distributed

- Investors have the exact idea of potential returns

From the above assumptions, Horn (1999) identified two main principles of the MPT; the price of an asset is determined by two factors (the rate of total expected return and the risk that the actual return maybe lower than the expected return) and capital markets are efficient. From the first principle, it is noted that investors are risk averse and will definitely choose an asset with less risk. This implies that if investors are given two portfolios that offer the same expected return to choose from, investors will prefer the less risky one. Thus, an investor will take on increased risk only if compensated by higher expected returns. Contrariwise, an investor who wants higher expected returns should be prepared to accept more risk. The exact trade-off will be the same for all investors, but different investors will evaluate the trade-off differently based on individual risk aversion characteristics. The implication is that a rational investor will not invest in a portfolio if a second portfolio exists with a more favourable risk-expected return profile – i.e., if for that level of risk an alternative portfolio exists that has better expected returns.

The MPT utilizes mathematical models to create an idyllic portfolio, for an investor, which gives maximum return given his level of risk appetite by considering the relationship between risk and return. According to the theory, each security has its own risks and that a portfolio of diverse securities shall be of lower risk than a single security portfolio. Simply put, the theory emphasizes on the importance of diversifying to reduce risk. Early on, investors emphasized on individually picking combination of high yielding stocks to earn maximum profits. So if

one particular industry was offering good returns; an investor would have landed up picking all stocks of his portfolio from the same industry thereby making it a highly unwise act of portfolio management. Although it was intuitively understandable, the Portfolio Theory was the first of its kind to mathematically prove it. The main outcome of the Portfolio Theory (Taleb 2007) is that with optimum diversification, the risk weight of a portfolio shall be less than the average risk weights of the securities it contains. Thus an investor can reduce the level of risk by holding a basket of securities that are not perfectly positively correlated, in other words hold a "diversified" portfolio of assets which may allow for the same expected return as a single portfolio but at a lower risk level. This is because of the high probability of correlated risks related to resource constraints.

On the decision about the ideal combination of assets, the investor must consider the tradeoff between the risk and reward. According to the theory, every possible combination of securities can be plotted on a graph comprising the standard deviation of the securities (risks) and their expected returns on its two axes. The collection of all such portfolios on the risk-return space defines an area, which is bordered by an upward sloping line. This line is termed as the "efficient frontier". The collection of Portfolios which fall on the efficient frontier are the efficient or optimum portfolios that have the lowest amount of risk for a given amount of return or alternately the highest level of return for a given level of risk. Consider the figure below.
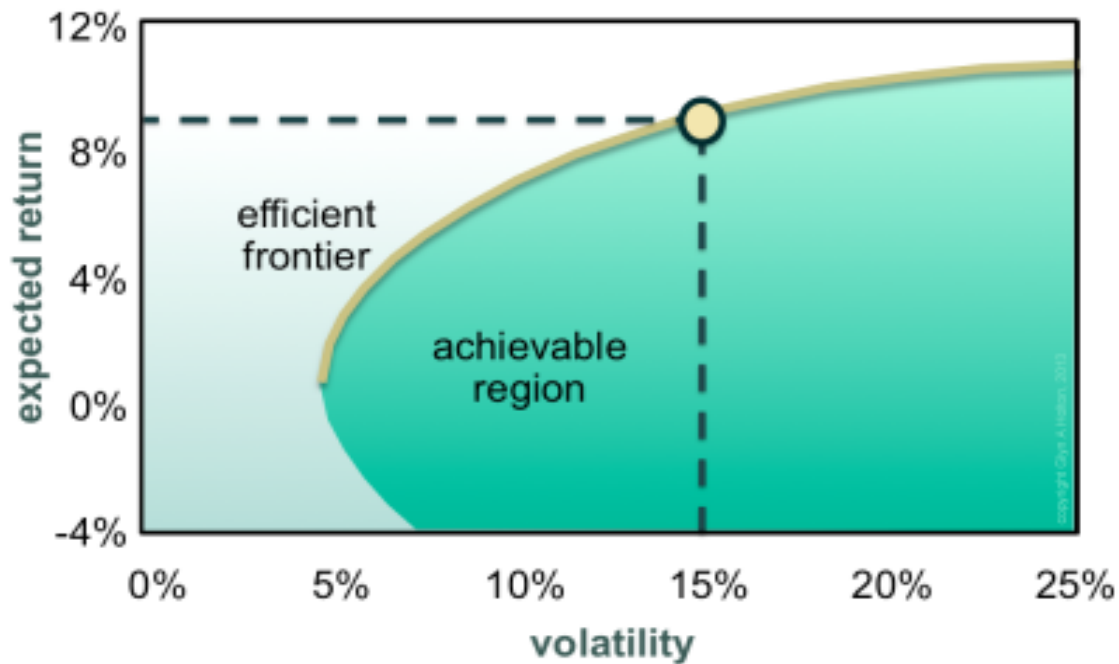
Fig. 3. Portfolio Efficiency Frontier (Taleb 2007)

From figure 3 above, for every point in the achievable region, there will be at least one portfolio derived from the assets having the level of volatility and expected returns corresponding to that point. The efficient frontier is the coloured curve that runs above the achievable region and the portfolios on this curve offer maximum expected return for a given level of risk and minimum risk for a given level of return.

The MPT has been applied to the analysis of the investment in natural resources. For instance, Domingues et al., (2001) investigated the application of the MPT for electrical energy markets in Europe and it was concluded that the MPT plays a decisive role in electric markets and in models of pricing establishment developed over the last decades. Also Orman & Duggan (2004) also assessed the application of the MPT in upstream investment decision making by the Exploration and Production (E & P) companies concerning investment in oil, and they found out that by incorporating risk throughout the portfolio-selection process, a company's strategic information system becomes far more robust and meaningful.

2.4.4.1.2. Capital Pricing Asset Model (CAPM)

The CAPM is a follow up of the portfolio theory, where the investor is assumed to be risk averse and cares only about the risk and return trade-off of the portfolio (mean and variance of their one period investment return) (Fama & French, 2004). The capital asset pricing model provides a theoretical structure for the pricing of assets with uncertain returns. The premium to induce risk-averse investors to bear risk is proportional to the non-diversifiable risk, which is measured by the covariance of the asset return with the market portfolio return (Bollerslev et al., 1988). The CAPM turns the portfolio asset weight mean variance efficiency into a testable prediction about the relationship between risk and expected return by recognizing a portfolio that must be efficient if asset prices are to clear the market of all assets. The assumptions of the CAPM are;

- All investors choose mean-variance efficient portfolios with a one- period horizon, although they need not have identical utility functions;
- All investors have the same subjective expectations on the means, variances, and covariance of returns;
- The market is fully efficient in that there are no transaction costs, indivisibilities, taxes, or constraints on borrowing or lending at a risk-free rate

The general idea behind CAPM is that investors need to be compensated in two ways: time value of money and risk. The time value of money is represented by the risk-free (rf) rate in the formula and compensates the investors for placing money in any investment over a period of time. The other half of the formula represents risk and calculates the amount of compensation the investor needs for taking on additional risk. This is calculated by taking a risk measure (beta) that compares the returns of the asset to the market over a period of time and to the market premium (Rm-rf).

$$R_a = R_f + \beta_a (R_m - R_f)$$

Where

R_a = return on asset

R_f = risk free rate

βa = beta of security

R_m = expected market return

Here the difference between the expected return on asset and the risk free rate is thus seen to be the product of the risk of the asset and the market price of risk. Investors are thus only rewarded for the systematic risk and not the risk attributed to a single asset. In other words, investors are less concerned with the variance of a single asset and more concerned if the assets return co-varies with the overall market return.

2.4.4.1.3. Efficient Market Hypothesis (EMH)

The EMH is based on the first three assumptions of the MPT. The efficient market hypothesis is also linked with the idea of a "random walk," which is a term roughly used in empirical finance literature to portray a price series where all subsequent changes in prices represent random movements from previous prices. The reasoning behind the random walk idea is that if the flow of information is unhampered and information is immediately reflected in stock prices, then tomorrow's price change will reflect only tomorrow's news and will be independent of the price changes today (Malkiel 2003).

The efficient market hypothesis is mainly concerned with the behaviour of prices in asset markets and states that asset prices in financial markets should reflect all available information therefore asserting that markets are efficient on the basis of current information (Beechey et al., 2001). Fama (1991) defines it as asset prices reflecting all the relevant and available information implying that markets process information in a rational manner such that the relevant information is not ignored and no systematic errors made and thus prices are at levels consistent with information. According to Timmerman and Granger (2004), three basic points are noted in the literature of the efficient market hypothesis; the importance of the information set adopted, the ability to exploit this information in a trading strategy and finally that the yardstick for testing if the efficient market hypothesis holds is measured in economic (i.e. risk-adjusted and net of transaction costs) profits.

There are three basic forms in which market efficiency can be portrayed; the weak form, semi strong form and the strong form (Fama, 1970; Fama, 1991; Timmermann & Granger, 2004; Milionis 2006).

In the weak form efficiency, future prices cannot be anticipated by analysing prices from the past. Surplus returns cannot be earned in the long run by using investment strategies based on

historical share prices or other historical data. Technical analysis and /or chartist techniques will be unable to steadily produce excess returns, and share prices exhibit no "serial dependencies", meaning that there are no "patterns" to asset prices. This implies that future price movements are determined entirely by information not contained in the price series. Therefore, prices must follow a random walk (Fama 1991). This weak EMH does not require that prices remain at or should be near equilibrium, but only that market participants will not be able to systematically profit from market 'inefficiencies'. However, while EMH predicts that all price movement is random (i.e., non-trending), except a change in fundamental information is observed, empirical literature has shown a marked probability for the stock markets to drift over time periods of weeks or more and that there is a positive relationship between the degree of drifting and length of time period under investigation (Milionis 2006). In a nutshell, the weaker version basically states that prices reflect information up to a point where the marginal benefits of acting on that information does not exceed the marginal cost of collecting it (Beechey et al., 2001).

2.4.4.1.4. The Random Walk Theory

The random walk hypothesis assumes that share price changes are and should be independent of each other and conforms to some probability distribution (Praetz 1973). It implies that stock price fluctuations are statistically independent over time and could be described as a random process and also implies that "technical" investors with their trading procedures will not gain profits higher than that obtained by the traditional buy and hold investors on the average (Van Horne & Parker 1976). "Most simply the theory of random walks implies that a series of stock price changes has no memory-the past history of the series cannot be used to predict the future in any meaningful way. The future path of the price level of a security is no more predict-able than the path of a series of cumulated random numbers." (Fama 1965).

The future market price of a stock or share can therefore not be predicted on the basis of past price performances, but however can be predicted by past information or any other information. Thus at any moment in time, the actual price of a share or stock is a representation of the market's best estimate of the intrinsic value of the stock based on available information (Fama 1965). According to Fama (1965) the intrinsic value of a share cannot be easily determined in an uncertain environment. As a result, there is always room for disagreement among market participants concerning just what the intrinsic value of an individual share is, and such

disagreement will give rise to discrepancies between actual prices and intrinsic values. In an efficient market, however, the actions of the many competing participants should cause the actual price of a security to wander randomly about its intrinsic value. However, intrinsic value can change with the availability of new information. This new information could be a change in management, a tariff imposed on the industry's product by a foreign country, increase in industrial production and success in current research and development process amongst others (Fama 1965; Van Horne & Parker 1967).

The semi-strong-form efficiency implies that share prices quickly change to publicly available new information in an unbiased fashion such that no excess returns can be earned by trading on that information (Fama 1965). Semi-strong-form efficiency implies that both fundamental analysis and the technical analysis techniques will be unreliable in producing surplus profits. To test for semi-strong-form efficiency, the adjustments to previously unknown news must be of a reasonable size and must be instantaneous. To test for this, consistent upward or downward adjustments after the initial change must be looked for. If there are any such adjustments it would suggest that investors had interpreted the information in a biased fashion and hence in an inefficient manner (Leuthold & Hartmann, 1979).

In strong-form efficiency, share prices reflect all information, public and private, and no excess profits can be earned. If there are legal barriers to private information becoming public, as with insider trading laws, strong-form efficiency is impossible, except in the case where the laws are universally ignored (Fama 1965). To test for strong-form efficiency, a market needs to exist where investors cannot consistently earn excess returns over a long period of time. Even if some money managers are consistently observed to beat the market, no refutation even of strong-form efficiency follows: with hundreds of thousands of fund managers worldwide, even a normal distribution of returns (as efficiency predicts) should be expected to produce a few dozen "star" performers (Leuthold & Hartmann, 1979).

The EMH theory with regards to natural resources, and to this research, is better reflected in oil and energy prices where such prices are sensitively and accurately responsive to changes in relevant information, and the question of whether energy prices can be characterized as following a random walk or mean trend has important implications. If energy prices are mean reverting, then it follows that the price level will return to its trend path over time and that it might be possible to predict future movements in energy prices based on past behaviour. By contrast, if energy prices follow a random walk process, then any shock to prices is permanent. This means that future returns cannot be predicted based on historical movements in energy prices and that volatility in energy markets increases without bound (Lee & Lee 2009).

2.4.4.2 Empirical Literature on Investments and Resource Constraints

There is the need for the comprehension and management of risks posed by resource scarcity, climate change, rising energy demand and failing access to water, which will gravely affect business performances and investment in the near future. These risks could affect financial performances of businesses and the entire economy yet they are barely considered when investment decisions are based on conventional financial analysis (Ellsworth & Spalding 2013)

Ross (1989) suggests that volatility of price changes may be an accurate measure of the rate of information flow in financial markets. Consequently, oil price volatility shocks may have impacts on real stock returns and thus investments.

According to Stausboll (2012) companies need to understand the critical risks faced in their investment portfolios especially risks involved with issues such as natural resource scarcity, climate change, supply chain pressures and other global sustainability challenges. Ignoring such risks fails to develop a long-term strategy to address them and diminishes the competitiveness in the 21st century. Smithwood & Hodum (2013) investigated the interest investors have for energy efficiency as a vehicle for investment and their current methods for mitigating climate change and resource constraint in their investment decisions. They concluded that resource constraints pose material risks which the investors are very well aware of and recognize that energy efficiency is one of the ways to mitigate the risks caused by climate change and resource scarcity. Pegram (2012) investigated the investment and business risks involved with resource scarcity, especially water scarcity, to businesses in the UK. The main investment risks revolved around the possibility that investors and retailers will be placed with the burden of the water replacement requirements as the comprehension of water risks spreads. This is most likely to occur through the establishment and mainstreaming of formal accreditation (labelling), stewardship standards and disclosure metrics around water. Morrison et al. (2009) assessed the possible risk of water scarcity on investors and businesses. They asserted that significant challenges are being created for businesses and investors due to diminishing availability, poor quality, and rising demand for water as these investors and businesses have traditionally taken clean, reliable and inexpensive water for granted. These problems are already causing decreases in companies' water allotments, shifts toward full-cost water pricing, more stringent water quality regulations, growing community opposition,

increased public scrutiny of corporate water practices and impacts on future growth and licensing to operate.

Regnier (2007) asserts that oil and energy price volatility could create a non-negative option value for irreversible investments, but if the volatility persists, prices would vary such that, over time, the value of investments is offset by prevailing prices and thus investment levels will be reduced. Also on a micro level, implicit discount rates for energy conservation investments will be higher than for other investments but energy price volatility drives up the option value of delaying the conservation investment. Commodity (oil) price volatility is relevant to pricing real investments that affect production inputs and outputs, such as investments in capacity and reductions in energy and material intensity. Sukcharoen et al., (2014) did a study on the relationship between oil price and stock market index for various countries during a 25-year period (1982-2007). Their results showed a weak dependence between oil price and stock indices. This was the case after controlling for stock from oil and gas companies to eliminate obvious direct linkages, except for large oil consuming countries like US and Canada which showed a relative strong dependence with oil prices. Berk & Yetkiner (2014) used the two-sector endogenous model to show that the growth rate of energy prices had a negative impact on the growth rate of energy use and on real GDP. They also found significant cointegrations between energy prices and real GDP per capita, also between energy prices and energy consumption per capita. Additionally, long-run estimates exposed negative and significant effects of composite energy prices on both GDP per capita and energy consumption per capita.

Henriques & Sadorsky (2011) investigated the effect of oil price volatility on strategic investment for a large panel of US firms and results showed a U shaped relationship between oil price volatility and firm investment, meaning during levels of increased uncertainty, the option value of waiting to invest increases as it becomes meaningful to wait until the uncertainty is resolved until investing. Consequently, the current period strategic investment is delayed. After some point, however, further increases in uncertainty lead to increases in investment as the value of the pre-emptive strategic effects of not growing the company starts to increase relative to the option value of waiting to invest. They also assert that while the impact that oil price volatility has on strategic investment is clearly of importance now, it is likely to become even more important in the future as oil price volatility increases due to energy security issues and climate change issues. Rafiq et al., (2009) examined the impact of oil price volatility on key macroeconomic indicators in Thailand. The Granger causality test, impulse response functions, and variance decomposition showed that oil price volatility had significant

impact on macroeconomic indicators, such as unemployment and investment. Increased volatility in oil price may affect investment by increasing uncertainty about future price movements.

Oberndorfer (2009) carried out a first analysis on the impact of oil prices on stock returns of energy corporations from the Eurozone. It focused on the relationship between energy market developments and the pricing of European energy stocks. Results showed that, oil price spikes impacted negatively on stock returns of European utilities. Forecastable oil market volatility negatively affects European oil and gas stocks, implying profit opportunities for strategic investors. Principally, they show that both oil price changes and oil price volatility affect oil and gas stocks, with oil prices being positively and oil volatility being negatively related to oil and gas stock returns. However, the effect of oil price volatility is small compared to absolute oil price impacts, although oil is barely used for electricity generation in Europe. This therefore suggests that for the European stock market, the oil price is the main indicator for energy price developments and investments as a whole. Degiannakis et al. (2014), affirm that oil supply side shocks and oil specific demand shocks do not affect volatility whereas aggregate demand shocks do lead to a reduction in stock market volatility. More precisely, "the aggregate demand oil price shocks have a significant explanatory power on both current- and forward-looking volatilities". After controlling for SP 500 and their returns, it was found that there was little evidence that PNG stocks automatically priced crude oil volatility. Still in Europe, Cunado & Gracia (2014) assert that there is a significant existence of a negative impact of oil prices on European stock returns and that the response of European stock returns to oil shocks depends on the underlying causes of the price changes. They came out with this conclusion after analysing the impact of oil price shocks on the returns of 12 European importing countries from 1973-2011.

Park & Ratti (2008) investigation on the stock returns of US markets and that of 13 European countries showed that oil price shocks had a significant effect on stock returns depressing it contemporaneously or within one month. Norway as an oil exporter shows a statistically significantly positive response of real stock returns to an oil price increase. The median result from variance decomposition analysis is that oil price shocks account for a statistically significant 6% of the volatility in real stock returns. For many European countries, but not for the U.S., increased volatility of oil prices significantly depresses real stock returns. The contribution of oil price shocks to variability in real stock returns in the U.S. and most other countries is greater than that of interest rate. An increase in real oil price is associated with a significant increase in the short-term interest rate in the U.S. and eight out of 13 European

countries within one or two months. Counter to findings for the U.S. and for Norway, there is little evidence of asymmetric effects on real stock returns of positive and negative oil price shocks for oil importing European countries. Kang et al., (2014) did a similar study on the effects of crude oil demand and supply shocks on the aggregate US bond index real returns. Results indicated decreases in aggregates bond index real returns 8 months following positive oil market-specific demand shocks, while a positive innovation in aggregate demand has a negative effect on real bond returns that is statistically significant and becomes more adverse over 2 years. Over 27.1% of such variations in the real bond returns over the 2-year period could be accounted for by structural shocks driving the global oil market.

According to Ji & Fan (2012) the impact of price volatility in the crude oil market is growing into non-energy commodity markets. The switch from fossil fuels to biofuel and the hedging strategies against inflation induced by high oil prices, has increased the link between crude oil market and agriculture markets and metal markets. This study measured the effect of the crude oil market on non-energy commodity markets before and after the 2008 financial crisis. The results disclosed the fact that the crude oil market had significant volatility spill over effects on non-energy commodity markets, which demonstrated its core position among commodity markets. The overall level of correlation strengthened after the crisis, which indicated that, the regularity of market price trends was enhanced and affected by economic recession. In addition, they assert that the influence of the US dollar index on commodity markets had weakened since the crisis. Papapetrou (2001) did a similar analysis in Greece and results showed that oil price shocks explained a significant proportion of the fluctuation of output and employment growth and also has an immediate negative effect on industrial production. Interest rates and growth in industrial production and employment are negatively associated, which suggests that a rise in interest rates is likely to be associated with a lower growth in industrial production and employment.

Just as highlighted in the empirical literature on oil prices and economic growth, Wang et al., (2013) reiterate the importance of differentiating between oil-importing and oil-exporting countries when analysing the effect of oil prices on stock markets. They assert that the direction, magnitude and duration of a stock market response to oil prices is dependent on whether the country is an exporter or importer of oil and the level of importance oil has in that economy. In this light, Ramos & Veiga (2013) found evidence that oil hikes have opposite effects for oil-importing and oil-exporting countries. Increases in oil prices have negative effects in stock markets (thus investments) in oil-importing countries and positive effects in oil-exporting countries. Also their statistical tests support the fact that oil volatility seems to be

affected asymmetrically by oil price changes and such asymmetry affects only oil-importing countries. However, the report doesn't take into account the stock of oil available which could influence prices and not all oil importing and exporting countries, especially developing countries, are part of the New York mercantile exchange (NYMEX) oil futures contract, where the data on oil prices are taken from by the authors under the assertion that NYMEX is the most widely traded futures contract on oil.

Kang et al., (2014) examined the effect of demand and supply shocks driving the global market for crude oil on US bond real returns. The structural VAR model was used to separate the three price shocks; shocks to global supply, shocks to world aggregate demand for commodities and oil market specific demand and an assessment on how they related to bond real returns. The results showed that the 31.2% of the variation in the real 30-day Treasury-bill return was explained by shocks to oil market-specific demand in the long run and a spillover index from rolling SVAR models is used to identify the interdependence between the oil market and bond returns. This is an indication that investment in bonds could be vulnerable oil price shocks. These results have a similar implication to the research done by Chatrath et al. (2014) who examined the relationship between crude oil, in its risk neutral moments, and the stock returns of PNG (Petroleum and natural gas), and the results showed that on average, PNG stocks performed poorly during crude oil volatility and perform well during general market volatility.

Sukcharoen et al., (2014) examined the effect of oil price on stock market index for a number of countries between 1982 and 2007. After oil and gas stock companies from the stock indices were excluded to eliminate the obvious direct linkage and converted oil price series into local currency to account for possible exchange rate effects, the method of copula was used to model the general dependence between stock returns and oil price returns. A weak dependence between oil prices and stock indices was found for most cases. Exceptions in the study were stock index returns of large oil consuming and producing countries (United States and Canada), which were shown to have a relatively strong dependence with the oil price series. Similarly, Reboredo & Rivera-Castro (2014) found out that oil prices changes had no significant impact on stock returns in USA and Europe before the onset of the financial crisis, and at the onset of the crisis, they found contagion and interdependency between oil prices and stock market returns. The introduction of Euro in 1999 altered considerably dependence between oil prices and stock returns. Could the UK be part of this exception, because it is a large oil consuming country and/or unlike the EU it is not part of the Euro?

The next section looks at systemic risks in the finance system cause by the interdependent nature of the system. This is important as it gives an understanding how the finance system can be crippled by a risks such as resource scarcity and how it can spread throughout the finance system and possibly cause another financial crisis.

2.5. Systemic Risks and the Financial System

"The understanding of systemic risk is of central importance for maintaining financial stability." (Martinez-Jaramillo et al., 2012, pg. 2358)

A wide range of literature has emerged about the occurrence of systemic risks in the financial and economic system as a result of the "eye-opening" consequences of the financial crisis of 2007-2009 and the need to curb and reduce some of the risks faced (Billio et al., 2012; Grace et al., 2013; Patro et al., 2013).

The finance sector is governed by a set of rules, in response to the 2007 financial crisis, regulating issues such as liquidity and capital requirements and risk management. These set of rules are the Basel III governing banks and Solvency II governing the insurance sector.

The new Basel III regulations are liable to making long-term financing costlier, which could affect the financing of capital-intensive renewable energy technologies, because they typically rely on long-term financing. Additionally, the capital and liquidity requirements of Basel III are likely to limit the amount of capital available for renewable energy financing from banks in the future. Together, these are threats to renewable energy deployment because limited financing may prevent the financing of some projects and because more expensive loans are likely to make a number of projects uninteresting financially (Narbel 2013).

According to Jackson & Perraudin (2002) the recognition that problems in one bank (financial institution) could spill over into more widespread difficulties in the financial and economic sector, was acknowledged since the early 19th century. This assertion was supported by Rodriguez-Moreno & Pena (2012) as they noted that the financial system plays an important part in the economy as a whole, acting as the mediator between both agents who need to borrow and those who are willing and able to lend and/or invest and is obviously linked to all economic sectors thus, if the financial system does not function properly, its systematic problems could have a strong effect on the real economy.

Allen & Gale, (1994, 1998, 2000, and 2004) developed a liquidity-based approach to understanding financial crises. When financial markets are imperfect, financial institutions could be forced to sell out assets if they face a liquidity shock. Suppliers of liquidity may have

to be compensated for holding the liquid asset because the liquid asset has a lower return than the risky asset. They can recover these costs if they can purchase assets at fire sale prices when liquidity shocks hit. Fire sales are an equilibrium phenomenon, where the suppliers of liquidity recover the opportunity costs of possessing excess liquidity. Nonetheless, lower market prices imply that more assets have to be sold in order to meet a particular liquidity needs. This imposes a negative externality on other banks because it becomes more expensive for them to recapitalize when they are hit by a liquidity shock. If enough banks are hit by a shock at the same time, the endeavour to achieve liquidity may even be "self-defeating" and force banks into default (Allen & Gale 2000).

Freixas et al. (2000) showed how risk and shocks could spread through the financial system. In their model, different banks operated in different regions and banks' depositors from one region may want to withdraw cash to spend on consumption in another region. As a result, banks run liquidity risk because they could suddenly be confronted with large cash withdrawals. Interbank credit lines allowed banks to cushion these shocks and reduced the cost of holding liquid assets. If depositors from one region wished to consume at some other region, but believed that the corresponding bank at that location did not have enough cash, they relied on their home bank instead. As a result, the home bank may have to liquidate some of its assets under obligation. The problems faced by this bank may then cause depositors from other regions that wanted to withdraw to turn to their home bank as well. Thus, a solvency shock could cause the entire system to collapse. However, there could also be an externality since depositors force their home bank to liquidate because they do not trust the quality of the assets of the corresponding bank (Bijlsma et al.,2010). Wagner (2006), asserted that the fire-sale externality depended on the similarity between banks. If there was a similarity amongst banks assets, then the externalities would be stronger. "Not only does the probability that both banks have to liquidate assets at the same time increases because assets are similar, but the reduction in prices when fire sales occur will also be larger if both banks are in bad health than when one of the banks is in good health" (Wagner 2006).

Martinez-Jarramillo et al., (2012) carried out an investigation to measure systemic risk, financial contagion and fragility and they showed how possible it is to estimate the distribution of losses within the financial system. Results showed that contagion in the financial system is particularly sensitive to undesirable transmissions especially liquidity and interest rates, and thus vulnerable to systemic risks. Acharya et al. (2010) developed an alternative indicator of systemic risk in the banking sector, measuring each institution's individual contribution to

systemic risk. They constructed each bank's systemic expected shortfall (SES), i.e. its propensity to be undercapitalized when the system as a whole is undercapitalized. Allen, Bali and Tang (2012) found that high levels of systemic risk in the banking sector have real macroeconomic effects due to reduction of supply of credit and decline in assets prices.

Also Billio et al. (2012) proposed a number of econometric measures of systemic risk to comprehend the "interconnectedness" among the monthly returns of hedge funds, banks, brokers, and insurance companies based on principal components analysis and Granger-causality tests. Their results showed that all four sectors had become highly interrelated over the past decade, thus increasing the level of systemic risk in the finance and insurance industries. These measures could also identify and quantify financial crisis periods, and seemed to contain predictive power for the current financial crisis. Their results also suggested that hedge funds can provide early indications of market dislocation, and systemic risk arises from a complex and dynamic network of relationships among hedge funds, banks, insurance companies, and brokers. Grace et al., (2013) examined the systemic risks and interconnectedness of the finance sector concentrating mainly on insurance –specific events and did not find any strong unusual stock market reactions for insurance companies, banks with insurance business and banks themselves during times of intra sector specific events indicating no spillover effects and therefore less probability of systemic risks occurring for insurance companies.

Huang et al., (2012) analyse and measure the systemic risk of a banking sector as a hypothetical distress insurance premium, identify various sources of financial instability, and allocate systemic risk to individual financial institutions. According to them, the systemic risk measure, defined as the insurance cost to insurance companies to guard against distressed losses in a banking system, is an instant indicator of market observed risk that mirrors expected default risk of individual banks, risk premia as well as correlated defaults. They applied a methodology to a portfolio of twenty-two major banks in Asia and the Pacific and it illustrated the dynamics of the spillover effects of the global financial crisis to the region. The increase in the observed systemic risk was mainly driven by the heightened risk aversion and the squeezed liquidity.

Concerning the indicator of systemic risks, Patro et al. (2013) analysed the significance and efficiency of stock return correlations among and within financial institutions as an indicator of systemic risk. An analysis of the movements and variations of stock return correlations and default correlations among the 22 largest bank holding companies and investment banks on a daily basis from 1988 to 2008 came up with the finding that daily stock return correlation was

a simple, timely, forward-looking and robust systemic risk indicator. There was a rising drift in stock return correlation among banks, whereas there was no obvious correlation trend among non-banks. They likewise disaggregated the stock returns into systematic and idiosyncratic components and found that the correlation increases were largely driven by the increases in correlations between banks' idiosyncratic risks, which gave rise to increasing systemic risk. Correlation spikes tend to predict or coincide with significant economic or market events, especially during the 2007–2008 financial crisis. Furthermore, they showed that stock return correlations offer a perspective on the level of systemic risk in the financial sector that is not already captured by default correlations. Stock return correlations are not subject to data limitations or model specification errors that other potential systemic risk measures may face.

Batram et al., (2007) developed three distinct methods to quantify the risk of a systemic failure for the international banking system. They examined a sample of 334 banks, a representation of approximately 80% of the global bank equity, in 28 countries around five global financial crises. Their results suggest statistically significant, but economically small, increases in systemic risk. Huang et al., (2009) proposed a framework for the measurement and stress testing of the systemic risk faced by a group of major financial institutions. The systemic risk was measured by the price of insurance against financial distress, which was based on ex ante measures of default probabilities of individual banks and forecasted asset return correlations. Importantly, using realized correlations estimated from high-frequency equity return data can significantly improve the accuracy of forecasted correlations. The stress testing methodology, using an integrated micro–macro model, took into account dynamic linkages between the wellbeing of major US banks and macro-financial conditions. Results suggested that the theoretical insurance premium that would be charged to protect against losses that equal or exceed 15% of total liabilities of 12 major US financial firms.

Nicolo & Lucchetta (2011) presented a modelled framework that delivered joint forecasts of indicators of systemic real risk and systemic financial risk, as well as stress-tests of these indicators as inclination responses to structural shocks recognized by standard macroeconomic and banking theory. The framework was implemented using large sets of quarterly time series of indicators of financial and real activity for the G-7 economies for the 1980Q1-2009Q3 period. Two main results were obtained. First, there was evidence suggesting the usefulness of the model as a risk monitoring tool and second, in all countries aggregate demand shocks were the main drivers of the real cycle, and bank credit demand shocks were the main drivers of the bank lending cycle. These results challenged the widespread perception that constraints in the

aggregate supply of credit has been a key driver of the sharp downturn in real activity experienced by the G-7 economies in 2008Q4-2009Q1.

Hellwig (2009) analysed the systemic risks in the financial sector of the USA, as a result of the then crisis of the global financial system, with particular emphasis on the systemic elements that turned the crisis of subprime mortgage-backed securities, into a worldwide crisis. He first explained the role of mortgage securitization as a mechanism for allocating risks from real estate investments and discusses what has gone wrong and why in the implementation of this mechanism in the United States. He then brought out and discussed the incidence of systemic risk in the crisis. Two elements of systemic risk were identified; First, there was excessive maturity transformation through conduits and structured-investment vehicles (SIVs); second, as the financial system accustomed to the appreciation of misbehaviours and non-payments in US mortgages and the breakdown of maturity transformation of conduits and SIVs, the interaction indication of market malfunctioning or even breakdown was imminent. Fair value accounting, the inadequacy of equity capital at financial institutions, and systemic effects of sensible regulation created a detrimental downward spiral in the overall financial system. He further argued that these developments have not only been caused by identifiably faulty decisions, but also by faults in the financial system architecture.

Black et al., (2013) recommended a hypothetical distress insurance premium (DIP) as a measure of the systemic risk in the European banking sector, which incorporated the characteristics of non-payment probability, interconnectedness and bank size. Based on the results of this measure, the systemic risk faced by European banks reached its height in late 2011 amounting to approximately €500 billion. Results also showed that the sovereign default spread was the factor driving this intensified risk in the banking sector during the European debt crisis. According to them, this methodology could also be used to recognize the distinct contributions of over 50 major European banks to the systemic risk measure.

This method captured an enormous contribution of a number of systemically important European banks, then again Italian and Spanish banks as a group had notably increased their systemic importance. Also it was found that bank-specific fundamentals predicted the one-year-ahead systemic risk contribution of our sample of banks in an economically meaningful way (Black et al., 2013).

According to Bijlsma et al. (2010), systemic risk has been put firmly on the policy agenda by the global financial crisis. They analysed the risk from an initial shock which gets enlarged and spreads to other financial intermediaries, ultimately disrupting the entire financial sector. They distinguished between two classes of risk instruments: "contagion within the financial sector

and pro-cyclical connection between the financial sector and the real economy". Regulation can diminish systemic risk by reducing these externalities. However, regulation of systemic risk faces several problems. First, systemic risk and its costs are difficult to quantify. Second, banks have strong incentives to evade regulation meant to reduce systemic risk. Third, regulators are prone to moderation. Finally, the inability of governments to commit not to bail out systemic institutions creates moral hazard and reduces the market's incentive to price systemic risk. Strengthening market discipline can play an important role in addressing these problems, because it reduces the scope for regulatory forbearance, does not rely on complex information requirements, and is difficult to manipulate.

As regards insurance being the potential cause of systemic risks in the financial system, Cummins & Weiss (2014) assessed the US insurance industry as a possible cause of systemic risks. After examining the primary factors of systemic risks and the contributing factors that could aggravate the economy's exposure to events of a systemic nature, they came to the conclusion that US insurance's main activities did not pose any risks systemically but life and property insurers were vulnerable to intra-sector and reinsurance crisis. On the other hand, "side" activities such as credit default swaps (CDs) issuing, asset lending, financial guarantees and other "banking" activities could cause systemic risks. However, Chen et al., (2014) differed in opinion when they concluded that banks could pose significant systemic risks for insurers and not the other way round, after econometrically analysing systemic risks in both banking and insurance industries.

This chapter has examined theory and recurrent empirical literature on the basic assumptions on the relationship between natural resource scarcity and the economy, with particular reference to the finance sector (insurance, pensions and banks). These relationships would be demonstrated in flow diagrams, to give a clear picture of the effect of resource scarcity on the finance sector. This would be done in the next chapter which is the conceptual framework of the research, where there is a clear pathway demonstrated from scarcity of a resource t potential effects on the finance sector.

Chapter 3. Conceptual Framework

3.1. Introduction

Natural resource scarcity and its relationships to, and effects on, the economy have been analysed by a vast amount of literature. The effect of natural resource scarcity on economic growth has been the main centre of attention and demonstrated in the literature review chapter (Mehrara, 2007; Gylfason, 2008; Stern, 2010) with it being closely related to climate change (Ayres, 2001;Sachs & Warner, 2001; Skoufias 2003; Stern, 2006;Brunnschweiler, 2007); related to sustainability (Martinet & Doyen, 2007) and finance (IMF 2013). Emphasis is also placed on the effect of resource scarcity on the finance sector with the main focus being on insurance (Dlugolecki, 2008; Young et al., 2009; Ceres, 2011; Stausboll, 2012; Leurig & Dlugolecki, 2013) and on investments (Regnier, 2007; Morrison et al., 2009 Sadorsky, 2011 Pegram, 2012 Ellsworth & Spalding, 2013). However, there has been very little research on the effect of natural resource constraints on banking activities and pensions except the Institute and Faculty of Actuary's publication on the effects of natural resources on pensions (Jones et al., 2013). In the context of the UK, literature on the effects of natural resource scarcity on the economy has also been in the spotlight, mostly related to environmental sustainability and climate change (Everett et al., 2010; Jones et al., 2013)

Thus the main gaps in the literature are;

- The lack of research on the effect of natural resource constraints on banking activities and pensions
- Natural resource constraints being investigated as the main cause of systemic risks in the finance sector
- Identification of the path taken from the scarcity of natural resources and the possible systemic risks in the finance sector

The subsequent sections of this chapter will present the conceptual framework developed for this thesis as an output of the literature review. It will examine the link between the various components of the finance sector and how natural resource scarcity could lead to a systemic risk in the finance sector. In order to be able to fully understand the link and framework of the interdependency of the economy and the finance system and how natural resource scarcity can affect its growth, the concept of natural resources and its role in the economy in the UK context will be examined in section 3.2. Section 3.3 will look at the UK economy and the role of the

finance sector, Section 3.4 will look at the components of the finance sector of interest to this research and the relationship between them and section 3.5 will establish the link and framework and how resource scarcity can affect the system.

3.2. Natural Resource Constraints and the UK Economy

If natural resource development is properly managed, the associated revenue can be used to speed up growth, reduce inequality, and lift people out of poverty.

(IMF 2014, pg. 1)

Natural resources are as important to the growth and development of an economy as physical and human capital (Barbier, 2002). Natural resources are part of the real wealth of a nation and they are the natural capital where all the other forms of capital are made (OECD 2011). They add value to fiscal revenue, income, and poverty reduction and natural resource related sectors provide jobs and are often the basis of livelihoods in poorer communities (World Bank 2006).

The UK has a variety of natural resources including both geological (coal, petroleum, natural gas, limestone, chalk, gypsum, silica, rock salt, china clay, iron ore, tin, silver, gold, lead) and agricultural (arable land, wheat, barley, sheep). The UK has large coal, natural gas, and oil resources; primary energy production accounts for 10% of GDP, one of the highest shares of any industrial nation. Due to the island location of the UK, the country has great potential for generating electricity from wave power and tidal power, although these have not yet been exploited on a commercial basis (UK Gov 2010).

According to OECD (2008), natural resources such as oil, gas, minerals and timber are anticipated to continue to play a major role in resource abundant economies, as demand from rapidly growing economies increases, and as supplies of non-renewable resources decline and renewable resource approach maximum sustained yield levels. Alongside providing revenues to resources rich countries, natural resources can play a vital role in enhancing poverty reduction efforts (Havro & Santiso, 2008). The poor are generally dependent on natural resources directly for their livelihoods, especially the rural poor. Furthermore, the revenues from natural resources, could also contribute to the development of human capital through investments in education and job training (UNDP 2005). Especially during times when commodity prices are high, countries have the opportunity to use a portion of the additional

profits realized from the sale of natural resources to support pro-poor policies and investments (OECD, 2006). Natural resources also have the potential to make a significant number of jobs available. However, the number of people employed in traditional extractive industries has declined steadily around the world due to mechanization and economies of scale, employment in the renewable energy sector has risen and has the potential to continue to rise over the long-term (UNEP, 2008). The figure below illustrates the role and importance of natural resources to the growth of an economy.
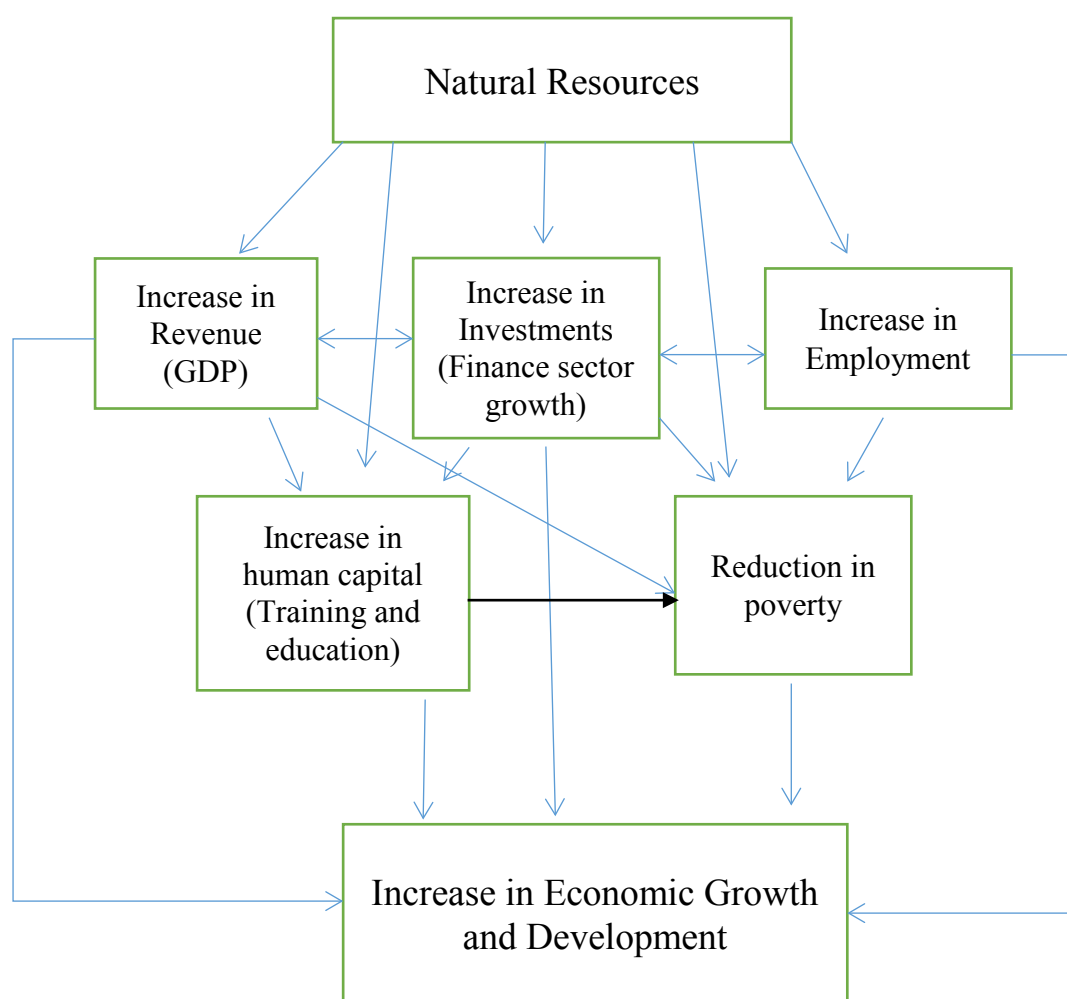
Fig 4. Role of Natural Resources in Economic Growth

Figure 4 above establishes the link between natural resources and the economy. The availability of natural resources increases GDP which in turns increase human capital development and investments and reduce poverty levels thereby increasing standards of living. Natural resources also increase levels of investments especially in the extraction and transportation to

manufacturing industries and in its general sales. Such increases in investments also contributes to the growth of the finance sector through the borrowing, lending, liquidity and credit activities involved in investment. This growth in investment and the finance sector increases human capital development and economic growth. There is also an increase in employment especially in resource extractive industries, transportation and manufacturing industries. Human capital development is increased and developed with the training and education on the exploitation and management of natural resources, and in turn reduces poverty as trained people would be able to work and look for ways to alleviate poverty both at the micro and macro level. Poverty reduction is enhanced through all the channels effects (from fig 4) and also independently, especially the rural poor who are more reliant on agricultural resources.

In the UK, Natural resources are playing a vital role;

- The agricultural resources (food sector) alone contributed £97.1 billion or 7.4% to national Gross Value Added in 2012, and 3.6 million or 13% of national employment in Q3 2013. Total Factor Productivity in the food sector (excluding agriculture) stabilised in 2012 having risen gradually since 2002. The beverage industry is the largest manufacturing group with a GVA of £5.3 billion in 2012; Alcoholic beverages contributed £4.1 billion (77%) of the total beverages GVA in 2012. Also the total value of exports from this sector rose to £18.9 million in 2013 which was £6 million up from 2005 (DEFRA 2014).

- The Energy sector's contribution to the UK economy in 2011, was estimated to be £89bn (the total direct contribution of the Energy sector to the UK economy's GDP in 2011 was £20.6bn; the direct and indirect contribution was approximately £86bn) (Ernst & Young, 2012). Also the Energy sector's total employment impact to the national economy in 2011 amounted to 137,000 full time and part time jobs, an increase of almost 9,000 jobs compared to 2010. Direct employment grew from 83,000 to 137,000 between 2008 and 2011, with growth of 6% between 2010 and 2011 (Energy UK, 2012). The indirect employment benefit is over three times the direct benefit, bringing the total number of jobs supported by the sector to around 655,000. Capital investment in the Power & Gas sector was in excess of £10bn in 2011 (Energy UK, 2012). Between 2007 and 2011 £43bn was invested in the Power & Gas sector. The

total direct contribution of the sector to the UK economy in 2011 was £20.6bn (ONS 2014).

- The oil and gas sector provides a source of employment for over 400 thousand people across the UK (45% Scotland and 55% England, Wales and Northern Ireland) (Oil & Gas UK Economic Report 2012), is Britain's largest industrial investor and is investing more than ever before (£11.5 billion in 2012 and DECC forecasts investment of £14 billion in 2013) (DECC 2012), meets almost one half of the UK's total primary energy needs, boosts the balance of payments by almost £50 billion a year, according to industry estimates, by reducing oil and gas imports, and by exporting goods around the world and has a strong domestic supply chain that has seen revenue growth each year since 2008, reaching £27 billion in 2011 (Ernst & Young 2012).

After examining the link between the availability of natural resources and the economy as a whole, the next section will examine the role of the most important part of the economy; the finance sector. The section will begin with an overview of the UK economy and then the role of the finance sector in an economy like that of the UK.

3.3. The UK Economy and Finance Sector

The UK has one of the most globalized economies, comprising the economies of England, Scotland, Wales and Northern Ireland. The economy of the UK, like any other economy comprises the primary sector (agriculture), the secondary sector (construction and production) and the tertiary sector (services) (ONS 2011). It was the 6[th] largest economy worldwide in terms of GDP and 8[th] in terms of the purchasing power parity in 2012. The British economy was boosted by North Sea oil and gas production and its reserves were valued at an estimated £250 billion in 2007 and in 2012 the UK was the 10th-largest exporter in the world of produced goods (mainly automotive products) and the 6th-largest importer of natural resources especially natural gas (UK Gov 2013) .

The UK economy is presently recuperating from a recession arising from the financial crisis of 2007/08, and as of the first quarter of 2014, its GDP remains 0.6% below its pre-recession peak (ONS 2014) and fell further to 0.4% in the first quarter of 2016 (The Guardian 2016); also the UK has experienced a deeper downturn than all of the G7 except Japan, and has equally

experienced a slower recovery than all but Italy. However, in 2013, the UK experienced its fastest growth since 2007; it is now the fastest growing major developed economy. It has also been suggested that the UK will become the 5th largest economy by 2016, suggesting fast growth in the UK economy throughout the forecast period. Government involvement in the British economy is primarily exercised by HM Treasury, headed by the Chancellor of the Exchequer, and the Department for Business, Innovation and Skills. Since 1979 management of the UK economy has followed a broadly laissez-faire approach. The Bank of England is the UK's central bank and its Monetary Policy Committee is responsible for setting interest rates. The currency of the UK is the pound sterling, which is also the world's third-largest reserve currency after the US dollar and the euro. The UK is a member of the Commonwealth of Nations, the European Union, the G7, the G8, the G20, the International Monetary Fund, the Organization for Economic Co-operation and Development, the World Bank, the World Trade Organization and the United Nations.

The service sector dominates the UK economy, contributing around 78% of GDP, with the financial services industry particularly important (Cribb 2013) adding a gross value of £125,363 million (9.4% of total value added) to the UK economy in 2011. The UK's exports of financial and business services make a significant positive contribution towards the country's balance of payments.

Theoretically, the finance service industry is a group of organizations, credit unions, banks, credit card companies, insurance companies, accountancy companies, consumer finance companies, stock brokerages, investment funds and some government sponsored enterprises that manage money and provide financial and economic services. The finance sector is the most important part of the economy especially highly developed economies like that of the UK, providing a link between organisations needing capital and those looking to invest. Though the number of organisations operating in the financial services industry is wide and varied there are two distinct sectors in financial services, the Wholesale and Retail sector. The wholesale sector comprises; international banking, bond markets, equity markets, foreign exchange, derivatives, fund management and insurance (major corporate and risk sharing insurance). The retail sector, on the other hand, includes; retail banking (commercial banks), pensions, investment services and financial planning/advice (CISI 2013).

The financial system is essentially important to the functioning of the economy as a whole; how well it works is a key factor to how the rest of the economy functions (Baily & Elliott 2013). The financial sector rallies savings and distributes credit across space and time. It also provides not only payment services, but more importantly products which enable firms and households to cope with economic uncertainties by hedging, pooling, sharing, and pricing risks (Herring & Santomero 2006). An efficient financial sector reduces the cost and risk of producing and trading goods and services and thus makes an important contribution to raising standards of living. The role of the finance sector can be summarised, but not limited to the following;

- Credit provision; Credit boosts economic activity by giving businesses the opportunity to invest beyond their cash on hand, households to buy homes without having to save the full cost beforehand, and give governments the ability to sort out their spending by moderating the cyclical pattern of tax revenues and to invest in infrastructure projects. Thus credit is critically important to a large economy like the UK, as difficulty in obtaining credit and lack of its availability could drive the economy into a recession (Laeven & Valencia 2012)

- Liquidity provision; Businesses and households need to be protected against unanticipated needs for cash. Banks (which are central to the financial system) are the leading direct providers of liquidity, both through offering demand deposits that can be withdrawn any time and by offering lines of credit. Investors are particular about liquidity because it affects their transaction costs of trading and the length of time it takes to execute each transaction (Diamond 2007).

- Risk management services; The finance sector helps businesses and households to pool their risks from exposures to financial market and commodity price risks. Much of this is provided by banks through derivatives transactions and by insurance companies (Mishkin 2012)

The growth of the financial sector and its contribution to economic growth in the UK is usually measured by the Gross value added (GVA) by the finance sector's net consumption. The GVA is derived from measures of the activities of wide range of firms, at the retail and wholesale level, including retail banks, building societies, investment banks and hedge funds, and are

wider than the activities of financial services firms. Most measures of the size of financial services therefore also include, for example, bank branches in different areas of the country (Maer & Broughton 2012). Just before the financial crisis (1997-2008), the growth of the finance sector averaged 6% annually compared to the 3% average annual growth of the economy (GDP). From the beginning of 2009 onwards, the level of output in the sector fell sharply and continued to do so even as the rest of the economy recovered. By the end of 2010, output was 10% below its pre-crisis peak (Burgess 2013).

Within the financial sector, monetary financial institutions, banks and building societies in 2006 accounted for over 55% of value added. The other 45% was accounted for by insurance companies and pension funds (around 20%) and a range of other financial intermediaries and auxiliary companies (around 25%). Table 2 below shows the various components of the finance service industry and their contribution to GDP.

Table 2 Composition of the finance service industry (William et al., 2009; Burgess, 2013)

Financial Service Industry	**Description/Examples**	**Weight in financial intermediation**	**Weight in GDP**
Monetary Financial Institutions	Banks and building societies	57%	4.4%
Insurance Companies	General insurance, reinsurance	13%	1%
Pension funds	Autonomous schemes	5%	0.4%
Activities auxiliary to financial intermediation	Advisory services, fund management	15%	1.1%
Other financial intermediation	Finance leasing, factoring companies	9%	0.7%
Total		100%	7.7%

The above table (2) illustrates that, in 2006, the financial service sector's contribution to the economy was 7.7% of GDP, which increased to 10.8% in 2009, shrunk to 9.4% in 2011 and

further to 8.9% in 2012 (Maer & Broughton 2012; Langston 2012), there by indicating a decreasing growth rate in the finance sector.
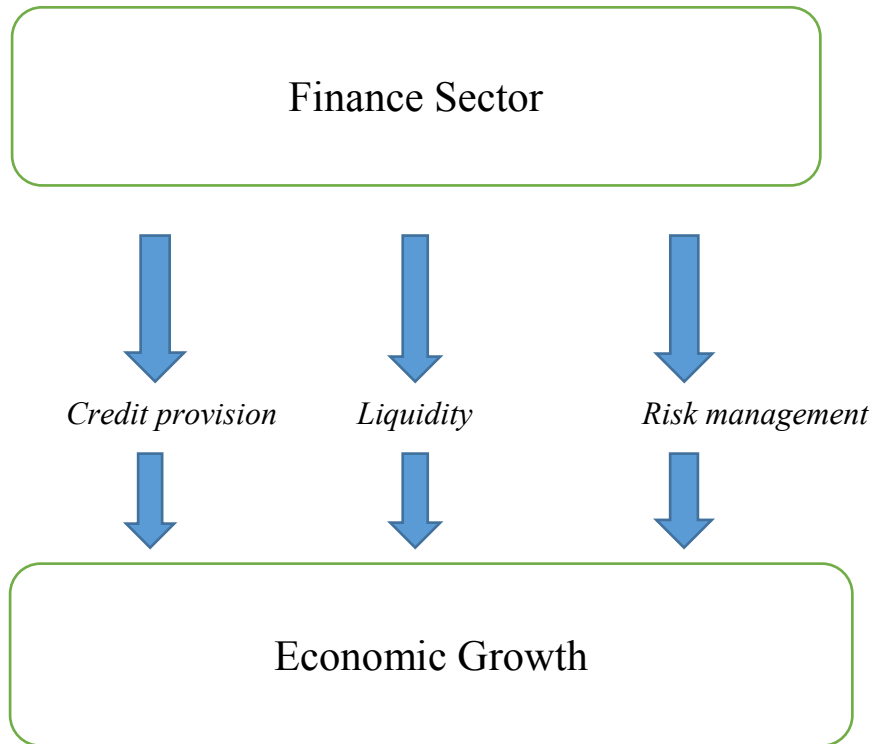
Fig 5; Major Role of the Finance sector to Economic growth

Table 3 Sources of Financial sector growth (Burgess, 2013)

	Average growth rates		
	2000-2007	2008-2010	Contribution to growth of finance sector (2000-2007)
Banks and Building societies	7.5	-4.7	5.2
General Insurance and pensions	-1.6	-0.3	-0.3
Other Financial Intermediaries	6.9	3.5	0.6
Auxiliary activities	4.4	3.3	0.7
Total	5.6	-2.1	

According to the IMF (2012), the U.K. financial sector and its regulatory framework have witnessed a crisis of unprecedented proportion during the period 2008-2011. There have been significant risks posed by large, complex, and interconnected financial institutions, exposing weaknesses in the policy and regulatory framework that had enabled their expansion and complexity, both domestically and internationally. As a result, authorities such as the Basel Committee of Banking Supervision (BCBS) and the Financial Service Authority (FSA), found that the supervisory approach for banks and insurers need to be further strengthened requiring financial institutions to build up capital and liquidity buffers. This concern came up with the formulation of the BASEL I, II and III and the Solvency I and II to regulate and supervise the UK financial system in terms of risk management, capital and liquidity requirements.

Before a description of the various facets of the finance sector and their role in the economic and finance sector, it will be important to have an overview of these regulatory instruments, as they potentially affect the behaviour of the financial service industry and thus its contribution to economic growth. Thus its behaviour to the effects of natural resource constraints could also be influenced to some extent by these regulations.

3.3.1. Financial System Regulation

The financial service industry is regulated by the Financial Service Authority (FSA), now split up into the Prudential Regulatory Authority (PRA) and the Financial Conduct Authority (FCA) and EU regulations of Solvency II and BASEL III.

These regulations came as a result of the impacts of the financial crisis which called for the need for a new approach to regulation which became effective from the 1st of April 2013 (Bank of England, 2013). The Financial Services Act 2012 launched an independent Financial Policy Committee which is charged with taking action to reduce systemic risks in the financial system, with the aim of improving on the enhancement and protection of the resilience financial system.

The PRA, created by the FSA as part of the Bank of England, is responsible for the supervision and regulation of banks, building societies, credit unions, insurers and major investment companies. It regulates over 1,700 financial firms with the aim of promoting the safety of these firms and contributing to the securing of a suitable degree of protection for policy holders especially for the insurance sector (ABI, 2013). In carrying out its functions, the PRA concentrates mainly on the damage the firms could cause to the financial system stability in the UK. This is because a stable finance system is one where the firms continue to provide critical financial services (Bank of England, 2013). The PRA carries out its aims through regulation and supervision; setting standards and/or policies for firms to meet and assesses the risks that firms could pose and takes action to reduce them. It's regulatory and supervision methods are characterised by the judgement based approach (judging soundness and safety of system), forward looking approach (against future risks), and the focused approach (on issues and firms with higher risks potential) (PRA, 2013).

The FCA is another regulatory body tasked with the responsibility of protecting and enhancing the UK financial system, protection of consumers and the promotion of effective competition between financial service providers, in the interest of the consumers (ABI, 2013). There are over 50,000 firms under the supervision and regulation of the FCA which are not covered by the PRA. The FCA intervenes when financial firms treat their consumers unfairly and its behaviour is risky to the stability and integrity of the financial system. Firms are supervised differently depending on their size and the nature of their business through;

- The observation and checking of products and other issues to ensure that firms act fairly and do not compromise the interest of consumer
- A continuous assessment of conduct for large firms and regular assessment for smaller firms
- Decisive and quick responses to events or problems that threaten the integrity of the industry
- Ensuring firms compensate consumers when necessary

The FCA also ensures that firms protect themselves against fraud, detect and protect against money laundering and the consequences of corrupt and unethical methods. (FCA, 2013)

Solvency II is a basic appraisal of the capital adequacy regime for the European Insurance industry with the main purpose of establishing a reviewed set of capital requirements and risk management standards within the EU aiming to increase the protection for policy holders. This reinforced rule should lessen the likelihood of consumer loss and market disruption in insurance (European parliament, 2009; ABI, 2013). Solvency II will be adopted in 28 EU member states, making it easier for business to be done across the EU. This is follow up of Solvency I which did not include risk management and governance of firms.

Solvency II aims to harmonise insurance across Europe through; risk-based capital, own risk and solvency assessment (ORSA), market consistent balance sheets, supervisory assessment and senior management accountability. It will apply to all insurance firms with the gross premium income above €5 million or gross technical provisions above €25 million. This will also depend on the amount of premiums written, type of business written or the value of technical provision (Bank of England, 2013).

Basel III is a wide-ranging set of reform measures, developed by the Basel Committee on Banking Supervision, to reinforce the regulation, supervision and risk management of the banking sector (Basel Committee on Banking Supervision (BCBS) 2010b). These measures aim to:

- Improve on the risk management and governance of the banking sector
- Improve on the ability of the banking sector to absorb shocks arising from financial and economic stress, regardless of the source
- Fortify the banks' transparency and disclosures.

And the reforms target:

- The macro-prudential, system wide risks that could develop and accumulate across the banking sector as well as the pro-cyclical amplification of these risks over time.
- The bank-level, or micro-prudential, regulation, which will help raise the resilience of individual banking institutions to periods of stress.

These two approaches to supervision are complementary as greater resilience at the individual bank level reduces the risk of system wide shocks (Basel Committee on Banking Supervision 2010b).

The figure below illustrates regulation in the finance sector;
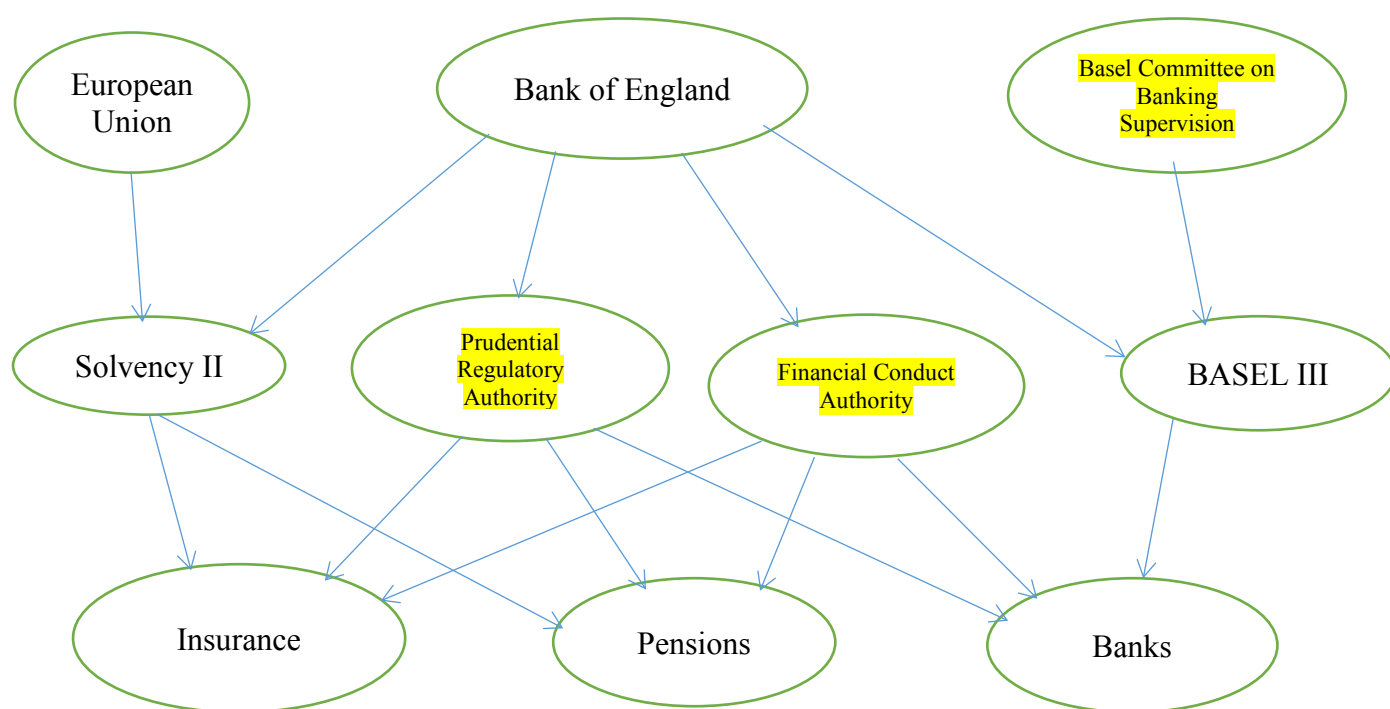
Fig 6; Regulation in the Finance Sector

H1; Financial Regulations significantly positively affects the way the finance sector responds to the effects of natural resource constraints.

3.3.2. Banking

Banks play an essential role in the growth of the finance sector and the economy as a whole (Bollard 2011), as little or no growth can be attained till savings are efficiently channelled into investment (Asenova, 2006). Banks are actively involved in capital provision for infrastructure, innovation, job creation and overall prosperity whereas playing an essential part in society because they affect the spending of individual consumers and the growth of entire industries (Cogan, 2008 in Komo & Ngugi 2013). Banks play a vicarious role of monitoring investments

in the best interests of investors and have the ability of reducing liquidity risk thereby creating investment opportunity (Komo & Ngugi, 2013). A number of important services are provided by banks to the wider economy, such as; the transfer of financial resources between borrowers and saver/lenders/depositors, the transformation of deposits into funding of households, businesses and the government who wish to borrow, facilitating trade systems through its clearing and settlement function, and risk and uncertainty transfer and insurance (Bollard, 2011; Burgess 2013). The above mentioned services lead to capital formation, investment in new venture, promotion of trade and industry, influence economic activity, and the monetization of the economy. These services can only be carried out effectively with the careful management of credit, liquidity, and interest rate risks.

The role of banks is dependent on the type of banking; the retail banking which consists of mostly commercial banks, credit unions and building societies deal mainly and directly with customers than other firms and banks. Its main services are savings, personal loans, debit and credit cards (Tiwari et al., 2006). Investment banks on the other hand are financial institutions that assist individuals, corporations and governments in raising capital by acting as the agents in the stock market. It also provides ancillary services such as trading of derivatives, market making, equity services and fixed income instruments, currencies and commodities (Morrison & Wilhelm 2007). While the central bank manages the money supply, currency and interest rates of the economy and acts as a lender of last resort to other banks during bank solvency or financial crisis. They also have supervisory and regulatory powers to govern the financial system, like the Bank of England in the UK context, thereby enhancing growth of the economy through price stability, stability of the financial market, interest rate stability and foreign exchange stability (Sheffrin, 2003; Quinn et al., 2006).
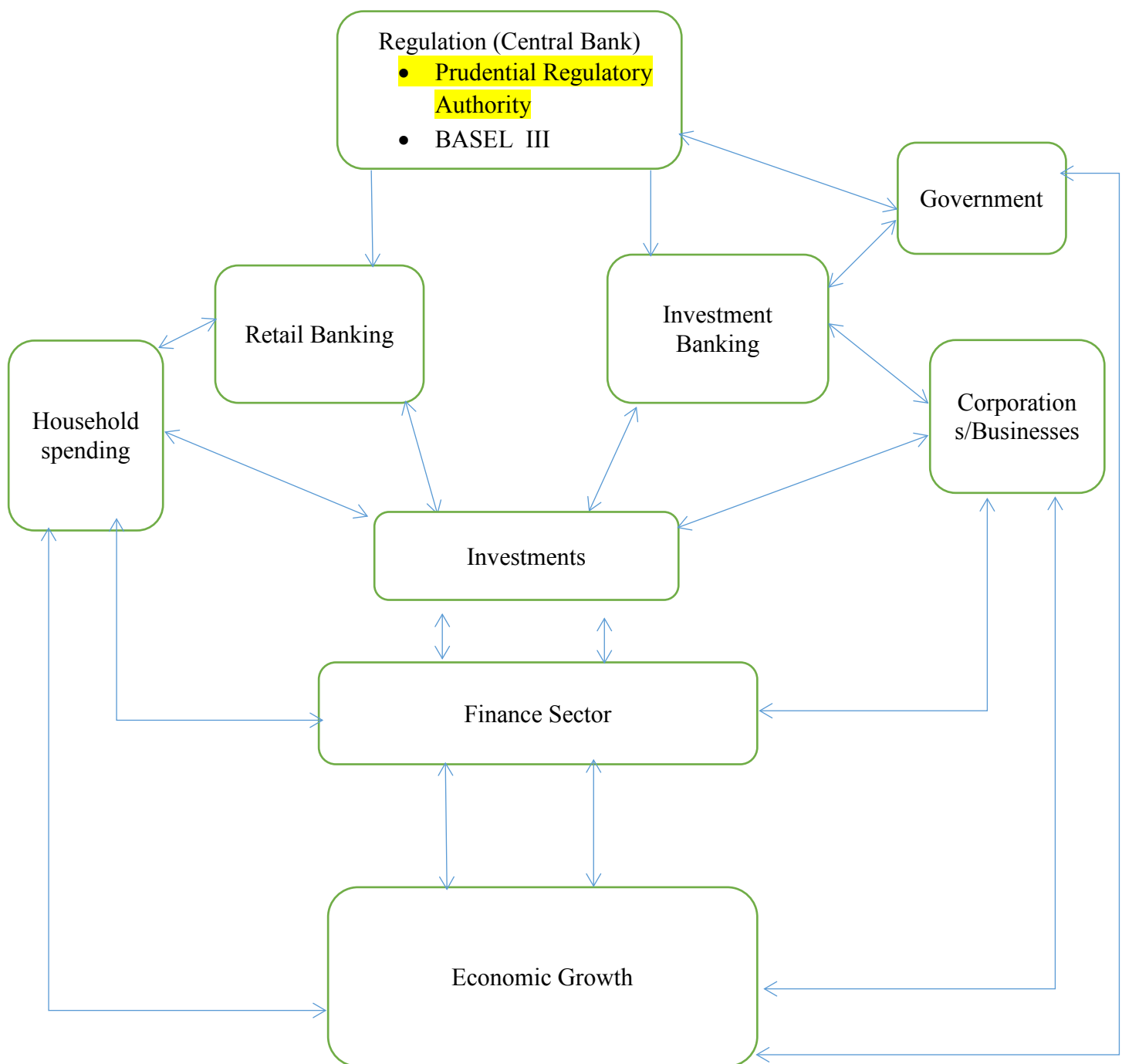
Fig 7; Role of the Banking Sector in Economic and Finance Sector Growth

The banking sector in the UK economy is one of the largest international financial centres, holding one-fifth of all European banking assets (BBA, 2013). The sector had been growing at an average annual rate of 7.5% from 2000-2007, contributing 5.2% to the growth of the finance sector, and fell to -4.7% growth rates from 2008-2010. It contributed over 4.4% of GDP in

2006 (William et al., 2009; Burgess 2013). According to the KPMG report (2012), the retail banking sector's output was over £7.1 billion in 2011.

3.3.3. Insurance

The insurance sector is also important to the growth of the finance sector and the economy as a whole as it promotes growth through;

- Encouraging investment and innovation by reducing risk and eliminating uncertainty, by the provision of insurance coverage to firms directly, to improve their financial soundness.

- Helping in the development of entrepreneurial skills and attitudes, innovation, encouraging investment, competition and market dynamism. Basically, the obtainability of insurance allows risk averse individuals and entrepreneurs to be involved in ventures with higher risk and higher return activities which would otherwise not have been taken in the absence of insurance, thus increasing productivity and growth (Brainard 2008)

- Facilitating the access to capital firms' needs in operations, by gathering dispersed financial resources and transferring them towards investment opportunities.

- Contributing to the modernisation of financial markets, enhancing financial intermediation, creating liquidity and mobilizing savings.

- Promoting a system of social protection especially for health and retirement, thereby releasing the pressure on public sector finance

- Promotes sensible risk-management by households and firms through the price mechanisms contributing to sustainability.

<div align="right">CEA (2013)</div>
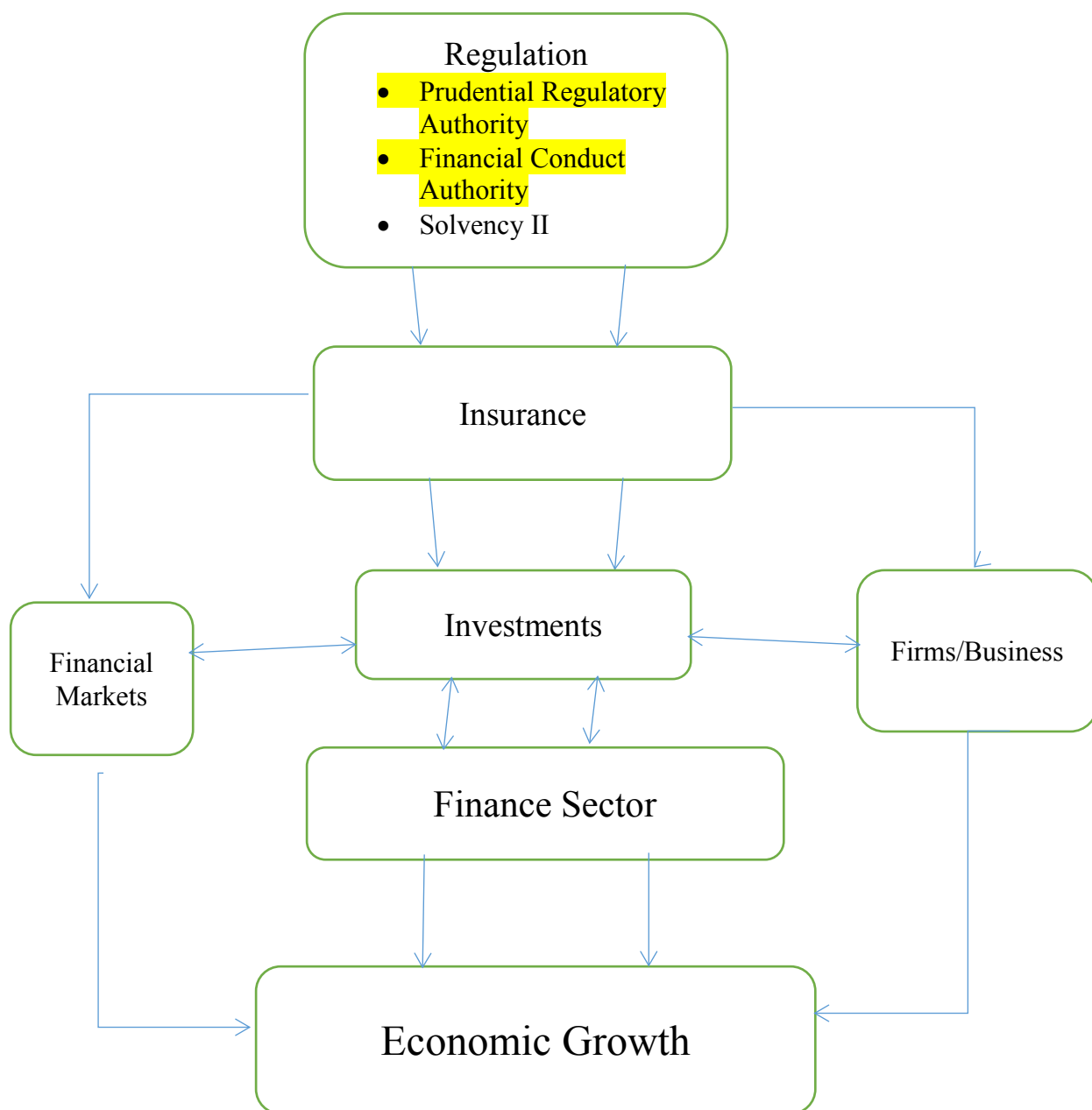
Fig 8; Role of Insurance to Finance Sector and Economic Growth

The UK Insurance sector is the largest in Europe and the third largest in the world (ABI 2013). It plays a fundamental role in assessing and managing risk – whether strengthening the resilience of local communities, sustaining regional growth, or underpinning global trade. In

the UK economy, the insurance sector contributes by employing approximately 320,000 people across the country, attracting global capital, serving the needs of consumers, and generating UK exports (UK Gov., 2013), with over 976 firms being authorised to provide general insurance. It also contributes approximately 2.6% of UK GDP (£25billion in terms of gross value added) and it is essential to asset management, managing over £1.8 trillion in investments in 2012 (TheCityUk, 2013; ABI, 2013), accounting for 25% of UK's net worth, and is also a major exporter with 30% (£46 billion) of its net premium coming from abroad, generating 22% of the total EU premium (ABI 2013). The insurance sector also contributes largely to the tax revenue in the UK, contributing over £10.4billion in taxes in the 2010/11 tax year which is equal to about 1.9% of the total tax received by the Government (ABI 2012), of which £1.6 billion from Insurance premium tax alone, £3.2 billion is from tax on employment income and annuities and £2.7 billion from Corporation tax (ABI 2013).

The insurance company, as part of the financial service industry, is regulated by the Financial Service Authority (FSA), now split up into the Prudential Regulatory Authority (PRA) and the Financial Conduct Authority (FCA) and Solvency II.

For the PRA approach to regulating insurance, its objectives require insurers to have pliability against disaster and evade interruption to the continuity of financial services. The PRA prioritises its method to protecting policyholders reflecting both the potential for adverse effects on policyholders if stability of policy provision were to be interrupted and the implication to policyholders of the risk insured (PRA, 2013).
Distinctly, the PRA identifies that the chances for insurers to be less safe and sound and convey a lower standard of policyholder protection than is in the public interest differs with the type of insurance. For instance, insurers who provide cover over long maturities, like life insurance, or general insurance where the cover spreads over many years, bring greater opportunities for failure and a lesser ability for policyholders to protect themselves. Reflecting these factors, the standards the PRA sets, including its approach to supervision and its approach to the arrangements for dealing with failing insurers, differ (PRA, 2013).

However, according to Hodgson, (2013), these regulations have huge costs and unintended consequences". Insurers in Europe find it hard to own foreign businesses and there are large capital penalties if the capital requirements are not met. The absence of multiplicity in the insurers' capability of managing risk also diminishes customer choice and eliminates vital sources of long-term finance from the economy. This also exposes the whole system to greater risk if fundamental misjudgments are made or if an original source of risk (like natural resource scarcity), which was not expected in the regulatory imagination, develops.

3.3.4. Pensions

Pension funds, according to Davis (2000), carry out and accomplish a number of the roles in the financial system even more effectively and efficiently than banks or direct holdings. Their growth supplements the growth of capital markets and has operated as key facilitators of change in the financial service industry. The growth of the pension fund scheme as a financial intermediary is not only a result of its financial efficiency but also due to the fiscal incentives and benefits to employers and the growing demand from an ever growing ageing population (Davis, 2000). By definition, pension funds are "forms of institutional investors, which collect, pool and invest funds contributed by sponsors and beneficiaries to provide for the future pension entitlements of beneficiaries" (Davis 1995a). They therefore provide the opportunity for the accumulation of savings over their life of employment to take care of their needs during retirement either as lump sums or a provision of an annuity (Davis 2000).

Pension funds are particularly important to the growth of an economy due to the long term nature of their financial liabilities; they have benefit liabilities that may not mature for decades unlike that of banks and other holdings. As a result, pensions could be a source of long term capital for businesses and corporations (Croce et al., 2011). The role of pension funds to the growth and development of the financial system include; saving, investment in securities and other financial assets, disbursing annuities, providing forms of insurance, acting as operators in securities markets, cross border investors and owners of companies, clearing and settling payments, provision of ways to transfer economic resources, providing price information and providing a means to deal with incentive problems (Davis, 2005) and providing long term funds to the corporate sector (Studart, 2010).

Pension plans offer a range of investment options designed to invest money until the age of retirement. With the two main options being the lifestyle funds and the self-invested personal pension (SIPP). In the long term, shares have historically been known to perform better than bonds or cash, which are lower-risk investments. Consequently, a common approach is for people to invest in a fund mostly holding shares until they get closer to retirement, and then start to lower the risk profile of their investments (Scottish Life 2012).

Jones et al., (2010) assert that pension funds have a role to play in the financing of green growth, as pensions could be the key source of capital especially in OECD countries. Also pension funds given its size could play a major role in the raising of capital for climate change policy financing (TUAC 2012).
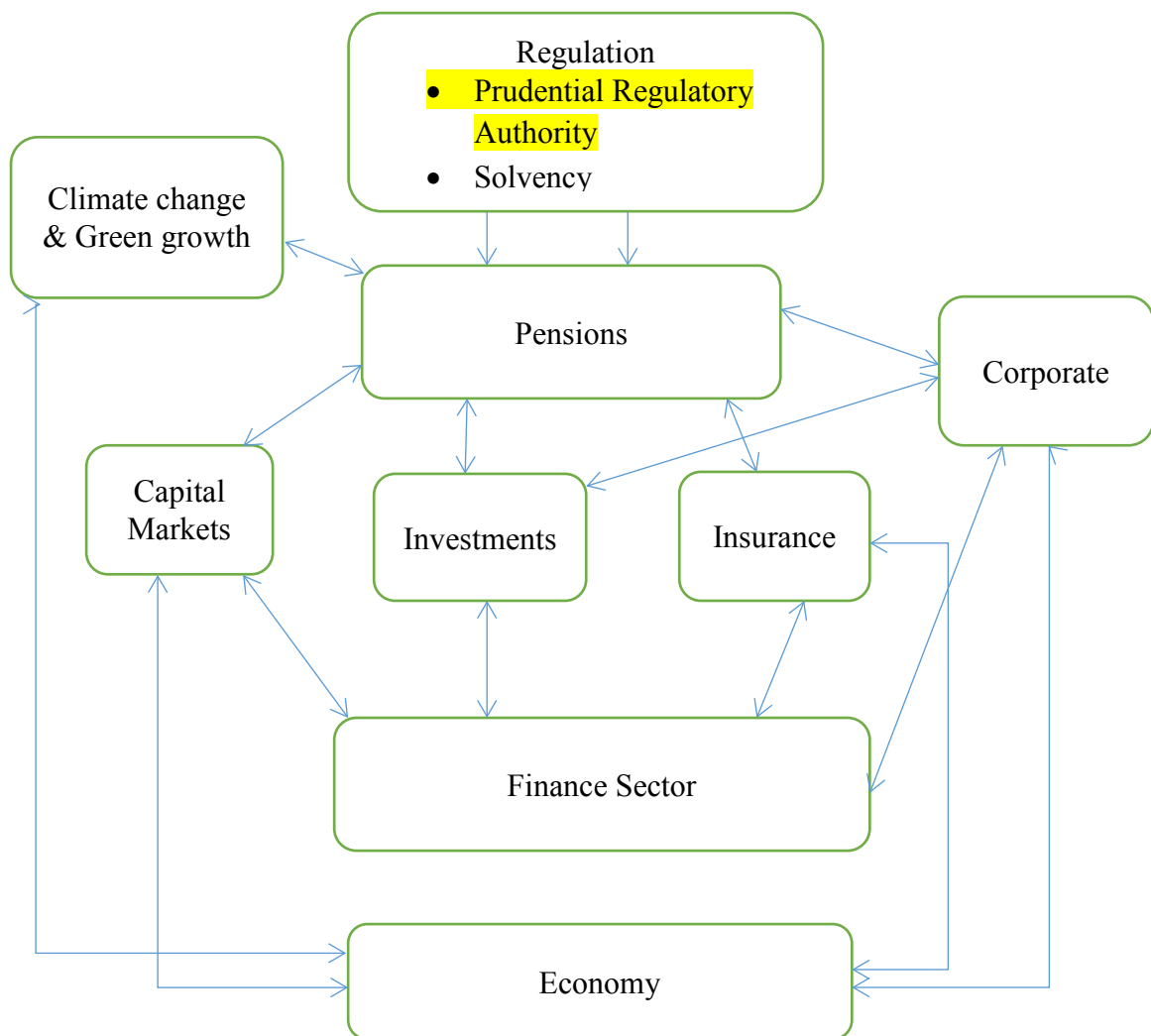
Fig 9; The Role of Pensions in Financial and Economic Development.

From the fig 9 above, the UK regulations monitor the actions of the pension schemes, which in turns affect their behaviour in carrying out its services in the finance service industry. There is a flow from pensions to the finance sector development through capital markets, investments, insurance, and the corporate sector.

Pension funds positively impact on the growth and function of capital markets (both stocks and bonds) (Meng & Pfau 2010) as the build-up of pension fund assets is likely to potentially encourage "depth and liquidity" in the capital markets due to the different investment conduct amid households and pension funds. With the accumulation of assets and the long life nature of their liabilities, pension funds are induced to invest more in illiquid and long-term assets that yield higher returns, and therefore provide a long-term supply of funds to the capital markets (Davis, 1995). However, according to Meng & Pfau, (2010) pension funds only impact capital

market development in countries with high financial development (like the UK) and little or no impact in countries with low financial development. In the UK, pension assets grew from 20% to 80% of GDP between 1980 and 2009. These funds drove the development of the stock market into one of the most liquid and sophisticated financial centres in the world. Before foreign investors became significant shareholders, pension funds and insurance companies held over 60% of issued shares (City of London Corporation, 2011).

Given the importance of pensions to the funding of investments both at the corporate and government level, the NABF Report (July 2013) asserts that with over £1trillion in assets held by Defined Benefit (DB) pension schemes, the management of their investment strategies could have an impact on the wider economy and financial markets especially the corporate sector. According to the Smith Institute report (2012), the UK had an asset value of over £1.6trillion under the management of pension funds in 2011, up to 9% of the world's total and larger than UK's GDP and there are over 100 local government pension schemes, employing 1.6 million employees, with a market value of £143 billion in the public sector alone. According to the IPE report release of 9th May 2014, sixty local pension authorities were valued at £120billion in assets.

3.3.5. Investments

It is generally agreed that there is a close connection between economic growth and the level of investment and/or capital formation (Anwer & Sampath, 1999). Investment basically refers to the economic activities that involve the use of resources for the production of goods and services. Investment spending makes direct contribution to economic activity because investment is the most volatile component of GDP. It plays a vital role in the long run and short run growth linking the present with the future (Ahmad et al., 2012). Investment is the part of overall financial planning. Haggblade (2007) asserts that investment in agriculture is necessary for rapid growth and poverty reduction. While public investment in education and training provides skilled labour, thereby increasing employment and investments in agricultural research improve and facilitate the diffusion of scientific research results which improves production.

According to ONS (2013), business investment in the UK rose by £1.1 billion to £31.1 billion in 2012 when compared to the last quarter on 2011.Total manufacturing investment rose slightly to £3.2 billion (1.4%) when compared with the previous quarter in 2011. Total non-

manufacturing investment rose by £1.1 billion to £28.1 billion (4.0%) when compared with the previous quarter. Compared with the third quarter of 2011, total manufacturing investment fell by £0.2 billion (-6.7%); total non-manufacturing investment rose by £1.6 billion (5.9%) (ONS, 2013).
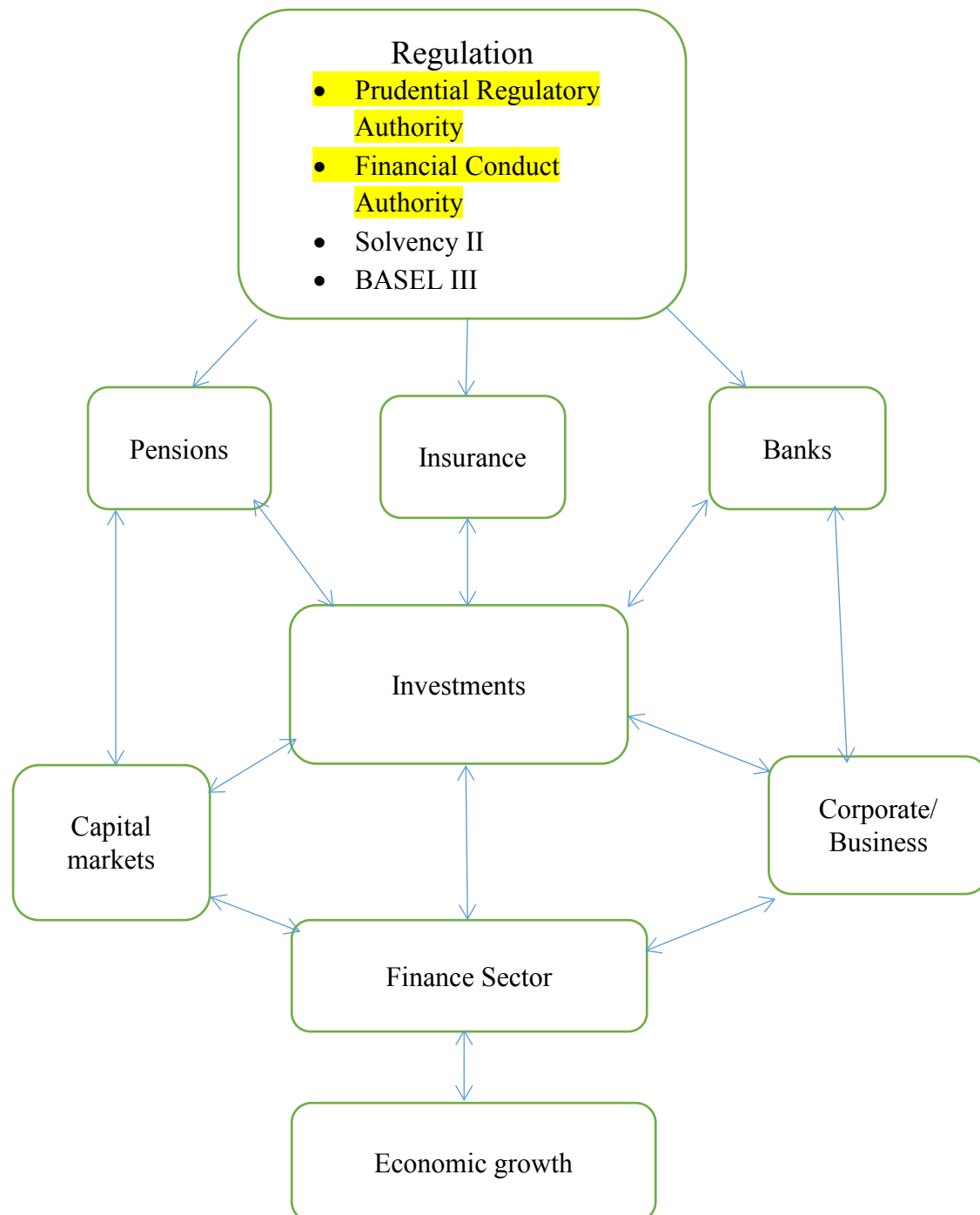
Fig 10; Role of Investment in Finance Sector and Economic Growth

The figure 10 above describes the role of investments to the growth of the finance sector and economic growth. As mentioned in the previous sections, banks, insurance and pensions undertake investment ventures to the benefit of the economy and for their own development. The success or failure of any investment will affect their performance. For instance, according to the Financial Times (July 2013), the fall in investment assets from 10.5 % of net assets to 8.6% of net assets in 2006 affected the financial performance of the UK economy. After the financial crisis, due to the volatility of the equity markets, pension funds changed investment strategies to curb risks of default. Also, a fall in investment in bank revenue could also have repercussions. The Reuter report (May 2014), reported that a fall in the investment for Barclays Plc. affected its first quarter profits as income from investments fell by 28% in the first quarter of 2014.

Before an examination of the effect of natural resource constraint on the finance sector and the economy, it would be necessary to examine the interdependent nature of the finance sector and therefore the possibility of a systemic risk in the finance sector as a result of a resource constraint.

3.3.6 Interdependence of the Finance Sector
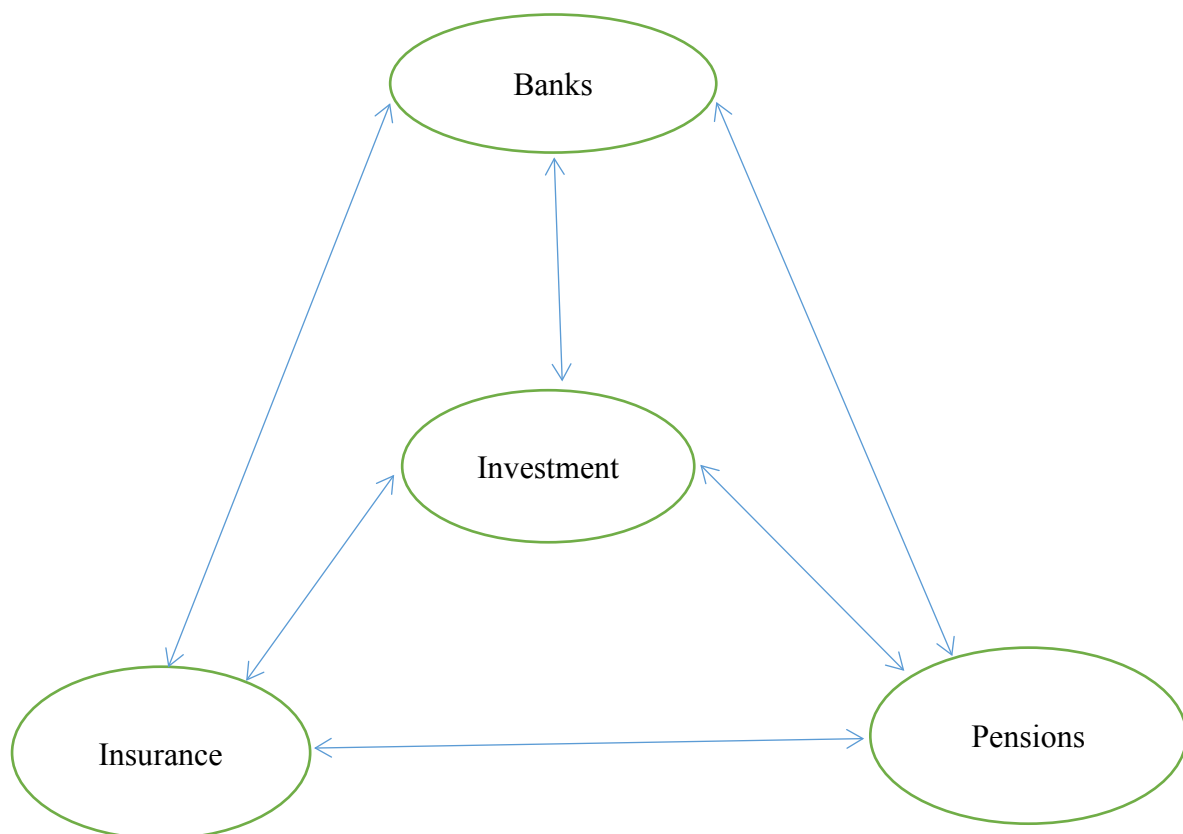
Fig 11; Interdependence in the Finance sector

The figure (11) above illustrates the interdependence of the banking sector to insurance and to pensions. Beginning with the relationship between banks and insurance, a major role is identified by Dumbreck (1998), where the bank is actively involved in the insurance market. Also known as Bancassurance (the provision of insurance and banking products and services through a common distribution channel and/or to the same client base), the insurance company uses the bank sales channel to promote and sell its insurance packages; therefore, the bank and an insurance company form a partnership so that the insurance company can sell its products to the bank's client base. As a result, the bank could make a profit in terms of commissions and introductory fees and make an equity investment on the insurance venture, reduction of the effect of the banks fixed costs as they are spread over insurance products, increased productivity of staff and the returns in terms of capital appreciation could be significant in the long term (Munich Re Group Report, 2011). From the view of the insurance company, it could benefit from the bank's clientele without having to increase sales forces or pay commissions to insurance agents and therefore boosts profits and to price future products with narrower margins, which helps to make the insurer's products more competitive. Also, the economics of the Bancassurance operation may allow the insurance company to offer products which are not feasible through the insurer's existing channels (BIS 2011). The following products are offered; credit insurance, depositor's insurance, overdraft insurance, savings insurance, capital repayments and investment products insurance. Consequently, if an adverse effect affects the performance of the bank for instance, that could cause reduced bank profitability, this could in turn affect the sales and profits of the partner insurance companies.

Pensions are deposited and saved in banks at interest rates. If banks' lending and credit activities are affected, the interest rates on these schemes could be reduced and also affect the annuities of these schemes.

Some pension schemes are provided and funded by insurance companies, mutual insurers or foundations; therefore, insurance companies are one of the main providers of pension revenues. For instance, Insurers provided €2200 billion for pension schemes in 2004 in the EU (CEA Statistics, 2007). Insurance companies also provide pension contract insurance that stipulates pension plan contributions to an insurance undertaking in exchange for which the pension plan benefits will be paid when the members reach a specified retirement age or on earlier exit of members from the plan (Hachett *et al.,* 2010). This implies that a decrease in the performance

of insurance companies, which could be caused by a fall in bank profitability, will impact on the insurance, benefits and costs of pensions.

Investments impact on banks, insurance and pensions especially if the financial markets in which these institutions have stocks, assets and equities are volatile and performing poorly, having low returns on assets for these institutions, thereby affecting their performance.

After having an overview of the interrelationships between banks, insurance and pensions and the effect of low investment returns on them, it would be easier to understand how natural resource constraints could affect and cause a systemic risk in the finance sector.

This leads to the following hypothesis:

H₂; Resource Constraint could cause a systemic risk in the finance sector

3.4. Natural Resource Constraint and the Finance Sector

The previous sections have established the relationship between natural resources and the economy and the role the finance sector plays in the growth of the economy, with separate emphasis on the role of banks, insurance, pensions and investments. This section will bring together the framework of 3.2 and 3.3 to establish the flow and link from natural resource constraints to the effects it would have on the finance sector through banks, insurance pensions and investments. A better way to illustrate this will involve an example of a scenario of the scarcity of a resource, for instance oil, and how the possible likely events would follow from then on.

Assume there is an increase in oil prices due to a fall in oil production below oil consumption and also a fall in export of oil from OPEC countries and subsequent increase in oil imports. The increase in price will affect the economy through the following channels;

- There will be an impact on the price level and thus increase in inflation. Its level of impact will depend on the degree of monetary tightening and the extent to which consumers seek to offset the decline in their real incomes through higher wage increases, and producers seek to restore profit margin (IMF 2010)
- There will also be a rise in the cost of production of goods and services in the economy, especially for oil-dependent production processes, given the increase in the relative price of energy inputs, putting pressure on profit margins. This will affect overall

performance of corporations and businesses. Consequently, firms could reduce investment and employment (lay off workers)

- Changes in relative prices could create incentives for energy suppliers to increase production and investment, and for oil consumers to economize. Because higher oil prices diminish real incomes of oil consumers globally, firms do not only suffer from a fall in demand in their home market but from foreign markets as well. So, exports decrease, potentially leading to a fall in GDP growth.

- There will be both direct and indirect impact on financial markets as asset prices will be affected. There will also be anticipated changes in economic activity, corporate earnings, inflation, and monetary policy following the oil price increases which will affect equity and bond valuations, and currency exchange rates. There has been a growing literature on the increases in price levels/inflation interfering with the ability of the financial sector to efficiently allocate resources (Boyd et al., 2000).

  The equity market will be affected by an increase in oil price as it would lead to the fall in the earnings of firms and corporations involved with intensive energy production and their market valuations, which is translated into higher production costs, severe enough for traditional manufacturing and transportation companies, slowing down demand, especially if there is a lack of diversification in the firms' portfolios (modern portfolio theory). Also the rate of inflation can adversely affect credit market frictions with negative repercussions for financial sector, especially equity market and stock market development.

  In the stock markets, there would be a fall in the market value of oil stocks and consequently a fall in stock prices, making the market sensitive to new information about supply of oil and could influence speculation.

- Increase in the prices of basic commodities and costs especially food prices (as oil and energy account for a third of grain production (OECD, 2011)) and for household energy, (use such as heating during winter). This would impact consumer spending.

  In the UK, the rise in oil prices, according to the Telegraph report by Rowley (2011), caused £8 billion in inflation, representing 0.5% of GDP. Energy prices pushed inflation up by 1% a year in 2011 and a predicted inflation rate of 2.9% in 2012. Input prices, which translated into cost of production, rose by 3.4% per month in 2012. Prices of basic commodities rose by 0.5% per month and by December 2012 increased by 4.2% (ONS 2013). The increase in oil prices following the 2005 hurricanes in the US, became

an issue for downstream energy producers in the UK, "increasing their costs and threatening their supplies" causing business interruption problems and affecting the general economy (Cooper, 2006).

To be able to illustrate the effect of the rise in oil price in the finance sector, the flow of events will be analysed through each of the above mentioned channels to the possible effects on insurance, pensions, banks and investments.

3.4.1. Effect on Insurance

The insurance company can be affected by a rise in inflation, as a result of increase in oil prices due to scarcity, especially consumer price index inflation, due to a rise in oil prices. Even though the general rate of inflation as measured by the Bureau of Labour Statistics and reported as a percentage change in CPI is one indicator of price increases, the effects on insurers may be dramatically different.

Inflation could affect insurers through the rising levels of claims costs, loss of reserves, investment returns and asset portfolios. As regards the costs of claims, insurers would be particularly affected by the cost of future claims for current policies. For example, "Workers compensation indemnity" claims are centred on wages at the time of a loss, for property policies, the values of the insured property are centred on the price to repair or replace the item at the time of loss in virtually all cases. Consequently, if inflation raises the value of the property, the cost of claims increases (Ahlgrim & D'Arcy, 2012). Also insurers are likely to experience a loss in reserves if inflation increases. Loss of reserves are commonly set based on the inherent assumption that the inflation rate experienced in the recent past will continue until these claims are closed. For some liability insurance lines, it can take decades for these losses to close. However, if inflation increases above expectations it will cost more than expected to settle these claims and the loss reserves will prove inadequate.

On the effect on insurance investment, inflation could increase interest rates which would reduce the value of long term fixed income holdings, which make up a significant proportion of investments for property-liability insurers. From written literature, insurances and investment returns are negatively correlated (Pecora & Roe, (2003); Krivo, (2009); Lowe & Watson, (2010); D'Arcy & Au (2011); Ahlgrim & D'Arcy, (2012)). Therefore, if inflation rates are to increase abruptly, the effect on property-liability insurers would be very substantial and significant as income from both underwriting and investments would fall and policyholder surplus would decrease due to both increased liabilities and reduced asset values.

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Life insurers on the other hand are not directly affected by inflation. However, they are indirectly affected by; an erosion of the current value of fixed future payments, creating a disincentive for the demand for life insurance, the definite rate of return on older policies would be unsatisfactory during continuous periods of inflation (Ahlgrim & D'Arcy, 2012). In general, inflation would have adverse effects on the insurance companies' balance sheets financial performance; return on equity and return on assets.

Inflation, however, doesn't have an" isolated" impact on insurer performance. While high inflation in itself could increase claims of insurers, the interaction with other economic and financial variables may lead to the risk assessment being more complex. For instance, in the event of extreme inflation levels leading to a recession, there is the possibility of an increase in the frequency and severity of claims which are not a true representation of the actual picture of claims. This represents the increase of fraudulent claims possession to be able to benefit more than deserved to meet up with the rising costs of living. According to the Insurance Fraud Bureau (IFB) undetected insurance claims fraud costs £2.1 billion yearly for UK insurance companies which is transferred to policy holders by an average increase of their costs by £50. However, attempts are being made to uncover such fraudulent claims as £1.3 billion claims were uncovered in 2013 by the IFB (IFB Report, May 2014).

With rising costs of production and services in the economy, caused by a rise in oil prices, which could affect the performance and profit margins of businesses and corporations, claims on business interruption insurance would increase. With rising costs of production and services in the economy, caused by a rise in food prices, which could affect the performance and profit margins of businesses and corporations, claims on supply chain and business interruption insurance would increase, given the significant financial losses and reputational damage to the business (Lloyds Report 2013). The supply chain risk is particularly peculiar with food manufacturing industries, which are reliant on a massive network of supply chains for the production of different food types at different levels of production. An increase in food prices, and thus food supply shortage caused by climate change related events, natural disasters, oil price shocks and economic downturns could therefore increase the cost of production and business would be interrupted.

As the supply chain risks increases with increases in food prices, the probability of the reduction in the quality of food production also increases. If the quality of the food product is tampered with and it is discovered, the business risks having its products recalled which could cause the business its reputation and ability to attract new customers (Lloyds report 2013). As a result, Product recall insurers will be at risk of increased claims from such businesses, thus

an increase in reimbursement costs and product replacements in markets. The rising costs could also cause a wage loss for workers which could increase claims on that insurance and also the possibility of employee layoffs.   Another major risk insurer may face is the increase in claims from agricultural businesses. With the provision of crop insurance, which is a major component of agricultural insurance, an increase in food prices could cause an increase in agricultural claims, especially if the main cause of the increase in prices is climate change imparted such as flood or drought. The rising costs could also cause a wage loss for workers which could increase claims on that insurance and also the possibility of employee layoffs.

The effect on equity markets which could affect corporations and manufacturing companies involved in energy production could increase claims on business and corporate insurance as well as fall in investment returns from these corporations. Also any disproportionate impact between countries could lead to an impact on currency exchange rates which in turn could affect overseas investment returns, especially if the pound sterling depreciates as a result of an increase in inflation levels. For instance, Clements and Fry (2008) found that spill overs from commodities to currencies accounted for approximately 1% of the volatility of currency exchange rates, while spill overs from currency exchange rates to commodities contributed between 2 and 5.2% to commodity price volatility. This is very peculiar with the case of UK insurance as over 30% of its investments are overseas (ABI 2013). As such, Moshirian (2007) asserted that reduced volatility of exchange rates could improve on financial institutions' (insurance) growth in international business.

In the UK, the increase in oil prices following the 2004/2005 hurricane seasons resulted in energy insurance losses recorded by Lloyd's of approximately £1,307 million for 2005 (Lloyd's 2006). This also added to business interruption costs which caused many insurers to move towards an agreed value form of cover by fixing the oil prices form the start of the contract (Cooper, 2006).

Insurance companies may also face the risks of increased claims from political risks. Increase in oil prices and its volatility could cause civil unrest, riots and commotions, which could further lead to business interruptions, Supply chain interruptions, contract and event cancellation and lost investments (Business interruption insurance). There could also be an increase in property casualty claims as a result of lost and/or damaged property through the rioting and commotion. For instance, though unrelated to increases in oil prices, the Association of British Insurers (ABI) claimed over £100 million in insurance claims were paid from a three-night riot in the UK in 2011 (Telegraph Report, Aug 2011). Thus, the possibility of civil unrest and riots as a result of food prices could be very costly for British insurers. With

over 30% of UK insurance being issued abroad, political unrest (political risk insurance) and the possibility of terrorist attacks (terrorism cover) as a result of food shortages in any of the countries holding UK insurance, especially developing countries, could be extremely costly for UK insurance companies. Not only would political risks affect insurance companies through claims, it would affect their investment returns; political events such as unrest and instability can affect the equity markets as there would be asset pricing implications and increased volatility of variances in returns while depressing stock prices (Kelly *et al.,* 2012).

Summarily, the impact of the scarcity of a resource like oil, leading to high oil prices could affect the insurance basically through increases in cost of claims and fall in investment returns. The figure below illustrates the effect of an increase in oil price on insurance.
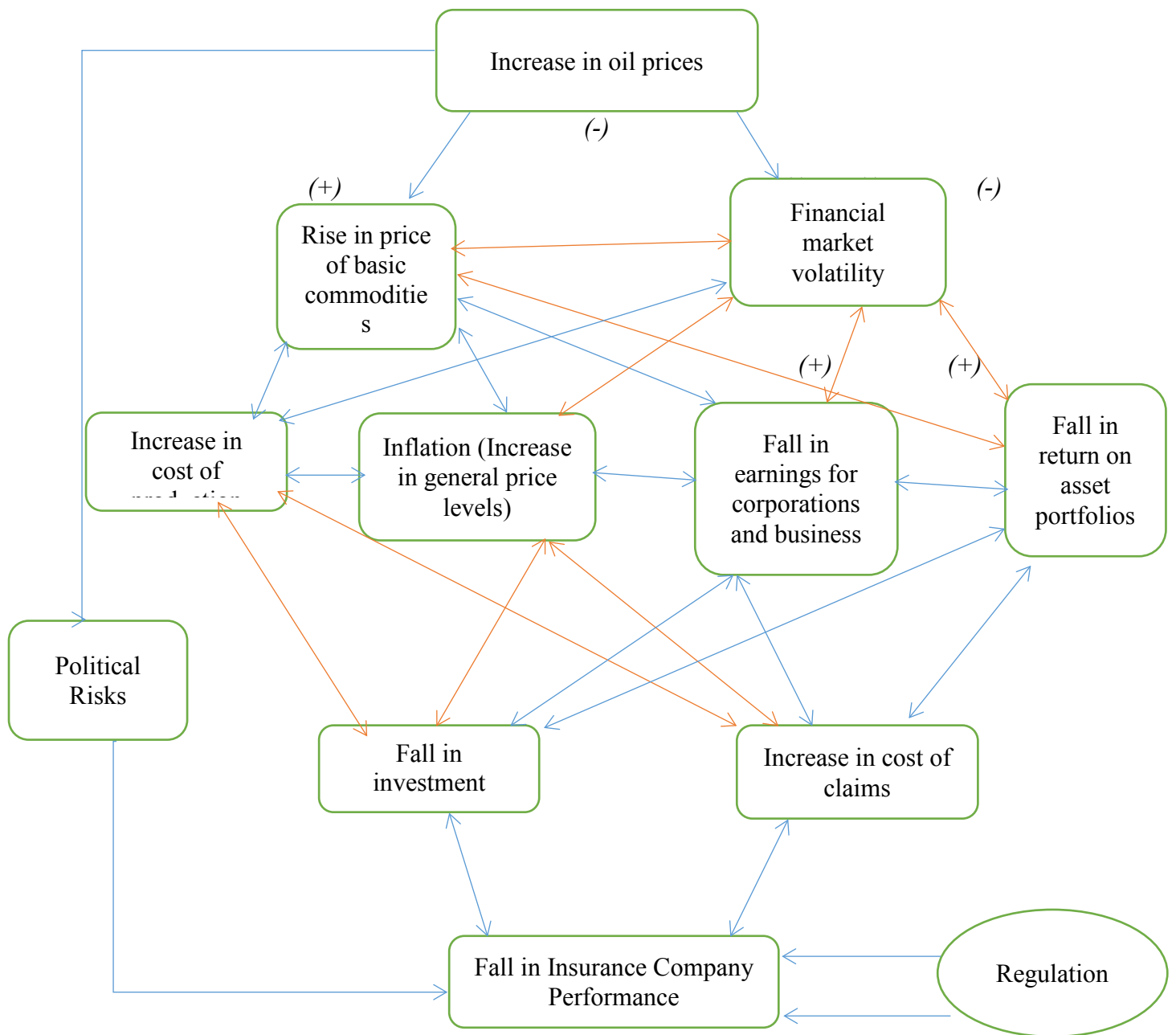
Fig 12; Effect of Increase in Oil Price on Insurance

(red arrows = negative feedback; blue arrows= positive feedback)

The negative feedback loops indicate that as a factor increases with time above a certain threshold, its impact "flattens out" in the long run. In other words, the effect becomes less significant. While the positive feedback arrows indicate that as a factor increases, its impact keeps increasing. For instance, the negative feedback from inflation and financial market

volatility shows that as inflation increases over a critical level there is a possibility of adjustments in the financial markets to changes in general price levels in the long run. Positive feedbacks on the other hand illustrate the increase in the magnitude of risks given a small amount of disturbance. For instance, a fall in investment returns will cause a fall in insurance performance which will further lead to a fall in investment and it goes down wards until risk management measures are implemented to augment investment or a fall in inflation which will reduce financial market volatility and increase investment returns. Therefore, the following hypothesis.

H3; Resource scarcity negatively affects insurance performance

3.4.2. Effects on Pensions

The inflationary effects of an increase in oil could affect pensions through the increases in pension costs and fall in investments by pensions. As mentioned in 3.2, pensions invest in securities and other financial assets and are one of the main sources of capital for corporations to finance their investments. A wave of inflation could affect financial markets and in turn adversely affect the return on assets and securities by pensions. The effect on the financial markets could also affect corporation profits, causing them to fall, thereby leading to a fall in pension investments, increased pension costs and pension benefits will not satisfy income replacement goals. According to Meredith et al., (2010) many defined benefit schemes are currently involved more in bonds than equity, but effects in the equity market could still affect the market value of their assets relative to their liabilities, thus increasing investment risks for pensions.

Also, an increase in oil prices could result in lower expectations of share prices rises, causing a strain in the investment returns of pensions. In most years, the growth of wages is higher than inflation which could lead to higher expectations for pensions although could also lead to higher contributions into pension schemes.

The figure below illustrates the effect of an increase in oil price on pensions;
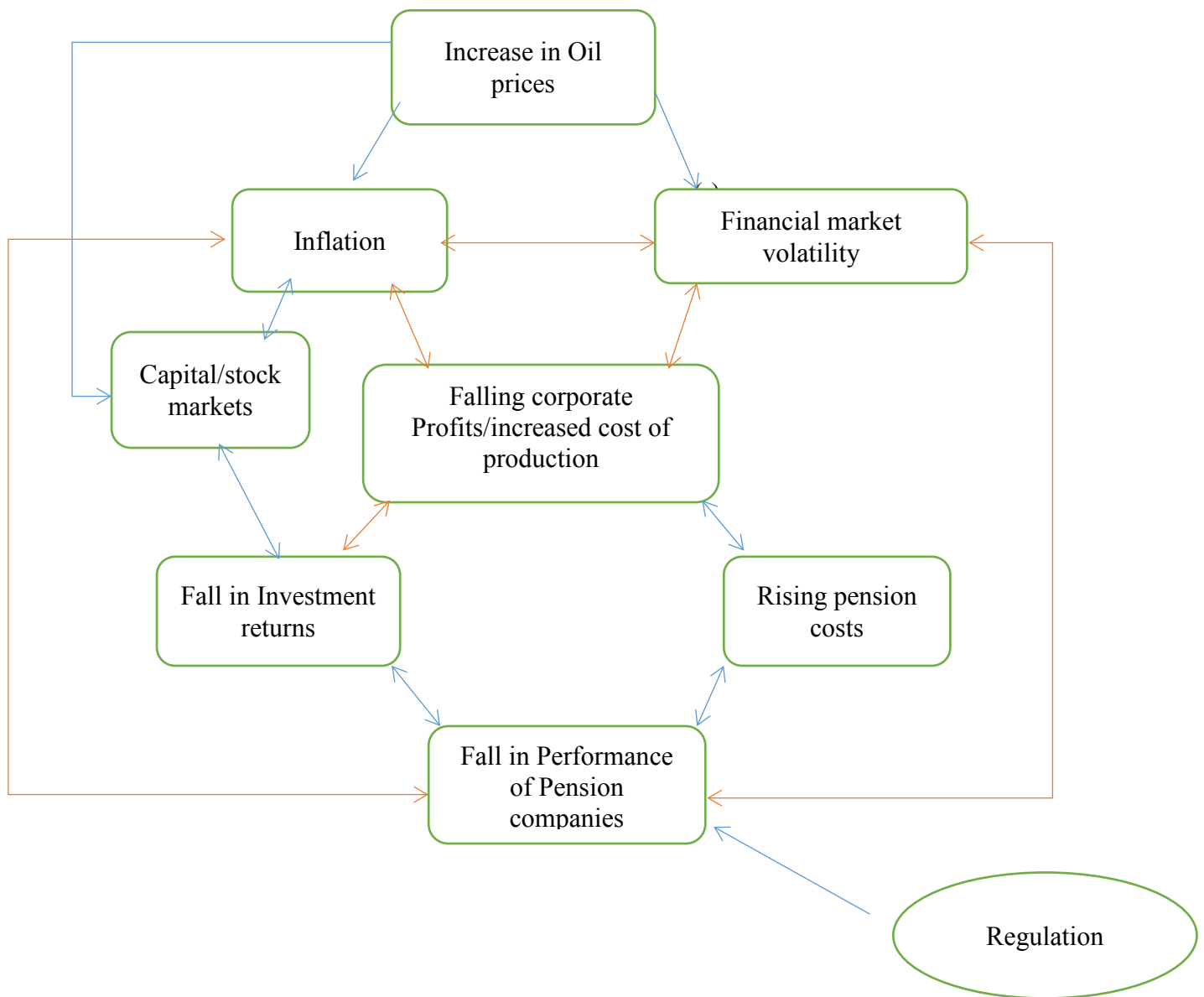
Fig 13; Effect of Increase in Oil Prices on Pensions

(red arrows = negative feedback; blue arrows= positive feedback)

Therefore, the following hypothesis:
H₄; Resource scarcity negatively affects the performance of pension companies

3.4.3. Effects on Banks

The effect of an increase in the price of oil (indicative of a resource constraint) on the banking sector can be seen theoretically and empirically, on its lending activities, ability to provide credit or efficiently allocate resources and its return on capital (investment returns). According to Hesse & Poghosyan (2009), oil price shocks have indirect effects on bank performance

through macroeconomic and institutional variables. The effect on banks will be examined following the channels identified in Fig. 13.

Higher inflation could decrease the real rate of return on assets. Lower real rates of return discourage saving but encourage borrowing. Consequently, new borrowers entering the market are likely to be of lesser quality and are more likely to default on their loans. Banks may react to the combined effects of lower real returns on their loans and the influx of riskier borrowers by rationing credit, meaning, if banks find difficulty in making a clear cut difference between old, new, good and bad borrowers, this may lead to the refusal of loan applications or reduce the quantity of loans given out. In a nutshell, this affects their ability to provide credit, reducing their lending activity to the private sector, corporations and the government (Boyd & Champ, 2006). Inflation could also affect the return on assets and bank profitability; there is a negative relationship between inflation and real Treasury bill rates, real deposit rates and real money market rates, meaning as inflation increases, the rate of return on these instruments fall (Boyd & Champ, 2006). On bank profitability, there is an intense negative effect from inflation. As inflation increases, the measures of bank profitability also decline in real terms, such as its rate of return on equity, net interest margins, net profits, and value added by the banking sector, thereby affecting the overall performance and profitability of the financial sector and the entire economy in general.

The effect of the increase in the cost of the production of goods and services in the economy on the banking sector will be seen through the effect of inflation. The increase in cost of production will be reflected in high prices, exacerbating the rate of inflation and thus impacting on the banking sector negatively.

According to BIS (2009), the level of volatility in the financial markets can influence the ability and willingness of banks to extend credit facilities. Thereby an increase in the volatility of financial markets, as a result of scarcity in oil, could affect the lending activity of banks and financial stability though the BIS report (2012) suggests it depends on the risk management practices involved in these institutions.

The figure below illustrates the effect of an increase in oil price on Banks;
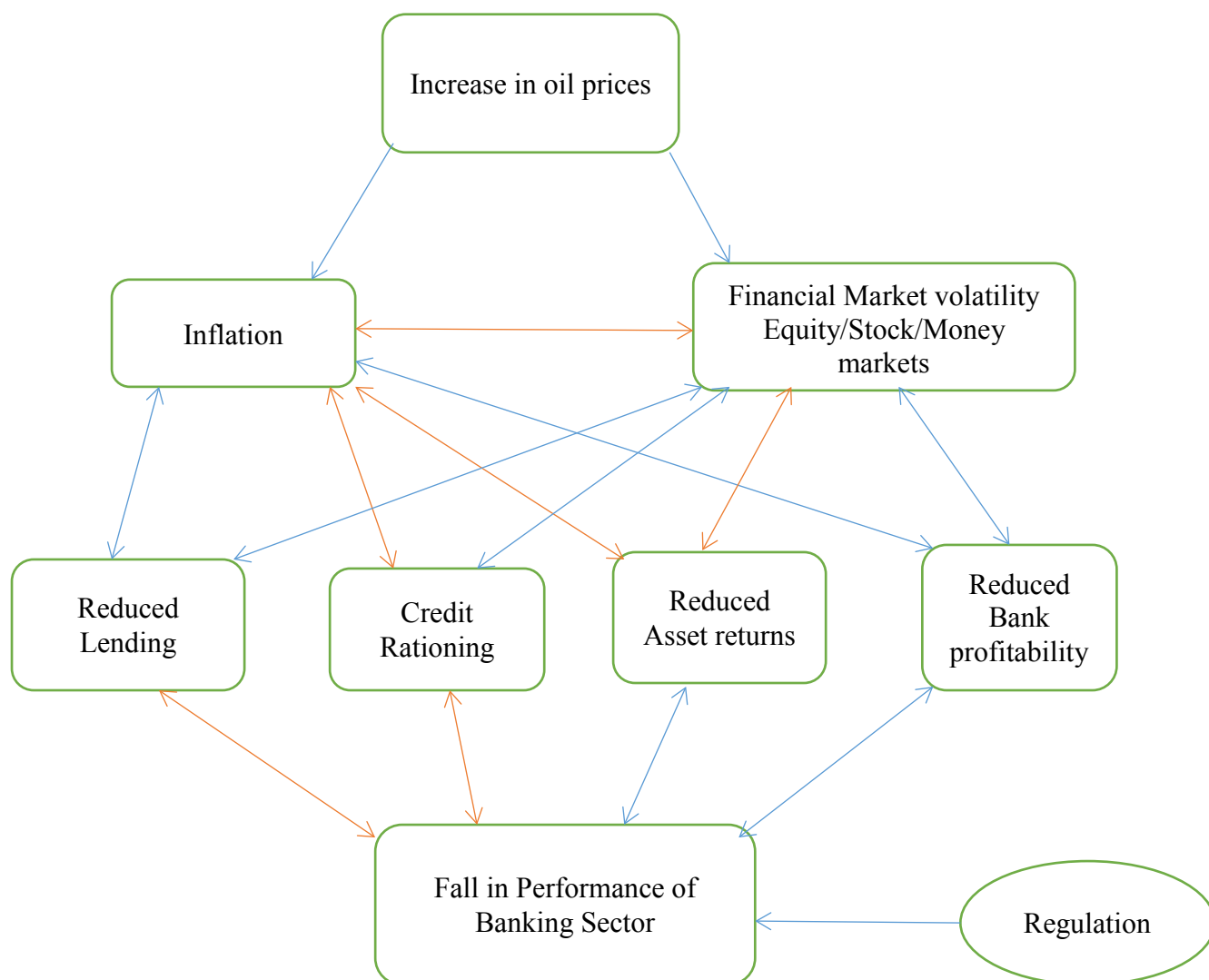
Fig 14; Effect of Oil Prices on the Banking Sector

(red arrows = negative feedback; blue arrows= positive feedback)

Therefore, the following hypothesis;
H₅; Resource scarcity negatively affects the banking sector

3.4.4. Effect on Investments

While it would be expected that high oil prices adversely affect general investment levels, oil prices could cause investors to shift investments towards oil related investments due to its potential to increase levels of return. However, when there is uncertainty about oil prices by firms and households, the desire to postpone investment increases. Where technology is

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embedded in capital and household items, such decisions make an irreversible commitment to the energy intensity of respective process/consumption items. As such uncertainty about how firms might fare in an environment of higher energy prices is likely to reduce investor confidence and increase the interest rates that firms must pay for capital, thereby reducing investment spending (Bataa, 2010).

High oil price effect on economic activity and inflation could affect investment through higher input costs and increased price volatility (OECD, 2011). Edelstein and Kilian (2007) argue that oil price shocks may affect fixed investment through either a 'supply channel' in which an increase in the cost of production driven by an increase in real oil prices decreases production, or a 'demand channel' in which consumer spending falls in response to rising energy prices. The general trend from literature is the negative relationship between oil price increases and stock returns (Jones & Kaul, 1996; Sadorsky, 1999; Pollet, 2005; Driesprong et al., 2008; Lee et al., 2010). As already discussed in the above subsections, increase in oil prices affect investments of insurance, pensions and banks through the fall in returns in the stock market and the overall volatile behaviour of the financial markets.

The figure below illustrates the effect of an increase in oil price on Investments;
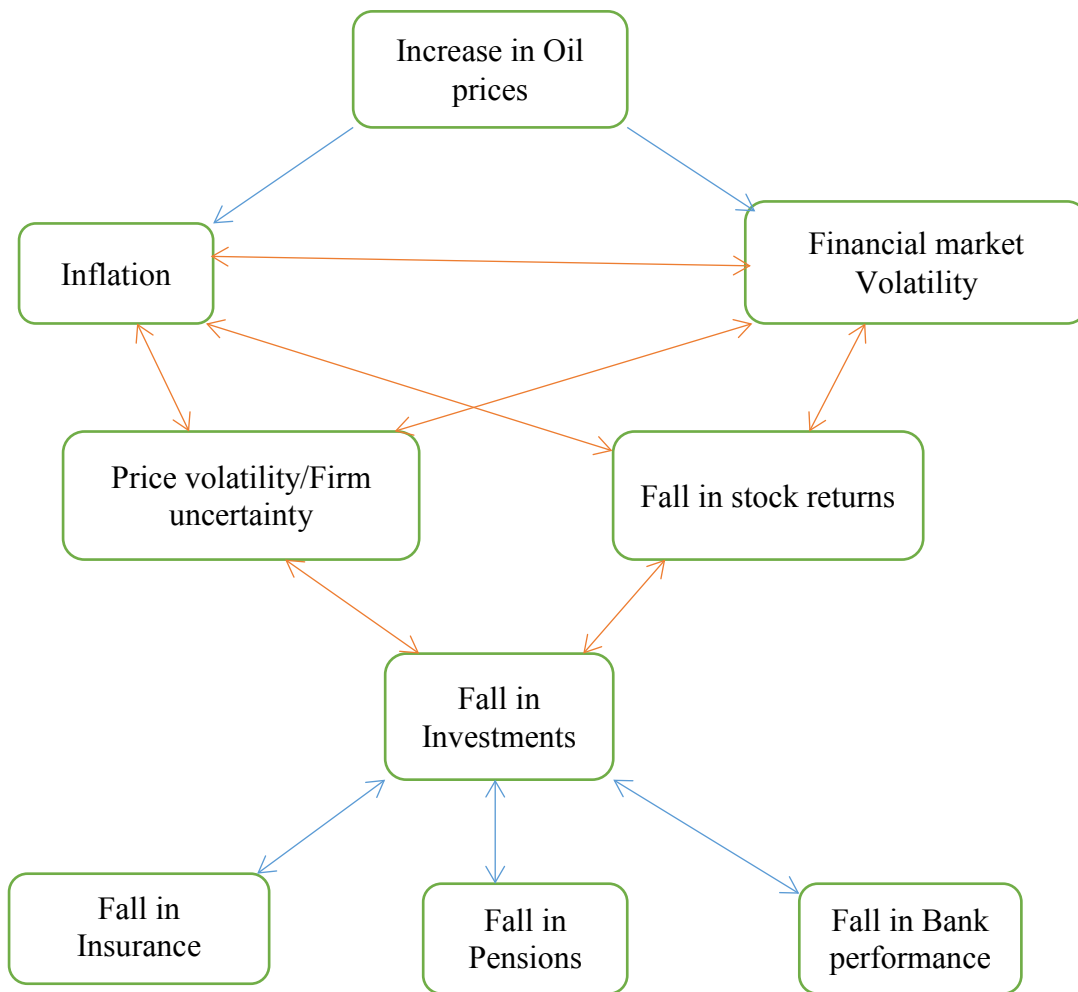
Fig 15; Effect of Increase in Oil on Investments

(red arrows = negative feedback; blue arrows= positive feedback)

In a nutshell, the effect of constraint in a natural resource, like oil, could impact the finance sector and the economy as a whole through;

- Increase in general price levels or higher inflation
- Which will lead on to increase in cost of production
- Increase in the price of basic commodities
- Direct and indirect effects on financial markets making it more volatile and affecting asset returns, stock prices, equity and bond prices
- This will affect investments of corporations, banks, insurance and pensions
- The poor investment returns and high cost of production will affect corporate performance which could increase claims for insurance, increase pension costs and

could affect their credit with banks, causing banks to ration credit and curb lending activities

- Poor investment returns if involved with highly risky portfolios (MPT), where oil prices follow the random walk theory where prices are independent of each other, therefore hard to predict, or prices of resources follow the EMH, where prices are determined by daily market information, which is therefore vulnerable to speculation.

- As a result of inflation the government could raise interest rates which would affect investment lending and borrowing, thus making it difficult for the finance sector to allocate resources

- An effect of resource constraint on bank performance could affect insurance profits which could lead to a fall in pension insurance and benefits. On the other hand, a fall in insurance profits could affect not only pensions but the profitability of banks, affecting its investment in insurance ventures and its general sales linked to insurance products as well as the confidence from its clientele could be lost based on insurance poor performance as a result of resource constraint. Also if pensions are affected, it could affect its deposits and savings in banks, affecting the profitability on banks and also affecting profitability and increasing the costs of claims for insurance.

- The effect of regulations is also included which restricts, to some extent, the reactions of banks and insurance companies to such risks given capital and liquidity requirements certain risk management guidelines.

  o For instance, during a crisis caused by a resource constraint, banks are still obliged to raise capital and long term funding to the required amount. This puts pressure on such institutions and therefore affects performance.

  o Also for insurance companies, in the face of falling asset prices due to resource scarcity, they may be forced to liquidate these assets to meet up with the liquidity requirements and they face higher capital requirements than they could wish for (Hodgson, 2013). Under regulation, the insurance company will have to take into consideration the trade-off between the expected return on its investment portfolio against the cost of capital required to cover the investment risk. If the cost of capital surpasses the expected return, the insurance company will probably try to reduce the level of investment risk by reallocating into lower-charge investments. Thus pressure both from regulation and market performance could cripple the finance sector.

3.5 Framework of Effect of Resource Constraint on Finance Sector

The figure (15) below is a combination of figure 11, 12, 13 & 14 to better illustrate the flow from an increase in oil prices to the effect on the finance sector and the economy.

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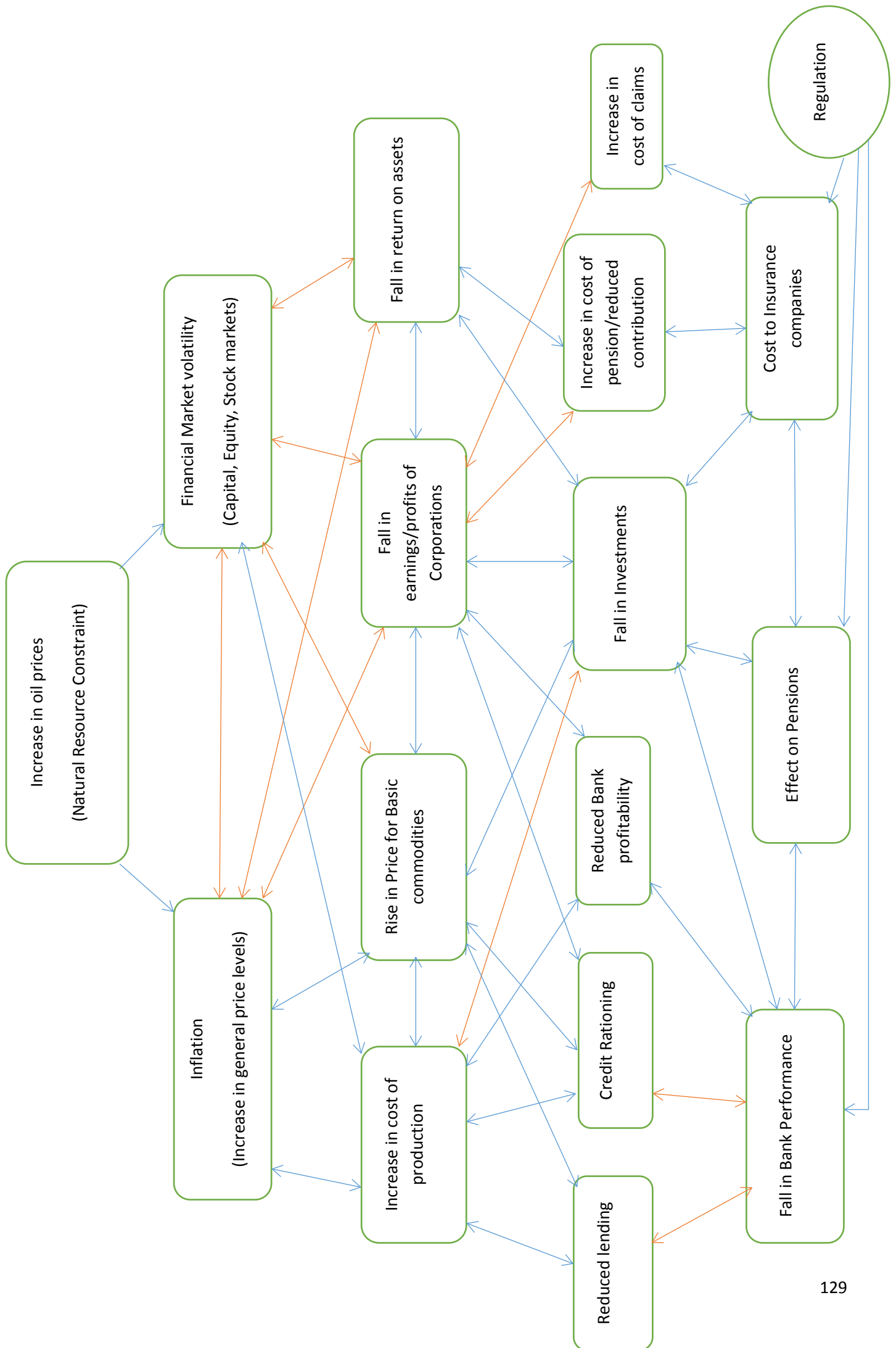
It can therefore be seen from the diagram above, that natural resource constraint affects the finance sector through macroeconomic mechanisms which are directly affected by the strain involved with a scarce resource. As can be seen in the diagram the effect of such constraints could "flatten out" or become insignificant in the long run through some of the negative feedback mechanisms in the system (red arrows). However, a majority of the interactions in the system have positive feedbacks implying an escalation of effects which could possibly lead to systemic risks in the economy in general and the financial sector in particular. The presence of regulations, and their revision and tightening after the financial crisis, potentially aggravates the weight of the effect of natural resource constraint on the finance sector with capital and liquidity requirements which could be difficult to meet up with alongside coping with effects of high priced resources due to scarcity.

The purpose of this research therefore is to quantitatively measure the effect of resource scarcity on the finance sector, taking into consideration the linkages in the system and qualitatively assess how these financial institutions cope with such effects alongside regulation and if there could be any other possible links with other unidentified risks with natural resource scarcity. And to qualitatively check that the framework is close to a true representation of the effect of resource scarcity (through interviews).

The premise of the quantitative and qualitative measures will be examined under the mixed method methodology in the next chapter. Here, the ideology behind the mixed methods would be examined, encompassing aspects from both quantitative and qualitative characteristics and the rationale, why this method is most appropriate fro this research.

Chapter 4. Research Methodology

4.1. Introduction

The main purpose of this research is to examine the impact of resource constraints on the financial sector. This basically encompasses the questions on "will", "how" and "why" resource constraints have an impact on the financial sector. In order for the research questions to be answered and the specific objectives achieved, the quantitative and qualitative methods was used; the quantitative methods answered the questions on "will" and "how" and the qualitative answered the questions on "why". Thus a mixed methods design was used. According to Johnson & Onwuegbuzie (2004), many research questions and objectives are best and most usefully answered using mixed research methods. The purpose for the mixed methods research was that both quantitative and qualitative methods would give a better understanding of the research problem than any of the single methods would provide.

The main purpose for research in general was the need to establish or confirm facts, reaffirm the results of previous work, solve new or existing problems, support theorems, or develop new theories. According to OECD (2002) research comprises a creative work carried out on a systematic basis for the purpose of increasing the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications. In order to carry out such creative work, two main traditional methods of research have been used for centuries; the quantitative and the qualitative methods. The use of either the quantitative or qualitative methods depends on the type of research and what it aims to achieve; be it exploratory, constructive or empirical research.

Before providing further explanations why this research employed the quantitative and qualitative methods, it would be important to establish the research philosophy and/or tradition this research was based on. There are two main contrasting philosophical positions/traditions that underlie researches in the social sciences especially finance and business. These include the positivism and the social constructionism positions (Easterby-Smith et al., 2008).

4.1.1. *Positivism*

The main idea underlying positivism is the fact that the social world exists externally and operates by general laws thereby its properties should be measured through objective methods instead of being measured subjectively by reflection or intuition. Comte (1853) encapsulated the positivist view based on two assumptions; an ontological assumption that reality is external

and objective and an epistemological assumption that knowledge is only significant if it is based on observations of the external reality. It assumes that

- The observer has to be independent
- The freedom to study whatever seems of interest and how to study it
- Identify causal relationships
- Hypothesizing fundamental laws and deducing from observation to support or reject hypothesis
- Operationalization of concepts to be measured quantitatively
- Regularities can be identified by comparison of variations across samples

(Easterby-Smith et al., 2008)

Thus the positivist tradition is mainly based on quantitative methods. This view, however, was criticized by sociologists such as Berger & Luckman (1966), Watzlawick (1984) and Shotter (1993) on the grounds that reality is not objective and exterior, but is socially constructed and given meaning by people. They further developed the social constructionism approach.

4.1.2. Social Constructionism

The key idea of social constructionism is that reality is determined by people rather than being measured objectively. Its main focus is to discover ways in which individuals and groups contribute to the development of their perceived social reality, and how they communicate with each other either verbally or non-verbally (Easterby-Smith et al., 2008). Therefore, the main focus of the researcher is to understand and explain why people have different experiences. Constructionists view knowledge and truth as created not discovered by the mind and supports the view that being a realist is not inconsistent with being a constructionist. One can believe that concepts are constructed rather than discovered yet maintain that they correspond to something real in the world (Schwandt 2003). Thus this approach is solely based on qualitative methods of research.

Therefore, the ideas and methods of the classical positivists and the social constructionists differ considerably and are summarized on the table below.

Table 4; Contrasting Ideas and Methods of Positivism and Social Constructionism (Easterby-Smith et al., 2008)

	Positivism	Constructionism
The observer	Independent	Part of observation
Human Interests	Irrelevant	Main drivers of science
Explanations	Demonstrate causality	Increase understanding of a situation
Research goes through…	Hypotheses and deductions	Ideas induced from data
Concepts	Defined for measurement	Incorporate stakeholder experience rather than expertise
Units of analysis	Reduced to simplest terms	Include complexity of whole situations
Generalisations	Statistical probability	Theoretical abstraction
Sampling Requirements	Randomly selected numbers	Small numbers of case study

This research is going to be based on certain aspects of both philosophies to better capture the effect of natural resource constraints on the finance sector performance;

- The observer is going to be independent and not be part of the observation.
- However, human interest will be relevant in this research as it often drives financial responses to some extent and thus would be advantageous to get the views of participants in the finance sector.
- The explanations will demonstrate causality between resource scarcity and sector performance AND will also seek to increase the understanding of the effect of resource scarcity on the finance sector.
- The research will go through formulation of hypotheses and deductions from observed data AND at the same time will let more ideas about the effect of resource scarcity emerge from data.
- The research will have concepts on resource scarcity and sector performance defined for measurement AND will incorporate the perspectives and experience, rather than the

expertise of important stakeholders of the finance sector on the effects of resource scarcity.

- The complexity of the effect of resource scarcity as a whole will be included in the study.

From the above points, it is evident that it is a mixture of ideas from the positivists and social constructivists approach. Thus to be able to achieve all of the above points, both the quantitative and qualitative methods have to be employed in the research.

In recent years, there has been the growing interest on the possibility of combining the quantitative and qualitative methods in a single study (mixed methods) (Bryman 2004), but such ideas have been argued against by the purists of the respective research traditional approaches on the basis of difference in conventions and paradigms. Both groups of purists regard their paradigms as the ideal for research, and, implicitly if not explicitly, support the "incompatibility thesis" (Howe, 1988), which postulates that qualitative and quantitative research paradigms, including their associated methods, cannot and should not be mixed (Johnson & Onwuegbuzie 2004). Advocates of mixed methods research (Bryman, 2004; Onwuegbuzie & Leech, 2005) propose that this purist opinion, that quantitative and qualitative methods cannot be combined, poses a "menace" to the advancement of science and that while epistemological and ontological commitments may be associated with certain research methods, the connections are not necessarily deterministic.

Though there are many important classic differences between qualitative and quantitative research there are some similarities between the various methods that are occasionally ignored. For instance, empirical observations are used by both quantitative and qualitative researchers to handle research questions. Sechrest and Sidani (1995) point out that both methodologies "describe their data, construct explanatory arguments from their data, and speculate about why the outcomes they observed happened as they did." Moreover, both circles of researchers incorporate safeguards into their inquiries in order to minimize confirmation bias and other sources of invalidity (or lack of trustworthiness) that have the potential to exist in every research study (Sandelowski, 2000).

This chapter will be organised thus; section 4.1 will be an overview of mixed methods and its major types of designs, section 4.2 will examine the explanatory sequential mixed methods design and the rationale behind the use of this design, section three will describe how the

quantitative phase of the research will be carried out and section four will look at the qualitative phase.

4.2. Mixed Methods

For the last two decades, the mixed methods research design has been the subject of interest and debate (Greene & Caracelli, 1997a; Tashakkori & Teddlie, 1998; Sandelowski, 2000; Johnson & Onwuegbuzie, 2004). The centre of the debate is the feasibility of the possibility of combining both quantitative and qualitative research methods given their different epistemological and ontological assumptions and paradigms associated with these different methods (Sale et al 2002; Morgan 2007).

Mixed methods research has been defined in a number of ways; Johnson & Onwuegbuzie (2004) define mixed methods as "the class of research where the researcher mixes or combines quantitative and qualitative research techniques, methods, approaches, concepts or language into a single study." Tashakkori and Creswell (2007) broadly define mixed methods research as ''research in which the investigator collects and analyses data, integrates the findings and draws inferences using both qualitative and quantitative approaches'' while Johnson et al (2007) define mixed methods research as the type of research in which a researcher or team of researchers combines elements of qualitative and quantitative research approaches (e.g., use of qualitative and quantitative viewpoints, data collection, analysis, inference techniques) for the broad purpose of breadth and depth of understanding and corroboration. In a nutshell, mixed methods research is the procedure for the collecting, analysing, and integrating/combination of qualitative and quantitative methods at some stage in the research process in a single study for the purpose of getting a better understanding of the research problem.

Philosophically, mixed methods is a "third research movement" that moves past the paradigm wars between qualitative and quantitative methods, by offering a logical and practical alternative. Mixed research makes use of the pragmatic method and system of philosophy. Its method of inquiry includes the use of induction (or discovery of patterns), deduction (theories and hypotheses testing), and abduction (uncovering and relying on the best of a set of explanations for understanding one's results) (de Waal, 2001) and is also an effort to legitimate the utilization of multiple approaches in answering research questions, rather than limiting or restraining researchers' choices (Morgan 2007; Harrison III, 2013).

Researchers increasingly have used mixed method techniques to expand the scope of their studies and such techniques draw from the strength and minimize the weaknesses of each single research method in a single study and across studies (Johnson & Onwuegbuzie, 2004; Ostlund et al 2011), thus integrating both methods in a single study could yield more distinct and precise results than assessing them in isolation (Shaw et al., 2010). Thus the main reason for the use of mixed methods is the fact that the quantitative and/or qualitative methods are insufficient on their own to effectively capture the details and trends of a given situation.

In business studies, the use of mixed methods has been considered and observed by scholars (e.g Hanson & Grimmer, 2007), Hurmerinta-Peltomäki & Nummela, 2006) and Molina-Azorin, 2011) with the main concern as to what types of mixed methods designs are being used and how they are used in business studies. An attempt to address such concerns was made by Harrison & Reilly (2011) who took steps in identifying trends in the types of mixed methods design being employed in research. The types of design are basically characterised by the level of interaction between the quantitative and qualitative strands of data (independent or interactive), the timing of the use of the data (sequential, concurrent or multiphase combination), the priority given to the data and the integration (mixing) of the data (Harrison III, 2013). The characteristics of the type of design is dependent on the rationale for using mixed methods research of which such reasons include; explanation, exploration, triangulation, unexpected results, different research questions, credibility, sampling, confirmation and discovery (Bryman 2006; Ostlund et al., 2011). The rationale for using mixed methods is influenced by the research questions and the aims of the research, which should be clear, so as to determine how analytical techniques could be related to each other and how the findings could be integrated (O'Cathain et al., 2008). Forty mixed methods design have been reported in literature (Tashakkori & Teddlie 2003), but six major mixed methods design have been identified and their rationales (Creswell et al., 2003);

- The Convergent parallel design (Mitgaard et al., 2006; Rauscher and Greenfield, 2009; Harrison & Reilly, 2011); where the qualitative and quantitative methods are used concurrently with equal priority.
  Rationale (Triangulation, offset weaknesses of other method, completeness, different research questions, credibility, utility and diversity of view)

- The Explanatory sequential design (Rauscher and Greenfield, 2009; Harrison & Reilly, 2011); occurs in two distinct interactive phases where the design begins with the

quantitative method, which has the priority for addressing the study's questions. This phase is followed by the qualitative method. The qualitative phase of the study is designed so that it follows from the results of the first, quantitative phase. The researcher interprets how the qualitative results help to explain the initial quantitative results.

Rationale (Completeness, process, explanation, unexpected results, sampling, credibility, context, illustration and utility)

- The Exploratory sequential design (Rauscher and Greenfield, 2009; Harrison & Reilly, 2011); the exploratory design begins with and prioritizes the collection and analysis of qualitative data in the first phase. Building from the exploratory results, the researcher conducts a second, quantitative phase to test or generalize the initial findings. The researcher then interprets how the quantitative results build on the initial qualitative results.

  Rationale (Completeness, process, instrument development, sampling, credibility, context, utility, confirmation and discovery)

- The Embedded design (Harrison & Reilly, 2011; Harrison III, 2013); the quantitative and qualitative data is collected within their respective designs, then the researcher may add a strand of quantitative data in the qualitative design such as a case study and/or a qualitative design within a quantitative design for the purpose of an experiment for instance.

  Rationale (Unexpected results, utility and diversity of view)

- The Transformative design (Caracelli & Greene 1997; Bazely, 2009); the researcher shapes the design within the transformative theoretical framework. Decisions on interaction, priority, timing and mixing are made within the context of the transformative framework.

  Rationale (Context, diversity of view, utility)

- The Multiphase design (Bazely, 2009); combines both sequential and concurrent strands over a period of time that the researcher implements within a program of study addressing an overall program objective. This approach is often used in program evaluation where quantitative and qualitative approaches are used over time to support the development, adaptation, and evaluation of specific programs.

  Rationale (Explanation, exploration, different research questions)

Given the rationales of the various designs, the purpose and aim of this research encompasses the rationale for the explanatory sequential design. To be able to assess the impact of natural resource constraint on the finance sector, that is, answering the research questions and achieving the aims of the research, there would be an illustration on "how" resource constraints impart on the finance sector (Quantitative phase) and an explanation on the reasons for such an impact ("why") following up from the results of the quantitative phase, especially in the case of unexpected results (Qualitative phase).

4.3. The Explanatory Sequential Design

The explanatory sequential design basically implies the collection and analysis of quantitative data, then following up with the analysis of the qualitative data in two different phases within a single study. In this design, importance/priority is usually unequal and given to the quantitative data. Qualitative data are used predominantly to enhance quantitative data, by helping explain and elaborate on the results obtain from the quantitative phase. The data analysis is usually connected, and combination usually occurs at the data interpretation stage and in the discussion. Thus the qualitative phase is based on the quantitative phase and the two methods can also be connected at the intermediate stage. These designs are mainly suitable for explaining relationships and/or study findings, especially if such relationships are unexpected (Hanson et al., 2005).

The justification for the use of this methodology is that a general understanding of the research problem is provided by the quantitative data and their subsequent analysis, while the qualitative data and their analysis refine and explain those statistical results by exploring participants' views in more depth (Tashakkori and Teddlie 1998; Creswell, 2003). Following this assertion, the quantitative phase will give a better understanding of my research problem and the qualitative data will give the view of the participants (insurance companies, pensions and banks) on the risks and how the resource constraints impart on the financial sector the way it does. Also, since resource constraint risks are not properly currently managed in the finance sector, the qualitative data will be able to engage the finance sector more thoroughly on the topic of resource risks and help in better understanding of such risks.

According to Ivankova et al. (2006) though the explanatory method is popular, especially amongst social and behavioural science researchers, the implementation of this design is not as straightforward and easy. Certain methodological issues such as the weight/priority given to the quantitative and qualitative data collection and analysis, the sequence of the analysis the

stage in the research process at which the quantitative and qualitative phases are connected and where the results are integrated are difficult decisions to make (Creswell et al., 2003). In trying to solve these issues, the decision making process has to be guided by the objectives of the research and the research questions as well as the methodology discussed in the literature (Ivankova et al., 2006).

The priority given to either of the methods depends on the interest of the researcher, the audience and what the researcher seeks to emphasize in the study (Creswell, 2003). Typically, in this design, the priority is given to the quantitative method though, according to Morgan (1998), the priority may be given to the qualitative method given the goals of the research, such decisions could be done either at the study design stage before the data collection begins or later during the data collection and analysis process. In this research, the quantitative data was collected and analysed first to establish how resource constraints affect the financial sector through the relationship between resource scarcity through the prices of selected natural resources and the finance sector performance (insurance, pensions and banks). This quantitative data was collected from public databases and the analysis was based on correlation analysis, regression, and granger causality analysis (details in section 4.4 on the quantitative phase). This decision is influenced by the main objective which is assessing and examining the extent to which resource constraints affects the finance sector. Then the qualitative data was collected and analysed to better explore, interpret and explain the results (expected and/or unexpected) of the quantitative phase. The secondary purpose of this phase was to find out the views of the participants and the possible discovery of other factors and/or elements related (or unrelated) to resource scarcity which could affect the growth of the finance sector. The qualitative data collection primarily came from interviews conducted with management of insurance and pension companies and banks. The interviews were transcribed and analysed (details in section 4.5 on the qualitative phase).

The possibilities of integration/combination of both methods varies from integration at the initial phase of the study while framing its objectives and introducing both quantitative and qualitative research questions (Teddlie and Tashakkori 2003) to the integration of the quantitative and qualitative findings at the interpretation stage of the study (Onwuegbuzie and Teddlie 2003). In this research both methods were connected at the mid stage of the study where the results of the quantitative phase informed the qualitative phase, especially the selection of the participants and the types of interview questions (Hanson et al., 2005). That is based on the results from the quantitative phase, interview questions were formulated targeting particular trends in the results and more in depth explanation of the behaviour of certain

variables and parameters. Then both phases were integrated during the discussion of the results to fully answer the research questions and presented a more vigorous picture of the research problem.

   Summarily, the sequential explanatory design of this research focused on measuring the extent to which (how) resource constraint affects the finance sector, followed by a qualitative analysis which was conducted interviews to selected participants on themes gotten from the results of the quantitative analysis. The details on the data collection and analysis of both methods were discussed in the subsequent sections.

4.4. Quantitative Phase

   As mentioned in the previous section, the purpose of the quantitative phase was to illustrate if, how, and to some extent why, natural resource constraint affected the finance sector. The quantitative data was collected from website databases and the analysis was carried out in the following way; descriptive statistics, correlation analysis, unit root and stationary tests, regression analysis, and Granger Causality analysis.

4.4.1 Sample & Data Collection

 Data was collected on the prices of selected resources, which are; food, oil and energy/gas. Data on finance sector performance for the UK finance sector from website database in the UK and will be collected as follows; Data on insurance expenditure and investment were collected from the ABI (Association of British Insurers) website database, pension and banking expenditure and investment were collected from the ONS (Office of National Statistics) website. The timeframe for both sets of data will be from 1995-2013 (18yrs).

 The reason for the selection of food, oil and energy/gas prices was the volatility of its prices during the past decades and its high rate of fluctuations in its price in the last decade (World Bank, 2009; UNEP, 2009; FAO 2009). For food prices, the 2007/08 agricultural/food price spikes pushed a further 200 million people worldwide into hunger and the UK in particular was affected by a rise in food prices by 12% in real terms (HM Report 2010). Oil prices have been on the rise in the UK since the beginning of this century while gas production has been falling since then (UK Gov. 2012). And the reason for collecting data on insurance, pensions and banking is because these sectors are the main activities in the finance sector.

4.4.2 Variables

     i)   Food/oil/gas prices

The prices would be global/international prices of the basket of food commodity items like wheat/cereal, vegetable oil, diary meat and sugar. To be able to capture such prices, the data was collected from the FAO food price index (FFPI), which measured the monthly changes in the international prices of a basket of food commodities. It consists of the average of the five commodity (mentioned above) group price indices in dollars.

The FFPI is calculated with the base year being 2002-2004, though an analysis considering three different base years (2008-2010, 2009-9010 and 2009-2011) to reflect the significant price hikes of 2008 and the price falls between 2009-2010, the statistical difference was not very significant and thus is still currently 2002-2004 (FAO, 2013). In the calculation, 23 commodities and 73 price series where included;

Wheat – 10 price quotations

Maize – 1 price quotation

Rice – 16 quotations

Butter, whole and skimmed milk powder – 2 quotations each

Cheese – 1 quotation

Poultry – 13 quotations

Pig – 6 quotations

Bovine – 7 quotations

Ovine – 1 quotation

Sugar – 1 quotation

Oils (soybean, sunflower, rapeseed, groundnut, cotton seed, copra, palm kernel, palm, linseed and castor) – 1 quotation

(FAO, 2013)

Data on oil prices was historical data on the Brent crude oil, as it is one of the major benchmarks for oil prices globally. Brent Crude is extracted from the North Sea, and comprises Brent Blend, Forties Blend, Oseberg and Ekofisk crudes. The Brent Crude oil marker is also known as Brent Blend, London Brent and Brent petroleum. Brent is also the leading global price benchmark

for Atlantic basin crude oils. It is used to price two thirds of the world's internationally traded crude oil supplies. Collected in US dollars/barrel

Data on gas prices was collected from the UK Heren NBP (National Balancing Point) Index. This index is a virtual trading location for the sale, purchase and exchange of UK natural gas. It is the pricing and delivery point for the ICE (Intercontinental Exchange) natural gas futures contract. It is the most liquid gas trading point in Europe and is a major influence on the price and the domestic price paid by customers (European Gas Market Report, 2013). Collected in US dollars/ million BTU (British Thermal Unit)

ii)   Insurance

The data collected on insurance was insurance expenditure on claims and investment annually. This was to better measure the possible risks associated with resource constraints especially with the possible increase in claims on liability insurance and losses incurred on investments.

iii)   Pensions

Data on pensions was on the level of pension contributions and expenditure and income from investments.

iv)   Banking

Data collected on banking was on the default on credit and investments. This was to be able to assess how resource constraints will impact on the level of credit supply, personal deposits, loan activity, non-personal or commercial lending and overdraft lending activities of banks in the UK.

4.4.3 Descriptive Statistics

This section simply describes the trend of resource prices and finance sector performance from 1995-2013. It will also include the mean and standard deviation of the data.

4.4.4 Correlation

This analysis determined the level of the relationship and dependence amongst the variables under investigation. Correlation simply refers to any of a broad class of statistical relationships involving dependence (Nikoli *et al.,* 2012). In order to be able to illustrate, in part, how resource constraint affects finance sector performance, the relationship and dependence between them has to be established. The correlation analysis also helped determine if there was a possible systemic risk among the financial variables by just establishing the level of dependence at a superficial level. If there was a high dependence level among these variables, then there could be high possibility of systemic risks.

There are several correlation coefficients, which measure the degree of correlation among variables, often denoted ρ or r. The most common of these coefficients is the Pearson correlation coefficient, which is sensitive only to a linear relationship between two variables, which may exist even if one is a nonlinear function of the other, (Mahdavi, 2013) and which will be used in this research. The Pearson correlation coefficient indicates the strength of a linear relationship between two variables, for instance insurance expenditure and gas prices, but its value generally does not completely characterize their relationship. That is why a regression analysis will be carried out to establish the magnitude and sign of such relationships and the level of significance and the Granger causality will be carried out to determine the nature and direction of the causal relationship between the variables.

Other correlation coefficients have been developed to be more robust than the Pearson correlation, that is, more sensitive to nonlinear relationships.

4.4.5 Regression analysis

The main regression analysis technique was the basic OLS technique. The OLS technique was used to investigate the effect of resource constraints on the finance sector for the UK.

Regression analysis is basically a statistical tool for the examination of relationships between variables. Usually, the researcher seeks to determine the causal effect of one variable

upon another. The researcher then collects data on the principal variables of importance and employs regression to estimate the quantitative effect of the causal (independent) variables upon the (dependent) variable that they influence. The researcher also naturally evaluates the "statistical significance" of the estimated relationships, that is, the degree of confidence that the true relationship is close to the estimated relationship (Sykes 2005). Regression analysis is generally used for prediction and forecasting and also used to understand which among the independent variables are related to the dependent variable, and to explore the forms of these relationships. In restricted circumstances, regression analysis can be used to infer causal relationships between the independent and dependent variables. However, this can lead to illusions or a false relationship that is why the Granger causality test will be used in this research to determine the causal relationships and the direction of causation among the variables in the study (details in next subsection).

Two main types of regression analysis are used in research; the simple regression using a single explanatory/independent variable and the multiple regression which uses two or more explanatory / independent variables in the analysis. Multiple regression is an analytical method that permits additional variables to be analysed independently so that the outcome of each can be estimated. It is valued for quantifying the effect of different simultaneous influences upon a single dependent variable. Also, because of omitted variables bias with simple regression, multiple regression is often important even when the researcher is only interested in the effects of one of the independent variables. This research will use the multiple regression technique as it is going to use more than one explanatory variable i.e the prices of three resources to investigate their impact on the finance sector.

There are many techniques involved in carrying out regression analysis. Traditional methods such as linear regression and ordinary least squares regression are parametric, in that the regression function is defined in terms of a finite number of unknown parameters that are estimated from the data (O'Brien & Scott 2012) while the nonparametric regression refers to techniques that allow the regression function to lie in a specified set of functions, which may be infinite-dimensional (Tofallis 2009). The OLS technique, also known as the classical least square (CLS) is a method of deriving the estimates of parameters in economic relationships from statistical observations. Under the OLS techniques, there is the simple regression model which is a relationship between two variables, one dependent and one explanatory variable related with a linear function and the multiple regression analysis or model which refers to the relationship between more than two variables and which are used in this study.

The time series analysis was carried out in six steps involving six models for all the above mentioned variables. Each of the dependent variables was regressed against the prices of resources annually and quarterly. This was to determine the effect of a unit change in the price of a resource on the change in the dependent variable. In other words, to determine how a one unit change in the price of food, for instance, would affect the change in insurance claims/expenditure. Consider the following models;

$$INS_e = \alpha + \beta_1 FP + \beta_2 OP + \beta_3 GP + \mu \quad \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots(1)$$

$$INS_i = \alpha + \beta_1 FP + \beta_2 OP + \beta_3 GP + \mu \quad \dots\dots\dots\dots\dots\dots\dots\dots\dots(1a)$$

$$PEN_e = \alpha + \beta_1 FP + \beta_2 OP + \beta_3 GP + \mu \quad \dots\dots\dots\dots\dots\dots\dots\dots\dots(2)$$

$$PEN_i = \alpha + \beta_1 FP + \beta_2 OP + \beta_3 GP + \mu \quad \dots\dots\dots\dots\dots\dots\dots\dots\dots(2a)$$

$$BAN_l = \alpha + \beta_1 FP + \beta_2 OP + \beta_3 GP + \mu \quad \dots\dots\dots\dots\dots\dots\dots\dots(3)$$

$$BAN_{od} = \alpha + \beta_1 FP + \beta_2 OP + \beta_3 GP + \mu \quad \dots\dots\dots\dots\dots\dots\dots\dots(3a)$$

$$BAN_c = \alpha + \beta_1 FP + \beta_2 OP + \beta_3 GP + \mu \quad \dots\dots\dots\dots\dots\dots\dots\dots(3b)$$

$$BAN_{pd} = \alpha + \beta_1 FP + \beta_2 OP + \beta_3 GP + \mu \quad \dots\dots\dots\dots\dots\dots\dots\dots(3c)$$

$$BAN_{npl} = \alpha + \beta_1 FP + \beta_2 OP + \beta_3 GP + \mu \quad \dots\dots\dots\dots\dots\dots\dots\dots(3d)$$

Where;

INS_e = Insurance expenditure (claims)

INS_i = Insurance investments

PEN_e = Pension expenditure

PEN_i = Pension investment

BAN_l = Bank Loans

BAN_{od} = Bank Overdraft lending

BAN_c = Bank Credit activities

BAN_{pd} = Bank Personal Deposits (deposits from individual consumers)

BAN_{npl} = BANK Non-Personal Lending

FP = Food prices

OP = Oil prices

GP = Gas prices

Before the OLS was carried out a unit root and stationary test will be carried out to test the stationarity of the data involved. Time series data like the ones used in this study could exhibit either a stochastic or deterministic time trend and are therefore non- stationary. According to Engle and Granger (1987), the application of OLS to non-stationary data produces regressions that are mis-specified in nature and tend to produce statistics that are inflated in nature such as high R^2 s and t statistics which could lead to Type I errors which is rejecting the null hypothesis when it is true. Consequently, this study tested the variables for a unit root or non-stationarity by using the Augmented Dickey-Fuller test.

The Augmented Dickey–Fuller test (ADF) is a test for a unit root in a time series sample. It is an augmented version of the Dickey–Fuller test for a larger and more complicated set of time series models. The Augmented Dickey–Fuller (ADF) statistic used in the test is a negative number. The more negative it is, the stronger the rejections of the hypothesis that there is a unit root at some level of confidence (Greene 2002). The testing procedure for the ADF test is as follows:

Consider the equation

$\Delta y_t = \beta_1 + \beta_2 t + \delta y_{t-1} + \alpha_i \Sigma^m_{i=1} \Delta y_{t-I} + \varepsilon_t$……………….. (4)

where yt = is our variable of interest = {INS_t, PEN_t, BAN_t, FP_t, OP_t, GP_t}, Δ is the differencing operator, t is the time trend and ε is the white noise residual of zero mean and constant variance. {β_1, β_2, δ, α_1…, α_m} is a set of parameters to be estimated. Both of the null and alternative hypotheses in unit root tests are:

H0: $\delta = 0$ (y_t is non-stationary / a unit)

H1: $\delta \neq 0$ (y_t is stationary)

The unit root hypothesis of the Dickey-Fuller can be rejected if the t-test statistic from these tests is negatively less than the critical value tabulated. In other words, by the Augmented Dickey Fuller (ADF) test, a unit root exists in the series yt (implies non-stationary) if the null hypothesis of δ equals zero is not rejected (Gujarati 1995, p. 719- 720).

The unit root test is then carried out thus:

$$DF_\tau = \frac{\hat{\gamma}}{SE(\hat{\gamma})}$$ …………………….. (4a)

Once a value for the test statistic is computed it can be compared to the relevant critical value for the Dickey–Fuller Test. If the test statistic is less (this test is non symmetrical so we do not consider an absolute value) than (a larger negative) the critical value, then the null hypothesis of $\gamma = 0$ is rejected and no unit root is present.

This test was carried out for all the variables to determine whether there exists a unit root at some level of confidence, in other words, to find out if the variables are stationary or non-stationary.

4.4.6. Granger causality Analysis

The Granger causality tests was carried out to find out if there is a causal relationship between the variables, and also to determine the direction of the causality.

The Granger causality test is a statistical hypothesis test for predicting whether one-time series is useful in forecasting another. Usually, regressions reflect "ordinary" correlations, but Clive Granger (1969) claimed that causality in economics could be revealed by some sort of tests. Meanwhile the question of "true causality" is deeply philosophical; econometricians declare that the Granger test finds only "predictive causality".

This method of analysis has also been carried out in studies related to resource constraints such as Cunado & Gracia (2005). This analysis will also be carried out between the dependent variables to find out if there is a possibility of a systemic risk among them and the direction of the risk. An example of the test will be carried out thus;

$$INS_t = \Sigma^n_{i=1} \alpha_i OP_{t-i} + \Sigma^n_{i=1} \beta_j INS_{t-i} + \mu_{1t} .... (5)$$

$$BAN_t = \Sigma^n_{i=1} \lambda_i OP_{t-i} + \Sigma^n_{i=1} \delta_j INS_{t-i} + \mu_{2t} .... (5a)$$

Equation (5) postulates that current INS_e (insurance expenditure) is related to past values of itself as well as that of BAN (Banking activities) and (5a) postulates a similar behaviour for OP. Four cases can be distinguished:

- Unidirectional causality from BAN to INS_e is indicated if the estimated coefficients on the lagged INS in (5) are statistically different from zero as a group (i.e. $\Sigma^n_{i=1} \alpha_i \neq 0$) and the set of estimated coefficients on the lagged BAN in (5a) is not statistically different from zero (i.e. $\Sigma^n_{i=1} \delta_j = 0$).

- Conversely, unidirectional causality from INS to BAN exists if the set of lagged INS coefficients in (5) is not statistically different from zero (i.e. $\Sigma^n_{i=1} \alpha_i = 0$) and the set of the lagged BAN coefficients in (5a) is statistically different from zero (i.e. $\Sigma^n_{i=1} \delta_j \neq 0$).

- Feedback, or bilateral causality, is suggested when the sets of BAN and INS_e coefficients are statistically significantly different from zero in both regressions.

- Finally, independence is suggested when the sets of BAN and INS_e coefficients are not statistically significant in both the regressions.

Each of the finance variables were analysed in pairs, except the resource variables, to each other in order to establish a causal relationship between them. In so doing it enabled the establishment of the possibility of systemic risk and the direction of the risk in the finance sector and to also determined the route natural resource scarcity took to affect the finance sector and in turn the economy.

4.5 Qualitative Phase

While the quantitative phase investigated the "how" and part of the "why" natural resource scarcity affected finance sector performance, it may not have captured emerging trends on resource risks and its potential effects on the finance sector. The qualitative part therefore provided an in-depth assessment as to "why" natural resources affect the finance sector the way it does and focused on the perceptions of the future "how" that would not be captured in the quantitative data sets. This phase was done after the quantitative phase to give a more detailed picture and hence a "story" of how such effects gravely (or not) impacted the finance sector and to also gave possible explanations to the behaviour of certain results in the quantitative phase which were out of the norm and/or were either statistically significantly significant or not significant at all. This phase also exposed other potential effects and the risks faced by natural resource scarcity which the quantitative phase could not capture.

Qualitative research has received a variety of definitions and interpretations (Merriam, 2009; Denzin & Lincoln, (2005)), but the definition which best suits the nature of this research is that by Parkinson & Drislane (2011);

"Qualitative research is research using methods such as participant observation (and interviews) or case studies which result in a narrative, descriptive account of a setting or practice [natural resource and finance sector performance]."

Qualitative research is not only finding out what people think about a situation/setting but also why they think what they think. As a result, an attempt will be made to find out what the finance sector thinks about the effect of natural resource scarcity on their performance and why

they think what they think. This will add to the in-depth detailed picture of the actual effect of resource scarcity.

Given that qualitative research gives a detail description of a setting and/or situation, this phase entailed conducting interviews on an individual and possibly group level. The results of the quantitative phase gave a guideline on the type of questions to ask given the type of answer targeted. In other words, the type of questions posed came as a follow up from the results of the quantitative phase. The quantitative phase also helped to be able to identify the types of individuals to interview especially top officials in the finance sector, specifically the insurance, banking sector and actuarial professionals.

4.5.1. Data Collection

The data collection methods in this phase were interviews. The target population for these interviews were top officials or "people" in the finance sector including top officers in insurance companies, banks, and pension companies. The reason for this target population was because they were better placed to give a detailed and in depth opinion on the effect on natural resources on finance sector performance.

4.5.1.1 Interviews

Interviews are the most common type of qualitative data collection, the individual (person-to-person) format is the most common form of interviews performed (Thomas *et al.,* 2012). Three main types of interviews are used ranging from structured, semi-structured and unstructured interviews;

- Structured interviews are verbally administered questions where the questions are already predetermined and provide the interviewee with a limited range of answers, giving no room for further detail or discussion. Thus they are easy and quick to implement.
- Semi- structured interviews are a series of open ended questions being asked on the topic areas the researcher is interested in investigating, that is, defining key areas for discussion. The open ended nature of the questions allows room for more detailed discussions and allows the researcher to encourage the interviewee into providing more information.

- Unstructured interviews are carried with little or no organisation and having very little or no structure at all. It can also be considered an in-depth interview as there is room for detailed discussion on a topic of interest. This allows the researcher to find out more about a specific area of study without any preconceived plan.

Given the above types, the semi-structured interview best suited this research as open ended questions were asked from results of the quantitative phase and other follow up questions and there was room for further detailed discussions to get the full opinions from the finance sector officials. The objective of semi-structured interviews was to understand the view of the interviewee rather than make generalisations about a phenomenon. This method provided highly valid information as respondents spoke in depth and in detail, complex issues of interests were discussed and clarified and the problem of determining what will or will not be discussed during the interview was resolved as questions are prepared beforehand.

The main aim of qualitative interviewing was basically to gain an understanding of the interviewee's perspective which included their viewpoint and why they had that view (King, 2004), thus data was collected in a manner in which the meaning and interpretation of the situation, such as natural resource scarcity, was captured in relation to the interviewee's worldview. Easterby-Smith *et al.,* (2008) describe the approach of collecting information from organizational members such as managers as "natural language data" as it aims to discover the views, opinions and perceptions from individuals through language and the best way to achieve this is through in-depth interviews.

In-depth interviews are used where the main purpose is to understand the meanings the interviewees attach to issues and situations in context for a better understanding of the research topic and an added value to research outcomes. This type of interview gives the researcher the opportunity to probe more deeply to uncover new clues and open up new dimensions of a problem and thus secure accurate inclusive accounts of a situation (Burgess 1982). As such using in-depth interviews in this research will help discover other effects and risks that resource scarcity could possibly impact on the financial sector from the perspective of top officials in the finance sector. Interviews are, therefore, most appropriate where detailed insights are required from individual participants and also mostly suitable for exploring sensitive topics, where participants may not want to talk about such issues in a group environment, such as focus groups.

4.5.1.1 Data Analysis

The data from the interviews was a combination of aspects from content analysis and grounded analysis. This was to be able to draw key aspects from the data, such as key words, phrases and/or variables, while at the same time allowing the material to remain the same, letting the "data speak for itself" which can be used as evidence to the conclusions drawn at the end of the research.

4.5.1.1.1 Content Analysis

Content analysis is basically a set of procedures in collecting and organising information in a format that allows the researcher to make inferences about the characteristics and meaning of the data collected, written and recorded from interviews (GAO, 2001). Mayring (2000) asserts that qualitative content analysis expresses itself within the framework of qualitative analysis as an "approach of empirical, methodological controlled analysis of texts within their context of communication, following content analytical rules and step by step models, without rash quantification". Hsien & Shannon, (2005) define it as the research method for the "subjective interpretation" of the content of text/recorded data through a systematic process of coding and pattern identification.

The goal of content analysis in this research is to provide knowledge and understanding of a situation/phenomenon under study. By analysing the data through coding and identifying patterns in the communicated data, it would be possible to identify similar and contrasting ideas on the concept of resource scarcity and its effect on the finance sector. It would also be possible to deduce common variables/concepts (conceptual analysis) and the possible causal linkages (relational analysis) from the perspective of people having a practical experience in the finance sector and therefore be able to combine these findings with the findings of the quantitative phase to give a more detailed comprehensive result on the effect of natural resource scarcity on the sector and an opportunity to examine that result from various possible views.

Hsien & Shannon (2005) identify three approaches to content analysis; Conventional, Directed and Summative Content analysis.

Conventional content analysis is carried out with the aim of describing a particular phenomenon and particularly useful when current theory and literature on that phenomenon is limited. In this approach, coding and categories are not preconceived and allowed to flow from data, therefore allowing the data to come up with new insights on the phenomenon. Data

analysis with this approach starts with reading the data as a whole (in this case listening to all the recorded interviews) to make sense of it, and then further read word by word to derive codes. Then the researcher makes notes on initial thoughts, impressions and initial analysis (Kondracki & Wellman, 2002). Codes are then set up in different categories based on how the codes are linked and related to each other. Categories are then organized into smaller categories and a tree diagram is set up to organize categories into a hierarchical structure. Based on the aims of the research, the relationships among categories can further be analysed based on concurrence and/or consequences. The main advantage of this approach is obtaining direct information from interviewees without imposing preconceived categories and a major challenge is that it fails to develop an understanding of the context, thereby failing to identify key categories (Mayring 2000). This approach is very similar to and sometimes considered as grounded analysis.

Another approach is the directed approach, which unlike the conventional approach, is more structured. It aims to either validate and/or extend theory and existing literature of a particular phenomenon conceptually. The existing theory and literature makes the research question focus and thus variables and codes (and relationship between codes) are determined at the initial stage before data is collected. Then operational definitions of the categories are determined using theory (Potter & Levine-Donnerstein, 1999). Two strategies are then considered when coding, based on the research question; first by reading the transcript as a whole then coding can be done by highlighting passages which are concurrent with predetermined codes or second, begin coding immediately with the predetermined codes. The results from such an analysis either provide supportive or non-supportive evidence for a theory. The main advantage of this approach is that it provides the support and extension of a theory. It also has disadvantages as it causes the research to be biased and tend to sway towards a particular theory, and thus can make researchers to be blind to other important contextual issues related to a phenomenon which may have been ignored by theory and other literature. Participants may be influenced to answer questions in a way which would be supportive of the researcher and his/her ideas and concepts (Hsien & Shannon, 2005).

The third approach, the summative content analysis, begins by identifying and quantifying words in a text with the aim of trying to understand the contextual meaning and use of these words thereby exploring the usage of these words. It also goes further to include latent content analysis which is interpreting the content to discover the underlying meaning of these words. Its main advantage is that is provides a basic insight into how certain words are used and thus is a non-reactive way of studying a phenomenon of interest, but on the down side is limited by

its lack of attention to the broader meaning of the phenomenon from the data (Kondracki & Wellman, 2002).

All of these approaches have the same analytical classical steps which include; formulating the research questions, selecting the sample size, defining categories, outlining coding process, carry out coding, and analysing the results of the coding process (Hsien & Shannon, 2005).

Given the limitations of the above approaches and the fact that there is an overlap of characteristics and procedures between these approaches, the content analysis of this research will employ certain aspects of all three approaches. The use of the three approaches is to make up for the weaknesses of one approach or the other and take advantage of the overlapping nature of certain procedures. From the conventional approach, the codes and categories are not preconceived and thus the categories will flow from the data. As such the categories will be determined after listening to the recorded interviews as a whole. Since the research is also interested in causal relationships, the categories will also be set according to how concepts relate to each other. In addition, to cover up for the failure of the conventional approach to understanding the context of the research, part of the directed approach will also be used as the research also aims to validate and extend theory on natural resource economics and fundamental finance theories. As such, though the codes will not be preconceived, one of the coding strategies will be used which will be listening to the entire recording before coding (same with conventional; indication of an instance of overlap between approaches) and the codes could be revised as the analysis proceeds. Lastly an aspect of the summative approach will be used by identifying certain words and concepts in the recorded interviews and quantifying them to emphasize the importance of such words and concepts to the study. Thus this research will use the aim of one approach and employ the procedures of another approach.

Two basic types of content analysis exist, which incorporate the above three approaches and thus will be combined and used in this study. They include the conceptual and relational analysis.

Conceptual analysis involves choosing concepts for examination and measuring their occurrence in a text to emphasis its importance in the information gathered. On the other hand, relational analysis begins with identifying concepts for examination and goes a step further to explore and measure the relationship between these concepts to look for meaningful relationships and causality.

The content analysis of this study combined both analysis and was carried out in the following manner;

- Read/listened to the script/recording to get an overall meaning and context.

- Decided on the level of analysis, whether to code single words like "scarcity" or phrases like "effect of natural resource scarcity".

- Also decided on how many concepts to code for, which will involve determining a pre-defined and interactive group of concepts and categories. It also involved determining which words are relevant, or not, to the effect of resource scarcity on the finance sector, so that it will keep the coding within restricted lines and avoid diversion from the study.

- After deciding on the number of concepts to examine, it was then necessary to determine whether coding was according to the existence of the concept in the text or the frequency of that concept in the text. Coding according to existence only did not illustrate the importance of that particular concept, like "resource scarcity" in the study. But if coding is according to the frequency of "resources scarcity" in the interview recordings, the number of times that concept is mentioned by various interviewees, showed how important it was to the research.

- Coding was done based on generalisation as opposed to how they appear, to avoid duplication and thus invalid results. For instance, coding treated "natural resource scarcity" and "natural resource constraint" under one category instead of two different categories as they appear. This rule was consistent throughout the text/interview recording
The relational analysis came in after the coding to explore the relationships between concepts for strength, sign and direction of these relationships;

- The strength of the relationship refers to the degree to which these concepts are related to each other. Allocating strength to such relationships preserves a greater degree of the detail found in the original text.

- The sign of the relationship refers to whether the concepts are positively or negatively related to each other. As such concepts which imply negative relationships from the text will be coded as showing negative relationships to each other and same will be done for concepts showing positive relationships.

- The direction of the relationship implies determining which concept causes movement in the other concept; for instance, a change in the availability of resources causes increase in prices therefore, movement in the availability of resources causes movement in prices. The direction of such a relationship is therefore from resource availability to prices (if fall in resource availability, then increases in prices). Some relationships could

be bi-directional where one concept X causes movements in concept Y and vice versa, thus having equal influence to each other.

After the relationships had been identified and coded, a statistical analysis was performed to determine the level of causality which will be used to either further explain or refute the results of the causality results of the quantitative phase.

Grounded analysis is a more open approach to data analysis and closely linked to grounded theory. Like the conventional content analysis, the data analysis lets concepts and variables flow from the data rather than preconceived concepts being imposed on the data, even though it is not the aim of this research to formulate theory/theories from data. Thus the aspect of grounded analysis which will be used in the data analysis of this research is reflected in the conventional approach bit of the content analysis and also represented in the main stages of the data analysis of the research.

4.6 Integration of Results of the Quantitative and Qualitative Phases

After the quantitative phase was completed (data collection and analysis), the results of both the quantitative phase and the qualitative phase were integrated and presented to bring out the full picture of both analyses which then proceeded with the discussion of the results.

The quantitative phase was first be presented, highlighting the results which need further explanation and/or confirmation from the qualitative phase. Then the qualitative results were presented highlighting the explanations and confirmation of the quantitative results. This was basically from the stakeholders of the finance sector point of view and experience. Then there was also an emphasis on new ideas and/or issues that emanated from the qualitative phase which may not have been considered, was unclear and/or not properly expressed in the quantitative phase which is vitally important to the effect of resource constraint on the finance sector. There was also the possibility of both results contradicting each other. If that happened to be the case, then such differences were highlighted for further discussion in the study. The results were presented in the next chapter, beginning with the quantitative results (descriptive statistics, correlations, regression and Granger causality tests) followed by the qualitative results.

Chapter 5. Results

5.1 Quantitative Results

The main aim of this study was to investigate and evaluate the risks involved with resource constraint and global growth, with evidence from the finance sector. This was part of the GRO (Global Resource Observatory) project at the GSI, whose main project aim was to investigate how the scarcity of finite resources will impact global social and political fragility in the short term. This particular research focused on how the scarcity of these finite resources would impact on the financial sector especially through investments, insurance, pension schemes and banking activities. This research aims basically encompassed the questions on "will", "how" and "why" resource constraints have an impact on the financial sector. In order for the research questions to be answered and the specific objectives achieved, the quantitative and qualitative methods were used; the quantitative methods answered the questions on "will" and "how" and the qualitative answered the questions on "why".

The purpose of the quantitative phase was to illustrate how, and to some extent why, natural resource constraint affects the finance sector. The quantitative data was collected from public databases and the analysis was carried out in the following way; descriptive statistics, correlation analysis, unit root and stationary tests, regression analysis, and Granger Causality analysis. The qualitative part provided an in-depth assessment as to "why" natural resources affect the finance sector the way it does and focused on the perceptions of the future "how" that would not be captured in the quantitative data sets. This phase was done after the quantitative phase to give a more detailed picture and hence a "story" of how such effects gravely (or not) impact the finance sector and to also give possible explanations to the behaviour of certain results in the quantitative phase which are out of the norm and/or are either statistically significantly significant or not significant at all. This phase also exposed other potential effects and the risks faced by natural resource scarcity which the quantitative phase could not capture. This phase was done using interviews.

The quantitative analysis was carried out using the Ordinary least square (OLS) regression, with eleven models for each dependent variable. Each model either regressed a single independent variable or a combination of two variables and the eighth model comprised all three variables, with a fourth variable, UK GDP to see how the variables would react. This was done in order to see the effect of a single resource on the independent variable and see whether the effect of that variable would change significantly with the addition of another variable in the model and also the possibility of rendering the effect of the first variable insignificant. This

will be better understood as the results would be presented and interpreted. Most of the analysis was done on a quarterly basis from 1995-2013 and some on an annual basis from 1983-2013, depending on the amount of data available to the researcher.

5.1.1. Descriptive Statistics
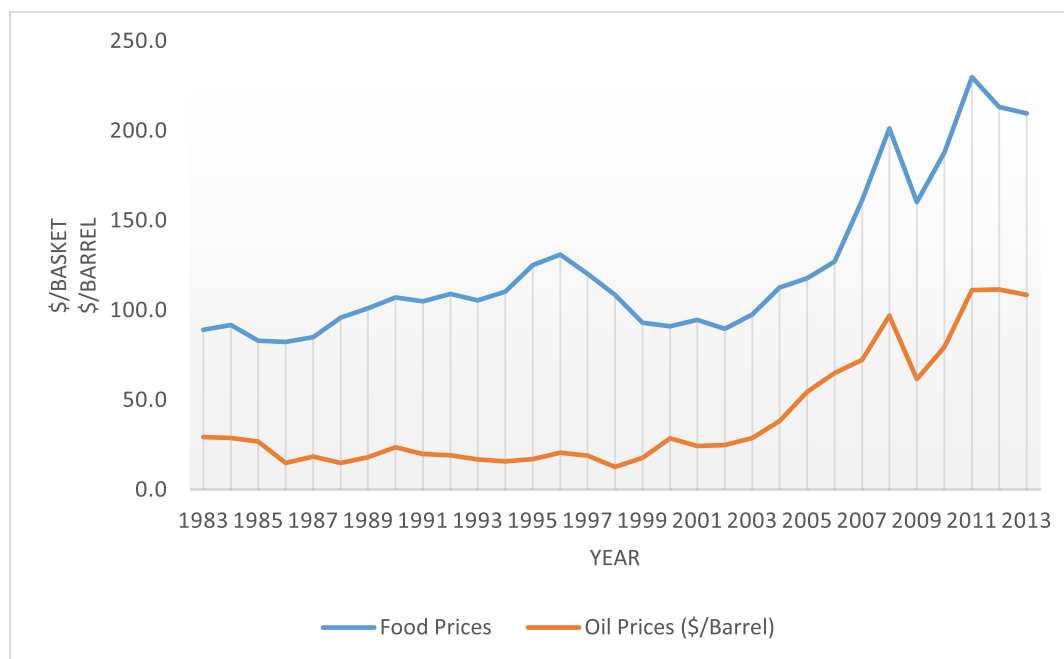
Fig. 17. Food and oil Prices (Food and Agricultural Organisation, 2013)

Food and oil prices have been following the same trend from around 2001-2011. Food prices recorded its lowest at $91 per basket in 2000, then rose steadily to its first peak at above $201 per basket in 2008, a steep drop to $160 a basket in 2009, then rose to its second peak at $229 in 2011, then steadily and slowly dropping to $213 in 2012, $209 in 2013 and $208 in 2014. Oil prices followed a somewhat similar pattern; beginning at a very low price at $12/barrel, oil prices steadily increased to its first peak a $96/barrel in 2008, falling sharply to $61 in 2009, ten increased to another peak in 2011 at $111.26/barrel, increased slightly to $111.63/barrel in 2012, then fell to $108 in 2013.
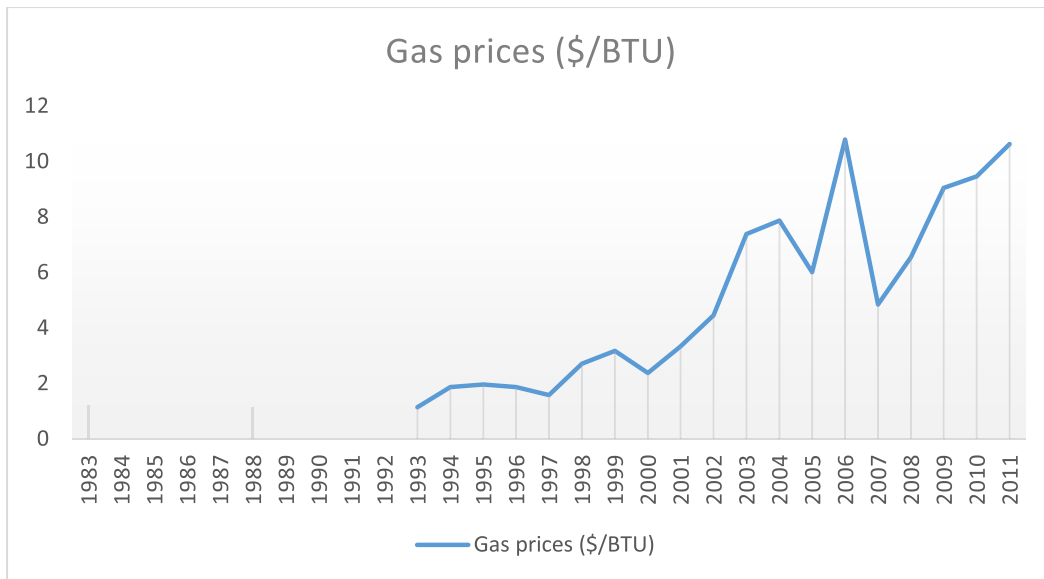
Fig. 18. Gas Prices (UK Heren National Balancing Point , 2014)

Gas prices are characterised by a series of spikes with the highest price being $10/btu in 2008 and the lowest being $1.58 in 2009. Prices fell after 2008 to $4.85, then increased again to $6.56 in 2011, $9.04 and $9.46 in 2012 and 2013 respectively.

In a nut shell, the prices of these resources are higher than they were before 2008. Though the prices indicate that a further reduction after 2015, its still uncertain if the prices will remain low.
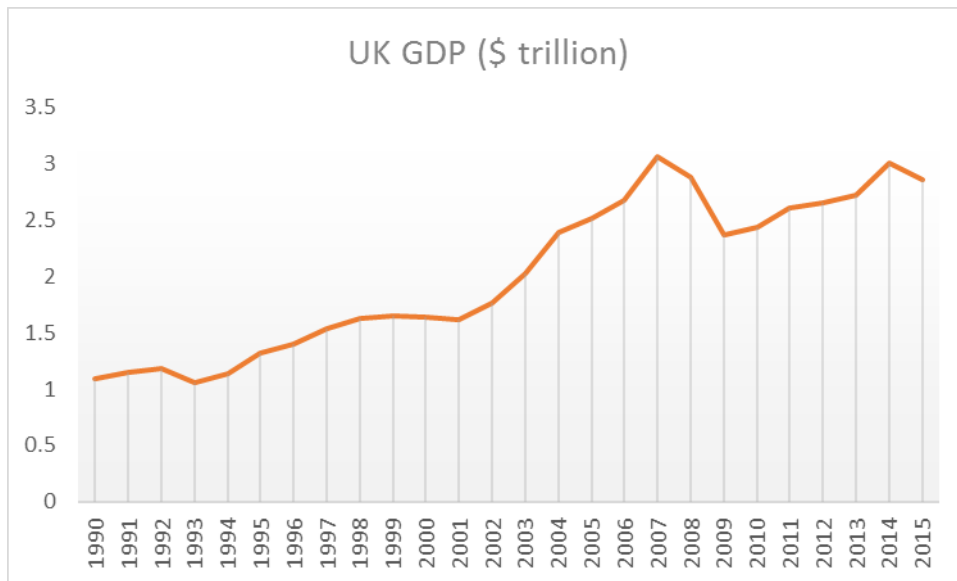
Fig. 19. UK GDP (World Bank, 2016)

Movements in UK GDP follow a slightly similar trend like that of food, oil and gas prices presented in fig 17 and 18. The most common trend is the dip in 2008 following the global financial crisis. The highest recorded UK GDP was $3.063 trillion in 2007 just before the crisis, which fell, by $188 billion, to $2.875 trillion in 2008. The UK economy then picked up in 2011 at $2.609 trillion and almost reached its 2007 level in 2014 ($2.999 trillion) then fell slightly to $2.858 trillion in 2015.
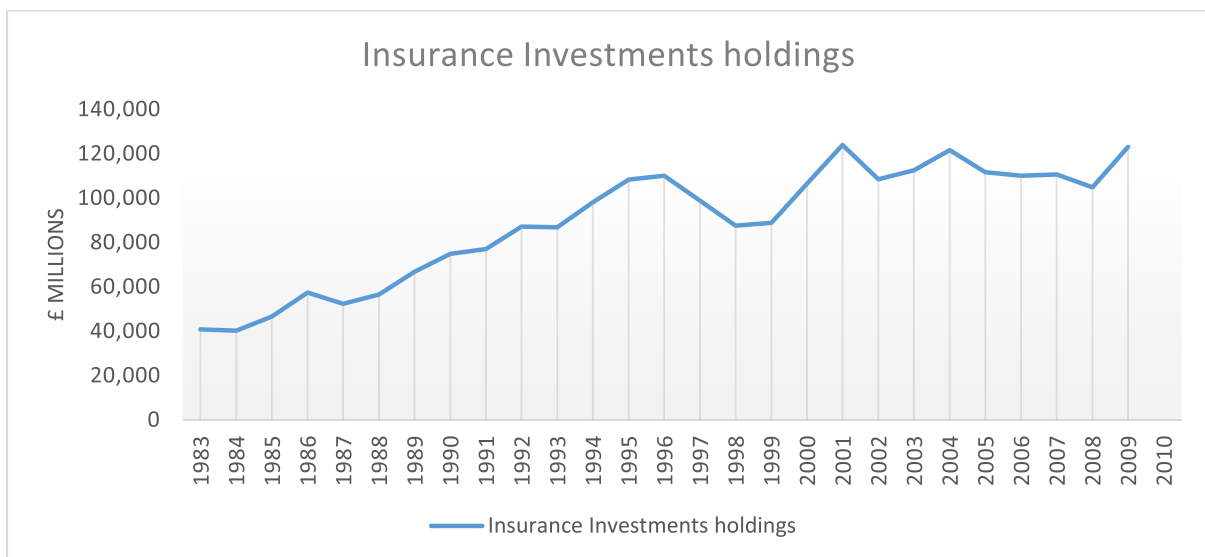
Fig. 20. Insurance Investment Holdings (Association British Insurers 2014)
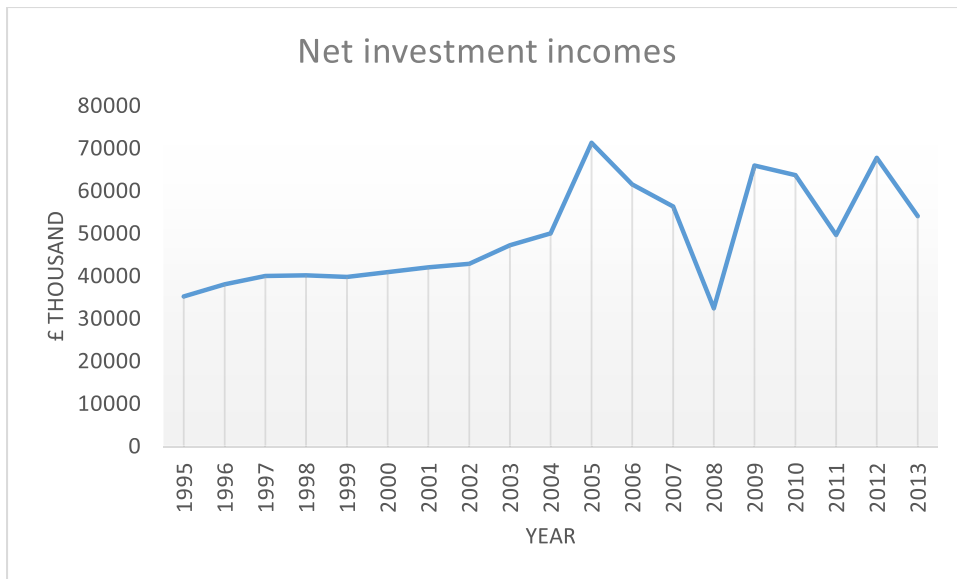
Fig. 21. Insurance Investment Income (Association British Insurers 2014)

Insurance investment holdings and income have slightly different patterns but the common trend is the fall in holdings and income in 2008, which corresponds to increase in resource prices and the financial crisis, and both recovered and increased in 2009. Investment income fell again in 2011, fell sharply in 2012, and then increased again in 2013.
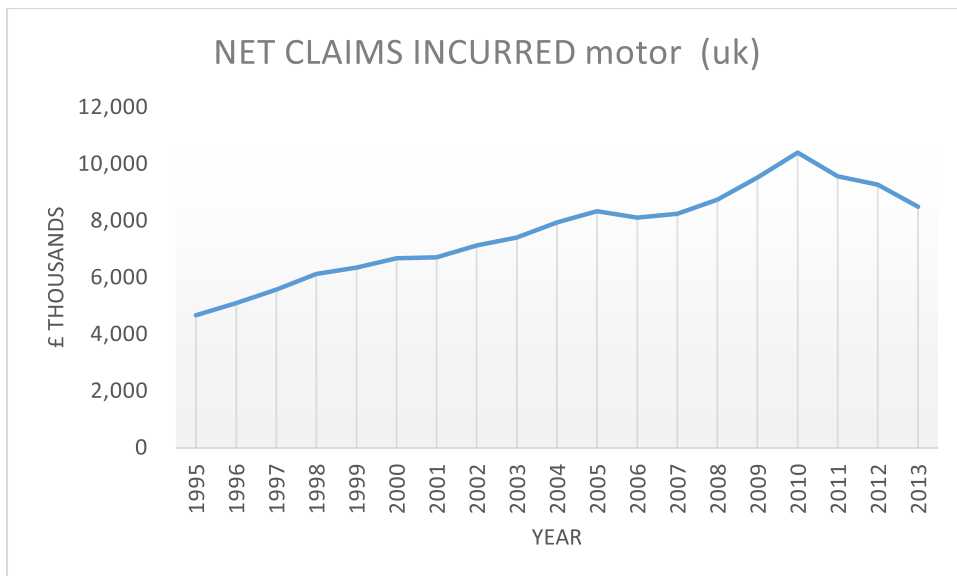
Fig. 22. Insurance Motor Claims (Association British Insurers, 2014).
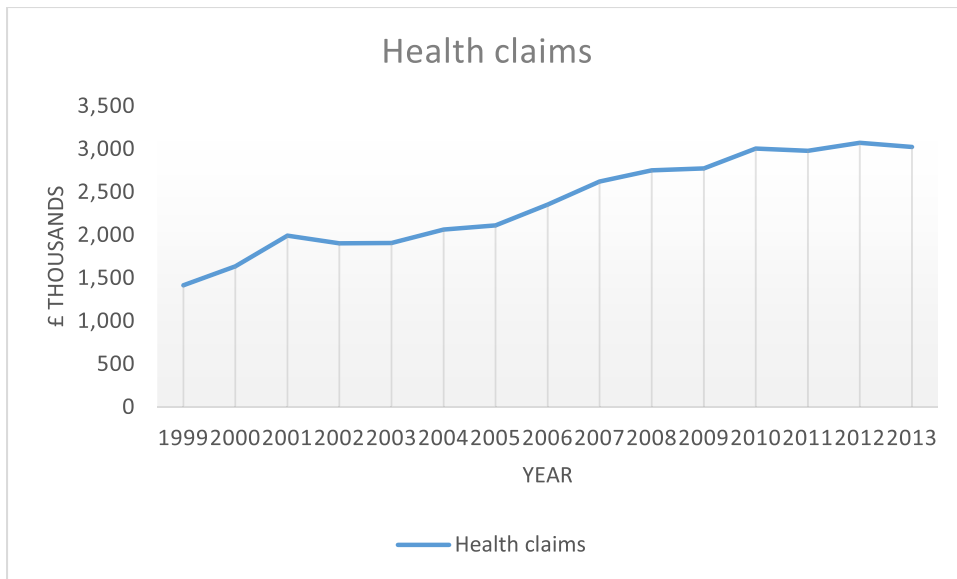
Fig. 23. Insurance Health Claims (Association British Insurers, 2014).

Health and motor insurance claims have been on a steady increase since 1999 and 1995 respectively. Motor insurance peaked slightly in 2005, then had another peak in 2010 and has been slowly decreasing since. Health insurance on the other hand, has had gentle sloping increases in 2001, 2004, 2007, 2010 and 2012, which could be considered to some extent insignificant increases.
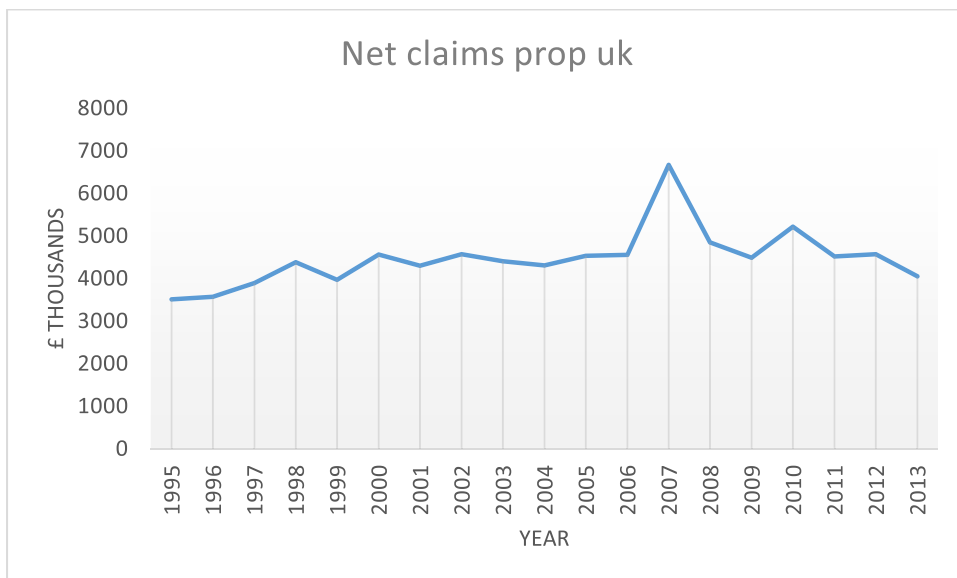
Fig. 24. Insurance Property Claims (Association British Insurers, 2014)

Property claims in the UK have a completely different pattern to health and motor insurance, having more series of fluctuations. A record high peak is noted in 2007, falling in 2008 and falling further in 2009.
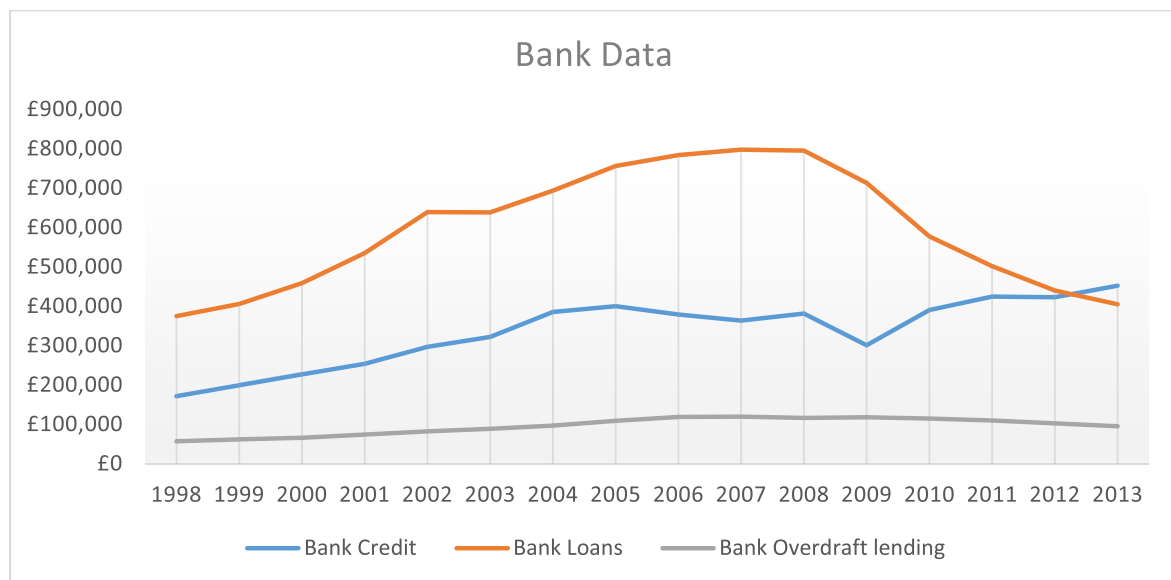
Fig. 25. Bank Data (British Bankers Association, 2014)

Bank credit, loans and overdraft lending have different patterns, but the commonality among them is their peak periods being around 2008, corresponding to the high food, oil and gas prices. Bank loans have been falling since 2008 and may continue to fall, meanwhile bank credits fell after 2008, for a period and have been on a rise since 2009. Bank overdraft lending have been somewhat steady, with a slight fall from 2012.
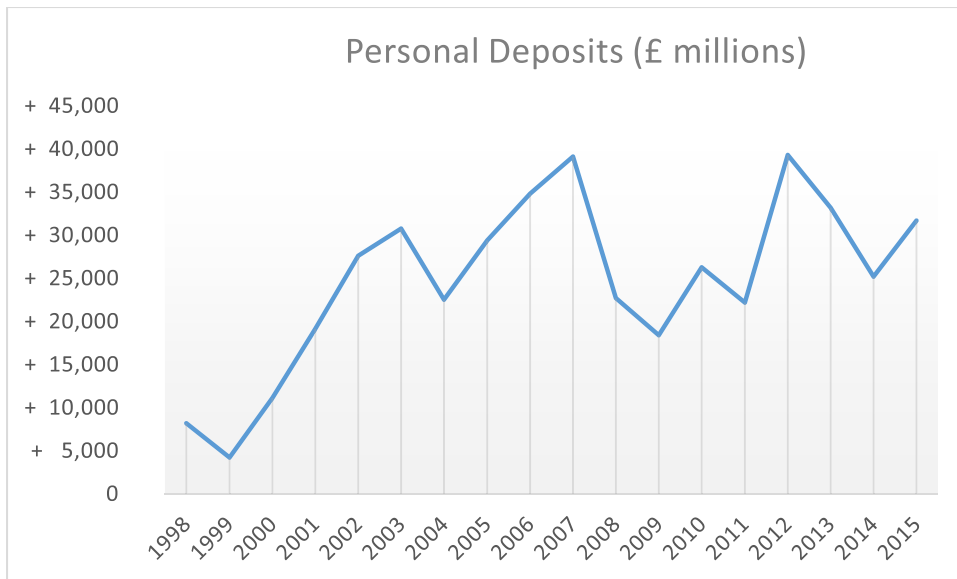
Fig. 26. Personal Bank Deposits (British Bankers Association, 2014)

UK bank personal deposits recorded high values in 2007 (£39,155 million) and fell in 2008 and lower in 2009 at £18,414 million, which could be accounted for by the effect of the financial crisis and its consequent effect on income. Then experienced periods of highs and lows and increased exceedingly in 2012 at £39,320 million, slightly higher than 2009, fell gently to £25,217 million in 2014 and in November 2015 stood at £31, 722 million.
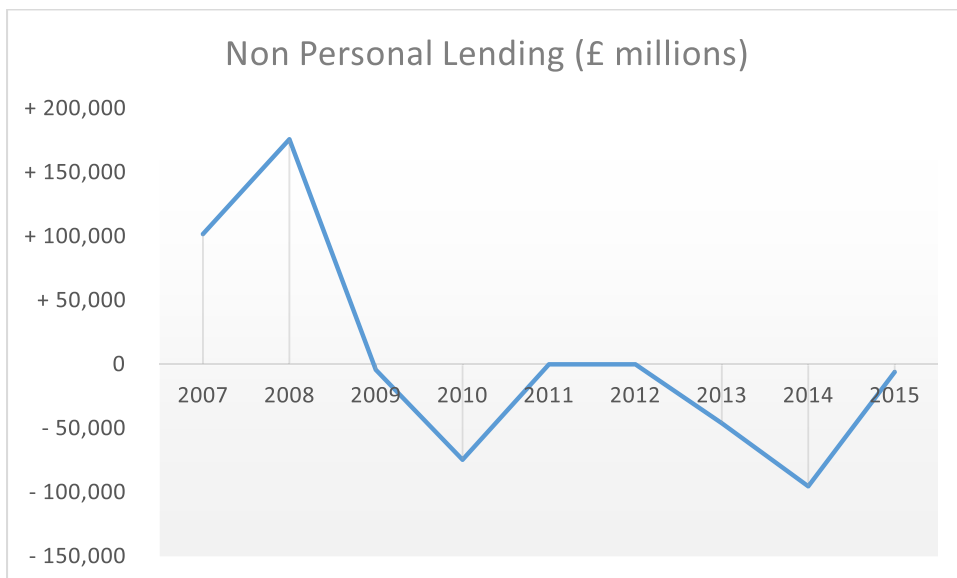
Fig. 27. Non Personal Bank Lending (British Bankers Association, 2014)

Non personal lending by UK banks which comprise lending to businesses and commercial purposes (financial intermediation, insurance companies, agriculture, mining, manufacturing,

electricity gas and water, construction, wholesale and retail trade, transport and communication, education, health, recreational services and financial administration). It is clear and evident from the graph that the highest recorded lending was in 2008 (£175,935 million) rising from £101,908 million in 2007, which could be attributed to the effects of the financial crisis and the consequent result of a high demand of lending from these companies and institutions. After 2008, net lending to these institutions have been on the low with the lowest value in 2014 at -£95,373 million.
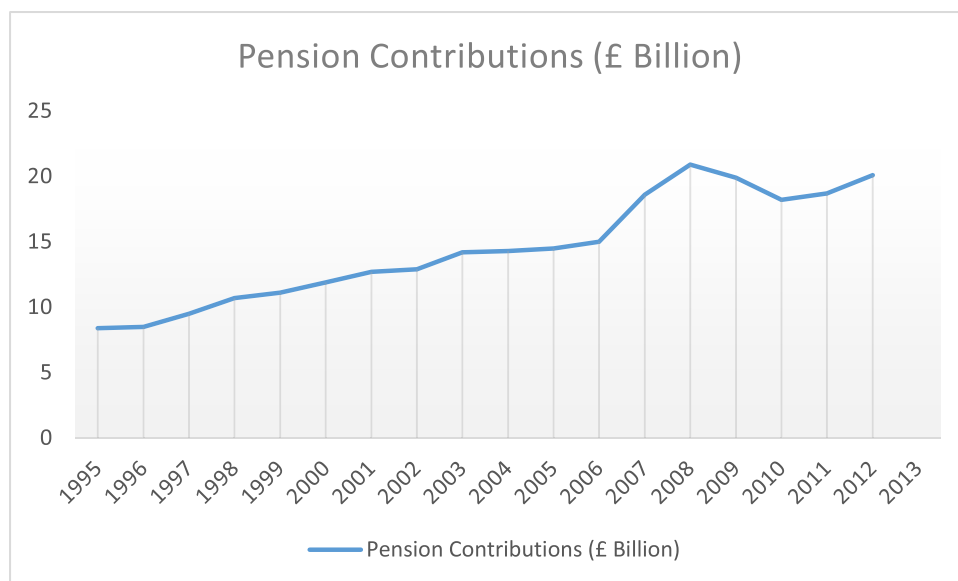
Fig. 28. Pensions Contributions (Office of National Statistics, 2014)

An interesting aspect about both pension contributions and investment, is that the highest recorded contributions (£20.9 billion) and investment (£130 million) occurred around 2008 which was the same time the prices of food and oil were at their highest. Pension contribution has been in a steady rise since 1995 to 2008, then a slight fall to £18.2 billion 2011 and picked up again to £20.1 billion in 2012. Pension investment fell to its lowest at £67 million in 2002 from £75 million in 2001, ten steadily increasing to its peak in 2007 (£130 million), then fell sharply £91 million, then increased again to £118 million in 2013.
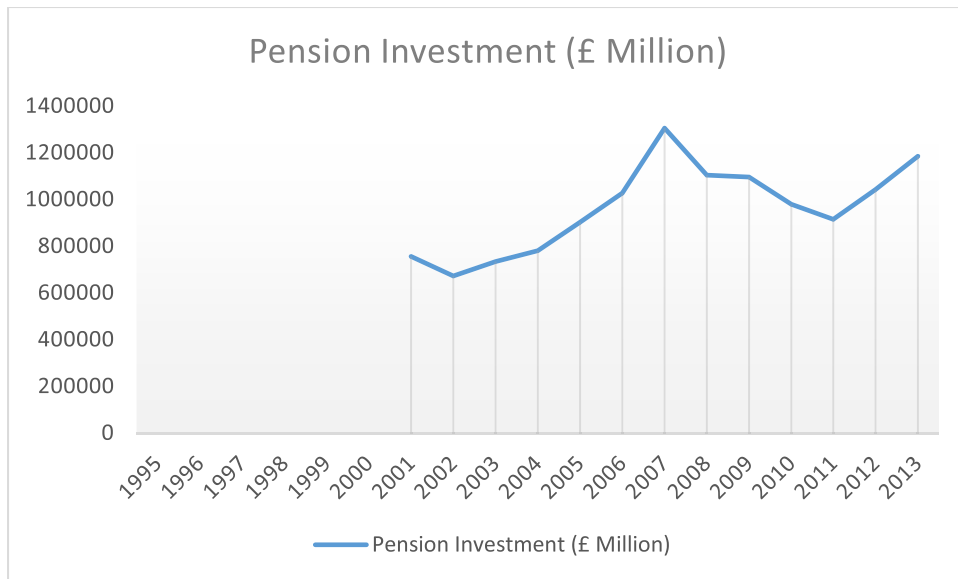
Fig 29. Pension Investment Income (Office of National Statistics, 2014)

5.1.2. Correlation Analysis

The correlation analysis was carried out first to establish the basic relationship amongst the independent (resource) variables and the dependent variables (finance) variables. However, before any of the analyses were carried out, all the variables were transformed into logs because of the abnormal distribution of the variables, which could give inaccurate results. Below are the following logs;

LFP = Log of Food Prices
LOP = Log of Oil Prices
LGP = Log of Gas prices
LIV = Log of Insurance Investment
LNCMUK = Log of Net Claims on Motors for UK
LNCMW = Log of Net Claims on Motors for Worldwide
LNCPUK = Log of Net Claims on property for UK
LNCMcUK = Log of Net Claims on Miscellaneous and Pecuniary Losses for UK
LNCPW = Log of Net Claims on property Worldwide
LNCHUK = Log of Net Claims on Health for UK
LNCMcW = Log of Net Claims on Miscellaneous & pecuniary Losses for Worldwide
LBC = Log of Bank Credit
LBL = Log of Bank lending
LBOL = Log of Bank Overdraft Lending
LPC = Log of Pension Contribution
LPI = Log of Pension Investment

Below are the correlation results;

Table 5. Correlation for the Resource variables

Correlations

		LFP	LOP	LGP
LFP	Pearson Correlation	1	.755**	.261*
	Sig. (2-tailed)		.000	.024
	N	76	76	75
LOP	Pearson Correlation	.755**	1	.523**
	Sig. (2-tailed)	.000		.000
	N	76	76	75
LGP	Pearson Correlation	.261*	.523**	1
	Sig. (2-tailed)	.024	.000	
	N	75	75	75

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

From the table (5) above food prices (LFP) highly correlates positively with oil prices (LOP) at .755 (75.5%) and it is significant at 1%, and correlates with gas prices (LGP) at a lower magnitude and lower level of significance, .261 (26.1%) at 5% level of significance. Oil prices and gas prices correlate at .523 (52.3%) at 1% level of significance. Meaning all these variables move in the same direction; an increase in food prices would increase oil prices and vice versa, an increase in gas prices would increase oil prices and vice versa.

In this analysis, as well, a correlation of the UK GDP with the independent variables (resources) and dependent variables (finance variables) was done separately. The GDP variable was transformed into logs as well.

Table 6. Correlation for the Resource variables including GDP

Correlations

		LFP	LOP	LGP	LUKGDP
LFP	Pearson Correlation	1	.755**	.261*	.625**
	Sig. (2-tailed)		.000	.024	.000
	N	76	76	75	74
LOP	Pearson Correlation	.755**	1	.523**	.932**
	Sig. (2-tailed)	.000		.000	.000
	N	76	76	75	74
LGP	Pearson Correlation	.261*	.523**	1	.558**
	Sig. (2-tailed)	.024	.000		.000
	N	75	75	75	73
LUKGDP	Pearson Correlation	.625**	.932**	.558**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	74	74	73	74

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

From the above results all the resource prices are positively significantly correlated to UK GDP with oil prices having the highest correlation figure of 93.2% (.932). All the correlations are significant at 1% level of significance. The other correlations remain the same as in the previous results without UK GDP

Table 7. Correlation for the Finance variables

Correlations

		LIV	LBC	LBL	LBOL	LPC	LPI
LIV	Pearson Correlation	1	.009	.129	-.061	.090	-.439**
	Sig. (2-tailed)		.944	.326	.646	.451	.002
	N	72	60	60	60	72	48
LBC	Pearson Correlation	.009	1	.446**	.867**	.812**	.515**
	Sig. (2-tailed)	.944		.000	.000	.000	.000
	N	60	64	64	64	64	52
LBL	Pearson Correlation	.129	.446**	1	.710**	.281*	.035
	Sig. (2-tailed)	.326	.000		.000	.025	.807
	N	60	64	64	64	64	52
LBOL	Pearson Correlation	-.061	.867**	.710**	1	.817**	.744**
	Sig. (2-tailed)	.646	.000	.000		.000	.000
	N	60	64	64	64	64	52
LPC	Pearson Correlation	.090	.812**	.281*	.817**	1	.841**
	Sig. (2-tailed)	.451	.000	.025	.000		.000
	N	72	64	64	64	76	52
LPI	Pearson Correlation	-.439**	.515**	.035	.744**	.841**	1
	Sig. (2-tailed)	.002	.000	.807	.000	.000	
	N	48	52	52	52	52	52

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

The table (7) above shows that insurance investment holdings (LIV) does not significantly correlate with any of the finance variables except pension investment (LPI), which shows a significant negative correlation, meaning as either variable increase, the other would decrease by 43.9%. The banking variables; bank credit (LBC), bank loans (LBL) and bank overdraft lending (LBOL) are all highly significantly positively correlated. An increase in either bank credit or loans would increase the other by 44.6% and vice versa, while the relationship between overdraft lending and credit is much higher and stronger at 86.7%. The pension variables have high significant positive relationships with the banking variables; Pension Investments (LPI) positively correlates with bank credit (51.5%), overdraft lending (74.4%) but not significantly correlated to loans. Pension contribution (LPC) correlates with credit (81.2%), overdraft lending (81.7%) and loans (28.1%).

Table 8. Correlation for the Finance variables including GDP

Correlations

		LIV	LBL	LBC	LBOL	LPC	LPI	LUKGDP
LIV	Pearson Correlation	1	.129	.009	-.061	.090	-.439**	.097
	Sig. (2-tailed)		.326	.944	.646	.451	.002	.419
	N	72	60	60	60	72	48	72
LBL	Pearson Correlation	.129	1	.446**	.710**	.281*	.035	.414**
	Sig. (2-tailed)	.326		.000	.000	.025	.807	.001
	N	60	64	64	64	64	52	62
LBC	Pearson Correlation	.009	.446**	1	.867**	.812**	.515**	.903**
	Sig. (2-tailed)	.944	.000		.000	.000	.000	.000
	N	60	64	64	64	64	52	62
LBOL	Pearson Correlation	-.061	.710**	.867**	1	.817**	.744**	.909**
	Sig. (2-tailed)	.646	.000	.000		.000	.000	.000
	N	60	64	64	64	64	52	62
LPC	Pearson Correlation	.090	.281*	.812**	.817**	1	.841**	.979**
	Sig. (2-tailed)	.451	.025	.000	.000		.000	.000
	N	72	64	64	64	76	52	74
LPI	Pearson Correlation	-.439**	.035	.515**	.744**	.841**	1	.812**
	Sig. (2-tailed)	.002	.807	.000	.000	.000		.000
	N	48	52	52	52	52	52	50
LUKGDP	Pearson Correlation	.097	.414**	.903**	.909**	.979**	.812**	1
	Sig. (2-tailed)	.419	.001	.000	.000	.000	.000	
	N	72	62	62	62	74	50	74

The correlation among the finance variables remain the same as in the previous results. With the inclusion of UK GDP in the analysis, insurance investment holdings are still not significantly correlated to UK GDP and even if it was significant the relationship would be quite low at 9.7%. The other variables are statistically correlated to UK GDP at 1% level of significance with pension contribution having the highest valued relationship of up to 97.9%, then followed by overdraft lending and bank credit which are 90.9% and 90.3% respectively, the pension investment correlates with GDP at 81.2% and bank loans has just a 41.4% relationship with GDP.

Table 9. Correlation of both Resource and Finance variables

Correlations

		LIV	LBC	LBL	LBOL	LPC	LPI	LFP	LOP	LGP
LIV	Pearson Correlation	1	.009	.129	-.061	.090	-.439**	-.191	-.029	.014
	Sig. (2-tailed)		.944	.326	.646	.451	.002	.108	.809	.908
	N	72	60	60	60	72	48	72	72	71
LBC	Pearson Correlation	.009	1	.446**	.867**	.812**	.515**	.630**	.875**	.452**
	Sig. (2-tailed)	.944		.000	.000	.000	.000	.000	.000	.000
	N	60	64	64	64	64	52	64	64	63
LBL	Pearson Correlation	.129	.446**	1	.710**	.281*	.035	.028	.299*	.422**
	Sig. (2-tailed)	.326	.000		.000	.025	.807	.828	.016	.001
	N	60	64	64	64	64	52	64	64	63
LBOL	Pearson Correlation	-.061	.867**	.710**	1	.817**	.744**	.595**	.845**	.485**
	Sig. (2-tailed)	.646	.000	.000		.000	.000	.000	.000	.000
	N	60	64	64	64	64	52	64	64	63
LPC	Pearson Correlation	.090	.812**	.281*	.817**	1	.841**	.648**	.906**	.507**
	Sig. (2-tailed)	.451	.000	.025	.000		.000	.000	.000	.000
	N	72	64	64	64	76	52	76	76	75
LPI	Pearson Correlation	-.439**	.515**	.035	.744**	.841**	1	.679**	.793**	.202
	Sig. (2-tailed)	.002	.000	.807	.000	.000		.000	.000	.155
	N	48	52	52	52	52	52	52	52	51
LFP	Pearson Correlation	-.191	.630**	.028	.595**	.648**	.679**	1	.755**	.261*
	Sig. (2-tailed)	.108	.000	.828	.000	.000	.000		.000	.024
	N	72	64	64	64	76	52	76	76	75
LOP	Pearson Correlation	-.029	.875**	.299*	.845**	.906**	.793**	.755**	1	.523**
	Sig. (2-tailed)	.809	.000	.016	.000	.000	.000	.000		.000
	N	72	64	64	64	76	52	76	76	75
LGP	Pearson Correlation	.014	.452**	.422**	.485**	.507**	.202	.261*	.523**	1
	Sig. (2-tailed)	.908	.000	.001	.000	.000	.155	.024	.000	
	N	71	63	63	63	75	51	75	75	75

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

On the correlation between the resource and the finance variables, insurance investment again indicates no significant correlation with any of the resource variables. Credit (LBC) on the other hand is highly positively and significantly correlated to food prices (63%), oil prices (87.5%) and gas prices (45.2%). The same positive and significant relationship goes for all the other variables except in the case of pension investment which is not significantly correlated with gas prices.

Table 10. Correlation of both Resource and Finance variables II

Correlations

		LFP	LOP	LGP	LNCMUK	LNCMW	LNCPUK	LNCMcUK
LFP	Pearson Correlation	1	.827**	.755**	.679**	.659**	.566**	.573**
	Sig. (2-tailed)		.000	.000	.000	.000	.001	.001
	N	31	31	21	31	31	31	31
LOP	Pearson Correlation	.827**	1	.920**	.585**	.509**	.469**	.398*
	Sig. (2-tailed)	.000		.000	.001	.003	.008	.027
	N	31	31	21	31	31	31	31
LGP	Pearson Correlation	.755**	.920**	1	.790**	.671**	.554**	.680**
	Sig. (2-tailed)	.000	.000		.000	.001	.009	.001
	N	21	21	21	21	21	21	21
LNCMUK	Pearson Correlation	.679**	.585**	.790**	1	.987**	.945**	.919**
	Sig. (2-tailed)	.000	.001	.000		.000	.000	.000
	N	31	31	21	31	31	31	31
LNCMW	Pearson Correlation	.659**	.509**	.671**	.987**	1	.936**	.924**
	Sig. (2-tailed)	.000	.003	.001	.000		.000	.000
	N	31	31	21	31	31	31	31
LNCPUK	Pearson Correlation	.566**	.469**	.554**	.945**	.936**	1	.910**
	Sig. (2-tailed)	.001	.008	.009	.000	.000		.000
	N	31	31	21	31	31	31	31
LNCMcUK	Pearson Correlation	.573**	.398*	.680**	.919**	.924**	.910**	1
	Sig. (2-tailed)	.001	.027	.001	.000	.000	.000	
	N	31	31	21	31	31	31	31

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

The lines included in miscellaneous & pecuniary loss are: assistance, creditor, extended warranty, legal expenses, mortgage indemnity, pet, other personal financial loss, fidelity and contract guarantee, all 'bond' business, credit, suretyship, commercial contingency, trade indemnity, special indemnity, licence business, foot and mouth, rainfall (pluvius).

Table 11. Correlation of both Resource and Finance variables III

Correlations

		LFP	LOP	LGP	LIV	LBL	LBC	LBOL	LPC	LPI	LNCPW	LNICHUK	LNICMdW
LFP	Pearson Correlation	1	.755**	.261*	-.191	.028	.630**	.595**	.648**	.679**	.313**	.822**	.526**
	Sig. (2-tailed)		.000	.024	.108	.828	.000	.000	.000	.000	.006	.000	.000
	N	76	76	75	72	64	64	64	76	52	76	60	76
LOP	Pearson Correlation	.755**	1	.523**	-.029	.299*	.875**	.845**	.906**	.793**	.288*	.920**	.775**
	Sig. (2-tailed)	.000		.000	.809	.016	.000	.000	.000	.000	.012	.000	.000
	N	76	76	75	72	64	64	64	76	52	76	60	76
LGP	Pearson Correlation	.261*	.523**	1	.014	.422**	.452**	.485**	.507**	.202	.011	.268*	.448**
	Sig. (2-tailed)	.024	.000		.908	.001	.000	.000	.000	.155	.925	.040	.000
	N	75	75	75	71	63	63	63	75	51	75	59	75
LIV	Pearson Correlation	-.191	-.029	.014	1	.129	.009	-.061	.090	-.439**	-.069	-.148	-.063
	Sig. (2-tailed)	.108	.809	.908		.326	.944	.646	.451	.002	.566	.276	.602
	N	72	72	71	72	60	60	60	72	48	72	56	72
LBL	Pearson Correlation	.028	.299*	.422**	.129	1	.446**	.710**	.281*	.035	-.230	.131	.292*
	Sig. (2-tailed)	.828	.016	.001	.326		.000	.000	.025	.807	.067	.318	.019
	N	64	64	63	60	64	64	64	64	52	64	60	64
LBC	Pearson Correlation	.630**	.875**	.452**	.009	.446**	1	.867**	.812**	.515**	-.088	.823**	.693**
	Sig. (2-tailed)	.000	.000	.000	.944	.000		.000	.000	.000	.491	.000	.000
	N	64	64	63	60	64	64	64	64	52	64	60	64
LBOL	Pearson Correlation	.595**	.845**	.485**	-.061	.710**	.867**	1	.817**	.744**	.022	.816**	.695**
	Sig. (2-tailed)	.000	.000	.000	.646	.000	.000		.000	.000	.866	.000	.000
	N	64	64	63	60	64	64	64	64	52	64	60	64
LPC	Pearson Correlation	.648**	.906**	.507**	.090	.281*	.812**	.817**	1	.841**	.325*	.951**	.864**
	Sig. (2-tailed)	.000	.000	.000	.451	.025	.000	.000		.000	.004	.000	.000
	N	76	76	75	72	64	64	64	76	52	76	60	76
LPI	Pearson Correlation	.679**	.793**	.202	-.439**	.035	.515**	.744**	.841**	1	.552**	.785**	.673**
	Sig. (2-tailed)	.000	.000	.155	.002	.807	.000	.000	.000		.000	.000	.000
	N	52	52	51	48	52	52	52	52	52	52	52	52
LNCPW	Pearson Correlation	.313**	.288*	.011	-.069	-.230	-.088	.022	.325*	.552**	1	.316*	.125
	Sig. (2-tailed)	.006	.012	.925	.566	.067	.491	.866	.004	.000		.014	.281
	N	76	76	75	72	64	64	64	76	52	76	60	76
LNICHUK	Pearson Correlation	.822**	.920**	.268*	-.148	.131	.823**	.816**	.951**	.785**	.316*	1	.759**
	Sig. (2-tailed)	.000	.000	.040	.276	.318	.000	.000	.000	.000	.014		.000
	N	60	60	59	56	60	60	60	60	52	60	60	60
LNICMdW	Pearson Correlation	.526**	.775**	.448**	-.063	.292*	.693**	.695**	.864**	.673**	.125	.759**	1
	Sig. (2-tailed)	.000	.000	.000	.602	.019	.000	.000	.000	.000	.281	.000	
	N	76	76	75	72	64	64	64	76	52	76	60	76

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

5.1.3. Regression Analysis

 The regression analysis is carried out using the Ordinary least square (OLS) regression, with eleven models for each dependent variable. Each model either regressed a single independent variable or a combination of two variables and the eighth model comprised all three variables, with a fourth variable, UK GDP to see how the variables would react. This was done in order to see the effect of a single resource on the independent variable and see whether the effect of that variable would change significantly with the addition of another variable in the model and also the possibility of rendering the effect of the first variable insignificant. This will be better understood as the results would be presented and interpreted. Most of the analysis was done on a quarterly basis from 1995-2013 and some on an annual basis from 1983-2013, depending on the amount of data available to the researcher.

The analysis was done in 11 models as follows

Model 1 = Food prices (LFP)

Model 2= Oil Prices (LOP)

Model 3 = Gas Prices (LGP)

Model 4= LFP and LOP

Model 5 = LOP and LGP

Model 6 = LFP and LGP

Model 7 = LFP, LOP, LGP

Model 8 = LFP, LOP, LGP, LUKGDP

Model 9 = LOP, LGP, LUKGDP

Model 10 = LGP, LUKGDP

Model 11 = LUKGDP

Table 12. Insurance Investment Holdings (Quarterly)

Model	Food Prices	Oil Prices	Gas Prices	UK GDP	Adjusted R^2	ANOVA
Model 1	-46.2%*				6.8%	Insignificant
Model 2		-7.1%			-0.3%	Insignificant
Model 3			-7.2%		-0.04%	Insignificant
Model 4	-104%**	30.6%*			11.5%	significant
Model 5		-5.4%	-1.9%		-1.7%	Insignificant
Model 6	-34%		5.4		1.6%	Insignificant
Model 7	-131%***	88.6*%	-52%		13.9%	significant
Model 8	-41.5%	-38.9%	-4.8%	167.3%	9.2%	Insignificant
Model 9		-62.7%	-2.3%	192.9%	7.4%	Insignificant
Model 10			-4.5%	28.2%	-1.7%	Insignificant
Model 11				20.4%	-0.5%	Insignificant

*** = significant at 1%   ** = significant at 5%   *= significant at 10%

From the results on the table (12), food prices alone affect insurance investment at -46.2% meaning an increase in food prices by one unit will decrease insurance investment by 46.2%. Oil prices also decrease insurance investment by 7.1% while gas prices decrease it by 7.2%. In model 4, with the addition of oil prices to food prices, the effect of food prices on insurance investment further increase to 104% (an increase in food prices will decrease insurance investment by 104% significantly), while oil prices now significantly increase investment by 30.6%. In model 7, with all the variables in the model, increase in food price decreases investment significantly by 131%, gas prices reduce investment by 52.6% but oil prices increase investment by 88.6%. This just illustrates how other variables can affect the effect of a particular variable on the dependent variable, which could be partly explained by their levels of correlation. However, only two of the model results (model 4 and 7) are statistically significant according to the t tests, all the other models do not significantly predict the outcome of the dependent variables (insurance investment) and the adjusted R^2 indicate that the models do not explain the variance in insurance investment (for the negative values) and explain very little (2-3%) of the variance in insurance investment. The results from the above table, with the inclusion of UK GDP, still have no significance in predicting movements in insurance

investment. The adjusted R^2s are all very low with the lowest being model 3, meaning gas prices alone cannot predict insurance investment holdings. This follows with UK GDP being the sole independent variable, having an adjusted R^2 at -0.5%, meaning that UK GDP on its own cannot explain variations in insurance investment. With the full model (model 8), the R^2 is the highest at 9.2%, meaning the entire model can just explain 9.2% of the variations in insurance investment.

Table 13. Net Insurance Investment Income (Annual)

Model	Food Prices	Oil Prices	Gas Prices	UKGDP	Adjusted R^2	ANOVA
Model 1	35.9%				9.4%	Insignificant
Model 2		24%*			29.4%	significant
Model 3			27.1%**		43.5%	significant
Model 4	-33.1%	36%			29.1%	Insignificant
Model 5		-23%	47.7%		44.2%	Insignificant
Model 6	-24.3%		34.5%*		43.6%	significant
Model 7	-12.3%	-16.1%	45.3%		41.2%	Insignificant
Model 8	12.6%	-14.1%	-5.3%	226.2%*	52.3%	significant
Model 9		-8%	-4.5%	212.8%	55%	significant
Model 10			-13.9%	224.7%	57.4%	significant
Model 11				215.1%*	83.7%	significant

*** = significant at 1%   ** = significant at 5%   *= significant at 10%

To some extent, unlike investment holdings, investment income is significantly affected by oil and gas prices in the absence of GDP. In model 2, oil affects investment income positively by 24%, significant at 10% and gas prices in model 3 affects investment income at 27.1%, significant at 5% with both models significantly predicting movements in income. With the inclusion of GDP in model 8, none of the resource variables are significant, except GDP. Yet, GDP barely significantly affects Investment income.

Table 14. Health Insurance Claims

Model	Food Prices	Oil Prices	Gas Prices	UKGDP	Adjusted R^2	ANOVA
Model 1	75.9%***				71.9%	significant
Model 2		43.4%***			73%	significant
Model 3			42.6%***		62.4%	significant
Model 4	32.1%	25.9%			73.2%	significant
Model 5		58.1%**	-16.3%		73.3%	significant
Model 6	58.5%**		12.1%		72.7%	significant
Model 7	23.5%	37.6%***	-7.8%		73.2%	significant
Model 8	0.2%	-2.5%	-1.3%	144%***	93.1%	significant
Model 9		-2.4%	-1.3%	144.2%***	93.3%	significant
Model 10			-1.4%	136.1%***	93.4%	significant
Model 11				134.3%***	93.4%	significant

*** = significant at 1%   ** = significant at 5%   *= significant at 10%

Food and oil prices have more significant effects on health insurance claims, than gas prices in the UK. In model 1 food prices solely affects health claims by 75.9%, meaning a unit increase in food prices would increase health insurance claims by 75.9%, significant at 1% and accounting for over 71.9% of the movements in health claims. In model 2, oil prices follow the same pattern positively affecting health claims by 43.4%. However, in model 4 where food and oil prices are analysed together, both food and oil prices become insignificant in affecting health insurance claims, though the entire model explains movements in claims by 73.2%. Therefore, from these results, health claims are predominantly affected by oil prices, holding GDP constant.

Table 15. Motor Insurance UK (Annual)

Model	Food Prices	Oil Prices	Gas Prices	UKGDP	Adjusted R²	ANOVA
Model 1	71.5%*				33.2%	significant
Model 2		33.4%*			35%	significant
Model 3			38.7%***		60.4%	significant
Model 4	34.7%	20.3%			34.5%	significant
Model 5		-38%	70.5%***		66.7%	significant
Model 6	2.1%		38.1%***		58.3%	significant
Model 7	37.3%	-52.6%	71%***		68.4%	significant
Model 8	26.2%	-4.5%	-18.8%	252.2%***	94.3%	significant
Model 9		7.2%	-22.8%	262.5%***	92.8%	significant
Model 10			-14.1%	249.5%***	93%	significant
Model 11				217.5%***	91.3%	significant

*** = significant at 1%   ** = significant at 5%   *= significant at 10%

  For motor insurance claims for the UK, food and oil prices barely significantly affect the increase in the cost of motor insurance claims. Gas prices on the hand significantly affect motor insurance claims for all the models it is analysed in. In model 7, an increase in gas prices by one unit would increase the cost of motor claims for insurance companies by up to 71%. However, all the resources become insignificant with the inclusion of UK GDP.

Table 16. Motor Insurance Worldwide (Annual)

Model	Food Prices	Oil Prices	Gas Prices	UKGDP	Adjusted R^2	ANOVA
Model 1	47.4%*				29.4%	significant
Model 2		18.4%			19.8%	Insignificant
Model 3			23%*		42.2%	significant
Model 4	44.4%	1.7%			25.6%	Insignificant
Model 5		-31.8%	49.6%**		51.1%	Insignificant
Model 6	12.9%		19%		40.1%	significant
Model 7	46.3%	-49.9%*	50.2%**		59.9%	significant
Model 8	36.8%	-14.2%	-16.9%	188.1%***	87.3%	significant
Model 9		2.2%	-22.6%	202.1%***	80.7%	significant
Model 10			-19.8%	198.1%***	81.8%	significant
Model 11				151.4%***	83.9%	significant

*** = significant at 1%   ** = significant at 5%   *= significant at 10%

For the cost of motor insurance claims worldwide to UK insurance companies, gas prices, still have significant effects on its performance, though at a lower level of significance than that of UK motor insurance and lower prediction levels than the UK motor insurance claims. However, in model 7, oil prices significantly affect motor insurance claims at -49.9%, meaning an increase in oil prices would reduce motor insurance claims worldwide, but this effect is dampened by the strength of significance of gas prices, as they positively increase these insurance claims by 50.2%.

Table 17. Property Insurance UK (Annual)

Model	Food Prices	Oil Prices	Gas Prices	UKGDP	Adjusted R^2	ANOVA
Model 1	30.7%				12.8%	Insignificant
Model 2		13.4%			11.1%	Insignificant
Model 3			17%		27%	significant
Model 4	20.7%	5.6%			8.9%	Insignificant
Model 5		-25.5%	38.4%		32.7%	Insignificant
Model 6	-0.7%		17.3%		23%	Insignificant

Model						
Model 7	22.1%	-34.2%	38.6%		32%	Insignificant
Model 8	14.6%	4.1%	-32.2%	199.9%***	75.3%	significant
Model 9		10.6%	-34.5%	205.5%***	75.5%	significant
Model 10			-21.6%*	186.4%***	75.7%	significant
Model 11				141.7%***	77.9%	significant

*** = significant at 1%   ** = significant at 5%   *= significant at 10%

None of the resources in the analysis had a significant effect on property insurance claims in the UK. Except gas prices in model 10, with the inclusion of GDP, where it still had a negative effect on property insurance. An increase in gas prices would therefore reduce property insurance claims by 26%, though the level of significance is much lower than that of GDP.

Table 18. Property Insurance Worldwide (Quarterly)

Model	Food Prices	Oil Prices	Gas Prices	UKGDP	Adjusted R^2	ANOVA
Model 1	9.1%				7.9%	Insignificant
Model 2		4%			6.9%	Insignificant
Model 3			0.2%		-1.4%	Insignificant
Model 4	6.1%	1.8%			7.4%	Insignificant
Model 5		5.4%	-2.7%		8.3%	Insignificant
Model 6	9.7%*		-1%		7.2%	Insignificant
Model 7	4.6%	3.6%	-2.3%		8%	Insignificant
Model 8	4.9%	3.2%	-2.4%	1.6%	6.5%	Insignificant
Model 9		6%	-2.8%	-1.3%	6.8%	Insignificant
Model 10			-2.6%	14.6%	5.8%	Insignificant
Model 11				10.4%	4.8%	Insignificant

*** = significant at 1%   ** = significant at 5%   *= significant at 10%

None of the resources in the analysis had a significant effect on worldwide property insurance claims incurred by UK insurance companies, not even with the inclusion of GDP. Therefore, the cost of property insurance worldwide to UK insurance companies is not significantly affected by the price of any of the resources under study.

Table 19. Miscellaneous and Pecuniary Loss UK (Annual)

Model	Food Prices	Oil Prices	Gas Prices	UKGDP	Adjusted R^2	ANOVA
Model 1	155%				34.4%	Insignificant
Model 2		50.5%			16.8%	Insignificant
Model 3			47.4%*		46.3%	significant
Model 4	205%	-26.4%			33.8%	Insignificant
Model 5		-52.3%	91.8%*		57.1%	significant
Model 6	16.1%		42.1%		44%	Insignificant
Model 7	72.3%	-81.5%	93.1%*		56%	Significant
Model 8	44.3%	-17.6%	-34.4%	364.6%***	83.8%	significant
Model 9		2.2%	-41.1%	381.5%***	81.8%	significant
Model 10			-38.5%*	377.6%***	82.9%	significant
Model 11				255.2%***	61.7%	significant

*** = significant at 1%   ** = significant at 5%   *= significant at 10%

On insurance claims for Miscellaneous and pecuniary loss incurred by UK insurance companies, only gas prices significantly affect increases in such claims, holding GDP constant. An increase in gas prices by one unit in model 5, increases claims by up to 91.8% in the presence of oil prices, significant at 1%.

Table 20. Miscellaneous and Pecuniary Loss Worldwide (Quarterly)

Model	Food Prices	Oil Prices	Gas Prices	UKGDP	Adjusted R^2	ANOVA
Model 1	31.9%***				26.6%	significant
Model 2		22%***			59.4%	significant
Model 3			12.9%***		19%	significant
Model 4	-8.5	25%***			59.7%	significant
Model 5		21.1%***	1.7%		59.4%	significant
Model 6	26.6%***		9.6%**		36.3%	significant
Model 7	-7.9%	24.3%***	1%		59.3%	significant
Model 8	0%	-6%	0%	85.3%***	70.6%	significant

Model						
Model 9		-6%	0%	85.4%***	71%	significant
Model 10			-0.1%	69.4%***	70.8%	significant
Model 11				69.1%***	71.2%	significant

*** = significant at 1%   ** = significant at 5%   *= significant at 10%

For worldwide insurance claims for Miscellaneous and pecuniary loss incurred by UK insurance companies, oil prices and gas prices consistently, significantly affect these claims across all models holding GDP constant. An increase in oil prices, in model 7, decreases the cost of claims by 7.9%, significant by 1%. Therefore, gas prices significantly affect such claims in the UK, while both oil and gas prices affect such claims worldwide.

Table 21. Bank Loans (Quarterly)

Model	Food Prices	Oil Prices	Gas Prices	UK GDP	Adjusted R^2	ANOVA
Model 1	-4.5%				-1.1%	Insignificant
Model 2		7.6%			2.5%	Insignificant
Model 3			11.5%		5.7%	Insignificant
Model 4	-100%**	53.4%***			32.9%	Significant
Model 5		-28.6%	42.3%		17.1%	Insignificant
Model 6	-79.6%***		49.5**		34%	Significant
Model 7	-97.4%***	27.1%	28.9%		35.5%	Significant
Model 8	-43.3%	-6.8%	8.7%*	132%*	34%	Significant
Model 9		-18.4%	11.4%*	102.7%*	22.7%	Significant
Model 10			10.8%*	39.8%*	22.3%	Significant
Model 11				56.5%**	15.8%	Significant

*** = significant at 1%   ** = significant at 5%   *= significant at 10%

The results on the analysis on bank loans indicate that, in model 4, an increase in food price will reduce the amount of bank loans by 100%, while oil prices increase these loans by 53.4%. These results are significant statistically, the model significantly predicts the outcome on loans and the R^2 show that 32.9% of the variance in the amount loans can be explained by the model. In the seventh model, the effect of food price on loans have fallen from a decrease by 100% in model 4 to a decrease in loans by 97.4%, the effect of oil has also been reduced, with the inclusion of gas prices, from an increase in loans by 53.4% to 27.1%, though not significant statistically. Gas prices on the other hand increase bank loans insignificantly by 28.9%. The

R^2 of the model shows that 35.5% of the variance in loans can be explained by the model, and it significantly predicts the outcome on loans.

Most of the models (7 out of 10) for bank loans with UK GDP significantly predict movement in bank loans, though in all the models, oil prices are the only significant in model 4. It is important to note that the inclusion of UK GDP made the impact of oil prices on bank loans insignificant, and the effect of gas prices even less significant (from 5% to 10%). The effect of UK GDP on bank loans is as follows; 56.5%, from model 11 meaning an increase in UK GDP would increase bank loans by 56.5%, it then dropped to 39.8% with the inclusion of gas prices, increased to 102.7 % with the inclusion of oil prices and increased again to 132% with the inclusion of food prices. Meaning oil and food prices increase the effect of UK GDP on bank loans.

Table 22. Bank Credit (Quarterly)

Model	Food Prices	Oil Prices	Gas Prices	UK GDP	Adjusted R^2	ANOVA
Model 1	63.5%**				50%	Significant
Model 2		38.1%***			71.9%	Significant
Model 3			42.8%*		82.2%	Significant
Model 4	-28.3%*	50.9%***			73.3%	Significant
Model 5		14.9%***	26.8%*		77.1%	Significant
Model 6	-15.4%*		50.2%**		82.8%	Significant
Model 7	-40.3%***	37.9%***	21.2%*		86.7%	Significant
Model 8	-23.4%*	3.7%	2.9%	154.2%***	84.8%	Significant
Model 9		-2.6%	4.3%*	138.3%***	82.1%	Significant
Model 10			4.3%*	129.5%***	82.4%	Significant
Model 11				135.6%***	81.3%	Significant

*** = significant at 1%   ** = significant at 5%   *= significant at 10%

In model 1, the effect of food prices on credit is positive at 63.5%, but with the inclusion of oil prices in model 4, the effect becomes negative at -28.3% and less significant, while oil prices in model 4 has increased from an effect of 38.1% in model 2 to 50.9% when analysed with food prices. In model 7, the effect of food prices on credit slightly improves to a decrease in credit by 40.3% instead of 28.3% in model 4. All the models are significant in predicting the

outcome on credit and the R^2s show that the variation in credit can be explained by these models.

For bank credit, the inclusion of UK GDP into the models still has the same effect it had on bank loans; oil prices have become insignificant in affecting bank credit alongside GDP. In model 8, food price was the only variable which significantly affected bank credit, with GDP, negatively affecting credit by 23.4%. In model 9 and 10, the effect of gas prices remains the same for both models and is significant at 10%. The effect of GDP in all the models 8-11 is very high, above a 100%. It is highest at 154% with the inclusion of all the variables, 138% with just oil and gas prices, 129.5% with just gas prices and independently affects bank credit at 135.6%.

Table 23. Bank Overdraft lending (Quarterly)

Model	Food Prices	Oil Prices	Gas Prices	UK GDP	Adjusted R^2	ANOVA
Model 1	43%***				38%	Significant
Model 2		30%***			71.1%	Significant
Model 3			31%***		64.7%	Significant
Model 4	-38.5%**	45.2%***			70%	Significant
Model 5		14.2%***	15.7%*		65.6%	Significant
Model 6	-15.7%		38.5%***		65.7%	Significant
Model 7	-40.1%***	37.1%*	10.2%		71.1%	Significant
Model 8	-21.1%***	-2.8%	3.1%	155.8%***	86.6%	Significant
Model 9		-8.4%	4.4%	141.3%***	83.6%	Significant
Model 10			4.2%	112.5%***	83.5%	Significant
Model 11				118.8%***	82.4%	Significant

*** = significant at 1%   ** = significant at 5%   *= significant at 10%

The results on overdraft lending basically takes on the same pattern as the results on credit, though with different magnitudes and all the models are also significantly predictive.

Just like the above two bank variables, the presence of UK GDP in the models has made the impact of oil prices on bank overdraft lending insignificant. In model 8, food prices, again, is

the only variable which significantly affects overdraft lending, alongside GDP, while oil and gas prices remain insignificant. The effects of GDP remain high for bank overdraft lending.

Table 24. Personal Deposits (Quarterly)

Model	Food Prices	Oil Prices	Gas Prices	UK GDP	Adjusted R^2	ANOVA
Model 1	22.3%				4%	Insignificant
Model 2		19%**			13%	Significant
Model 3			23.2%		23%	Insignificant
Model 4	60.8%*	46.6%**			20.4%	Significant
Model 5		32.6%	-8.6%		17.1%	Insignificant
Model 6	-44.5%		44.8%***		24%	Significant
Model 7	-61.5%**	26.7%	23.9%		24.5%	Significant
Model 8	-70.9%**	-22.4%	21.5%	474%*	32.1%	Significant
Model 9		-48.3%	31.2%	358%*	21.9%	Significant
Model 10			11.8%	100.4%*	19.9%	Significant
Model 11				181.6%***	20.7%	Significant

*** = significant at 1%   ** = significant at 5%   *= significant at 10%

Personal deposits in UK banks are affected basically by food and oil prices in model 4 where both variables are analysed together and in model 7 only food price is significant where an increase in food prices by one unit would decrease the volume of personal deposits by 61.5%, significant at 5% t statistic. Also, with the presence of GDP in the analysis in model 8, food prices, again, is the only significant variable reducing personal deposits by 70.9% with a unit increase in food prices. However, with the absence of oil prices in model 6, where food and gas process are analysed, food prices losses its significance to gas prices, which significantly increases personal deposits by 44.8% with a unit increase. GDP on its own increases personal deposits by over 181.6%, significant at 1%. The table above indicates that; food prices alone and solely gas prices cannot significantly predict movements in personal deposits and oil and gas prices together also cannot predict movements in deposits. Only oil prices alone (model 2) can significantly increase personal deposits by 19% with a unit increase in price.

Table 25. Non Personal Lending (Quarterly)

Model	Food Prices	Oil Prices	Gas Prices	UK GDP	Adjusted R^2	ANOVA
Model 1	-108%				0.3%	Insignificant
Model 2		35.2%			-4%	Insignificant
Model 3			-29.9%		-5.8%	Insignificant
Model 4	-26.2%	84.4%			-4.1%	Insignificant
Model 5		-45.9%*	26%		50.3%	Significant
Model 6	-50%		17%		20.1%	Insignificant
Model 7	37.8%	-68.2%	25.5%		50.7%	Insignificant
Model 8	38%	-5.9%	21%	-73.6%	46%	Insignificant
Model 9		-31%	20.7%	-113.6%	46.5%	Insignificant
Model 10			76.4%	-303%	46.4%	Insignificant
Model 11				-229%	41.3%	Insignificant

Unlike personal deposits, non-personal lending by UK banks is insignificantly affected by movement in prices of food oil and gas, and even movements in GDP. Model 5 is the only model which significantly predicts movements in non-personal lending. Here, oil prices significantly (at 10% t statistic) reduces lending by 45.9% and predicts movements in lending by 50.3%.

Table 26. Pension Contribution (Quarterly)

Model	Food Prices	Oil Prices	Gas Prices	UK GDP	Adjusted R^2	ANOVA
Model 1	78.1%***				41.7%	Significant
Model 2		39.7%***			49%	Significant
Model 3			39.3%***		74.7%	Significant
Model 4	18.2%	32.3%***			48.8%	Significant
Model 5		49.7%***	-12.8%		84.3%	Significant
Model 6	22.2%*		30.6%***		76.4%	Significant
Model 7	-10.7%	56.4%***	15.4%		84.4%	Significant
Model 8	6.6%	-7.1%	-0.6%	134.6%***	96%	Significant
Model 9		-3.3%	-1.1%	130.7%	95.8%	Significant

Model			-1.2%	121.9%***	95.8%	Significant
Model 10						
Model 11				119.9%***	95.7%	Significant

*** = significant at 1%   ** = significant at 5%   *= significant at 10%

The only significant result on the effect of food prices on pension contribution is the result on model 1 where food positively affects contribution by 78.1%. Food prices become less significant in model 6 and insignificant for the rest of the models. In model 4, the effect of oil prices in pension falls from significantly increasing pension contribution by 39.7% in model 2 to causing a significant increase by 32.3% when included alongside food prices, possibly making the effect of food prices drop and become insignificant. In model 7, with the inclusion of gas prices to food and oil prices, oil prices effect increases significantly to 56.4%, while the effect of gas prices become insignificant down from its significant effect from model 3 and 5. However, all the models are significant in predicting the outcome of pension contribution according to ANOVA and the R^2s show that the variance in contribution can be explained by these models, particularly those which include the oil price variable.

For pension contribution, none of the effects of the resource variables remain significant with the inclusion of UK GDP and the effects are also high at above 100%.

Table 27. Pension Investment (Quarterly)

Model	Food Prices	Oil Prices	Gas Prices	UK GDP	Adjusted R^2	ANOVA
Model 1	50.6%***				56.8%	Significant
Model 2		27.9%***			41.3%	Significant
Model 3			23.7%***		23.2%	Significant
Model 4	100%***	-33.4%*			61.8%	Significant
Model 5		66.4%***	45.6%***		60.9%	Significant
Model 6	69.4%***		-17.5%*		63.4%	Significant
Model 7	46.3%	23.8%***	-28.6%		62%	Significant
Model 8	-3.3%	2.4%	2.3%	108.8%*	62.6%	Significant
Model 9		1.2%	2.3%	106.2%*	63.4%	Significant

Model 10			2.4%	110.5%*	64.2%	Significant
Model 11				113.7%*	65.2%	Significant

*** = significant at 1%   ** = significant at 5%   *= significant at 10%

Food, oil and gas prices have significant impacts on pension investments returns. However, in model 7, only oil prices significantly affect investment. Food prices individually in model 1, 4 and 6 food prices have a significant positive effect on investments at 50.6%, 100% and 69.6% respectively. Oil prices on the other hand have significant effects in investment for all the models at 27.9 % to 66.4% positive effect, with the exception of model 4 where its effect becomes negative (-33.4%) when analysed with food prices. All the models significantly predict the outcome on investments. Therefore, pension investment returns can be significantly affected by prices in resources like food, oil and gas.

The effect of UK GDP on pension investment and on the effect of the resource variables on pension investment remain the same as that of pension contribution above.

5.1.4. Granger Results

The Granger causality test was carried out with a lag period of 12 quarters and 4 quarters, meaning determining the forecasting power of a variable over another for a period of 3 years and 1 year respectively (short term, since most the data is in quarters, all the annual data was then transformed to quarters). The results are displayed with the null hypothesis being that one variable (X) does not granger cause another variable (Y). The F statistic values are the values of the analysis, if it is significant, the null hypothesis is rejected and thus X granger causes Y, having the power to forecast the movement of Y either in the positive or negative direction in 3 and 1 year periods. If the F value is not significant then we accept the null hypothesis and X does not granger cause Y.

Table 28. Granger Results

Hypothesis (Ho)	F Statistic	Significance	Result	lag (years)
Bank Credit does not granger cause world misc. claims	8.35***	Significant	Reject Ho	1
UK Health claims does not granger cause bank loans	5.13**	Significant	Reject Ho	3
UK Health claims does not granger cause bank loans	8.87***	Significant	Reject Ho	1
UK motor claims does not granger cause bank loans	14.77***	Significant	Reject Ho	1
Bank loans does not granger cause UK motor claims	5.57**	Significant	Reject Ho	1
Worldwide motor claims do not granger cause bank loans	12.75***	Significant	Reject Ho	1
Worldwide property claims do not granger cause bank overdraft	5.17**	Significant	Reject Ho	1
UK Health claims does not granger cause bank overdraft	16.30***	Significant	Reject Ho	1
Bank overdraft does not granger cause health claims	6.37**	Significant	Reject Ho	1
Worldwide motor claims do not granger cause bank overdraft	5.82**	Significant	Reject Ho	1
pension contribution does not granger cause worldwide misc. claims	6.37**	Significant	Reject Ho	1
UK property claims does not granger cause pension investment	7.41**	Significant	Reject Ho	3
pension investment does not granger cause insurance investment income	7.30**	Significant	Reject Ho	3
Insurance Investment does not granger cause Bank loans	3.91*	Significant	Reject Ho	3
pension investment does not granger cause bank credit	7.86***	Significant	Reject Ho	3
UKGDP does not granger cause bank credit	4.97*	Significant	Reject Ho	3
World GDP does not granger cause pension contribution	3.92*	Significant	Reject Ho	3

In the full analysis with over 100 combinations, most of the financial variables are independent, that is, no causal relationship between them. The analyses presented on the table above are the variables which have causal relationship either in the 1 year or 3-year period. From the table above, most of the finance variables have causal relationships in 1 year periods than 3 year periods (10:7), meaning movements in one variable can predict movements in the other variables or cause the other variable to move in the same or opposite direction during a period of 1 or 3 years.

Beginning with the 1 year relationships, Bank credit can cause movements in miscellaneous claims in the UK in 1 year. There is a unidirectional causality from UK health claims to bank loans both in 1 and 3 year periods, with the 1-year period being more significant, meaning movements in health claims can predict movements in bank loans in 1 year. Bank loans and UK motor claims have a bidirectional relationship with the direction from UK motor insurance being more significant. Meaning if UK motor insurance moved first it could have a more

predictive power to movements in bank loans than vice versa. There is a unidirectional relationship insurance investment to bank loans, meaning, insurance investment can forecast or predict the movement of bank loans in 3 years, or a movement in insurance investment would cause a reaction in bank loans, either negatively or positively in 3 years. Pension investment has the same causal relationship with bank credit and it is even more significant (1%). A movement in pension investment could cause a movement in bank credits in 3 years. From the results illustrated, it can be concluded that most of the unidirectional relationships come from insurance variables, meaning these insurance variables have a more predictive power over the other finance variables, and thus if insurance is affected first by resource scarcity, the rest of the finance sector could be affected in the short run (1-3 years).

A causality analysis was also done between UK GDP, World GDP and the finance variables. Out of all the variables, UK GDP had a causal relationship with bank credit only in a period of 3 years, meaning a movement in UK GDP would cause an upward or downward movement in bank credit in 3 years. This can be linked with its high effects on bank credit in the regression analysis. The causal relationship between World GDP and the finance variable, in the short term showed a high level of independence from World GDP, except with pension contribution where a movement in World GDP would affect pension contribution in 3 years.

The qualitative analysis was carried out through interviews to either validate, confirm and/or contradict these results. This phase was expected to give reasons for behaviours (normal or abnormal) and why some results are significant or not, and in a nutshell, to get an in-depth understanding of these effects and discover other effects not captured in these analyses.

5.2 Qualitative Results

As a follow up from the quantitative results, the qualitative analysis was carried out to support the quantitative results, to confirm, validate and/or contradict these results. It was also done to better explain the quantitative results, better explain anomalies and capture other effects which the quantitative analysis could not capture. The quantitative results answered the questions on "will" and "how" natural resource scarcity affects the finance sector; the qualitative analysis will help answer "why" it affects the finance sector.

The qualitative analysis was carried out in the form of interviews with individuals with expert knowledge and experience in the finance sector, to find out their perspective and opinions,

based on their experience on "why" and "how" resource scarcity would affect the finance sector. Thus the interview data provides validity to the phenomenon under study as it gives more in-depth analysis to the issues surrounding natural resource scarcity and its effects.

For those who did agree to be interviewed, the interviews were done face to face for 5 out of 10 interviews which took approximately 20-30 minutes and the other 5 interviews were telephone interviews which lasted approximately 25 minutes. The qualitative data was analysed using content analysis which entailed coding and identifying patterns in the communicated data, to identify similar and contrasting ideas on the concept of resource scarcity and its effect on the finance sector. Various themes were identified which reflected expert views on resource scarcity and its effect on the finance sector, which include;

- Natural resource scarcity
- Measurement of resource scarcity
- Effect of resource scarcity on the economy
- Effect of resource scarcity on the finance sector
- Part of the finance sector most vulnerable to resource scarcity
- Systemic risks
- Resource with highest potential of effects
- Politics versus natural resource scarcity
- Financial regulation's role
- Legislation versus financial regulation in resource risks

For the sake of anonymity, the responses would be reported as "respondent A, respondent B" and so on, following the ethical agreement between the researcher and the interviewee.

Given the fact that the qualitative analysis was just a follow up to the quantitative analysis, to either confirm, validate or contradict the analysis, 10 interviews were enough as the responses and ideas were the same at some point in the interviews. That is all the respondents were starting to say and imply the same thing. The interviews were carried out to the point of saturation, where the answers were similar in context, and the last interview didn't bring anything new.

Below is a table summarising the type of institutions and job titles of the interviewees.

Table 29; Interviewees

Type of Institution	Job Title
Research Institute	Insurance and pensions analyst
Bank	Risk Analyst
Bank	Risk analyst
Research Institute	Environmental Economist
Insurance Company	Insurer and pensions
Insurance Company	Insurer
Investment Bank	Long Term Savings Expert
Investment Institute	Environmental Investor
Bank	Pricing and risk analyst

5.2.1. Natural Resource Scarcity

The interviews began with a general question on natural resource scarcity to find out their perspectives about this phenomenon, if they actually believed natural resources are scarce and how they would define it. The question was asked "Are natural resources getting scarce? And if they are, how would you define it?" this question had a variety of answers with the most popular being "*yes they are*", to "*I would not say they are*" respondent A (Banking) puts it thus;

"*There is always going to be scarcity of some resources… you can get price shocks of certain commodities which are particularly rare… scarcity can occur at different levels of demand for different commodities*"

Respondent B (Environment investor) had a more detailed view of resource scarcity by differentiating scarcity on two levels; renewable and non-renewable,

"*Yes, absolutely, it's scarce and increasingly so, and there are two aspects to that… finite natural resources (minerals, fossil fuel etc), they are scarce and getting scarce…. Also the scarcity in terms of overall ecosystems, clearly human population and geography*"

Respondent G and respondent H both also supported the view that resources are growing exceedingly scarce respectively

"Yes, I believe resources are scarce and getting more scare as the years go by and with population growth"

"Yes, natural resources are scarce and by definition, we live in a finite planet, within a finite world, there is not an indefinite abundance of natural resources"

Respondent D, an insurer, agreed that natural resources are scarce, are a problem but does not indicate the end of the world as insinuated by most respondents and technology and research have found substitutes for "disappearing" resources

"Obviously generally when resources are being used at some point they get lesser and disappear… Is scarcity a problem? Well, yes it is, but that's not going to be the end of the world because otherwise resources are going to disappear, resources have always disappeared"

Some respondents had a partial view on the fact that resources are scarce and getting scarce. Respondent E, an expert in the long term savings sector, expressed his view as;

"I wouldn't say they are scarce: I would just acknowledge they are limited"

Respondent F, an economist, had quite a similar view and expression as respondent E, on not being dramatic with the "scarce" issue of natural resources, linking his perspective to Malthusian economics;

"I think resource scarcity is a bit of a red herring, I think there is potentially huge resource scarcity, but I would not say there is resource scarcity compared to what there was… Malthus thought there was limited resources in the world, so as population goes up there would be less resources to go round, he was right till the age of industrial revolution"

Respondent I, had a view of resource scarcity which sits in the middles of the two almost extreme views, of the other respondents, by saying that

"Some resources are scarce and finite and some of them we have great reserves of them than others"

All the above responses captures to some extent the varying views and controversy which exists both in empirical and theoretical literature on the issue of scarcity of resources. These views encompass two extremes; some with the view that resources are scarce and are a problem and those that depict that natural resources are not scarce especially with technological advancement and therefore not a threat to wellbeing.

5.2.2. Measurement of Natural Resource Scarcity

After having established the perspective of the respondents on the existence on resource scarcity, it was equally imperative to get their views on how scarcity was measured. Theory and empirical literature have identified price to be the predominant measure of resource scarcity, followed by the stock of the resource available. This question was used to ease in to the effects on resource scarcity, given its measurement. A variety of the responses identified and agreed that price was the appropriate measure, with 2 respondents arguing that price and stock were both appropriate measures, 2 respondents argued that stocks of the resources alone were a better measure, 2 arguing that price alone was dominant and 2 argued price is the dominant measure but disagreed it was appropriate enough, while 2 weren't very sure which of them, price or stock was more appropriate.

Respondent A, argued that price was the dominant measure which is derived from demand and supply which could cause "big price movements";

"in terms of how it's measured, it's done in terms of supply and demand…. you can get price shocks of certain commodities which are particularly rare relative to demand…. You can end up with big price movements which are of considerable interest to financial markets"

Respondent E also argued that price is a tool to measure and give a signal of scarcity;

"Price is a tool used to give you a signal of scarcity, where externalities are captured"

One of the responses on the inappropriateness of price being the dominant measure of scarcity was expressed by respondent G who asserts that;

"as resources get more scarce, the price may go up…. Obviously looking at prices to see what they tell you"

But went further to say

"I didn't say prices are the best measure, they are one of the factors you look at when measuring resource scarcity"

Respondent I, also was sceptical about prices being the best measure after mentioning the mass and volume of the resource as a measurement of scarcity

"I would think of measurement in terms of the mass and volume of the resource, I suppose from an economic perspective you think about resource scarcity being translated into an effect on prices, but I'm sceptical that market prices effectively capture that information in practice"

Some respondents were of the view that the stock of the resources is a better measure of resource scarcity. Respondent B, strongly supported the argument that stock estimates could tell whether a resource was scarce or not;

"...how much they (oil and mining companies) think is on the ground…that estimate tells us that they are indeed scarce…measuring a stock is relatively straightforward, you can get a sense and scale of the stock in it…. if you are looking at scarcity then it's about stocks"

Respondent H, followed in that line of thought with regards to stock versus consumption when he argued that;

"Resources are measure in terms of how many years have we got left if we consume at the current rate…resources can be measured in terms of the actual amount of stuff in the ground"
However, he mentioned that
"resources can be looked at with reference to the ability to economically extract these resources (price)"

Other responses are of the view or conclude that both price and stock are related and thus are both measures of resource scarcity. Respondent D was expressed this view in his statement;

"I think they (price and stock) are related…. If it looks like 28% of the oil in the ground is ok for the next 100 years it wouldn't impact prices, but if that same 28% might last another 22 years it will obviously impact prices"

Respondent C also followed in the same argument;

"Price and inventory…. for instance, oil, so obviously you have benchmarks on how much a barrel is, then there's obviously lots of different measurements of how much oil is stock piled by various institutions and countries around the world"

But went further to state that;

"you know price isn't a perfect indicator…. the price is not necessarily a simple pure representation of supply and demand, but is an indication for sure"

Given the variety of responses reported above, a majority point at prices to be the tool which indicates and measures scarcity, though some of the responses added the need for stocks to be measured to give a better picture of scarcity.

5.2.3. Effects of Resource Scarcity on the Economy

With their views and perspectives of the measurement of scarcity established, the researcher wanted to find out if they saw natural resource scarcity as a threat to the economy given their definition and measurement of resource scarcity. All the interviewees agreed that resource scarcity was a threat to the economy, even those who initially believed resource scarcity didn't exist and wasn't a problem.

Respondent A addressed the question of resource scarcity being a problem to the economy with reference to a particular commodity;

"there's always a particular commodity, that their scarcity is quite problematic, there would always be situations where a particular type of scarcity is causing a problem somewhere in the economy… it would be a major trouble for any economy"

Respondent B was more elaborate, arguing from the perspective of economic production and how resource scarcity could be a problem to the economy through that interface;

"Absolutely, well, for a number of reasons, if you talk about raw material scarcity, it's a threat because obviously the economy relies on production, production relies on a number of raw materials available, if those resources are not available and no replacements found, then those production routes will diminish"

He then goes further to argue that the threat to the economy would differ is the economy had a circular model or a circular economy;

"if we talk about models like the circular economy, then scarcity would be less of a threat because you then have a more regular supply of raw materials through recycling, but on the current model, it (scarcity) is a huge threat."

The above argument was supported by respondent C, who asserts that it would affect the economy through the lack of raw materials

"Absolutely, you can't have economic growth without raw materials to support that growth particularly in emerging economies"

Some responses were tied to a particular resource, like the statement made by respondent E about the threat of scarcity to the economy;

"yes it would be a threat because clearly the market mechanism tends to drive the way things work and the risk with carbon, the externalities around carbon would be a potential threat to the economy"

Respondent G had this to say about the effect of resource scarcity on the economy in general;

"yes it is a threat, the effects it may have at different times in relation to different resources as well and also depends on the economy especially if it's going through a recession. If there is a big decline in demand for certain resources, like oil, it could affect production and so decision makers should be concerned about resource scarcity"

Respondent H on the other hand had two different views on the effect of resource scarcity on the economy, he asserts that resource scarcity could probably not be a threat to the economy in the short run, but in the long run the effects would affect a substantial part of the economy;

"Resource scarcity might not be a threat to the economy in the short run, because the supply of natural resources against short term demand, the economy is typically adjusting to take care of its self...it's just a continuation of business.
In the long run, I think you cannot get away from the fact that resources like oil can affects a substantial part of the economy, from the ability to transport goods, to extraction of more resources, so you can have a risk that stems from resource constraint that can wind over 30-50years"

Some responses assert that as resources get scarcer, they could potentially disrupt the economy, respondent I put it this way;

"Yea, I think it is, as business decisions are made dependent on these resources indefinitely, so when resource scarcity starts to bite or bite more strongly, then there is a significant disruption in the economy"

It is evident therefore that resource scarcity will affect the economy as a whole in the future, given the responses from the interviews. There is a general consensus that the effect would be through the lack of the availability of raw materials and therefore production and businesses could be disrupted, causing a slowdown in economic activity.

5.2.4. Effect of Resource Scarcity on the Finance Sector

Given their thoughts and perspectives on how and why resource scarcity affects the economy, it became imperative to dive into one of the research questions on whether resource scarcity affected the finance sector. The question was asked "Do you think resources scarcity affects the finance sector?" A variety of responses were recorded targeting various parts of the finance sector, but the general consensus was that resource scarcity affected the finance sector. The following responses explain why.

The response from respondent A began with a general comment on the need for the finance sector to be able to care for its staff and their homes, indicating that in the first instance the finance sector cannot be immune from such effects, then went further to illustrate the effects on the finance sector, using the insurance industry;

"If there is some sort of disruption in the availability of resources, the conversion through insurance and reinsurance industry, where insurance you have big risks derived from its relationships, which goes out to reinsurance. Also, resources like base metals, where the finance sector is an owner rather than just a broker, resource scarcity could cause the sector to suffer."

Respondent D in his explanation used the investment sector as an example;

"To better explain about the finance sector I would use the investment sector. I imagine the investment sector because depending on where their investments are, for instance if they are highly invested in raw materials and resources, resource scarcity could cause losses to their investments and a potential loss of clients"

Respondent I;

"In terms of threats to the finance sector, I suppose that would feed through the value of investments, if the invested sector is affected by resource scarcity"

Some responses, in explaining why resources affect the finance sector, brought out the reliance of the finance sector to the economy as a whole. One of such responses is Respondent B, who linked the effect on the finance sector with the reliance of the finance sector on the economy;

"The role of the finance sector is effectively dependent on the economy as a whole…if you look at the finance sector in terms of asset management part of it, which relies on the production economy, if the production economy is threatened by virtue of reduced availability of resources, then the finance sector would be threatened"

Another of such responses was made by respondent C, who reiterated that the finance sector is driven by the real economy and thus would be affected if the economy as a whole is affected;

"Well it (resource scarcity effects) has a knock on effect into the finance sector. The finance sector is quite still predominantly driven by the real economy, if the real economy is affected the finance sector would be affected and vice versa"

Respondent G followed in that line of thought;

"The finance sector is just part of the economy, obviously resource scarcity is going to affect the value of its investments and could affect the financial stability of most businesses"

Respondent F agreed that resources scarcity affects the finance sector on a daily basis, but completely refutes the fact that is could cause a financial crisis and considers it simplistic;

"Resource scarcity affects the financial sector every single day, always have done always will do, but I think that the narrative that resources are running out and it would cause a financial crisis is highly simplistic and flawed"

5.2.5. The Part of Finance Sector Most Vulnerable to Resource Scarcity

It is apparent, from the above mentioned and analysed theme, that the respondents had a particular part of the finance sector in mind when trying to explain how it would be affected by resource scarcity. It was now important to be able to get their detailed view on what part of the finance sector they believed would be most affected by resource scarcity (and least affected), to be able to establish in the next theme the probability of a systemic risk in the finance sector and from which part the risk would begin from. The respondents had divided opinions on which part was affected most and in what time frame, long term or short term. The

banking sector was identified by a few for short term vulnerability, while pension funds where identified for long term vulnerability. A slight majority however, identified the insurance sector as being most vulnerable due to its day to day transactions, though there was still a division in opinion concerning long and short term scenarios.

Respondent A is one of the advocates for insurance being most vulnerable in the short term, while pension funds are least affected in the short term and most vulnerable in the long term. This was reflected in his statement;

"Insurers are quite affected a lot, …. particular short periods of time, that is a resource problem the insurers are in a hook for it. For very long term stuff, then it would be more pension funds. This is because they buy assets that would generate a real return over long periods of time, so if there is a catastrophic global scarcity, a lot of corporate pension schemes would struggle from such risks"

Respondent B also followed in that line of thought and went further to opine that banks and investment banks are not as affected and asset management was also vulnerable given its dependence on the production economy;

"I think banks in terms of their savings and investment role is not as threatened, as it's not directly affected by scarce resources, and investment banking not threatened as it generates funds through the provision of services and transactions. However, insurance is threatened by resource scarcity because our increase in use of resources (fossils fuel) could increase the risk of climate change and damages that insurance companies will have to pay either in reinsurance or claims."

Respondent G also agreed that insurance could be affected in the short term but would be more indirectly affected by resource scarcity than they would be directly affected and also asserted that their investments could be affected directly both in the long and short term. He/she added in their final comments that pensions were concerned about resource scarcity in the long term while banks were concerned in the short term.

"I suppose the insurance sector is concerned by insuring risk on a year by year basis and their investments can be shorter term than others, but you can say they are less directly affected than they would be indirectly affected by resource scarcity through the level of economic activity….

things like pensions, it's obvious where it becomes a concern because they are very long term, whereas banks are short term"

Respondent I had a different opinion and stated that general insurance is less vulnerable to resource scarcity than the rest of the finance sector. The main focus of his argument was that pension funds and their investments were more vulnerable in the long run.

"...sort of which bit of the finance sector is most hit, I would say institutional investors like pension funds. Pension funds pool assets in order to pay pensions in the future, these assets are invested at market value, and they could either grow up in value or not due to resource scarcity.

I suppose there are parts of the finance sector that are independent from resource scarcity like general insurance, where they got a much shorter time in investments and deal with cash like ventures and so might be less vulnerable."

Some respondents on the other hand believed that banks were more at risks in the short term and if pensions and insurance were ever vulnerable to resource scarcity it would be in the long term. Respondent H, expressed this opinion in his statement;

"Pension schemes and insurance companies do not recognise long term risks caused by resource scarcity, not yet.... The banking sector is probably more at risk, as they are more short term, and even when the route from resource constraint to risk is when problems are long term they are materialised by short term periodic shocks to the system, so the banking system is at greater risks."

A similar view was expressed by respondent E when he asserted that;

"in the banking sector, the risks from resource scarcity would be shorter term, because in general terms banks often do financing for limited periods. Pension schemes as long term savings institutions, are really subject to risks on the longer time frame."

Respondent C had a difference in opinion concerning banks, when he stated that banks may not be very affected because resource risks may just make up a small part of their balance sheet;

"I would say the banking sector may be affected indirectly through the financing of industries related to natural resources, but given how large these institutions are, resource risk is not a predominant risk in their balance sheet and can't affect the scheme of things."

While respondent D summarised his/her view thus;

"as regards the scale of the vulnerability to resource scarcity, insurance companies are probably at the bottom of the scale, investments at the top and banks and everything else in the middle."

In a nutshell, the general opinion from the majority of responses is that insurance would be most vulnerable, either in the short or long run, which is closely followed by banks being most vulnerable in the short run and pensions in the long run. These opinions validate most of the quantitative results which have been discussed in the previous sections and would be compared side by side in the next section. However, it is interesting to note that the response on the vulnerability of these institutions varied according to the job titles of the interviewees and the institutions they worked for. Below is a table showing the job titles and response on which institution the interviewee identified as most vulnerable to resource risks. As can be seen all individuals identified a sector other than their own as most at risk. This could indicate that individuals believe there is a real risk but struggle to identify its direct impact. Additionally, it could indicate that the risk is not well managed anywhere in the finance sector as no one takes ownership of the risk which would make the finance sector more vulnerable to any systemic exposure to risk.

Table 30: Interviewee Response on Institute Vulnerability to Resource Risks

Job Title	Vulnerable Institute
Insurance and pensions analyst	Not Pensions
Bank Risk Analyst	Insurance
Bank Risk analyst	Not Banks
Environmental Economist	Banks
Insurer and pensions	Not Insurance
Insurer	Banks
Long Term Savings Expert	Banks
Environmental Investor	Insurance
Pricing and risk analyst	Insurance

5.2.6. Systemic Risks

One of the objectives of this research is to find out if resource scarcity could cause a systemic risk in the finance sector. In order to fulfil this objective, it was imperative to find out if the respondents believed the finance sector was interlinked, which could indicate the possibility of risks being transferred from one part of the sector to another.

A majority of the respondent agreed the finance system was interlinked but some disagreed that resource scarcity could cause a systemic risk in the finance sector.

Respondent I was of the opinion that the financial system was interlinked and complicated and could cause systemic risks;

"The financial system being a bit complicated and interlinked, I think it could cause systemic problems in the economy due to resource scarcity, it could have a knock on effect on everything due to its interconnectedness."

This opinion was supported by respondent H, whose perspective was reflected thus;

"All parts of the finance system are interlinked and could be argued that one part could be more at risk which could cause the system in its entirety to become vulnerable tor resource risks"

Respondent C had an affirmative view regarding systemic risks;

"Absolutely, resource scarcity could cause systemic risks in the finance sector and the global economy"

Respondent F, on the other hand disagreed that resource scarcity could cause a systemic risk in the finance sector;

"I think that the narrative that oh, resource scarcity would hit the financial markets and cause systemic risks is a low narrative unless it takes into account extra factors."

The aspect of the financial system being interlinked is generally accepted, but the view that resource scarcity could cause a systemic risk in the finance sector is not yet generally accepted. This risk may be exacerbated because most institutions do not regard themselves as vulnerable to such risks (see Table 30) making the finance sector more exposed to systemic risks from natural resource scarcity.

5.2.7. Resource with Highest Potential of Effects

After having established whether and why resource scarcity affects the economy and finance sector, it was important to determine, from the perspective of the interviewees, the resource which had the highest potential of causing hard hit effects on the finance sector if they eventually got scarce. They were to determine between three resources (oil, food and gas) which of them could affect the finance sector badly.

The main opinion was that oil had the highest potential to cause economic and financial uncertainty and crisis, if it got scarce, because of the heavy reliance on oil for daily living (production, transportation, heating), while food scarcity on the other hand could cause social unrest and political instability.

Respondent I encompassed this opinion in the statement made that all three resources could have high potential effects at different times and in different ways;

"we are very dependent on oil for all sorts of things particularly petrol and there could be various economic and financial disruptions if petrol prices change drastically because of resource scarcity. Food scarcity would manifest itself differently through social unrest if people are faced with high prices. I think out of the three, oil has the highest potential for disruption."

Respondent B's perspective supported this view when he stated that;

"food scarcity causes political and social instability, while oil and gas produce more direct economic uncertainty, this is because very few sectors can function without energy... oil and gas then would be a greater threat to the finance sector and the economy."

Respondent D's response was simple and straight forward, indicating oil had the highest potential to cause effects in the economy;

"I guess oil, probably, oil is used a lot more that could have more of an impact and be more of an issue"

Respondent C gave his response and explanation in terms of short term scarcity;

"For the finance sector I would say oil. In terms of short term scarcity, I would say food is incredibly important.... Oil shortage could drive a massive slowdown in the global economy whereas food shortages cause social unrest. In a macro sense oil is of utter paramount importance to the global economy and the finance sector."

Respondent G shared the view on food scarcity being important in the short run when he stated that;

"It depends on the level of scarcity, food is obviously an issue because of economic shocks, in terms of prices which could affect poorer parts of society. When the economy is running out of oil and gas the prices fluctuate, which could affect the economy whereas with food you can get problems from year to year and world grain prices could cause an inflationary impact on the UK."

Respondent F was of the opinion that it depends on where the resource shock was coming from;

"Anytime you get a shock in the system, it's always a problem, so if that's a shock from food, oil, gas or whatever, that's always going to cause a shock whether each one will cause a shock it's difficult to ascertain."

Respondent H's view was that the three resources are dependent on each other and it is difficult to determine which of them had the highest potential to cause risks in the finance sector, this was reflected in his statement that;

"The financial system is more dependent on energy than it is on food and oil, I think is a main contributor of the production of food, I think the three select resources one dependent on others, you can't say the financial system is dependent on one rather than the other"

Though there were slight differences in opinions and perspectives, the majority claim was that oil had the highest potential of causing an economic and financial disruption, while food caused more social and political unrest.

5.2.8. Politics Versus Natural Resource Scarcity

The finance sector, particularly in the UK, is influenced to some extent by legislation and regulation such as BASEL I, II, III, and Solvency I, and II. It would be worth noting that both politics/legislation and policies/regulations are regarded as "politics" in the context of this research and interview. Politics includes the bigger picture where legislation regarding the administration of the entire economy, as well as social and international relations were taken into consideration and policies just looks at the regulations pertaining to the financial sector only. It was necessary to find out, from the perspective of experts in the sector, if politics had a bigger influence in the performance of the finance sector than resource scarcity, to be able to ascertain the weight and attention given to resource scarcity as an important factor and a potential risk by the finance sector itself. So the question was asked; was the performance of the finance sector largely driven by political reasons than by resource scarcity? When asking the question, political reasons were discussed first to ascertain if the legislation on the whole economy (agriculture, manufacturing and other tertiary services), social aspects and international relations had a stronger effect on the finance sector than resource scarcity. Then

regulations were discussed later to analyse if they had a stronger impact on the finance sector than resource constraints

A majority of the responses reflected the fact that both political and regulatory issues were more important and had more attention from the finance sector as issues of resource scarcity, climate change and sustainability have not yet gained solid grounds in importance in the finance sector, as their thoughts and actions towards such issues were still premature.

One of the respondents to completely assert that politics had more influence was respondent C, who said in his statement;

"I'd say the answer is yes. The finance sector like banks and insurance companies have their future hugely being shaped by the regulation that's coming in and has come in and is due to come in. that's political, some people call it political meddling, political involvement for the better of society or so, so absolutely yea, at the moment politics plays a larger role."

Respondent I, linked the response to self-interest when he asserted that;

"I think political reasons do have a strong influence in the finance sector, especially if people are acting in their own self-interest."

And respondent G believed that

"It is more political than strategic. I think the finance sector has been hugely affected by political action for over the last 20 years, there have been huge changes in the regulations or lack of regulations, so political issues at the moment have more influence than resource scarcity"

Some responses were linked to the banking sector and its recovery from the financial crisis due to political intervention. Respondent E and B expressed their views in their responses respectively;

"The banking sector, since the financial crisis has been subject to political intervention, so in a sense, this political intervention would be breaching resource scarcity…. however, resource scarcity sits within the economic system which is obviously framed by the political system."

"Banks have received strong political support after the crisis, or many of them would not have been in existence… I think in the short term, political reasons have a greater influence, but in the long run, resource scarcity would have a much greater impact, as it can undermine any sector."

According to respondent H, the finance system doesn't really think about issues of resource scarcity and thus is undermined in favour of politics and other reasons;

"Resource scarcity is a risk that some appreciate but that's probably a significant minority, the finance system doesn't recognise issues of resource constraint and the impact of sustainability, but is more politically aware."

Respondent A believed that resource scarcity and political reasons for the finance sector could mean the same thing or work together;

"They (resource scarcity and politics) can often be the same thing, it can be a political or geo-political factor that causes resource scarcity"

Respondent F summarised his view the following way;
"The finance sector is driven by power and closely controlled, yea, we are political animals"

Some were of the opinion that the finance sector is neither driven by politics nor resource scarcity and it was driven primarily by profit and money, this was reflected in respondent D's response;

"The finance sector is primarily driven by profit and money…politicians fundamentally at the end of the day care about what the financial institutions could give in them in the form of money"

The main perspective and overall opinion is that the finance sector is more influenced by political reasons than resource scarcity, which could undermine the importance of resource scarcity risks in the risk management portfolio of financial institutions, as the issue of resource scarcity and sustainability is barely recognised as important and vital in the finance sector.

5.2.9. Financial Regulation's Role

The issue of financial regulations came up a few times when asked about the balance between the influence of politics and resource scarcity in the finance sector. It was therefore important to delve further into their opinions and perspectives about the how these financial regulations could affect the way resource scarcity affected the finance sector and how it could help (or not help) the finance sector respond and/or recover from the effects of resource scarcity. The general response was that the financial regulations had little or no impact on the way resource scarcity affected the finance sector and therefore could be of little help in the response and/or recovery of the sector to such effects. The main reason was that resource scarcity was not considered when such regulations were made.

Most of the responses indicated that financial regulations impacted on how resource scarcity affected the finance sector, as it is not considered when making the regulations thus making the finance sector "blind" to such risks, actively ignoring their existence and therefore increasing its vulnerability. Respondent B kicked off this view in his statement;

"I don't think they (financial regulations) do have an impact on the finance institutions ability to manage resource scarcity. I don't think they include that in their thinking…. I don't think that those regulations are in anyway explicitly acknowledging the need to address resource scarcity which is a blind spot, similar to the way the financial crisis was driven by another blind spot… in terms of resource scarcity and climate change, there is a blind spot and there is far too limited awareness on that issue"

Respondent I supported this view when he asserted that the finance sector was blind to resource risks due to the failure of regulations to include such risks in their rules;

"In an indirect fashion, the regulations in place doesn't encourage people to think about the impact of resource scarcity and in some ways encourage people (finance sector) to be blind to such risks. In terms of recovery from such risks the regulations don't help much as there is a lot of herding where people are reluctant to take risky actions out of the norm"

Respondent H followed in that line of thought linking it to the duration of risks considered by these regulations when he stated that

"I can't say financial regulations have any meaningful impact when it comes to resource scarcity. These regulations consider risk that might emerge over 12 month periods but actually you have risks that exists over decades"

Respondent G agreed that regulations could affect the way resources affect any sector, like agriculture but expressed the lack of resource scarcity recognition in such financial regulations;

"I suppose such regulations are not really in the finance sector, there is no sign of regulation in the finance sector which relates to resource scarcity in full term."

In terms of recovery and response of the finance sector, respondent A believed that these regulations made it difficult for them to react quickly to such risk;

"If anything it's probably the opposite, so the rule set up by banks, for their inventories and investments when they put a cap on it becomes expensive for them to do it (recover)… I don't think resource scarcity is the main concern of regulators when they are setting such rules"

Then went further to conclude that
"In any case the existence of rules means they absorb risks"

Respondent C came up with the same conclusion after stating that;
"I don't think the current regulations have that (resource scarcity) in mind, no they are designed in making sure that there's not a huge systemic risk within the finance sector…they are making institutions increase their capital base to be capable of withstanding severe shocks"

Respondent D commented that regulations haven't changed anything much fundamentally for decades nor have they prevented the emergence of crisis in the past;
"Regulations at the end of the day is not driving a hell of a lot on what people do or don't otherwise we wouldn't have had the financial crisis… finances globally have been regulated for over 20 years, there have been changes but the fundamentals have hardly moved"

This final response summarised the perspective of respondent E and a majority of the other respondents;

"I believe that good regulation causes good behaviour and bad regulation brings bad behaviour."

The general consensus is that the present financial regulations cannot influence the way resource scarcity affects the finance sector nor can it help the sector respond or recover quickly from such risks. This is because these regulations have not yet considered resource risks as vital therefore causing the finance sector to be blind and vulnerable to such risks. However, it is believed that these same financial regulations may, in the long run, indirectly make the risks of resource constraints more exposed to the finance sector.

5.2.10. Legislation Versus Financial Regulation in Resource Risks

Given the fact that it has been established by the above responses that political reasons have a greater influence than resource scarcity in the finance sector and that financial regulations had no impact nor help in the effect of resource scarcity, it was now imperative to find out if, from their perspective, legislation, both national and international, had a greater influence on the exposure of the finance sector to resource scarcity than financial regulations would. This was to determine whether in the "political" realm legislation had more power than financial regulations in the finance sector. A majority of the respondents preferred not to answer and asked to think about it for later, and some just didn't have a definite answer for this question. However, a few respondents had opinions on this issue.

Some of the respondent agreed that national and international legislation had a greater influence to the exposure of the finance sector to resource scarcity than financial regulation would. Respondent G had this to say;

"Yea, in the UK we are affected by regulations coming from the European community and they have an effect. The European Union has developed a number of regulations which recognise the problem of scarcity and thus rules about recycling have been put in place, and they don't generally relate to the finance sector"

Respondent C supported the notion but claimed natural resource scarcity was more of a social issue;

"I think so, because natural resource scarcity is more of a social issue rather than a purely financial issue, so I think legislation and government regulations would have a better impact than financial regulations. Regulators in the finance sector only regulate the finance sector while the government and international bodies consider the wider picture which include other sectors which could protect and/or expose the finance sector to resource scarcity"

Respondent D just stated clearly;
"I think national regulation will have an impact"

Respondent H had a different view, refuting the idea that national and/or international legislation had a greater impact
"I would say no, I guess sort of the impact of the financial regulation have a greater influence unless these legislations specifically address the issue of resource scarcity."

Based on the above responses, national and international legislation do have a greater influence than financial regulation on the exposure of the finance sector. This is because they believed these legislations capture the bigger picture of which the finance sector is part of, while the financial regulation just handles the finance sector only.

5.2.11. Summary of Qualitative Findings

The findings of the qualitative analysis are summarised according to the themes as follows;

- **Natural Resource Scarcity;** Natural resource scarcity exists
- **Measurement of Resource scarcity;** measured by both price and stock on the ground.
- **Effect of Resource Scarcity on the Economy;** can affect the economy especially through lack of availability of raw materials for production
- **Effect of resource scarcity on the finance sector;** affects the finance sector especially through investments
- **Part of the finance sector most vulnerable to resource scarcity;** Insurance would be most vulnerable in the short term and long term, banks vulnerable in short term and pensions less vulnerable in short term but is in the long term

- **Systemic risks;** Though generally accepted that the finance sector is interlinked and vulnerable to systemic risks, the potential of resource scarcity causing such risks is not yet generally accepted.

- **Resource with highest potential of effects;** Oil had the highest potential for hard hit effects on the finance sector and economy

- **Politics versus natural resource scarcity;** Political reasons have a greater influence on the performance of the finance sector than resource scarcity

- **Financial regulation's role;** Regulations have an impact on the effect of resource scarcity in the finance sector, as it makes the finance sector more vulnerable to resource risks and is of little or no help in its quick response and/or recovery to such risks

- **Legislation versus financial regulation in resource risks**; National and international legislation have a greater influence on the exposure of the finance sector to resource scarcity than financial regulation itself.

Both quantitative and qualitative results would be integrated and discussed in the next chapter, bringing out their areas of confirmation, validation and contrast (if any). This would follow on to a discussion and explanation of these results in line with theory, empirical literature and current events, bringing out its implications to the various stakeholders directly and/or indirectly involved.

Chapter 6. Discussion of Results

6.1. Introduction

It has been identified earlier (chapter one), that very little has been done on the potential of resource scarcity to affect the growth of the economy, especially the finance sector in the UK. Not enough thought and analysis has been given to the risks of resource constraints on financial institutions in the UK, given the fact that scarcity in resources could have the potential to have a significant effect on the finance sector such as; insurance companies through an increase in the cost of claims for affected parties, underwriting risks and risks on investments. Banks on the other hand are vulnerable to the effects of resource scarcity such as inflation, causing risks such as credit risks and investment risks. Thus the main issue of concern or problem statement of this research has been to find out if resource scarcity affects the finance sector, how it does affect the finance sector and why.

These concerns led to some objectives, which aimed at addressing such concerns, targeting finance institutions like insurance, pensions and banks. The objectives were;

- Examine and determine how and why resource scarcity affects the insurance sector
- Identify and investigate potential risks on banking activities as a result of resource scarcity
- Investigate how resource constraint affects pension funds and the risks involved
- Identify and examine the potential systemic risks in the economy through the finance sector
- Examine and evaluate how financial regulations could impact on the performance of the finance sector in the event of resource scarcity.

The research methodology encompassed both quantitative and qualitative analysis to be able to answer the research questions and attain the objectives. Quantitative methods answered the questions on if and how resources affect the finance sector and qualitative methods answered questions on why resource scarcity affects the finance sector. The results of both analysis, complemented and validated each other and will be discussed accordingly.

Thus this chapter is aimed at discussing the results both from the quantitative and qualitative results and aspects, bringing out their areas of validation, confirmation and contrast and also relating the findings back to literature. This will be done for each of the financial institutions under study (Insurance, pensions and banks), which will further encompass the research

question and objective for each institution on how and why each of the natural resources (oil, food and gas) affect these institutions. The discussions will also determine whether the research questions were answered and if the research objectives were attained.

Natural resource scarcity, especially oil, could have cascading effects in the economy, having macroeconomic systemic risks (Jimenez-Rodriguez & Sanchez, 2004) which could therefore affect the finance sector through contagion and speculation. Empirical and theoretical literature have identified a link between oil and GDP which cannot be ignored. Because oil prices are part of and affect almost every part of the production process in an economy, its impact on GDP is therefore significantly linked. This makes the direct impact of oil on financial institutions slightly difficult and can only be examined through impacted economic lines and activities. On the other hand, prices of these resources could also have direct impacts on individual financial institutions (businesses) and consumers as well. As a result, this chapter would discuss findings and at the end bring out the indirect impact, through macroeconomic risks, and direct impacts to businesses and consumers.

6.2. Insurance

Research Question;

"What is the effect of resource constraint on insurance? Are insurance companies affected directly by resource constraints through its stock availability and market prices (investments) or indirectly through insured parties?"

Research Objective;

"Examine and determine how and why resource scarcity affects the insurance sector"

Hypothesis;

H_2; Resource scarcity negatively affects insurance performance

Theory, empirical literature (Ceres, 2011; Mills *et al.,* 2012; Stausboll, 2012; Leurig & Dlugolecki, 2013) and the conceptual framework of this research depict that natural resource constraint has a negative impact on the performance of the insurance sector, be it from its increasing costs on claims and/or from its low investment returns.

The quantitative results show that only food and oil prices had a significant effect on insurance investment holdings in the UK, and oil and gas had a 10% and 5% significance on insurance investment income respectively, during the period 1983-2013. On the other hand,

the cost of claims incurred by these insurance companies, both in the UK and abroad, were to an extent affected by some of the resources. For instance, motor insurance claims both in the UK and abroad were significantly positively affected by gas prices, while health insurance claims were positively affected by increasing food, oil and gas prices but reacted more significantly to oil prices. Property insurance was not significantly affected by any of these resources. These quantitative results were validated by the qualitative results which showed that the insurance companies could be affected by resource constraints, especially on its investment income. Little was said about insurance claims being affected, but there was an indication, by some of the respondents, that insurance claims could be affected by scarce resources, which confirms the quantitative results on that part. The outcome of the interviews also specified that insurance, especially its investments are more indirectly affected by resource constraints through economic activity than being affected directly. The results on claims being affected by resource scarcity supports studies carried out by Haufler (2006), Hetch (2008), Gardiner *et al.,* (2012), Mills *et al.,* (2012), Leurig & Dlugolecki, (2013) where the effect of resource constraint on insurance was investigated and the general consensus was that the scarcity of resources is of high risk to the insurance sector, having financial consequences on the insuring of risks for businesses and individuals. For instance, insuring risks for businesses on product lines, supply chain constraint and/or failure and default in contract terms due to a resource constraint consequence, of which a typical example could be high oil prices. Risks on individuals could be increase in health insurance claims and motor insurance.

It would be expected, from theory and empirical literature (Dlugolecki (2008); Young *et al.,* (2009); Leurig & Dlugolecki, 2013) that the investments of insurance companies in the UK would be adversely affected by resource constraint, but it is not entirely the case in this research, from the quantitative perspective, as increases in oil and gas prices/barrel have a less significant effect on investment holdings and income than expected. One of the reasons for this less impact could be the fact that UK insurance investments have been highly geared towards government bonds, which have fallen from 25% of insurance investment in the 1980s to about 15% in 2011(City of London Corporation, 2011). This is also evident from data on insurance investment holdings which is made up of British government bonds, corporate bonds, public sector debt securities, loans and rents on property, all of which were affected insignificantly by increasing international food and oil prices, in the past during the time frame of the research (1983-2013). Although corporate bonds could be more affected than the others, it would not be significant enough to create a major impact on the rest of the holdings. Also, UK Insurance has a large amount of fixed income instruments and less investment abroad than pensions, to

be affected by rising prices of natural resources (City of London, 2011). Given the fact that most of the investment holdings owned by UK insurance companies both in the UK and abroad, are long term and illiquid in nature, the effect of the increase in prices of resources have to be long term in nature to be able to significantly impact investment income. This is consistent with the study done by Sukcharoen et al., (2014), where they recorded an insignificant relationship between oil prices and the prices of stocks and bonds in the US. Recent events in the oil and gas industry in the first quarter of 2016 emerged, where investments in the North Sea oil were expected to fall by 90% later that year due to the falling prices of oil (huge cut of 70% of oil prices since mid-2014) and the forced cut in the cost of production of oil from $29.30 in 2014 to $21 a barrel in 2015, according to the Telegraph Feb 2016 report by Ambrose, J. As a result, this poses a risk to businesses and a personal cost to consumers as they will be both affected by supply chain constraints and job losses due to this fall in investments and fall in demand for goods and services. This fall in investments could be reflected in oil and energy related projects being postponed and/or cancelled which would further bring down income and premium rates for insurance companies and also discourage new investments. Insurance investment income and holdings may be insignificantly affected by such events (given quantitative results) but may be significantly affected indirectly (as indicated from interviews with some actuaries and insurers) where these fall in investments could pose a systemic risk to the financial system and economy as a whole. Reflecting back on investment theories in chapter 2 (section 2.4.4.1), where the Modern Portfolio Theory, CAPM (capital asset pricing model) and the EMH (efficiency market hypothesis) all emphasise the risk averseness of investors except when they are ready to face high risks for high returns. The fact that resource scarcity risks are very oblique and unclear to the insurance sector, it would be difficult to be prepared for such risks in their investment portfolio and as such extreme cases of resource scarcity could adversely affect their portfolio returns.

Health insurance claims have been on the steady rise since 1999, with insignificant decreasing levels around 2005 and 2009. This rise in health claims could be accounted for by increasing food, oil and gas prices, as the quantitative results indicates, but it is equally important to note that the UK ageing population increases the volume of health claims as more health care is needed and provided by and for its population and thereby an increase in health insurance possession by the ageing population and also a significant portion of the adult working population (HM Treasury, 2013). The increase in the price of oil, which could be used in the production of food, leading to increase in local food prices, which are essential to a healthy diet is bound to increase health insurance claims. Healthy meals become increasingly expensive

and easily substituted for "artificial", "fertilised" canned and processed food which cause health problems, such as food poisoning, unhealthy weight levels (obesity) and even cancer (Kushi et al., 2012), increasing health care costs, thus health insurance claims as well as an increase in life insurance claims. Oil prices as well, both in the long term and short term, could affect household heating levels, as many individuals ration energy levels and end up not having adequate heating, this causes severe health issues like pneumonia, increasing health care costs (Price Water Coopers, 2002). One of the direct responses to oil price increase and volatility, is declining consumer demand which reflects levels of uncertainty towards the flow of individual income. As a result, many consumers change their diets to lower quality products or "almost expired" products on sale which could cause health issues and increase in health claims costs for insurance companies.

Motor insurance claims both in the UK and worldwide, are significantly affected by oil and gas prices. UK insurance companies, are mainly significantly affected by gas prices according to the quantitative results. However, given the fact that there is no direct link from natural gas to transportation and car use in the UK, results on natural gas impact on motor insurance claims may be attributed to coincidence. Even though natural gas is used as fuel to some vehicles (natural gas cars), these cars are not readily available in the UK due to its high cost of maintenance. And a main barrier to the use of natural gas for fuel in the UK, is the limited number of publicly accessible gas re-fuelling stations in the UK which is currently less than 15 (Lane, 2016). As such the direct link from natural gas prices to car use and therefore motor insurance is difficult to pin point. However, the link between natural gas prices and motor insurance maybe indirect. An increase in natural gas prices, maybe a trigger to a series of events and/or factors which could increase the volume of insurance claims. Such factors or events could be through general increase in prices (inflation), where an increase in natural gas prices could affect the purchase of vehicles, due to constrained income and also increase fuel prices, which could potentially impact on car use and volume of insurance claims. Petroleum fuels used by most cars are made up of crude oil and liquefied natural gas, but liquefied natural gas is very tiny and/or almost not noticed in the UK, and thus its impact on car use and motor insurance would be insignificant. Another indirect link, which could be attributed to coincidence, could be the increase of natural gas prices during the winter reflected in increased heating bills, which could coincide with bad and slippery weather conditions for driving, increasing the number of accidents and thus increased the number of insurance claims.

Oil prices also significantly affect motor insurance indirectly, through its effect on the general price levels, affecting fuel prices in the medium term and also having an impact on car prices, thereby reducing the volume of cost of claims. The impact of crude oil price increases on fuel prices, would be more significant than the impact of natural gas prices, due to the larger impact oil prices have on the economy as a whole. As such impacts of the increase in oil prices would have a much more immediate significant impact on fuel prices in the UK. Motor insurance claims have been on the rise and according to ABI (2014), the UK motor insurance market made a loss of over £53 million in 2013, with the average cost of claims being £2,767, and had its last profit (premiums higher than claims) in 1993. It is also asserted by ABI, that the average motor insurance premium has been on a decline since 2012. Low fuel prices, due to a fall in oil prices, could increase cost of car insurance for insurance providers as there could be an increase in accident claims as a result as people drove more and faster; this was an assertion by an article published by the Financial Times by Rovnick, N (March, 2015), also indicating that share prices of the providers of UK motor insurance fell by 9% as a result of higher accident claims which coincided with lower fuel prices. As a result, if fuel prices reduce further, insurers would have to increase motor insurance premiums to curb losses incurred from these increased accident claims.

Property insurance claims for UK insurance companies are not significantly affected by the scarcity of resources such as the increase in the price of food, oil, or gas. This may be due to the fact that property insurance claims are often, if not totally, related to reasons such as; weather conditions (rain, snow, and flood), fire, theft, accidental damage, vandalism and other domestic accidents. The property insurance market recorded a profit of £930 million, with insurers paying over £11.1 million a day in insurance claims (ABI, 2014). Property insurance claims may be affected indirectly by scarce resources through inflation, affecting the overall costs of property maintenance and damages, and increase in energy (oil and gas prices) could cause excessive rationing by homeowners on heating and this could cause damages to the property, increasing insurance claims, though such increases as a result, may not be significant.

Claims for miscellaneous and pecuniary losses are mainly significantly affected by oil prices; an increase in oil prices increase the cost of claims for these losses. This is very peculiar for worldwide claims incurred by UK insurance companies. A reminder of the fact that miscellaneous and pecuniary losses encompass insurance on assistance, creditor, extended warranty, legal expenses, mortgage indemnity, pet, other personal financial loss, fidelity and contract guarantee, all 'bond' business, credit, suretyship, commercial contingency, trade

indemnity, special indemnity, licence business. Given the fact that oil is the main raw material in production, an increase in its global price could cause industrial production to decline in response, corresponding to a fall in consumer demand and general economic uncertainty. This brings along a decrease in investment in the short term and increase supply side inelasticity in the medium term which could cause inflation for consumer goods. This fall in production and investment could lead to increase in cost of claims for creditors, legal expenses, commercial contingencies, contract guarantee, if certain contracts are not met on time. Business licenses too could suffer, if businesses do not perform as expected due to oil price induced inflation which could in turn increase the cost of claims on such insurance lines. Food prices could also increase the cost of claims for other insured lines could be affected like product recall insurance. In a nutshell, these encompasses all other insured lines that could be directly or indirectly affected by increase in the price of resources.

Some insurance companies also carry out "non-traditional" insurance activities which further exposes them to resource risks, especially if such risks are reflected in increases in food and oil prices. Such non-traditional insurance activities could be lending securities to other financial institutions such as banks and/or financial houses, financial activities that are out of the licensed insurance category, shadow banking (imperfect transfer of credit risks) securities and mortgages (IAIS, 2013; IAIS, 2015). These activities make the insurance companies, who practice them, vulnerable to risk not associated with traditional insurance activities, mainly liquidity risks, which may also lead to systemic risks (Bank of England, 2015).

Thus the findings of this research accept the hypothesis that resource scarcity affects the performance of the insurance sector in the UK, through its investments and insured parties, and to some extent through its non-traditional insurance activities. However, in the long term future, the effect on investment could be more significant due to the increased exposure of the insurance market to short and long term direct and indirect effects of natural resource scarcity, through economic activities. Also the ever increasing links within financial institutions and between financial institutions and the economy enhancing the interdependent nature of the finance and economic system also put the insurance sector more at risks as more investments projects would be created with the prospects for profits and more insured lines would and could be created, increasing the possibility of increased costs of claims. Yet, it is expected, given recent ongoing changes in regulations that the insurance sector would be more resilient to be able to cope with and curb the risks of resource constraint.

6.3. Pensions

Research Question;

Are pension funds affected by natural resource constraints?

Research Objective;

Investigate how resource constraint affects pension funds.

Hypothesis;

Resource scarcity negatively affects the performance of pension companies

Pensions, according to theory and literature are vulnerable to the effects of natural resource constraints especially oil (Jones et al., 2013). Both quantitative and qualitative results indicate that resources like oil have a great impact both on pension contributions and investment incomes, with the qualitative results emphasising effects on pension investment income in the long run.

It is evident that food and oil prices have a positive impact on pension investment income in the UK. Meaning high prices in both food and oil, could increase pension investment incomes because most of the pension schemes invest in public sector and corporate securities (quoted and unquoted) and equities. As oil prices increase, the equity markets perform better and the bond and security shares increase in value especially if these shares are tied to oil and gas proceedings (energy profits). On the other hand, falling oil prices affect pension funds' investments as oil related shares could lose value. On average, schemes have 39% of their investments on equities with 17% being UK equities and 21% being overseas investments and since the oil sector accounts for roughly 12.5% of the FTSE All-Share index, and 7.6% of the MSCI World ex-UK, total scheme allocation to energy-related stocks is around 3.7%. As a result, when energy stocks in the UK fell by over 15% in the second half of 2014, and this fall could affect UK pension investments to the tune of around 0.6% of NAV, which comes to around £7bn (Toby Nangle in the Trustee Magazine, 2015). Also in other words, the equity market would be badly affected and pension share value would fall alongside. However, the oil spill at the Gulf of Mexico in 2010, caused a panic with BP oil shares as they were expected to fall and affect pension asset share value, given the fact that BP shares were considered safe to invest in, and had been providing a robust and regular dividend. For instance, during that period, the Yorkshire public sector workers saw their pension funds take an £80 million hit

following the spill (Yorkshire Newspaper, May 2010). This therefore indicated that an increase in oil prices following the spill had a negative effect on pension investments, especially for those retiring sooner as the impact on the loss of the value of their assets would be felt immediately, compared to those who still have a couple of decades before retirement where the losses could be ameliorated by future high returns. Thus pension investments returns could go either way whether oil prices increase or decrease, depending on the cause and/or nature of the price change. Given the unpredictable nature of oil prices during the last five years and in the decades to come, longer term prospects have become uncertain and this volatility could have consequences for pension funds as their asset values of pensions could be more vulnerable than expected.

It would be worth noting that over the last decade, pension funds have invested in a wide range of asset classes and new investments, comprising mostly of overseas assets (NAPF, 2013). Between 2000 and 2010, equity allocation by the Local Government Pension Scheme decreased by 10%. And following this decrease, pension schemes have reduced their allocation to UK equities across the board. Based on investment theories, pension investors are ready to face high risks for higher returns. Investing in new asset classes, increases the range of diversification where their risks are spread through a range of portfolios and as such resource scarcity could have little or no negative impact on returns as long as the impact of such scarcity is specific enough to only affect a limited set of asset classes.

Food and gas prices also have significant effects on pension investment income, and to some extent they could have an effect on pension contributions. This may be an indirect effect as such prices could indirectly affect wage levels, through inflation, which in turn affect pension contributions. But in the case of the UK, such impacts are less significant.

Pensions also run the risk of being underfunded following a natural resource scarcity crisis. For instance, if there is a potential increase in oil, gas and/or food prices which would eventually lead to inflation and high cost of living, firms and/or organisations may find themselves at the low end of their balance sheets. According to the theory of underfunding of pensions, this could lead to firms not having enough internal finance to repay its debts and loans and thus be forced to underfund the pensions of its employees and consequently low retirement pay. Not only would the insufficient capital affect employee pensions, it would also affect the level of wages paid to these employees and thus cause the living standards to fall. This will eventually cause consumer demand to fall as well, bringing down the price of commodities, leading to a fall in oil and gas prices as well, as already happened in 2014/2015. These fall in prices as earlier mentioned, is not very good news for employees and pensioners

of the oil and gas industry. This is evident from the Chronicle journal report by Tom Keighly (30th August 2015) where it was recorded that the increase in the wages of employees in the oil and gas industry fell from an increase of 5.5% in 2014 to 2.3% in 2015. Thus indicating that the impact of falling oil prices have an impact on the industry with energy companies cutting down on capital expenditure and creating cost savings strategies through large scale redundancies. It is therefore possible that the pension schemes of the industry suffer from underfunding due to scarce natural resources.

On the investment side, these fall in prices would affect most of the return on earnings of pension assets, thereby affecting future income for pensioners. In a nutshell, it is very possible that pension funds, both contributions and investments, are affected by the performance of the prices of natural resources, which are also, to some extent dependent on other economic factors. Therefore, the hypothesis on the impact of resource scarcity on pension performance would be accepted in the case of oil, which could account for the effects of food and gas scarcity in the UK economy. This is mainly because pension investments are significantly made up of oil related assets in the financial markets which are volatile and susceptible to both real information on oil prices and speculation. Oil on the other hand is very much linked to GDP growth in the UK and GDP also plays a huge role in pension contribution and investment (as seen in the results, both quantitative and qualitative). Oil prices therefore play a huge role in the performance of pension schemes.

6.4. Banking

Research Question;

  Are banking activities affected directly or indirectly by resource constraints?
Research Objective;
Identify and investigate potential risks on banking activities as a result of resource scarcity.
Hypothesis;
H_4; Resource scarcity negatively affects the banking sector

Banking sector development is expected to be negatively affected by resource constraint, mainly reflected in high prices or inflation (Boyd *et al.,* 2000). Quantitative results indicate that banking sector activities such as its lending activities, loans and credit are significantly affected by food and oil prices, with food prices being on the negative side of the spectrum. An increase in food prices therefore, decreases the amount of lending activities, loans and credits by banks in the UK, while oil prices, and to some extent, gas prices increase banking activities

with an increase in their prices. This ties in with the qualitative results which show that banks are more at risk of resource constraints especially in the short term because of its daily interaction with both public and private sectors and its savings and investments role in the economy.

Much of this reduction in banking activity is in response to the unanticipated food price fuelled inflation rates which occur after, especially if, the increase in food price was unexpected like the case of food price increase in 2008 and 2011 (Telegraph Report, February 2011). Theory depicts that increase in inflation rates drive down real rates of return which in turn lead to financial market frictions which lead to credit rationing, fewer loans being given out and less efficient allocation of resources on the part of banks. It would be worth noting that the reduction in banking activities could also be as a result of, besides the constraint in natural resources, the effects of the global financial crisis. The UK banking system witnessed a drastic drop in lending and credit activities as well as profitability, thereby reducing their liquidity levels due to the volatility in financial markets as a result of the financial crisis. One of the reasons for the fall in lending activities during the crisis was due to banks becoming risk averse thus tightening terms for loan applications and increasing boundaries between lending and borrowing (Anderson & Mulineux, 2009). This was in attempt to retain as much liquidity as possible, curb losses and maintain profitability to considerate levels, and use the retained profits to boost the capital base of the bank.

However, looking at the diagrams on food price and bank loans in chapter five, it can be seen that bank loans fell in 2008 and further in 2011 coinciding with the sharp increases in global food prices during that same period. Personal deposits also had an identical pattern to loans, falling in 2008, falling further in 2009 and rising to the 2008 level in 2011. The negative impact of food prices on credit was less significant, looking again at the graphs in chapter five, bank credit and overdraft spending did not really fall as loans did, but fell in 2009 (as a result of the major banking crisis following the financial crisis), after the sharp increase in food prices and even less so in 2011 and 2012, meaning the impact on credit was barely significant. Non personal lending on the other hand increased in 2008 and net lending fell sharply below £0 (-£95,373 million) in 2009 and has stayed below that level since then and also demonstrating no significant reaction to food prices or oil and gas prices either.

Oil prices on the other hand had a more significant positive effect on banking activities in the UK, meaning an increase in oil prices increased (personal) lending and loan activities, which is not expected both by theory and empirical literature. Quantitative results imply otherwise, showing a positive relationship between oil prices and banking activities except non personal

lending activities of which oil prices have an insignificant relationship with. Non personal lending comprise both commercial and public sector services and companies, which may not have a direct relationship with oil/gas prices, but may have an indirect relationship with such prices, through economic activities and crisis, which is evident in the surge of lending in 2008 during the financial crisis of that period, and oil price- related inflation.UK banks are one of the main investors of oil related assets and the oil and gas companies, as well, have one of the significant savings accounts in UK banks. Thus it would be possible that increase in oil prices would increase the profits of oil and gas companies which they in turn increase their savings deposits and accounts in banks, and the rate of return on energy related assets would have increased, increasing the income and capital base of UK banks. This increase in the stream of income as a result of increase in oil prices, makes more money available for banks to be able to offer loans and increase credit limits and overdraft spending, thus the increase in these activities. On the other hand, low oil prices could reduce banking activities as the stream of income both from return on oil related assets in the financial markets reduces and the decrease in profits from energy companies, and also the probable inability for these companies and other businesses as well, to pay back their loans and/or interest in credit (default on credit), could makes less money available for loaning and lending activities. For instance, the low oil prices, down by 40% since June 2014, could have impacts on financial stability and financial markets as many investors holding oil related assets are threatened and may sell off these assets if their expected return is much lower and sustained at low rates and their dividends are cut short or off completely (The Guardian, December, 2014). Consumers could be indirectly affected by these dividend cuts by companies as a bid to hold on to the falling profits due to falling prices, as their savings and pensions could be affected by this action, as they have some kind of exposure to these firms (Russ Mould of AJ Bell Youinvest, quoted in the Telegraph, December 2014, By Kyle Caldwell). This is also in line with the report from the UK government Actuary Department (2014), where they asserted that the shares in energy companies are heavily linked to oil prices and as a result, energy stocks fell as investors reacted to OPEC's decision not to impose cuts in production.

According to an article by Lee Wild (Sept 8[th], 2015) in the Interactive Investor journal, JP Morgan assert that after carrying out a harmonisation analysis of the capital ratios for 35 European banks, focusing on their capital and risk weighted assets, banks in the UK such as Barclays, Standard Chartered, HSBC and Royal Bank of Scotland (RBS) were vulnerable to market capital deficits and commodity exposure to low oil prices. According to the analysis, Barclays had £22billion of exposure at default to energy (oil & gas) and water, RBS had £13

billion of exposure to oil and gas, and £3billion to metals and mining. Standard Chartered was exposed at default to oil and gas worth over £26 billion while HSBC was exposed at default to oil and gas by £34billion. Also as earlier mentioned, the expected fall in investment in North Sea oil by 90% in 2016, falling to £1billion in 2016 from the usual £8billion a year, (Ambrose, J. Telegraph Feb 2016 Report) could also pose threats to investments returns for the UK banking sector in the oil and gas industry and also affect the flow of income form this industry to banks due to a strain in income and profits.

So the hypothesis that states that resource scarcity (as measured by price) negatively impacts banking sector performance could be rejected in terms of oil and gas and accepted in terms of food, implying oil and gas prices positively and significant affect bank sector performance. However, it would be difficult to put a fine line on whether resource scarcity affects the finance sector in the UK negatively, because so many factors are in play, which could distort and/or change expectations of such effects. Also there is the possibility that in the long term, these positive significant effects of high oil and gas prices, could negatively affect the banking sector. This could be an indirect effect through economic activities being affected negatively through inflation and affected supply and production lines. As such the asset side of the balance sheet for banks could be negatively affected in the long run as and if their investments in some economic activities and production lines are affected. Also, a fall in deposits from individuals, companies and organisations could be affected as well, reducing the volume of liquidity available to the bank. The pressure from regulations on capital and liquidity requirements won't make it easier for such banks during that period as well.

6.5. Systemic Risks in the Finance Sector

Research Question; *Are there systemic risks in the economy that are manifest through the finance sector as a result of resource constraints?*

Research Objective; *Determine if there are potential systemic risks in the finance sector through the resource constraints.*

Hypothesis; *Resource Constraint could cause a systemic risk in the finance sector*

Since the outbreak of the financial crisis in 2007/2008, empirical literature has been buzzing with the issue of systemic risk in the finance sector and its indicators. A lot has been said about the finance sector being at risk of systemic risks especially if such risks come from the banking sector. However, little or nothing has been said about natural resource constraints such as oil

and food scarcity to be indicators of systemic risks. Nevertheless, assertions with regards to oil price being the cause of systemic risks have been made recently like Tverberg (2010) in the Business Insider where she asserts that if oil supply were to decrease further in the future, there could be a systemic risk in the finance sector which could lead to another financial crisis. The quantitative and qualitative results prove this point in the case of the UK. Results indicate that given the interdependent nature of the finance system in the UK a systemic risk in the finance sector is possible. From the Granger results, it is therefore possible for resource constraint to be the cause of systemic risks if the insurance sector is affected first. To some extent also, banks could be at the fore front of such risks given their savings and investment roles in the financial system. The Granger results show that both insurance claims and investments could affect bank loans and overdraft in 1-3 years (short term), indicating that if resource constraints, for instance oil scarcity, affected the insurance sector first, then the banking sector activities could be affected as well. Also, putting banking activities at the forefront, there were fewer cases in the results where banking activities affected insurance claims in one year periods, and one of these cases was a bidirectional relationship between bank overdraft lending and cost of claims for UK health insurance, with UK health insurance effect on overdraft lending being more significant. This still to some extent indicates insurance as having a more immediate significant effect especially from its cost of claims. This could happen in the medium to long term thereby causing interest rates to increase and make consumers worst off, leading to deteriorating health, failing businesses, high costs of housing, causing insurance related costs such as high health claims cost, business failure claims and other claims from insured lines and thereby creating a possibility of a viscous cycle of liquidity and credit risk in the short term, till there is some sort of adjustment in, for instance monetary or fiscal policies, or even financial regulations from the Bank of England to curb further effects. This scenario could also be applicable if the insurance and banking sector are affected at the same time by an increase in the price of a resource like oil. Another reason why the effect on insurance is more significant and immediate in causation, could be the significant influence insurance has on economic activity in the UK, holding about £1.9trillion worth of assets in 2014 (French et al., 2015). A third reason why insurance could be more immediate in highlighting systemic risks, is the tendency of most insurance companies to carry out non-traditional insurance activities. Activities such as lending securities to other financial institutions such as banks and/or financial houses, financial activities that are out of the licensed insurance category, shadow banking (imperfect transfer of credit risks) securities and mortgages increases the interdependency between insurance and banks and other financial houses as well as the economy as a whole.

This increases the vulnerability to systemic risks as these activities themselves are exposed to both market and liquidity risks. These results support the work done by Billio et al., (2012) and Grace et al., (2013), especially when highlighting the link and interconnectivity between insurance and banks, and support the work by Cummins & Weiss (2014) done in the US with results highlighting insurance "side" activities as the possible cause of systemic risk. It could therefore be possible to conclude that the UK financial system vulnerability to systemic risk could be identical to that of the US on that note.

The Granger results also indicated, to a lesser extent, a unidirectional causality between pension investments and bank credit in the short run. The link between pension investment return and bank credit could be through the provision of liquidity to banks when such returns are deposited as savings in such banks. As such, banks have the liquidity needed to provide credit to its customers.

The effects of resource constraint on overall financial performance could be looked at on both sides of the coin. Looking at oil for instance, one of the most valuable traded commodities worldwide, its volatile prices (both high and low) have repercussions for the finance sector, causing systemic risks which could be tantamount to another financial crisis. High oil prices have effects such as fall in balance of payments, fall in company profits, debt default increases, recession which is part caused by fall in discretionary spending as consumers have to cut back on spending with the fall in disposable income and wages. One of such discretionary spending could be on buying new homes, which brings the prices of houses down. Businesses could default on their debt because of fall in profits, thus less savings in banks from these businesses and less income for banks. This increase in debt defaults, puts the whole debt system under the financial system at risk, especially the insurance sector which has most of its assets in bonds. From this scenario of debt default, insurance, investment, financial markets and banks are adversely affected, with one sector affecting the other through the contagion effect of systemic risks.

On the other hand, falling oil prices still have an adverse effect on the performance of the finance sector, ranging from banks to financial markets, to insurance and investments, reflecting the possibility of a systemic risks in the sector. Beginning from banks, a fall in oil prices could cause a strain on the lending activity of banks, as well as capital markets. This is particularly evident in banks with high loan activities with the oil sector and investment shares and portfolios with this same sector. Even banks who do not have direct loan links with the oil sector could be indirectly affected by the strain in economic and financial activity of the other banks, which in the medium to long term affect their own performance, especially through a

possible decline in consumer demand and investment. Investment banks are also dependent on revenue from the energy sector and thus would be affected by falling oil prices as such. In capital markets, equity underwriting is positively correlated with oil prices and falling oil prices could lead to a fall in short term activity in capital markets. This could follow on to affecting, to some extent, activities in the financial markets. Fall in financial activity in financial markets mean that investment returns could suffer and insurance companies could be at risk as part of their assets and investments are oil related, leading on to lower savings and deposits for banks, reduced lending and another viscous cycle continues.

The figure below demonstrates the linkages of the finance system, to which if one part of the system is affected by resource scarcity, it could intrude into other parts of the system as already discussed under the oil availability scenario above.
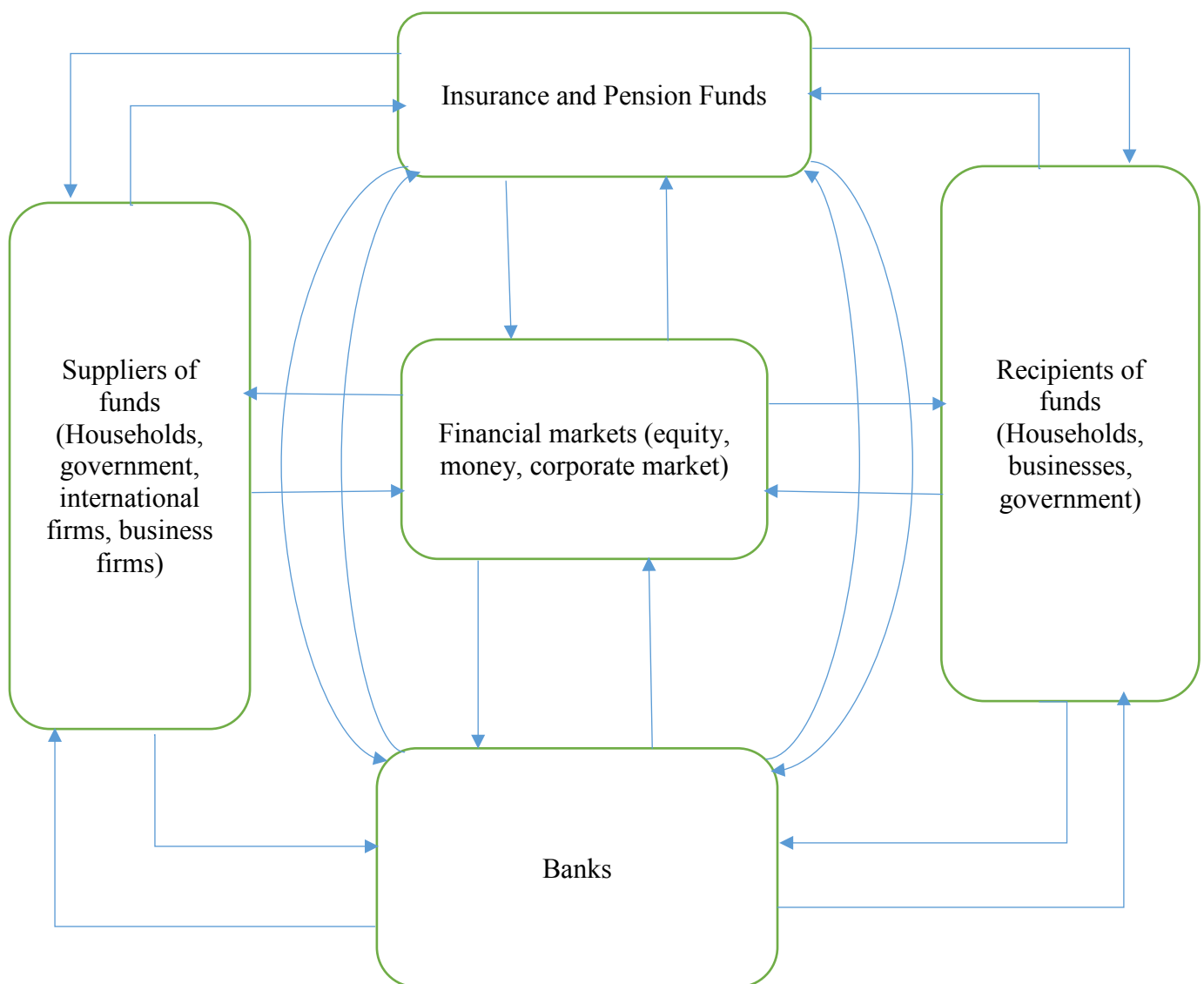
Fig. 30. Interdependence in the Finance system

From the above figure, suppliers of funds provide funds for insurance and pensions through insurance premiums, pension contributions through retirement plans, and purchase of shares in insurance companies. Insurance and pensions in turn give back to suppliers through dividends, claims on insurance, return on investments. Suppliers, who are also recipients of funds, provide cash to financial markets in return for corporate bonds, shares and commercial paper. Insurance and pensions also buy shares and bonds from financial markets. Financial markets on the other hand deposit the cash in banks in return for bank certificates of deposits. An indirect relationship between insurance, pensions and banks can be seen through financial market activities. A direct relationship between these institutions would be through bancassurance activities and deposits on the part of insurance and deposits on the part of pensions.

Thus systemic risks in the financial sector is probably unavoidable if natural resource availability occur at extreme ends of the spectrum; excess natural resources could lead to falling prices which affect the financial sector and could cause systemic effects. If the resources are extremely scarce they could affect the finance sector with their high prices and also cause systemic risks, though the links and the path to which such risks may occur differ slightly from each other at the mentioned extreme points.

6.6. Financial Regulations

Research Question; *Do financial regulations both in the UK and from abroad, have any significant effect on the response of the finance sector to resource constraints? Do these regulations make recovery from such effects easier or more difficult for the finance sector?*

Research Objective; *Examine and evaluate how financial regulations could impact on the performance of the finance sector in the event of resource scarcity.*

Hypothesis; *Financial Regulations significantly positively affects the way the finance sector responds to the effects of natural resource constraints.*

A lot has been said theoretically and empirically about the benefits and ills of the financial regulations on the performance of the finance sector in the UK. These regulations; BASEL I, II and III and Solvency I and II have been at the fore front of protecting the finance sector in

the UK from systemic risks and improving the resilience of the finance sector, setting rules encompass capital and liquidity requirements but unfortunately, these regulations, as identified by literature and the qualitative results, have not taken into consideration the risks involved with natural resource scarcity such as oil. Results from the interviews indicate that, financial regulations do not "explicitly (and directly) address natural resource scarcity as a risk, which is a blind spot". Though it can be argued that the rules on capital and liquidity requirements and risk management includes all types of risks, regardless of the source, meaning it includes that of resource scarcity, it would be difficult to pinpoint such effects as these effects could be direct, indirect, long term and short term. It is also argued, from the interviews, that these regulations could, if not already, limit the ability of the finance sector to react quickly to effects and risks of resource scarcity and thus cannot help the finance sector to recover quickly or in the short term from such effects.

It has been asserted by Morris & Shin (2008) that some of the requirements of these regulations such as the liquidity and risk-based capital requirements fail to distinguish between the riskiness of an asset and its systemic importance. It is therefore possible that risks generated from natural resources such as food and oil, be neglected despite its possible importance to the finance system as a whole, given the fact that most institutions are directly/indirectly linked to these resources; be it as part of their assets in the financial markets (especially oil) or being affected by the consequences of the scarcity of these resources in the economy as a whole.

However, Mark Carney, in his speech for the Bank of England Open forum in November 2015, declared that regulations have made banks safer, increasing capital requirements tenfold and liquidity requirements by fourfold. He also stated that the improvement of the simple leverage ratio which protects the financial system against risks "they" considered low, but are not- hopefully including natural resource risks in that category.

Given the fact that the UK financial system is crucially important to its economy (450% of GDP), being a source of employment to millions, tax revenue, and supports a large number of industries, its stability and resilience is extremely important. Financial regulations have made attempts to protect the sector from systemic risks, through financial regulators like the FPC (Financial Policy Committee) ensuring institutions like banks have the capability of absorbing their own losses and curb failure. However, according to Richard Sharp's speech at the Nottingham Trent University in 2015, the FPC came up with six top risks facing the UK financial system, the risk of natural resource scarcity was not mentioned. As asserted by one of the interviewees, natural resource scarcity is a blind spot in the face of regulation and if not

handled and taken into consideration, its effects could be the cause of the next financial crisis in the UK.

The revision of regulation in 2015/2016, may be able to protect the finance sector from systemic risks, with the requirement to hold much higher capital and liquid asset buffers, thereby strengthening their balance sheets and curbing "interbank exposure" and as such banks have better capital buffers through retained earnings and reduced leverage (Mark Carney in his Speech at the 8th Annual Institute of International Finance G20 Conference, Shanghai Feb.2016). He asserted in his speech that the banking system in the UK is fully prepared to handle two possible severe events; a UK balance of payment shock and failure from emerging markets. However, what if the underlying cause of such events are from scarcity of vital resources or if the risk of scarcity directly affects the banking and finance sector as a whole? What about other financial institutions, like insurance? It could be argued that the interdependent nature between banks and insurance could protect insurance companies from resource risks, but the international nature of the UK financial system especially the banking system, makes it particularly vulnerable to resource scarcity which could be reflected in energy prices volatility and/or food scarcity. However, regulation of systemic risk faces several problems. First, systemic risk and its costs are difficult to quantify. Second, banks have strong incentives to evade regulation meant to reduce systemic risk. Third, regulators are prone to moderation. Finally, the inability of governments to commit not to bail out systemic institutions creates moral hazard and reduces the market's incentive to price systemic risk.

With regards to insurance, the new Solvency II regulations have been identified to provide a restricted possibility for timely and tailored action and reaction by insurance companies against unforeseen risks and the inflexibility in the regulatory provision regarding insurance investment (David Worsfold, Insurance Investment Exchange, 2016). The new capital requirements, restrict the capability of insurers to meet liquidity requirements and at the same time handle long term liabilities. As such any changes and/or slight deviation from regulations must be negotiated and approved through lengthy processes, making the insurance sector vulnerable to investment and liquidity risks in the short term. This further proves the shortfall of the present regulations in protecting the insurance sector from natural resource risks, and further possible systemic risks as a result. Therefore, having a separate concise provision for such risks in regulation would be ideal for better resilience for insurance and the finance sector as a whole.

Therefore, the hypothesis that financial regulations positively affects the way the finance sector responds to resource risks could be rejected, as such risks are not specifically considered in the risks portfolio of regulatory bodies.

6.7. Summary of Impacts

Below is a table summarising the direct and indirect risks and impacts caused by resource scarcity on businesses and individual consumers.

Table 31; Direct Impacts of Resource Scarcity

Resource Change	Impact on Businesses	Impact on Consumers
Increase in oil Price	Decline in consumer spending due to oil price increase and volatility, less volume of sales for business, less profits Oil price increase and volatility could be costly to energy intensive companies (increase in cost of production)	Oil price volatility causing a decline in consumer spending
Increase in gas prices	Increase profit for fuel businesses in short run, reduced volume of sales in long run.	High gas prices, fall in consumer spending on fuel and gas, possible health care costs

Increase in price of resources (food, oil, gas)	Increase in price of natural resource, increase in price of production, decrease in investments volume and return, and supply side inelasticity in the short and medium term. Increase in prices of vital resources (food, oil, gas), could lead possible strain on balance sheet of business Fall in production, increase in cost of claims for creditors, legal expenses, and contract guarantee for insurers	Increase in price of natural resource; fall in consumer demand, increase in price of basic commodities Increase in price of resource, leading to possible risk of pension underfunding due to strain on business/company balance sheet
Fall in Oil prices	Fall in oil prices, increase in profits through reduction in cost of production. Fall in profits for businesses invested in energy projects and the oil industry. On the other hand, fall in oil prices, fall in lending and credit activities as less money is available from the oil and gas industry accounts and fall in energy related investment	Fall in oil prices, risk of job loss to individual working in the oil industry and then impact on their families. Less income available for consumers.
Increase in food prices	Increase in food prices, reduction in banking activities like lending and credit granting activities	Reduction in lending activities for banks, less income available for consumers for basic living expense and investment purposes

Table 32; Indirect Impacts of Resource Scarcity

Resource Change	Impact on Businesses	Impact on Consumers
Increase in oil Prices	Increase in oil prices; increase in food prices, non-healthy diets, increase in health care insurance claims for insurance companies, and increase in health care cost by NHS (liability risk for insurance companies)	Increase in oil prices; leading to increase in food prices, affect healthy diet, fall in disposable income
Fall in oil Prices	Fall in oil prices, fall in investment returns, strain on employers providing pension schemes for employees Fall in oil prices, supply chain inactivity, loss in productivity and profit (especially for oil and gas industry and businesses directly linked to it). Possible indirect risk for insurance through cost of claims for insured lines such as supply chain insurance, (due to supply chain inactivity and/or interruption) contract insurance, business insurance. Reduction in investment volume and return from oil and energy related lines of investment, fall in demand from insurance for invested	Fall in oil prices, fall in oil investment returns for pensions, reduction in retirement income for pensioners. Consumers could be indirectly affected by dividend cuts by companies as a bid to hold on to the falling profits due to falling oil prices, as their ISA and pensions could be affected by this action, as they have some kind of exposure to these firms.

	lines, fall in premium, reduction in income	
Increase in prices of all resources (food, oil and gas)	High price of resource; high price of property, profits for property letting and sales agents through management fees Fall in production as a result of high resource prices; could increase cost of claims for insured lines and thereby increase insurance premium by insurance company to business in the medium to long term. (liability risk) Increase in cost of claims for insurance as a result of resource scarcity, fall in savings from insurance to banks, fall in liquidity for banks	High price of resource; inflation, high price of property for instance houses, cars, high cost of property management, fall in consumer demand and disposable income Fall in production as a result of high prices; fall in supply of goods and services, thus high prices of basic commodities, inflation, leading to a fall in consumer spending Fall in liquidity for banks, fall in credit and loan availability, stricter conditions for loan applications for consumers, less income available for consumers
Increase in food prices	Increase in food and gas prices, fall in demand, fall in volume of profits	Increase in food and gas prices, fall in income, and fall in wage levels due to fall in profits of businesses and companies, fall in pension contribution, possible redundancy.
Fall in Gas Prices	Fall in gas prices; increase in volume of sales, increase in long run profits, fall in short term investment returns for	Fall in gas prices, increase in cost of motor insurance claims as a result of more accidents, insurance companies increase

	businesses invested in natural gas.	insurance premiums for consumers

The next chapter would conclude the research based on the results and the discussion that followed, highlighting and putting more emphasis on its implications. Recommendations would also be developed both for the finance sector and on further research.

Chapter 7. Conclusion and Recommendation

7.1. Conclusion.

For the past few years, scarcity of natural resources and its economic and socio-political effects have been an issue of concern. These social, political and economic effects have been investigated and documented empirically. The results of such investigation and documentation have demonstrated to have either confirmed or contradicted established and well-known theories in economics and finance regarding the effects of natural resource constraint. The global financial crisis in 2007-2008 and its cascading impacts in economies globally, also became an issue of concern as literature and theories emerged concerning the systemic risk effect emanating from the crisis and the need to identify possible causes of other systemic risks which could affect the finance sector and the economy in the future. Despite theory and empirical literature on the effect of natural resource scarcity on the economy and the finance sector and literature on systemic risks and its causes and effects, not enough literature has addressed the effect of resource scarcity, with vital resources such as oil, gas and food, on the performance of the finance sector in the UK and if such effects could cause systemic risks in this same finance sector.

As such the research, in order to investigate the effect of resource scarcity on the finance sector, had the following questions;

- What is the effect of resource constraint on insurance? /Are banking activities affected directly or indirectly by resource constraints?
- What is the effect of resource constraint on investments, and how do these effects become potential risks for investments?
- Are pension funds affected by natural resource constraints? / Are there systemic risks in the economy that are manifest through the finance sector as a result of resource constraints?
- Do financial regulations both in the UK and from abroad, have any significant effect on the response of the finance sector to resource constraints?

Providing answers to these questions required following and attaining these objectives;

- Main objective; investigate and evaluate the risks involved with Resource constraint and Global Growth, with evidence from the finance sector, which is part of the GRO (Global Resource Observatory) project at the GSI, whose main project aim is to investigate how the scarcity of finite resources will impact global social and political fragility in the short term.
- Examine the impact of resource constraint on the growth of the financial sector.
- Examine and determine how and why resource scarcity affects the insurance sector
- Investigate the risks involved with resource constraint on investment.
- Identify and investigate potential risks on banking activities as a result of resource scarcity.
- Investigate how resource constraint affects pension funds and the risks involved.
- Determine if there are potential systemic risks in the finance sector through the resource constraints.
- Examine and evaluate how financial regulations could impact on the performance of the finance sector in the event of resource scarcity.

A conceptual framework was developed to better understand the direct relationship between natural resource (oil, food & gas) availability and economic growth and the performance of the economy and also how natural resource scarcity could indirectly affect the finance sector through affected economic activity lines. The framework came up with the following hypothesis;

- H_1; Financial Regulations significantly positively affects the way the finance sector responds to the effects of natural resource constraints.
- H_2; Resource Constraint could cause a systemic risk in the finance sector.
- H_3; Resource scarcity negatively affects insurance performance
- H_4; Resource scarcity negatively affects the performance of pension companies
- H_5; Resource scarcity negatively affects the banking sector

Given the research questions and the objectives, the most effective way to answer these questions and attain the objectives, was adopting the mixed method methodology in the research. Here, the quantitative and qualitative methods were used in the research in a

sequential manner, where the quantitative analysis was done first, followed by the qualitative analysis. The quantitative part answered questions on will and how natural resource affected the finance sector and the qualitative part answered questions on why resource scarcity affects the finance sector the way it does and also answer the question of financial regulation as it was not quantitatively assessed.

For the quantitative analysis, data was collected on prices of food, oil and gas, insurance cost of claims and investments, pension contribution and investments and banking activities like personal deposits, non-personal lending, bank loans, credit and overdraft lending. The data was analysed in the first difference after analysing for stationarity using the Augmented Dickey Fuller test and were found stationary in the first difference. It was regressed with the prices of the resources as the independent variables and the finance variables as dependent. This was done to assess the impact of an increase in price on the performance of the finance variables and their basic relationship. Later on a Granger causality test was done to assess the causal relationship between the finance variables to determine the possibility of a systemic risk to occur in the finance sector, due to its interdependent nature.

The qualitative analysis comprised collecting data via interviews with officials in the finance sector (insurers, actuaries, bankers, investment bankers and pension officers). The data was transcribed and analysed using thermal content analysis. This analysis was carried out as a follow up to the quantitative analysis to either validate, confirm or contradict the quantitative results.

The quantitative results indicated the following;
- Historic data on resource variables are positively correlated to each other and GDP
- Finance Variables are positively significantly correlated to each other except insurance investment holdings which is negatively insignificantly correlated to the other finance variables.
- Positive significant correlation between resource variables and finance variables except between pension investment return and insurance investment holdings
- Regression analysis indicate that food and oil prices significantly affect insurance investment quarterly with food negatively affecting performance and oil prices having a positive effect
- Insurance investment income is positively significantly affected by oil and gas prices
- Cost of health insurance claims is mainly positively affected by food prices
- Cost of motor insurance is affected by gas prices positively and significantly

- Cost of property insurance is not significantly affected by the prices of any of the resources

- Cost of claims of miscellaneous and pecuniary losses are significantly positively affected by food and oil prices

- The Granger causality tests indicated that some costs of insurance claims and banking activities granger cause each other in 3 and 1-year lag periods, indicating their level of interdependence in the short term.

The qualitative results indicated that;

- Natural resource scarcity exists

- Resource scarcity is measured by both price and stock on the ground.

- Resource Scarcity can affect the economy especially through lack of availability of raw materials for production

- Resource scarcity affects the finance sector especially through investments

- Insurance would be most vulnerable in the short term and long term, banks vulnerable in short term and pensions are less vulnerable in short term but are in the long term

- Though generally accepted that the finance sector is interlinked and vulnerable to systemic risks, the potential of resource scarcity causing such risks is not yet generally accepted.

- Oil has the highest potential for hard hit effects on the finance sector and economy

- Political influence has a greater impact on the performance of the finance sector than resource scarcity

- Current regulations have an impact on the effect of resource scarcity in the finance sector, as it makes the finance sector more vulnerable to resource risks and is of little or no help in its quick response and/or recovery to such risks

- National and international legislation have a greater influence on the exposure of the finance sector to resource scarcity than financial regulation itself.

Both quantitative and qualitative results indicate imperatively that natural resource scarcity does affect the finance sector in the UK and that it is possible that a systemic risk could occur in this finance sector, given its interdependent nature, especially between insurance and the banking sector. The results were discussed in relation to empirical studies and literature and events occurring at the time of the discussion, also highlighting at the end (in a table) the direct

and indirect risks and impacts to both businesses and consumers. These impacts are based on past occurrences of scarce resources and performance of the finance sector and the economy. In the future, given the trend in resource availability which is volatile and complex, influenced by international demand and supply, politics and financial market speculation, the risks of resource scarcity to the financial sector would increase through further impact on economic activity, financial market vulnerability, investment outcomes and restrictions by financial regulations. Until the finance sector is well prepared to deal with such risks in the future, in its risk management strategies and financial regulations taking resource scarcity more into account, it would be more vulnerable to resource scarcity.

The results were discussed according to the financial institutions under investigation in the research. For insurance, it can be concluded that insurance investment holdings and returns are affected by energy prices (oil and gas) insignificantly in the short run, but the effect could be more significant in the long run. It has been ascertained that a fall in oil prices could negatively affect investment returns for insurance and also poses risks for both businesses and consumers in the long run. However, insurance investment income could be insignificantly directly affected by events arising from a fall in oil prices, but may be indirectly affected significantly which could pose a systemic risk in the economy. On the cost of claims, health claims are affected significantly by oil and food prices, motor insurance affected by mainly gas prices, property insurance claims are not significantly affected by resource constraints directly and in the short run and insurance claims for miscellaneous and pecuniary losses are affected significantly by food prices. In the case of motor insurance, the results on the volume claims being impacted by natural gas prices was attributed to coincidence and an indirect link at best. The coincidence was centred on having an increase in natural gas prices during the winter, coinciding with the possible potential increase of accidents due to bad weather conditions (slippery roads, poor vision), and increase in the volume of motor insurance claims. And the indirect link was an increase in natural gas prices affecting the purchase of vehicles and fuel prices through possible inflations and restrained economic activities. The findings of this research, therefore accept the hypothesis that resource scarcity affects the performance of the insurance sector in the UK, through its investments and insured parties (cost of claims).

On pensions, food and gas prices also have significant effects on pension investment income, and to some extent they could have an effect on pension contributions. This may be an indirect effect as such prices could affect wage levels which in turn affect pension contributions. But in the case of the UK, such impacts are less significant. It was also concluded that pensions run

the risk of underfunding due to resource scarcity as increases in prices of energy (oil and gas) could put a huge strain on balance sheets of companies and thus the risk of underfunding. Hence the hypothesis on the impact of resource scarcity on pension performance would be accepted in the case of oil. This is mainly because pension investments are significantly made up of oil related assets in the financial markets which are volatile and susceptible to both real information on oil prices and speculation. Oil on the other hand is very much linked to GDP growth in the UK and GDP also plays a huge role in pension contribution and investment. Oil prices therefore play a huge role in the performance of pension schemes.

Banking activities are negatively affected by food prices through its direct link to the reaction of its customers to such increases in price. As such credit and lending activities are affected through fall in liquidity as a result of credit defaults and fall in the volume of savings and deposits from consumers. Oil prices on the other hand positively affect banking activities, increasing lending activities and liquidity with an increase in oil prices, and a fall in such activities with a fall in oil prices. This is linked to the large customer base of UK banks being made up of oil and gas industries and their employees, who grow richer with an increase in oil prices, providing the banks with more liquidity through increased savings and deposits, and get poorer with fall in oil prices and thus a reduction of the flow of money into banks. Consequently, the hypothesis that states that resource scarcity through increase in price, affects banking sector performance negatively could be rejected in terms of oil and gas and accepted in terms of food. However, it would be difficult to put a fine line on whether resource scarcity, through price, affects the finance sector in the UK negatively, because so many factors are in play, which could distort and/or change expectations of such effects.

On the possibility of resource constraint causing a systemic risk in the finance sector, it was concluded that it was possible for resource scarcity to affect the finance sector if the insurance sector was affected first. The Granger causality test identified a bidirectional causality between banks and insurance in the short run, given the interlinked nature of their activities, indicating a high level of interdependency between these institutions. It was also demonstrated that (in the case of oil), both a rise and fall in price could cause a systemic risk, depending on how these fluctuations in prices affected these institutions and to what extent. This came to the conclusion that systemic risks in the financial sector is probably unavoidable if natural resource availability occur at extreme ends of the spectrum; excess natural resources could lead to falling prices which affect the financial sector and could cause systemic effects and if the resources are extremely scarce they could affect the finance sector with their high prices and also cause

systemic risks, though the links and the path to which such risks may occur differ slightly from each other at the mentioned extreme points.

Financial regulations have been noted not to provide enough protection for the finance sector against natural resource risks, even though it has been ascertained by the Governor of the Bank of England that banks have been made safer by including "risks they considered low". However, natural resource scarcity may not have been considered among such risks.

The next section will look at recommendations from the results on discussion and recommendations for future research.

7.2. Recommendations

Given the underlying trend in resource scarcity and prices in food, oil and gas, which depicts a highly volatile nature emanating from reasons which range from climate change conditions (general weather conditions, draught, flooding), to forces of demand and supply and speculation in financial markets, and the reaction from economies and the financial sector which is very much dependent on politics, financial regulations and consumer demand, the risks of resource constraint on the financial sector and the economy would be higher and more complicated to curb and manage in the future. This research indicates that such risks would be higher in the short term, and such short bursts of vulnerability to risks could strain the financial sector and drain its risk management resources which would be needed in the long term. Also, as earlier mentioned, the impacts of resource scarcity on the finance sector are based on past occurrences of scarce resources and performance of the finance sector and the economy. However, the availability and/or scarcity of natural resources in the future are difficult to determine given the complex nature of its demand and supply. Following the past trend of resource availability and the performance of the finance sector in regards to resource risks, the impact of resource risks would be higher, as current stakeholders in the finance sector do not really perceive resource risks as urgent, and thus treated under the cluster of "environmental risks" and probably taking the back seat in that cluster. As such resource scarcity has to be taken into serious consideration by financial regulations, the banking sector, insurance and pensions. This could be of particular interest to the Prudential Regulation Authority, in its regulation and supervision, using the forward approach to future risks, where more emphasis could be put on risks natural resource scarcity.

Resource scarcity, especially oil, should be incorporated among the risk factors in financial regulations as this very much impacts the finance sector, directly and indirectly in both long and short terms. Insurance companies and banks are currently struggling with the constraints and restrictions put in place by current regulations, posing a huge challenge to the finance sector as a whole and its investments prospects and future income. It would therefore be imperative that regulations be revised to not only protect the finance sector from risks of a natural resource nature, but also give the institutions the flexibility to act on such risks as is suitable for them.

Natural resource constraints, especially food and oil prices, should be included in the risk assessment of banks. As indicated in the quantitative and qualitative results, as well as in the discussion, banks are directly linked to the reaction of consumers to increases in food and energy prices which could be demonstrated in fall in deposits, increase in the demand for loans which could eventually lead to fall in liquidity and capital –asset ratios, credit defaults, stricter loan requirements leading to a fall in lending activities. In addition to following guidelines set by current regulations, banks should be able to set up strategies to be able to curb and/or cope with risks related to resource scarcity, especially through its price volatility. Also banks should structure their balance sheets to account for resource risks which they are sensitive to, so that measures to cope with such risks would be easier to implement.

Insurance companies should also incorporate increases in the price of natural resources in their long run risk assessments due to the impacts they could have on their cost of claims and investment returns. Following the approach by Solvency II in its balance sheet approach to set capital requirements according to the risks the industry faces (NGAM, 2015), it is imperative that resource risks be accounted for in the company balance sheets, so that risks of this nature be dealt within the requirements of regulation.

To reduce the risk of pensions being underfunded due to resource scarcity, businesses and organisations should regard resource risks in their risk assessment as top priority. Not only for pensions, but for their general performance and profitability as well.

7.2.1. Recommendations for Future Research

This research has revealed a mine of areas for future in-depth research. One of such areas could be examining in great detail and quantifying how big the impact of resource constraint would be under different scenarios (food shortages, oil spill, fuel substitution) in the economy

or international context and possibly exploring the granger causality tests further into impacts on the economy, and how the chosen scenarios could pose potential systemic risks.

Also, an in-depth analysis could also be done on the effect of low oil prices on insurance investments and/or banking activities, as this is an emerging concern especially for oil exporting countries. There has been the concentration of the effect of high prices or price volatility of oil on economic growth and financial performance in various countries, both developed and developing countries. Not enough literature has examined the impact of low oil prices on financial institutions like insurance and banks, and the economy as a whole. This would be particularly interesting if there is a comparative analysis for both oil importing and exporting countries.

Another area of potential academic research is examining the impact of financial regulations on the resilience of the finance sector; is the finance sector being protected as it ought to by financial regulations? Can financial regulations prevent systemic risks in the UK finance sector? Though there is a considerable amount of literature on financial regulations in the UK, not enough literature has been able to adequately analyse the way systemic risks can be (almost) completely prevented in the finance sector, by current regulations. The ongoing minor changes to regulations by the Bank of England could provide in depth information for such research and analysis.

Regarding regulations, emphasis could be also on the effect of the new Solvency II on the resilience and investment prospects and profits for insurers. There is currently an outcry by insurance companies on the restrictive nature of these regulations (NGAM, 2014; David Worsfold, Insurance Investment Exchange, 2016), an in-depth analysis on how and why these regulations are considered restrictive would be ideal.

Are pension schemes properly protected as well from resource risks by regulations? This question could be answered by an investigation on how current and future regulations could protect pension schemes, employers and retirement benefits in the UK. Empirical literature has emphasized on the effect in banks and insurance, but not enough attention has been given to the effect on pensions as well as its investments.

Another interesting area of research could be exploring specific risks to specific institutions (banks, insurance companies), under different risks scenarios. This could be in a bid to discover if certain institutions considered "too big to fail" could be vulnerable to resource risks and/or climate change risks.

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