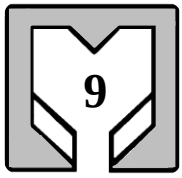


Antifragility of Islamic Finance: A Qualitative Comparison

Umar Rafi

Abstract Abstract

This research attempts to show that risk sharing, as defined under Islamic finance, makes financial systems antifragile. Antifragility specifies conditions under which systems become resilient to shocks caused by Black Swans. According to this concept, the long-term survivability of any system centers exclusively on its antifragile nature, that is, its ability to absorb and actually benefit from Black Swan-type shocks. This research aims to qualitatively investigate risk sharing Islamic finance against the criteria of antifragility. The methodology used is a *literature*-based *secondary* study. It relies primarily on extending the existing literature in the area of antifragility into the domain of risk sharing Islamic finance. The qualitative comparisons are accomplished via a juxtaposition of the ideas of Taleb [1] and Mirakhor et al [2]. The results of this research show a seamless overlap of the ideas of risk sharing and antifragility, thereby showing risk sharing Islamic finance to be more resilient than debt-based conventional finance to Black Swans. This creates a potential avenue for risk sharing Islamic finance to move into the mainstream of finance.

Keywords: Risk Sharing, Antifragility, Black Swan, Islamic Finance, al-ghunm-bil-ghurm

1-Introduction

This paper attempts to bring together two domains of knowledge, which until now have remained mutually exclusive: antifragility and risk sharing Islamic finance. It links these two domains together via an analysis centered on a mutual underlying thread: debt. Prohibition of interest (*riba*) is the defining characteristic of Islamic finance. At the same time, debt is the main cause of fragility in the economy. Hence, the purpose of this paper is to overlap one with the other, using their mutual aversion to debt (as well as their mutual affinity for equity). Figure 1 highlights, at a high level, how an insufficient understanding of the overlaps of risk sharing and antifragility, vis-à-vis debt, creates a knowledge gap, which establishes the justification of this research.

The recent financial crisis has given rise to discussions around a new term known as antifragility – used for evaluating the long-term stability of a financial system. Antifragility specifies conditions under which systems become resilient to shocks caused by Black Swans. These are highly unpredictable outlier events that have a major negative (or positive) consequence when they occur, with their occurrence only being explained retrospectively. According to this concept, the long-term survivability of any system centers exclusively on its antifragile nature, that is, its ability to absorb and actually benefit from Black Swan-type shocks.

This research primarily highlights efforts in the area of Black Swans and antifragility as presented by Lebanese-American statistician Nassim Nicholas Taleb[1]. His efforts have led academia

[1] Nassim Nicholas Taleb spent 20 years as a derivatives trader / risk taker before becoming a researcher in practical, mathematical, and philosophical problems in probability. He is currently Distinguished Professor of Risk Engineering at NYU's School of Engineering. His current focus is on the properties of systems that can handle disorder ("*antifragile*") as well as the development of statistical techniques with fat-tailed processes. Taleb is the author of a multivolume philosophical essay, the *Incerto* (*The Black Swan*, *Fooled by Randomness*, and *Antifragile*) covering broad facets of uncertainty. It has been translated into 36 languages. Taleb has also published, as a backup of the *Incerto*, close to 40 scholarly papers in statistical physics, statistics, philosophy, ethics, economics, international affairs, and quantitative finance, all around the notion of risk and probability.

to acknowledge the deficiencies in the field of quantitative finance due to its reliance on the Gaussian (Normal) probability distribution, as well as its reliance on inaccurate modeling techniques. In parallel, though lesser known in mainstream academia and (till this research) unrelated to antifragility, another development in finance has been taking place over the past three decades, led by

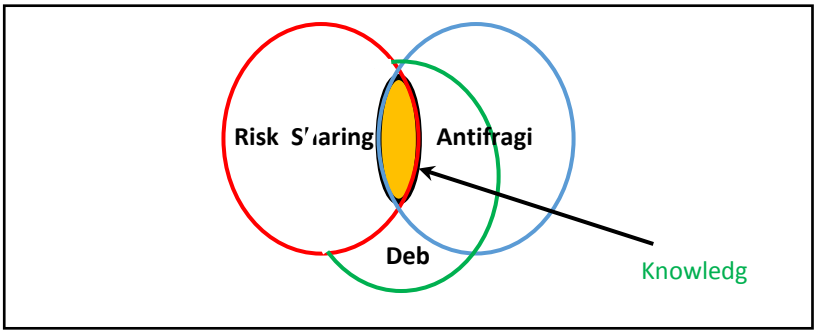


Figure 1: Knowledge Gap

Iranian-American economist Abbas Mirakhor[1] in the area of risk sharing Islamic finance. Mirakhor et al.[2], in a series of books and articles in the area of Islamic finance, over the past thirty years, have sequentially defined the structure of an economy and financial system based exclusively on risk-sharing (with no

[1] Abbas Mirakhor is the Distinguished Scholar and the First Holder of INCEIF's Chair in Islamic Finance. He was on the staff of the IMF from 1984-1990 before being elected, in 1990, as Executive Director for the IMF and the Dean of Executive Board; where he remained until his retirement in 2008. Before joining the IMF, he held various academic and administrative positions in the U.S. and in Iran. He was conferred the *Quaid-e-Azam* star for service to Pakistan by the President of Pakistan in 1997. The President of Ghana conferred on him the *Order of Companion of Volta* for service to Ghana in 2005.

[2] Mirakhor et al., in this research, refers to Abbas Mirakhor and his co-researchers / co-authors who have written extensively on the subject of risk sharing Islamic finance: Zamir Iqbal, Hossein Askari, Mohsin Khan and Noureddine Krichene.

interest-based debt). The foundational aspect of Mirakhor et al.'s research is an emphasis on a financial system centered on real-sector activities being a more viable alternative to the current debt-based conventional financial system. Their research presents Islamic finance in its classical form, centered on *al-ghunm-bil-ghurm*, which is significantly different from the operational procedures followed by present-day Islamic banks. This research feels if Islamic finance is to reach its true potential, it will eventually need to move towards the risk sharing ideas described by Mirakhor et al. The gist of their argument is summarized by Mirakhor & Askari [3]:

"Religions have much to contribute to righting the wrongs of economics by making available coherent and logically consistent alternative postulates and models. In my own tradition, Islam, research has begun to define the grand vision within which the economy is embedded. Similar to the conjecture about Adam Smith's unified theory, I believe that the Qur'an provides an explicit vision of an economy embedded in prescribed rules of behavior. Compliance with these rules assures sustainable development and growth."

Along with the research being carried out by Taleb and Mirakhor et al., as a result of the Great recession, a comprehensive re-evaluation of the relationship of debt with the global economy is taking place in academia and in industry. Describing inequality, as well as the *wiring in our brain* as two of the three main causes for our *lust* for debt, the Economist (May, 2015) comments,

"Today the world is crippled by too much debt. The borrowings of global households, governments, companies and financial firms have risen from 246% of GDP in 2000 to 286% today. Since the financial crisis began in 2007, debt-to-GDP has risen in 41 of 47 big economies ... For every extra dollar of output, the world cranks out more than a dollar of debt. Beyond a certain point an ever thicker mesh of debt contracts is bad for

growth, making firms and households vulnerable to shocks and disruptive defaults. Why is the world addicted to borrowing?"

Interestingly, similar intellectual discourse on debt - both at a philosophical and at a practical level - has been carried out periodically in human history. Mankind has regularly prohibited interest across cultures and religions, starting from the ancient Greeks to present-day Muslims (Graeber [4], Taleb [5]). This has resulted in recurring economic cycles leading to the outright prohibition of interest-based debt, followed by a gradual rise and resurrection of interest-based debt through a process extending over centuries; and then a prohibition on interest again as the cycle completed itself. Greek philosopher Aristotle – a father of Western (and Andalusian Muslim) thought - wrote in Book One, Part X in his 350 B.C. work, ***Politics***:

"*The most hated sort, and with the greatest reason, is usury, which makes a gain out of money itself, and not from the natural object of it. For money was intended to be used in exchange, but not to increase at interest. And this term interest, which means the birth of money from money, is applied to the breeding of money because the offspring resembles the parent. Wherefore of all the modes of getting wealth this is the most unnatural.*"

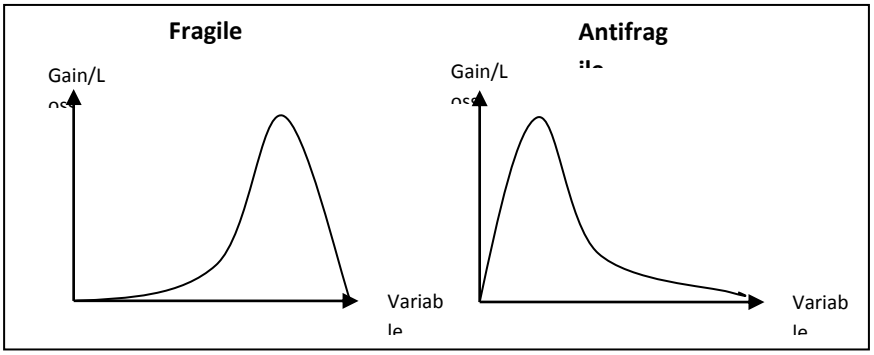


Figure 2: Statistical Definition of Fragility and Antifragility

This research feels that society may be moving towards another such reassessment of interest and subsequently of the debt-based conventional financial system. A large group of researchers in academia and in industry have been extremely critical of debt in the post-Great recession era. This research considers the contemporary criticism of debt to be different from previous such instances, which occurred after comparable financial crises. This is primarily due to the advances in computing technology as well as advances in the field of statistics allowing a more comprehensive and detailed analysis of the impact of debt on the economy than was earlier possible.

The recent ideas around antifragility being developed by Taleb [1] provide an avenue for the concepts in risk sharing being researched by Mirakhor et al. [2] to not only move into the mainstream of Islamic finance but, perhaps, at some point in the long-term future, also present themselves as a possible alternative to the established conventional financial system. This requires a qualitative (and quantitative) investigation of similarities and differences between risk sharing Islamic finance and antifragility. This paper attempts such an undertaking on the qualitative side.

2- Introduction to Antifragility

Antifragility is the opposite of fragility. It is a term and concept coined by Taleb [1] that aims to replace the entire field of traditional risk management as a more reliable method of evaluating the long term survivability of financial systems (as well of all other systems that are impacted by fat tails[1]). Antifragility refers to a resilient state of a system in which shocks from Black Swans strengthen, rather than weaken, the health of the system. For a financial system, antifragility is a calculable metric for measuring the resilience of the system to survive *negative* fat tail events and to gain from *positive* fat tail events. In option trading

[1] Fat tail is a technical term for Black Swan.

terms, antifragility implies *long gamma*[1]. In the statistics domain, antifragility is the sensitivity of the right tail to changes in the scale of the distribution (while fragility is a similar sensitivity of the left tail), as shown in **Error! Reference source not found.**. A fragile system will be skewed left in the probability space, while an antifragile system will be skewed right. Antifragility is thus a convex (decelerating) response to a harmful stressor. Convexity implies the graph of an antifragile function will result in more benefit than harm from random events. Figure 3 shows how, for an antifragile function, as the severity of the stressor increases, gains end up accelerating. While for a fragile function, the results are the opposite. Antifragility emphasizes the achievement of a stable financial system lies not in *predictions* (of tail risks), but in *preparedness* - accepting that tails risks and their consequences are unpredictable. This contrasts with the current methods of risk management that utilize past data in an attempt to predict the future occurrence of risks, and then allocate economic (and regulatory) capital to cater to such risks. The result is a financial system subjected repeatedly to crises caused by negative fat tail events, either because the consequences and / or occurrences of such events are incorrectly predicted and / or because of moral hazard - too many risks being *hidden* in the left tail by the risk practioners. In essence, antifragility does not utilize the *past* to predict the *future*; it concentrates on the *present* state of the system and tests it against the criteria of future survivability.

In his extensive and original research, Nassim Nicholas Taleb - the founder of the concepts of antifragility and Black Swans - specifically details the characteristics of antifragility around skin-in-the-game, fat tail events, optionality, debt to equity, too-big-to-fail, risk hiding in the tail, fragility of debt, and real-sector vs. financial

[1] Gamma is the second partial derivative of the change in the price of the option with respect to the change in the underlying.

sector, amongst others. He also analyzes and encourages the antifragile nature of venture capital. In addition, he specifically mentions the importance of heuristics gained through experience by humanity as incorporated into the world's various religions in the form of prohibition on interest. If considered at an abstract level, many of the above ideas map directly to the founding principles of Islamic finance as follows: most importantly, skin-in-the-game corresponds to *al-ghunm bil ghurm* (no profit without risk), fragility of debt and conversion of debt to equity relates to prohibition of *riba* (interest), risk hiding in the tail relates to prohibition of *gharar* (asymmetric information), speculation on the unpredictable nature of fat tail events relates to prohibition on maysir (gambling / speculation), real-sector activities corresponds to encouragement of al-bai (trade), and venture capital maps almost directly to mudaraba.

The above discourse leads seamlessly into the comparative discussion of Islamic finance and conventional finance around antifragility. This forms the basic argument for this research - risk sharing finance has a higher probability of surviving shocks originating from Black Swans (since it explicitly embraces the idea of skin-in-the-game via al-ghunm-bil-ghurm), while debt-based finance cannot absorb such shocks (due to its implicit avoidance of skin-in-the-game) resulting in perpetual crises. Hence, this study aims to show that risk sharing, as defined under Islamic finance, makes financial systems antifragile.

3- High Level Knowledge Gaps

At a high-level, this study attempts to define and fill the qualitative. Mirakhor et al. have defined in detail, over a series of books and papers, a theoretical[1] economy with its supporting financial system that does not allow interest-based debt.

[1] The reason their research remains theoretical is because there is no empirical data available from risk sharing banks; as such banks and systems do not exist at the moment.

Mirakhor et al. also describe the shortcomings of the debt-based financial system (specifically in light of the Great recession), and the advantages of an interest-free risk sharing system. However, Mirakhor et al.'s work on risk sharing pre-dates Taleb's research on antifragility and on Black Swans, hence the former does not touch upon the later.

At the same time, existing qualitative frameworks (and quantitative models) for evaluating and forecasting the long term stability of financial systems have been challenged / corrected / extended by Taleb's research on volatility (and subsequently, on antifragility); specifically in the area of probability distributions displaying fat tails. Taleb's research on antifragility focuses extensively on the implicit fragility created in financial system due to large amounts of debt. Taleb paints this new domain with a broad brush - his approach is extensive, relying on statistics, psychology and on philosophy to establish his cutting edge ideas. Statistically, Taleb [6] centralizes his argument in favor of antifragility on the inaccuracies in the predictive capabilities of current forecasting and risk management frameworks and models (Time series analysis and VaR being examples, respectively). He extends the research by the famous mathematician Benoit Mandelbrot[1], in the area of price movements with fat tails, towards a conclusive postulate. Taleb's research on Black Swans can be considered the final chapter of Mandelbrot's [7] work on price movements, while Taleb's research on antifragility can be considered the first chapter of an original domain within risk

[1] The late Benoit Mandelbrot was an American mathematician and scientist who was born in Poland (and grew up in France). He is most famous as the inventor of fractal theory and for describing the potential applications of fractals to nature and to design. Mandelbrot was the Sterling Professor Emeritus of Mathematical Sciences at the Mathematics Department - Yale University, and IBM Fellow Emeritus T.J. Watson Research Centre, International Business Machines Corporation. Amongst other honors, he is the recipient of the Franklin Medal, Wolf Prize and 15 honorary doctorate degrees.

management. Taleb also relies largely on the research carried out by Kahneman[1]. Kahneman presents his *Prospect* theory [8] as an alternative to Bernoulli's *Utility* theory, catering for the biases in individuals' behaviors in decision making. Kahneman explains how this impacts the financial system by highlighting that the stock picking industry is based on an *illusion of skill*, leading to perpetual financial crises as investors attempt to speculate on the future purely on the basis of luck.

Taleb has an impressive understanding of philosophy, as well as of the history of religion. He repeatedly emphasizes the fact, referencing the works of some of history's greatest philosophers, that the *ancients* possessed a more comprehensive understanding of Black Swans and had implicitly developed bottom-up heuristics to manage the impacts of such events (similar to those discussed under his umbrella of antifragility). Taleb also mentions the prohibition of interest by various *eastern Mediterranean* religions in his writing. However, he does not analyze this concept in depth. After qualitatively establishing the status-quo financial system as implicitly fragile with perpetual exposure to negative Black Swans, Taleb encourages a transfer of debt to equity and a long term reliance on equity-based systems as an antifragile solution. However, Taleb does not define a clear mechanism and sequence of steps for executing such a transformation. Moreover,

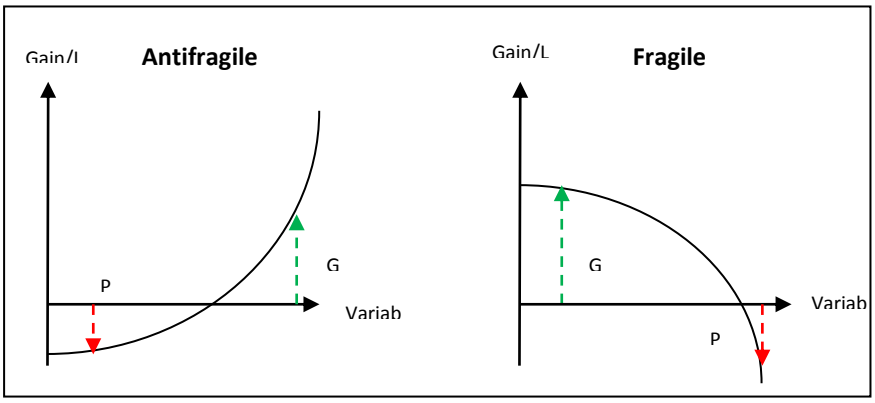
[1] Daniel Kahneman is a Senior Scholar at the Woodrow Wilson School of Public and and International Affairs. He is also a Professor of Psychology and Public Affairs Emeritus at the Woodrow Wilson School, the Eugene Higgins Professor of Psychology Emeritus at Princeton University, and a fellow of the Center of Rationality at Hebrew University in Jerusalem. He was awarded the Nobel Prize in Economic Sciences in 2002 for his pioneering work integrating insights from psychological research into economic science, especially concerning human judgment and decision-making under uncertainty. He is one of the fathers of the field of Behavioral science and the first psychologist to ever win a Nobel Prize in economics.

while Taleb insists on drastic reductions of government debt and personal debt, he does not take the concept to a possible logical conclusion of complete removal of debt via a prohibition on interest. Hence, qualitatively evaluating how Taleb's insights around antifragility may extend into the risk sharing universe defined by Mirakhor et al. fills the qualitative knowledge gap; adding to the field of risk sharing Islamic finance and to the field of antifragility.

4-Risk Sharing, Risk Transfer and Risk Shifting

Prior to proceeding ahead, it is essential to differentiate between the three available mechanisms of risk management - risk sharing, risk.

Figure 3: Measurement of Antifragility - Convex vs. Concave Functions



transfer and risk shifting. These are the only three mechanisms available in finance to *manage* risk. Islamic finance obviously encourages the first of the three mechanisms. However, it is important to understand how risk sharing relates to the other two modes of risk management: risk transfer and risk shifting. The comparative argument put forward by this study is that Islamic finance, due to its reliance on risk-*sharing* as a mechanism of risk

management, explicitly becomes antifragile, while debt based conventional finance, which relies on risk-*shifting* and on risk-*transfer* as mechanisms of risk management, is implicitly fragile. Thus as a starting point, a clear demarcation must be established between these three concepts: risk-sharing, risk-shifting and risk-transfer.

Askari, Iqbal, Krichene & Mirakhor [2] define risk sharing as a contractual or social arrangement whereby the outcome of a random event is borne collectively by a group of individuals or entities involved in a contract, or by individuals or entities in a community. Risk sharing can be of two types: in the first case, both counterparties have thorough knowledge of the details of the contract[1], while in the second case only one of the two counterparties has thorough knowledge of the details of the contract. Islamic finance, due to its strict adherence to Islamic law of contracts with religiously defined prohibitions of gharar, falls explicitly into the first category, while conventional finance, as indicated by the recent Great recession, due to the infiltration of financial contracts like CDOs, CMOs and various other complex derivative contracts, utilizing legal loopholes that caused information asymmetry, falls implicitly into the second category of risk sharing

Risk transfer refers to a risk management technique where risk is passed onto a third party outside the original contract signed by the counterparties, via insurance. This is a common mechanism of risk management in both conventional and Islamic finance; with one key difference: Islamic insurance, known as *takaful*, is based on mutuality. In takaful, the risk is not transferred but shared amongst a pool of participants, while under conventional insurance the risk is transferred from the policy holder to the insurance company. Hence, takaful is based on an implicit element of risk sharing,

[1] This research uses the term *Islamic finance* to refer only to this first category of risk sharing.

while conventional insurance is based explicitly on risk transfer[1].

Risk shifting refers to the tendency of financial institutions facing distress to shift the risk from the equity holders to the debt holders. As the shareholders' equity of the troubled company decreases, the motivation for taking excessive risks increases, since the potential profits amass to the equity holders, while the downside risk accumulates with the debt holders; basically the risk implicitly *shifts* from the equity holders to the debt holders. One of the main causes of the Great recession was the massive indulgence in speculation via risk shifting through interest-only and *ninja* (no income, no jobs, no assets) loans by subprime mortgage lenders facing shocks to their investment portfolios due to the tightening of monetary policy. Islamic finance, due to its explicit ban on riba and the resulting debt, closes all doors to risk shifting.

5-The Islamic Finance Antifragility Framework

In this section, risk sharing Islamic finance is qualitatively evaluated against each of the key characteristics of antifragility. A risk sharing Islamic bank is assumed that has an operational structure consisting of two categories of accounts: demand deposit (*wadiah*) account operating on a 100% Reserve system, as well as an Investment account operating of a 100% risk sharing perspective. The investment account consists of three categories of sukuk – low risk/short term, medium risk/medium term, and high risk/long term – offered to the investors. . The risk sharing Islamic bank is regulated to invest 20% of its own fund in each sukuk. **Error! Reference source not found.** details the antifragility characteristics against

[1] For a more detailed discussions on the differences between Takaful and conventional insurance, vis-à-vis Islamic finance and risk transfer, see Iqbal & Mirakhor (2011).

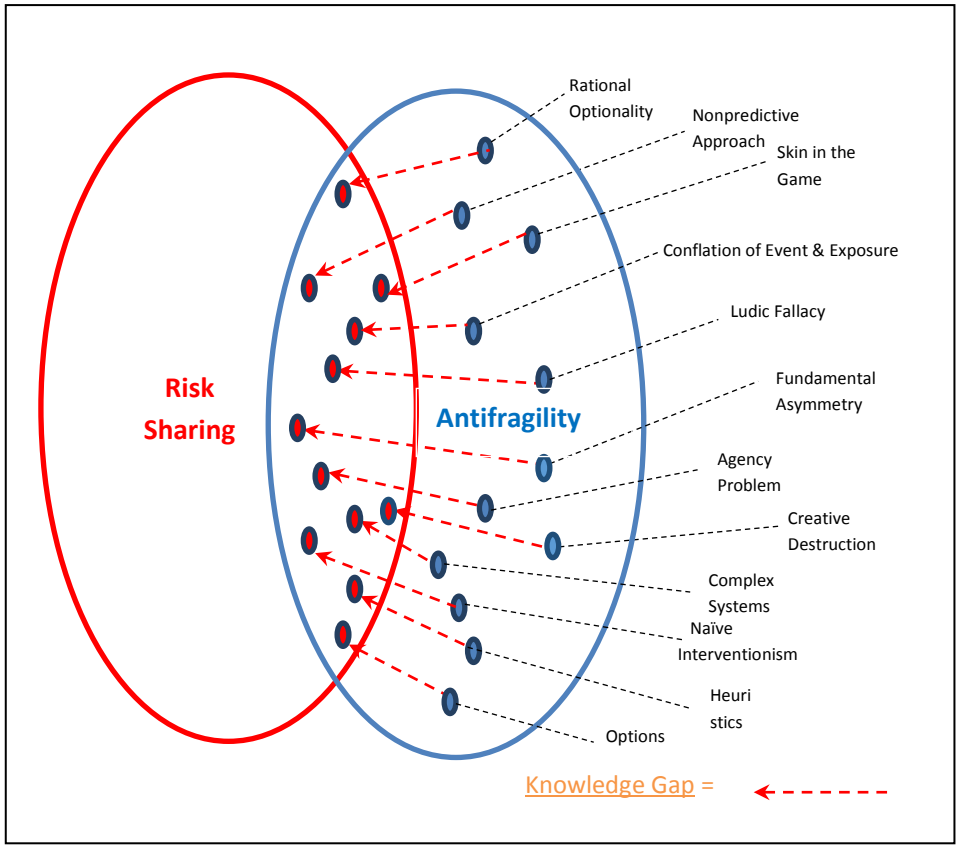


Figure 4: Qualitative Knowledge Gap

which risk sharing is being evaluated. The various characteristics of antifragility are shown in blue[1]. The (dashed) arrows in red indicate the qualitative knowledge gap this research will attempt to fill. These twelve criteria are explained and evaluated below:

The key characteristics relating antifragility to risk sharing Islamic finance are skin-in-the-game and al-ghunm-bil-ghurm, respectively. Skin-in-the-game, risk sharing and al-ghunm-bil-ghurm can be

[1] This is a subset of the complete list of characteristics of antifragility. In an effort to keep the scope manageable, the research will concentrate only on this list.

considered implied synonyms. They form the locus where antifragility meets and overlaps with risk sharing. Islamic finance takes skin-in-the-game to a level significantly beyond the level even suggested by contemporary supporters of this concept (including Taleb). Under risk sharing Islamic finance, not a single dollar, riyal, dirham or rupee can be made without skin-in-the-game. Islamic finance forces the whole society to put its *combined* financial skin-in-the-game for each other. The rest of the characteristics of antifragility and risk sharing Islamic finance flow out from these two characteristics respectively, and are explained below.

5-1-Complex Systems

Complex systems tend to be fragile; specifically when they are in the domain of social sciences with significant amount of human interventions built into the system workflow. Complex systems cannot be managed in a top-down manner. Top-down management makes such systems fragile, while bottom-up *tinkering* adds to their antifragility. As an example, the heuristics of the floor traders are based on tinkering, as opposed to being based on the financial theorems generated from models (which, as per antifragility, take on the impossible task of mapping complex systems). Based on the above, an antifragile system will consist of many non-specialized small parts. These parts will have redundancy, which will result in systems interacting with each other, via decentralized control[1]. Such parts will make a large number of errors at an individual (subsystem) level. However they will be resilient at the system

[1] The Internet is a good example of this. It is a system with many heads, and not a singular *big* head; making it nearly impossible to knock it out in one attempt.

level. Such systems rely on heuristics with many distributed sources, as opposed to concentrated sources of randomness. Such a system has the capability to regenerate itself on a continuous basis. It selects and reselects and destroys and replaces its parts aggressively. Another quality of such systems is that the failures and mistakes remain local and do not become systemic

It is important to understand that *complex* is not the same as *complicated*. Complexity implies interdependencies that make it difficult to track a cause to its consequence. Complex systems tend to have a large number of in-built opacities, due to which the impact of interventions become unclear. Such interventions lead to unexpected secondary effects, branching, and unexpected responses. Fragile systems have minimal redundancies and excessive concentration on efficiencies and optimizations. They emphasize on the immediate rather than on the long term. Within the domain of financial systems, complexity leads to unexpected impacts on the economy due to changes in monetary policy. It results in systemic risks that hugely fragilize the system. This makes it nearly impossible to manage the banking sector. Fragile

systems rely on debt and on leverage. They rely on upfront rewards before the completion of projects. Apart from interdependencies, the largest issue with complex systems is the presence of nonlinearities. Nonlinearity implies that the change in a variable is not linearly proportional to change in the function of that variable. Doubling the dose of a medicine may not lead to doubling of the initial cure provided by the medicine. The cure may be more or less than twice as much. Complex systems end up with nearly invisible runaway chains that can make predictions almost impossible.

Engineering systems tend to be complicated, but not complex. A cause results directly in an effect. If an aircraft accelerates to a certain speed, it will lift off the ground each and every time, despite the fact that an aircraft is a complicated system. However, social systems can be very complex with severe interdependencies. Not only are they complex at the system level, they can be very complex even at the minutest subsystem level. It is nearly impossible to predict the exact impact of a change in interest rate on the financial system. No model, irrespective of its detail, could have predicted the exact impact of shutting down Lehman Brothers on the global economy, prior to the Great recessions. Even at a product level, no one understood the complexities of the hundreds of billions of dollars of CDOs that were floating around in the global financial markets. In essence, the *butterfly* effect comes into play. Much like killing a butterfly in Brazil can cause a tornado in Japan, similarly shutting down a bank in Brazil can cause a bank run in Japan (or in Zimbabwe or in Canada; no one can accurately predict where, when or if). It is thus very difficult to isolate causal relationships in complex systems. A complex system works as per Adam Smith's ***invisible*** hand irrespective of the policies made by any of the *visible* hands.

Due to the above, since it is extremely difficult to make correct predictions about complex systems, hence risk management of such systems is also extremely difficult; primarily, because the nonlinear scalability of errors, such systems are vulnerable to randomness. Complex systems also result in the emergence of fat tails. Any complex system that has survived in nature has done so by virtue of its antifragility.

5-1-1-Risk Sharing Islamic Finance and Complex Systems

Risk sharing Islamic finance reduces the complexity of the financial system at multiple levels. In addition, it has certain built-in mechanisms to neutralize the possibility of risks becoming systemic. For starters, the top layer of financial products in Exter's (updated) inverted pyramid – derivatives – does not exist under Islamic finance. This, in and of itself, reduces the complexity of the financial system by trillions of dollars. In addition, credit creation via leverage is eliminated under Islamic finance. All demand deposits must be backed by 100% reserves by every bank holding deposits. This makes a bank run impossible, since funds will always be available to banks to cater to the demands of the depositors. Liquidity risk is minimized as it passed on directly from the borrowers (entrepreneurs) to the lenders (depositors).

The structure of the complete financial system under risk sharing reduces complexities by a great deal. A compelling case can be made that regulation of a risk sharing financial system without fractional reserve banking and no interest rate mechanism, operating within the confines of an institutional framework governed by rules mentioned above, would be less complicated and more effective than a risk-transfer and debt-dominated financial system. Arguably, the regulatory framework for finance is, by necessity, complex. Regulation has to protect depositors, creditors and the public at large, in a system replete with moral hazards and informational problems of fractional reserve banking, credit-creation ability of the banking system, debt bubbles and speculative activities incentivized by (cheap) credit expansion through leverage. This complexity is enhanced by the ability of politically powerful banks and creditors to *game* regulation (regulatory

capture and arbitrage) thus undermining the functioning of the oversight system whose ultimate objective should be the protection of the financial system's integrity and the interests of the public at large. Further complexity stems from the fact that a major lesson learned from the experience of the Great recession is the need for greater attention and focus of regulation on asset markets and potential systemic risk of banking operations. These additional considerations make the job of designing and implementing such a comprehensive regulatory / supervisory framework highly challenging. By contrast, regulation of a risk sharing system would be much less complicated because the framework would only have to focus on the balance sheet of financial institutions whose only function would be to serve as financial intermediaries or risk *sharers* with their own % of skin-in-the-game. The market would take care of the rest via price discovery based on real sector rate of return.

6-1-Naïve Interventionism

Naïve interventionism refers to the desire to do something over not doing anything. It is a by-product of an expert problem, where unqualified or under-informed experts feel the need to intervene in a system without correctly understanding the complex nature of the system. The inherent tendency of humans is to underestimate the randomness of systems due to an incorrect evaluation of the system's complexity and subsequent volatility. This is specifically true in finance, where a complete field of quantitative finance exists to define mathematical models on the basis of which interventionism is carried out on a regular basis at all levels. If the mathematical models are themselves incorrect, then the

interventionism can cause great harm.

One of the ways in which naïve interventionism harms systems is a desire for experts to artificially suppress volatility. Such an artificial suppression of volatility results in a system that seems calm at the surface, however it contains unseen risks accumulating under the surface. This is referred to as *Silent* risks [6] (which is also the title of Taleb's mathematical work on antifragility and Black Swans). The accumulation of these silent risks makes the system vulnerable to Black Swans. Systems that are fragile depend on events following an exact course, as planned. They cater for as little deviation as possible. For such a system, deviations are more harmful than helpful. This requires very accurate prediction and a reliance on predictive systems. This causes fragility.

6-1-1Risk Sharing Islamic Finance and Naïve Interventionism

Risk sharing Islamic finance will be more volatile at the subsystem (individual bank) level than conventional finance. However, it will less volatile at the system (complete financial system) level. Conventional finance is filled with naïve interventionism. In fact, naïve interventionism has occurred so often that it has now become standard practice and is actually considered *essential* interventionism. At the top of this list are three actions regularly taken (under naïve interventionism) by various federal governments that routinely fragilize the financial system - lender of last resort, deposit insurance and bank bailouts. These are steps used to keep the debt-based conventional system from collapsing. When a conventional bank runs into large asset-liability mismatches, ending up in a situation where it cannot pay back depositors, the central bank steps in as a LOLR, providing cash to

the bank instead of letting it fail. In addition, governments offer deposit insurance guaranteeing deposits up to a certain amount, in case a bank fails. The aim is to ensure that bank runs do not occur by ensuring the banks' customers their deposits are safe. Finally, if both of these actions fail, the government(s) actually steps in and bails out the banking system through massive handouts from taxpayer's money. The taxpayers have no option but to comply with the bail outs, knowing that if a single elephant dies, the complete jungle (of which the taxpayers are inhabitants) may get wiped out.

A risk sharing Islamic financial system does not believe in any type of interventionism. It does not support LOLR, FDIC or bank bailouts. This is not a trivial point. The market forces decide which risk sharing Islamic bank survives and which one fails. Each risk sharing Islamic bank is, itself, tied to the market forces via al-ghunm-bil-ghurm, thereby minimizing the agency problem. The mechanism put in place provides 100% reserves for deposit accounts. This results in a significant decrease in the amount of available credit (due to lack of the ability of the bank to fractionally create credit). However, it also results in a situation which ensures that LOLR and FDIC facilities are not required. This will also ensure that bank bailouts are not required. In addition, the bank's skin-in-the-game is ensured by a requirement of the bank having a 20% investment into all securitized investments from the investment accounts. This can be considered intelligent interventionism (as opposed to naïve interventionism).

7-1-The Agency Problem

The agency problem is a well understood phenomenon in conventional finance. It refers to the situation where the interest of

the agent is not aligned with the interests of the principal. A simple example is the possible lack of alignment between the interests of the CEO of a firm in expanding his / her managerial empire (irrespective of the impact on the profitability of the firm) against the interests of the shareholders in the firm. The agency problem occurs due to a series of asymmetries. There is an information asymmetry between the agent and the principal, where the agent has more information about the day-to-day operations of the firm than the principal. There can also be an asymmetry in the pay-off, where the agent, being an employee, may only be interested in short term pay-offs while the principle, being the investor, is interested in long term pay-off and survival of the firm. This was apparent during the Great recession, where subprime loans were made by bankers in light of the bonuses they were to receive in the short-term. Another good example are the CDOs sold to individual investors for the same reasons - immediate bonus payments - irrespective of the damage caused to the Investment banks or to the investors

Within conventional finance, agency problem is one of the main causes of financial crises. The bank managers take huge risks to increase their personal bonuses, knowing full well the risks are fragilizing the banks. The owners of the banks, under a second layer of the agency problem, do not provide the required oversight since they also gain from the accumulation of the risk. They are well aware if their bank is to go bankrupt, they will be bailed out by the taxpayers. Under agency problems, the fragility of the system is passed on by the beneficiary of the fragility to the owners (and subsequently, from the owners to the taxpayers). In essence, the

agency problem provides a free option to the agent at the expense of the principal and the taxpayers.

With an agency problem in place, volatility actually helps the agent, allowing the agent to make his / her position antifragile at the expense of making the bank more fragile. If the market does not move (no volatility), the agent (stock broker, investment bank, to name a few) does not make any commission; similarly the managers are unable to cash in their stock options. However, if the market is volatile – moves up and down regularly – the agent can make money in both directions of movements of the markets, even if the market ends up, in the end, at the same valuation from where it started. Furthermore, such a situation encourages speculation by the agent, since the agent is well aware that under the notion of too-big-to-fail, the agent's institution will always be bailed out. Agency problems thus allow the agent to hide risks and indulge in speculation with asymmetric pay-offs. The main cause of the agency problem is the lack of skin-in-the-game of the agent. The solution is to arrange economic systems in a fashion where the decision makers *must* be impacted by the consequences of their decision. Only individuals with skin-in-the-game should be trusted with decision making.

Systems with agency problems will eventually blow up due to the accumulation of issues related to agency problems. This is what happens to the global financial system periodically. However, even the perpetual blow-ups have been unable to solve the agency problem issues (on a long term basis), which immediately appear again. Lack of skin-in-the-game combined with acceptance of too-big-to-fail is a sure recipe for disaster. Hence, the current

conventional system exists in a perpetual state of fragility.

7-1-1- Risk Sharing Islamic Finance and the Agency Problem

One mechanism to resolve the agency problem issue is to explicitly enforce skin-in-the-game through legal and regulatory means. This has proven extremely difficult as agents are usually one step ahead of the regulations. The other mechanism is to change the financial system by making the complete system centered on risk sharing, thereby making it impossible to avoid skin-in-the-game. This is where risk sharing Islamic finance comes in. It is the ultimate form of a skin-in-the-game financial system.

The agency problem is significantly reduced under risk sharing Islamic finance through its emphasis on al-ghunm-bil-ghurm. Al-ghunm-bil-ghurm should ensure the depositors keep a strict check on the activities of the bank as their investments are directly at risk; specifically, since the liquidity risk will be passed on directly to the depositors. Depositors will have direct motivation of oversight over bank funding on the asset side. In case of deposit accounts, the agency problem is limited under risk sharing Islamic finance as deposit accounts cannot be used for investments. In case of investment accounts, the bank must be invested between 10-20% in all securitized investments. Based on this, a risk sharing Islamic bank has no mechanism or motivation available to indulge in agency problem (other than via outright fraud), since all moral hazard has been removed in the design of the system; again, primarily due to al-ghunm-bil-ghurm.

In addition to the above, one of the three key contractual prohibitions defined under Islamic finance is gharar (along with a prohibition on

riba and a prohibition on maysir). Gharar corresponds to information asymmetry. It is interesting to note that Islamic finance considers information asymmetry to be so destructive that it has explicitly and *unconditionally* banned it, by describing it as a *sin*. Once again, the reasoning for such a strong prohibition of information asymmetry is because (just as in the case of riba) Islamic finance considers gharar to be a direct obstacle in achieving the ultimate operational goal of Islamic finance – al-ghunm-bil-ghurm. Irrespective of one's religious views, the advantages of such a prohibition has been validated by the fact that one of the main causes of the Great recession was phenomenally high amount of information asymmetry in the trillions of dollars of financial contracts floating around in the market place. Hence, Islamic finance explicitly limits the agency problem via a prohibition on gharar and by a foundational encouragement of al-ghunm-bil-ghurm.

8-1-Fundamental Assymetry

Fundamental asymmetry refers to having more upside than downside to the disorder family. This implies antifragility, while the reverse implies fragility. The aim is to introduce antifragility by designing a system that has a fundamental asymmetry to the upside, that is, favorable asymmetry. The defining characteristic of antifragility – convexity – is an extension and generalization of the concept of fundamental asymmetry. Conventional banks have a negative asymmetry due to large amounts of debt, combined with significant moral hazard, resulting in excessive speculation. Excessive debt ensures that conventional banks have limited room to maneuver in gaining from any upside opportunities that may arise. Lack of equity participation results in moral hazard (since the banks'

managers have nothing to lose from the downside, with everything to gain from the upside). This encourages the bank to speculate with *other people's money*, leading to a situation where the complete conventional banking system (other than one specific group – the agents) ends up in a fundamentally negative asymmetric position.

Taleb's solution for achieving fundamental asymmetry is to implement a *barbell* approach - being simultaneously hyper-aggressive and hyper-conservative. Such an approach consists of a high % (80 – 90%) of investments in risk-free assets (cash, US Treasury bills, as an example) with a small % (10 – 20%) in very high risk / very high reward investments (speculative put options on the S&P, as an example). This corresponds to putting all of one's eggs in two baskets. The first step is to limit the downside (before moving towards increasing the upside). This results in reduced exposure to negative Black Swans.

8-1-1Risk Sharing Islamic Finance and Fundamental Asymmetry

In case of risk sharing Islamic finance, demand deposits have neither upside nor a downside. In terms of asymmetry, demand deposits are neutral; considering the fact that the demand deposits cannot be utilized for investments, hence they cannot be used to benefit from a positive upside opportunity. At the same time, the demand deposits cannot be loaned out (fractionally or otherwise), hence they are not impacted negatively by a downside movement. Basically, demand deposits of a risk sharing Islamic bank are *symmetric*; neither positively nor negatively asymmetric.

Once again, al-ghunm-bil-ghurm ensures, unlike lack of skin-in-the-game under conventional banking, that risk sharing Islamic

finance is fundamentally positively asymmetric; the upside benefits of f(x) outweigh the downside losses, for the same amount of movement in either direction of x. Firstly, risk sharing Islamic removes the biggest cause of asymmetry – the agency problem, since the bank must be invested (10 - 20%) in all the sukuk portfolios it offers. In addition, the portfolio of medium and long term sukuk consists of mudaraba and musharaka-based projects. The mudaraba projects are based on venture capital, which is a good mechanism for achieving fundamental asymmetry. Technically speaking, this implies the left tail is robust / bounded, while the right tail can have unbounded payoffs[1].

9-1-Nonpredictive Approach

A predictive approach tries to predict the future. After doing so, it calculates the risks / rewards of such a prediction, and then arrives at a response. A nonpredictive approach does not attempt to predict the future. In terms of quantitative finance, a predictive approach relies on Time series forecasting to predict the future and then on risk management techniques like VaR to calculate the risks / rewards; after which, the financial institution makes its decisions for capital allocation. There is a major problem with this approach - it is not possible to predict the future for fat tail distributions (irrespective of how many powerful computers one may use and how many qualified individuals one many employ). This is fine, if the errors (in the tails) in prediction have a minor and / or calculable impact. It is, as we have seen during the Great recession, disastrous if

[1] This concept is explained in detail, mathematically, in Chapter **Error! Reference source not found.**.

the errors are Black Swans.

In such a situation, it is safer to plan a future without relying on predictions. This implies construction of systems in a manner where they are adaptable to disorder, thereby making them robust to changes of future outcomes. Any system with randomness and unpredictability needs to follow a nonpredictive approach for survival. A nonpredictive approach implies the system is constructed in such a manner that dependencies on predictions are minimized; if not totally eliminated. This maps directly to entrepreneurship as those with entrepreneurship experience are more used to making decisions under uncertain conditions, while those indulging in debt-based finance tend to rely on decision making under predictive conditions (ex-ante interest rates for the short-term future being a good example). Predictive approaches tend to be linear extrapolations of historical data resulting in a continuation of the past. Nonpredictive approaches tend to be nonlinear with open-ended futures, making them nearly impossible to model. Hence a nonpredictive approach can be referred to as an *entrepreneurial* approach.

Predictive approaches tend to rely on forecasting for risk management. Forecasting in non-Gaussian domains results in regular failures due to inaccurate predictions. Large companies locked into predictive long-term strategies were unable to adjust when unexpected (non-predicted) variables appeared. The fall of cell phone giant Nokia due to its inability to react to the rise of Blackberry is one such example in the past few years. The subsequent fall of Blackberry due to its inability to predict the rise of Apple's iPhone is another good example. In fact, a survey

conducted by consulting firm Booz in 2001, showed that 53% of the senior executives did not think their company's strategy would be successful, since the strategies were based on a predictive approach in a nonpredictive world.

Nonpredictive systems are synergistic and non-additive. For complex systems, it may be impossible to break up the system and expect to predict the behavior of each and every subsystem, and subsequently, to accurately analyse the dependencies. Nonlinear systems have unpredictable cause-and-effect relationships resulting in side-effects. Nonlinear system results cannot be repeated based on well-defined models. The differences in the initial conditions may have significant impacts on the final results, as the non-linearities make it impossible to map the effect between input and output. Huge amounts of input for multiple variables may have no impact on the final results, while miniscule impacts on the input of any single variable can have huge impacts on the final outcomes; and vice versa. The weather is good example of a nonpredictive system.

Social systems, with a large number of variables and / or with extensive human interactions – consisting of emotions, fears, aspirations and desires - also become unpredictable under the Prospect theory of Behavioral finance. There is lack of prediction of causality or even the direction of causality, and it is impossible to know this in advance. Since behavior cannot be predicted, hence systems cannot learn. People tend to be forced to make predictions that are ***almost*** correct, as opposed to predictions that are *totally*

correct[1]. Hence, the phrase totally correct prediction is an oxymoron, since a totally correction prediction would be a *prophecy* and not a prediction. Making a wrong prediction is worse than making no prediction at all. In addition, it is impossible to deal with nonlinear systems by focusing on short-term variables. Nonpredictive systems have to be on the lookout for anomalies and outliers. Single outliers (Black Swans) can decisively impact the complete model.

9-1-1-Risk Sharing Islamic Finance and Nonpredictive Approaches

10-1-Conflation of Event and Exposure

It is important to understand the difference between the concept of event and the exposure to the event. This is the classical difference between x and f(x) on traditional graphs; x being the event and f(x) being the exposure to the event. This is the basis of the question which asks *how to survive in a world we do not understand*; the world of x. As per Taleb, we cannot understand x (much less predict it), however we can understand f(x). Hence the way to survive in a world we do not understand is to minimize the undesirable f(x) in our system and in our environment. An unpredictable *x* of massive consequence is a Black Swan and will, sooner or later, hit any (fat tailed) system. Since it cannot be predicted, its impact can be destructive. What can be adjusted is to modify f(x) in such a way that the left tail impacts of x are minimized or, if possible, even totally neutralized / bounded[2]. This is done by making the system – the entity experiencing x – as antifragile as possible. A pre-requisite of this is to ensure that x and

[1] This is the Achilles heel of econometrics.
[2] This should be done organically and not artificially.

f(x) are not combined (*conflated*), during the analysis, in such a manner that it becomes impossible to differentiate one from the other.

10-1-1-Risk Sharing Islamic Finance and Conflation of Event and Exposure

Risk sharing Islamic finance implicitly manages the issue of conflation of event and exposure. x and f(x) do not impact deposit account in a positive or in a negative manner, since f(x) = x; that is, the same value exists on both sides of the equal sign in case of demand deposits in a risk sharing Islamic bank. Another way to state this is that x remains a constant, with no f being applied on it. On the other hand, in case of investment accounts under risk sharing Islamic finance, f(x) is unknown and unpredictable, driven totally by a price discovery process operating under market forces. This ensures a clear demarcation of x and f(x); the latter only impacts investment accounts, and that too in a manner where the risks around f(x) can be managed. This is done via al-ghunm-bil-ghurm, by ensuring that the bank takes a % ownership of all investments, alongside the investment account holders. In addition the investments are securitized into short / medium / and long term securities. This ensures that the portfolio exposures of Islamic banks remain within certain risk profiles, that is, f(x) remains within certain manageable boundaries.

11-1-Ludic Fallacy

The ludic domain implies probabilities which work in well-defined games, where the rules of games are explicitly established beforehand. A different domain is the ecological domain where the rules of the game cannot be defined and variables cannot be isolated.

This is why casinos do not lose money, at a system level, in games of chance; even though they regularly lose money at the subsystem level (at specific Black jack tables, as an example). Rules for a ludic environment are set up ahead of time with clearly calculated probabilities. It is impossible to calculate the probabilities in advance for ecological domains. Hence, rules and skills are non- transferable from the ludic domain to the ecological domain. However, current risk management techniques do not differentiate between the ludic and ecological domains[1]. There is an explicit assumption in ***every*** available financial risk management technique of today that the future will mimic the past. This incorrectly implies the rules of finance can be defined in a ludic manner within well-established boundaries; a by-product of Bachelier's (incorrect) statistical independence assumption leading to the (vulnerable) Random walk model.

11-1-1-Risk Sharing Islamic Finance and the Ludic Fallacy

Behavioral finance has, of course, shown the financial world to be ecological and not ludic. Risk sharing Islamic finance works in the ecological domain of financial markets. *All* rates under risk sharing are decided by the market discovery process. The system, by its foundational design, does not allow any pre-defined ludic rates. This is completely in contrast with conventional finance, whose complete existence is based on ex-ante interest-rates that are calculated via inaccurate probability distributions based on models specifically defined in a ludic manner. Risk sharing Islamic finance is based on rates (every single one of which is) to be calculated ex-post. The

[1] This is the Achilles heel of contemporary risk management (including the Basel standards).

only ex-ante item is the ratio on which the profit / loss distributions will occur between the partners – investment account holders and the bank on the liability side and the bank and the entrepreneurs on the asset side. Specifically in case of the risk sharing Islamic finance structure described in this research, the bank takes a 20% of partnership in the sukuk, with the investment account depositors taking the remaining 80% ownership. The ownership ratio is defined ex-ante (much like in conventional venture capital). However the actual profits and losses are based on market returns from the real sector in a non-ludic manner.

12-1-Rational Optionality

Rational optionality refers to not being locked into a pre-planned program. It allows an individual / system / institution to change direction without excessive loss. Within finance, it is the combining of the benefits of optionality within a rational framework. The *rational* part of rational optionality refers to not repeating the same mistake twice; trial with small error, and subsequently learning from the errors. Such a system encourages bottom-up decision making (via tinkering) over top-down planning. This is based along the same ideas as convexity, and is a by-product of adapting nonpredictive approaches for decision making.

12-1-1-Risk Sharing Islamic Finance and Rational Optionality

A good example of rational optionality is venture capital. The basic concept of venture capital is based on a large number of small losses combined with a small number of huge positive pay-offs. The worse example of negative rational optionality is the debt-based conventional financial system; for the simple reason that debt reduces one's ability to benefit from positive Black Swans. On the

other hand, equity increases rational optionality. Equity provides the opportunity to benefit from positive Black Swans, and the security to manage the unexpected consequences of negative Black Swans.

The practical structure of risk sharing Islamic finance, described in this research, maps almost identically to the ideas of rational optionality; with one possible caveat. Deposit accounts with 100% reserve requirements ensure that cash remains available to allow depositors (though not the bank) to benefit from positive rational optionality. The depositors can take the cash out of demand deposit account and move it to investment accounts when convex opportunities arise. The rest of the funds are invested into sukuk-based investment accounts that are directly linked to the real sector. The sukuk include, as a part of their investments, mudaraba accounts. These are akin to venture capital. The one caveat that does exist is the insistence by Taleb on including options in any antifragile portfolio; Islamic finance considers options, in their conventional form, to be based on maysir and thus prohibited.

13-1-Non-Linearities

A nonlinear function does not follow a straight line, while a linear function follows a straight line. A nonlinear function is a polynomial function of degree of two or higher. A nonlinear function does not satisfy the superposition principle, which implies that the output of a nonlinear system is not directly proportional to the input. A linear function satisfies both of the following properties:

- Additivity (superposition): $f(x+y) = f(x) + f(y)$
- Homogeneity: $f(\alpha x) = \alpha f(x)$

Nonlinearity leads to opacity about a system, adding to its

unpredictability, thereby resulting in higher volatility. At the essence of the discussion of nonlinearity and linearity is the idea of convexity and concavity. Figure 3Figure 1 graphically highlights this in the form of convex and concave functions. Nonlinearities can be convex or concave (or a combination of both). Convexity effects are a by-product of fundamental asymmetry. Technically, fragility is negative convexity and antifragility is positive convexity. The convex function curves outwards, while the concave function curves inwards. Today's world has more nonlinearity in the form of asymmetries and convexities than before. In case of nonlinearities, the longer the time duration of the prediction, the lesser its accuracy.

13-1-1-Risk Sharing Islamic Finance and Non-linearities

A good example of nonlinearity is the melting of an ice cube. We can imagine an ice cube melting into a small puddle. However, it is impossible to reconstruct / reverse engineer the ice-cube from the puddle (other than the volume). The final state (puddle) does not contain sufficient information to determine the initial state (the ice cube). This indicates that, in case of nonlinearities, it is simply impossible to reach an exact conclusion on the final state, based on a specific set of initial conditions; there can be many possible final conditions.

Our mental capacities are not equipped to handle nonlinearities. Based on this, Taleb divides the statistical domain into two worlds: Mediocristan and Extremistan [5]. In Mediocristan, a single event cannot disproportionately impact the aggregate, while in Extremistan, a single event can disproportionately impact the aggregate. Mediocristan is thin-tailed, non-scalable, impervious to Black Swans (and thus easy to predict). Extremistan is fat-tailed,

scalable, vulnerable to Black Swans (and thus impossible to predict). The human mind is poorly equipped to handle issues that occur in Extremistan. The financial world is a part of Extremistan. However, we tend to analyze it via tools developed for Mediocristan. Mediocristan is (relatively) linear, while Extremistan is (completely) nonlinear.

There is no available mechanism to map non-linearities directly. The only mechanism available is to ensure a system is convex to the non-linearities that may display themselves, since non-linearities tend to accelerate much faster than linearities. By allowing the market to discover prices and adjust in real time (rather than allowing the effects of the volatilities related to price movements to pile up into a Black Swan) risk sharing Islamic finance makes itself convex to non-linearities.

14-1-Creative Destruction

Creative destruction implies that some subsystems need to break for the overall system to improve. Creative destruction is a term in economics that was identified by the Austrian economists' theory of economic innovation and business cycles. The idea of creative destruction was coined by the Austrian economist Joseph Schumpeter in *Capitalism, Socialism and Democracy*, in 1942. He defines it as, "A process of industrial mutation that incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one." Under creative destruction, something new destroys something older. One of the best ways to ensure creative destruction is via entrepreneurship. Entrepreneurship adds randomness and volatility to the economy. This is the essence of an entrepreneur addressing a *pain point;* an example being entrepreneurs providing the ability to book airline tickets online, thereby ***destroying*** the business of travel

agents, while simultaneously creating a newer, more efficient, and less costly online reservation business. The destruction occurs in a *creative* manner and not in a haphazard manner, thereby improving the overall ecosystem. Schumpeter considers creative destruction to be the essential quality of capitalism. The circle of life, with the birth and death of humans, can be consideration nature's implementation of creative destruction.

Creative destruction turns the concept of success on its head. The regular failure of entrepreneurs becomes a great strength for antifragility of the overall system. Entrepreneurs can have a very high individual failure rate, however at an overall system level, the few successes more than compensate for the overall failures. As one entrepreneur fails, the others learn from it and adapt, thereby becoming stronger and more antifragile. The failures happen early, while the successes are long-term. Creative destruction thus creates dynamism in the economic system, increasing healthy competition and reducing systemic risks to the system.

14-1-1-Risk Sharing Islamic Finance and Creative Destruction

It has been difficult for society to internalize the idea of creative destruction within the discourse on finance (specifically banking), since we are psychologically tuned to the fear of the negative impacts around bank failures. This is despite the fact that we regularly accept the failure of various other businesses - airlines, automotive, IT companies, to name a few. Bank collapses invariably lead to systemic failures across industries, with the sick elephant threatening destruction of the complete jungle. This is why there is significant paranoia around encouraging an environment that allows creative destruction in finance. This has resulted in a status-quo, based on paranoia, where destruction of *any* kind – creative or otherwise - is controlled artificially (via LOLR, FDIC and eventually

bank bailouts).

Risk sharing Islamic banks will be implicitly exposed to creative destruction and will actually benefit from this phenomenon. The deposit accounts in a risk sharing Islamic bank cannot fail as they are backed by 100% reserve requirements. The investment accounts can fail as per market dynamics. However, even there, they are set up in such a manner where there risk exposure is limited to operational risk and to the remote possibility of market price disclosure risk. This implies that risk sharing Islamic banks can fail without violating any of the rules of creative destruction; however, within such a set up they are exposed to the minimum possible risk.

15-1-Heuristics

Heuristics are simple rules of thumb that have been learnt by societies over generations. They are an expedient mechanism of making decisions in difficult situations. Their main advantage is that the user knows they are not exact and thus remains cautious of the results. The detection heuristic for antifragility is to test a system for convexity effects to evaluate whether the system is convex or concave to the disorder family. Heuristics tend to work outside the prediction effects. Heuristics and biases can be scaled against the ideas of antifragility as follows: ambiguity aversion, status quo bias, risk aversion and loss aversion is antifragile, while overconfidence and optimism is fragile. A key heuristic that make a system antifragile include the ability to judge convexity and concavity in a system. Another heuristic is to

construct systems with redundancy[1].

15-1-1-Risk Sharing Islamic Finance and Heuristics

This is a sensitive topic in regards to this study, as it sits on the border between divine religious beliefs and evolutionary best practices. Taleb views the concept of religion to be best practice heuristics formulated by mankind over centuries; not as a divine set of rules. As per Taleb, this explains many of the commonalities amongst the world's great religions – fasting, marriage, and, interestingly, the prohibition on interest, being some examples. Islamic finance, of course, does not consider the prohibition of interest, encouragement of al-ghunm-bil-ghurm and other similar concepts to be a product of human heuristics. It considers them to be divine instructions from Allah. This presents a situation where while antifragility and risk sharing Islamic finance agree on the common results, they greatly differ on the source. In that sense, this is a characteristic where risk sharing Islamic finance and antifragility differ at a primary level. Antifragility allows for changes in the basic heuristics as a process of social evolution. Risk sharing Islamic finance considers Shariah to be the ultimate divinely defined set of best practices; the gist of which can never be changed (only the interpretations can evolve, as per the timeframe in history). Hence, risk sharing Islamic finance and antifragility encourage identical heuristics in finance, while disagreeing at a primary level on the source of the heuristics.

[1] Nature has evolved the human body with many redundant systems – two kidneys, two lungs, to name a few. This implies avoiding over-optimization with appropriate margins of safety and an attempt to either cater for or to remove asymmetries in the system.

16-1-Options

As per Taleb's view of antifragility, optionality is what makes systems antifragile. Hence, he advises financial portfolios to be constructed in such a manner that they are based on options. Options allow a financial portfolio to benefit from the positive side of uncertainty without serious harm from the negative side. In essence, options are convex to volatility. Monte Carlo simulations have shown that any individual investing in options does not require knowledge or insight of the market to succeed. Those relying on options, with limited knowledge of the market movements, will be more successful than those relying on securities, like stocks, with good knowledge of the market. Options correspond to convex tinkering. The losses are discovered early and are thus limited / bounded, while the payoffs can be unbounded. Taleb (2012) describes an option as follows:

Option = Asymmetry + Rationality

The asymmetry portion refers to the imbalance between the bounded loss and the unbounded payoff, while the rationality refers to the ability (*option*) to benefit from the positive and to discard the negative. Fragile systems do not have options, while antifragile systems are constructed on options. Due to this, options benefit from the disorder family. The current financial system is based on negative optionality; prone to small profits followed by huge losses. In fact, conventional banks regularly lose more money than the combined profits in their history.

This is another area where antifragility does not map to risk sharing Islamic finance. Taleb suggested options as the building block of any

antifragile portfolio; since options, in general, are undervalued [5]. His investment portfolios are constructed in a barbell fashion, as described in a previous sub-section. This is bimodal strategy (since it has two different modes); as opposed to a unimodal strategy. It is a combination of an extreme risk-loving and extreme risk aversion strategy; as opposed to a moderate risk attitude, which, as per Taleb, is vulnerable to large measurement errors. Financial portfolios must be set up in a manner where they are long volatility. Taleb argues for extensive use of options as the best mechanism for achieving this.

16-1-1-Risk Sharing Islamic Finance and Options

It is importance to analyze this in light of the restriction on option contracts under Islamic finance due to their speculative nature. How do we accommodate the ideas of options into risk sharing Islamic finance, while simultaneously remaining outside the boundaries of maysir? As a starting point, the structure of accounts for risk sharing Islamic banks has an interesting (and perhaps not so coincidental) resemblance to Taleb's barbell. The deposit accounts, with 100% reserve requirements, can be viewed as the risk-free portion of the barbell, while the investment accounts can be viewed as the risk-loving portion. There is, however, a difference in that Taleb's suggested 80 / 20 to 90 / 10 percentage ratios may not be followed between the deposit accounts and investment accounts of a risk sharing Islamic bank. Another difference is that the risk profile of investment accounts does not fall into the extreme category of risks of option as described by Taleb.

A deeper analysis indicates that the requirement of options, in an antifragile portfolio / structure, may not apply if we assume the complete financial system operates on an interest-free basis. This

implies risk sharing Islamic finance explicitly incorporates optionality and, thus, implicitly implements a version of the barbell structure. The purpose of the barbell is to set up a convex portfolio by minimizing the risks and maximizing the profit as per the fragilities of debt-based conventional finance. This has an underlying assumption that the financial system is fragile to begin with and thus aims to take advantage of the counterparties' fragile decision making (specifically around incorrect pricing of options). However, under the rules of risk sharing Islamic finance, the system itself becomes antifragile; thereby removing the need for a barbell portfolio (along with the requirement for options). The only purpose of options in risk sharing system would be to hedge against risk; not a contract for making extreme profits (at the appearance of a negative Black Swan). To put it in another manner, a risk sharing system has the benefit of upside profits built into it. Hence, anyone operating in such a system is convex from the start, due to the convexity of the complete system. Thus, an attempt to set up a barbell portfolio, as well as the need to rely on options as a convexity tool, is a non-starter under risk sharing Islamic finance as convexity is implicitly built into such a system.

6-Results

The key objective of this research was to show that risk sharing, as defined under Islamic finance, makes financial systems antifragile. This objective was to be realized primarily via qualitative analysis. At a more ambitious level, this study may lay the theoretical foundation for antifragility of risk sharing Islamic finance as a sub-field of the rapidly emerging field of antifragility; much like

similar attempts being made to extend antifragility into various other fields – biology, medicine, computer science, engineering, project management, electronic warfare, service organizations, insurance / reinsurance, cloud computing, supply chain management, transportation systems, homeland security, to mention a few. A summary of the results of the research are presented below:

As its primary objective, this research has attempted to map the characteristics of antifragility to those of risk sharing Islamic finance, resulting in a qualitative framework on the basis of which future research can be carried out. A first step in this direction was to define a key insight around which such a connection could be established. This was done by relating al-ghunm-bil-ghurm from Islamic finance to skin-in-the-game from antifragility. From here, the relationship was extended towards the other characteristics of the two domains. Of the thirteen characteristics of antifragility covered by this study, it has been shown that risk sharing Islamic finance maps seamlessly to antifragility over eleven of these characteristics. Based on this, from the qualitative angle, this research has achieved its objectives and has shown risk sharing Islamic finance to be antifragile.

7-Conclusions

The perpetual financial disasters of debt-based conventional finance combined with the unraveling of Gaussian-centric forecasting and risk management techniques may be turning into a perfect storm that could devastate the existing financial system, which may prove too *fragile* to manage the consequences. In fact, in a roundabout manner, this may have happened after every global financial crisis, with the status-quo financial system(s) only

surviving due to massive bailouts by respective governments. However, eventually this cycle of bailouts may also reach its breaking point. What will happen then? It there a possibility the result may be a demand by the general public for foundational changes in the global financial system in the coming future? Can that be an opportunity for risk sharing Islamic finance to step in and fill the financial vacuum, sidelining interest-based debt? Writing in the Financial Times (2009) with Mark Spitznagel – the President and founder of multi-billion dollar hedge-fund Universa Investments L.P. -, Taleb states,

> "The core of the problem, the unavoidable truth, is that our economic system is laden with debt, about triple the amount relative to gross domestic product that we had in the 1980s. This does not sit well with globalisation. Our view is that government policies worldwide are causing more instability rather than curing the trouble in the system. The only solution is the immediate, forcible and systematic conversion of debt to equity***. There is no other option***."

In conclusion: this research has been an attempt to seamlessly link together two chains of original thought, centered around their mutual aversion to debt and their natural affinity towards equity. This research estimates that the accomplishments of Taleb in the area of antifragility combined with the accomplishments of Mirakhor et al. in risk sharing Islamic finance can have lasting impacts on the field of finance by shifting entrenched trends. To the author, conclusively proving bai to be antifragile and riba to be fragile becomes an analytical interpretation of the primary Quranic verse (2:275) on finance: "…because they say: "Trade is like interest" while God has permitted trade and forbidden interest…," and hopefully provides a possible avenue for risk sharing Islamic to move into the mainstream of finance, inshAllah (God willing).

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